

***PROCEEDINGS OF THE 16<sup>th</sup>***  
***INTERNATIONAL CONFERENCE ON***  
***INNOVATION AND MANAGEMENT***

**November 27-29, 2019**

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*Chen Xiaofang, Ma Ying, Luis Martínez*

**Associate Editor**

*Ken Kaminishi , Geert Duysters, Arnaldo de Hoyos,  
JosuTakala, Rubiyah Yusof*

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### 【Summary】

The proceedings include The Application of AI Innovation in Business Innovation; Internet of Things, Big Data and Business Analysis; Safety Engineering and Risk Management; Environmental Innovation and Sustainable Development; Operation Management, Supply Chain Management and Transportation Management Innovation; Human Resources and Organizational Behavior; Systems Engineering, Financial Engineering, Design Engineering and Industrial Engineering; Intellectual Property, Knowledge Management, Industry-University-Research Cooperation and Strategic Alliance; Investment, Corporate Finance and Corporate Governance; Miscellaneous.

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# **The 16<sup>th</sup> International Conference on Innovation and Management (ICIM 2019)**

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## Development of a System for Automatic Classification of Fake News in Portuguese Language

Roger Oliveira Monteiro<sup>1</sup>, Rodrigo Ramos Nogueira<sup>2</sup>

<sup>1</sup> Centro Universitário Leonardo da Vinci<sup>1</sup>, Universidade de Coimbra

<sup>2</sup> Indaial – SC - Brazil<sup>1</sup>, Coimbra - Portugal

(E-mail: roger.o.monteiro@gmail.com, rodrigonogueira@dei.uc.pt)

**Abstract:** With the rapid advancement of technology and easy access and dissemination of information, the term fake news has gained commanding attention, and research in several areas has been developed. This paper introduces the use of machine learning methods to discover, classify and store fake news texts for later ETL application of a Data Warehouse and a query environment that will contribute to future research. For this, a dataset was created and the Logistic Regression, Naive Bayes and SVM methods were evaluated. Finalizing the work with the selection of the best method that was inserted in an automatic classification system of fake news.

**Key words:** Machine learning; Text mining; Web mining; Fake detection; News mining

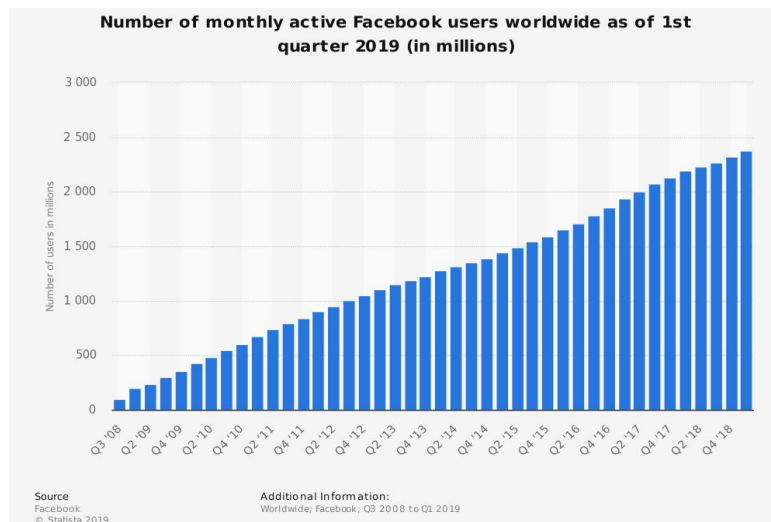
### 1 Introduction

In 1990, Tim Bernes-Lee created the well-known WWW (Tim, 2001), which allowed the manipulation of the graphical interface guaranteeing its expansion in the following years through the emergence and development of browsers, access providers and various portals of services.

According to a report by the International Telecommunication Union (ITU), a member of the UN, in 2018, the percentage of people connected to the Internet exceeded 3.9 billion people, representing 51.9% of the world population.

Brazil's 2018 data show that the percentage of people over 10 years old connected online in Brazil rose from 64.7% to 69.8% from the end of 2016 to the end of 2017. As a result, there was an increase of almost 10 million users within one year.

At the beginning of the twenty-first century there emerged an enormous tendency that follow until the present day: the use of social networks. More and more people are connected to each other through these platforms. Currently we have as examples of great cases of success of social networks: Facebook, Instagram, WhatsApp and Twitter. According to the Statistician Facebook had 608 thousand people connected at the end of 2010. At the beginning of 2019, the number of users reached 2,375 million, as shown in the chart below:



**Figure 1 Facebook Users**

Since the beginning of the Web, the volume of data that is in the repositories in the world network has grown exponentially, there are currently about 200 million active websites on the Internet, of which only the social network Twitter generates, on average, 500 million of posts per day. Such an explosion of data led to a study by the IDC (Institute Data Corporation) that estimates in the year 2020 we will

have 44 data zettabytes generated in worldwide (IDC. Gantz, J., & Reinsel, D. (2012), 2007).

In the different niches of social networks that have emerged, different ways of writing critiques, propitiated by the characteristics of the applications, have been observed. Specific sites, such as movie reviews, allow users to write relatively long texts. Microblogs, on the other hand, impose limits on the amount of message characters and are not exclusively intended for critical publishing. In the process of discovery and research that continued in social networks, the need to express opinions more directly arose (Von Lochter, J., 2015).

New sites are the third largest vehicle of information accessed by the Internet, second only to messaging applications and social networks. This information reflects the importance of using news sites and their impact on people's daily lives (Nogueira, R. R., 2017). Along with the importance of news stories and their sharing in social networks, comes the rise and spread of fake news. Since the middle of 2017, the number of events and debates about this phenomenon that has been called fake news has grown so. Fake news can be defined as news articles that are intentionally and verbatim fake and can fool readers. In this definition of fake news includes intentionally fabricated news articles, such as a widely shared article from the now defunct website denverguardian.com with the headline "FBI agent suspected in Hillary email leaks found dead in apparent murder-suicide" Hillary's e-mail leak found dead in apparent murder-suicide) (Delmazo, Caroline; VALENTE, Jonas CL., 2018).

Faced with the ease with which anyone can now access information, and with the ease of its use, we experience an era of great advances and solutions, followed by even greater problems, such as fake news. Because of its attractive nature, fake news spread rapidly, influencing people's behavior on a wide range of subjects, ranging from healthy issues (e.g. revealing miracle drugs) to politics and economics (as in the recent Cambridge Analytica scandal / Facebook and Brexit situation) (MONTEIRO, Rafael A.; SANTOS, Roney L. S.; PARDO, Thiago A. S.; ALMEIDA, Tiago A. de; RUIZ, Evandro E. S.; VALE, Oto A., 2018). Given its prominence, several multidisciplinary studies on the subject have been carried out. Aiming to contribute to such researches, this paper aims to couple to the ETL (Extract, Transform, Load) of a News Data Warehouse the semantic enrichment through classification of the type of news: real or false.

## 2 Related Works

About fake news and the application of Machine Learning, (GRUPPI, Maurício; HORNE, Benjamin D.; ADALI, Sibel., 2018.) constructed a dataset with news, in Portuguese and English, aiming to construct a classifier to predict whether the news source is reliable. Using an SVM algorithm with a linear kernel, it was possible to establish the most important characteristics as well as their classification. As a result, the classification algorithm obtained an accuracy of 85% for Brazilian datasets and 72% for American datasets. In a contribution to the news classification area, (MONTEIRO, Rafael A.; SANTOS, Roney L. S.; PARDO, Thiago A. S.; ALMEIDA, Tiago A. de; RUIZ, Evandro E. S.; VALE, Oto A., 2018) use the dataset Fake.br with the objective of evaluating the main methods of preprocessing texts to evaluate the performance of the SVM method. The best results were obtained with the combination of bag-of-words with feelings, as well as the use of all attributes, both with accuracy of 90%.

On your work, (MARUMO, Fabiano Shiiti, 2018) has collected news from truthful news sites and websites with fake news and / or satirical news, in order to find the best method for detecting fake news. As part of the pre-processing of the data, we used the Gensim framework to remove non-alphabetic characters, substitute spacing and line breaks for single spaces, remove words shorter than 3 characters, and convert capital letters to lowercase letters. The keras framework for data tokenization was also used. With the application of the classification algorithms LSTM and SVM, an accuracy was obtained above 90%.

Overfitting is a major problem in the case of a textual database. Therefore, FENG (Feng Xiaoyue; Liang Yanchun; Shi Xiaohu; Xu Dong; Wang Xu; Guan Renchu, 2017), used the algorithm AdaBoost, known to obtain great success for reduction of overfitting in face detection, character recognition (OCR) and vehicle classification. In his experiments, we used datasets from 20 newsgroups, Reuters dataset, which consists of 22 files with a total of 21,758 documents, and a BioMed dataset, which is divided into 10 topics, each containing between 1966 and 5022 news articles. The results were an average of 86% accuracy in the AdaBoost algorithm (Bonzaiboost).

## 3 System Architecture

After searching for a database with fake news, we found that there are few resources available in

the Portuguese language, in which the most used dataset is Fake.br (MONTEIRO, Rafael A.; SANTOS, Roney L. S.; PARDO, Thiago A. S.; ALMEIDA, Tiago A. de; RUIZ, Evandro E. S.; VALE, Oto A., 2018). This present proposal aims to provide an environment with consistent and clean data in the form of a multidimensional corpus for consumption by external applications and users. The multidimensional corpus is a set of texts stored according to a multidimensional model, which allows to explore the multidimensionality in different levels of abstraction: time, category of news, type (true or fake news).

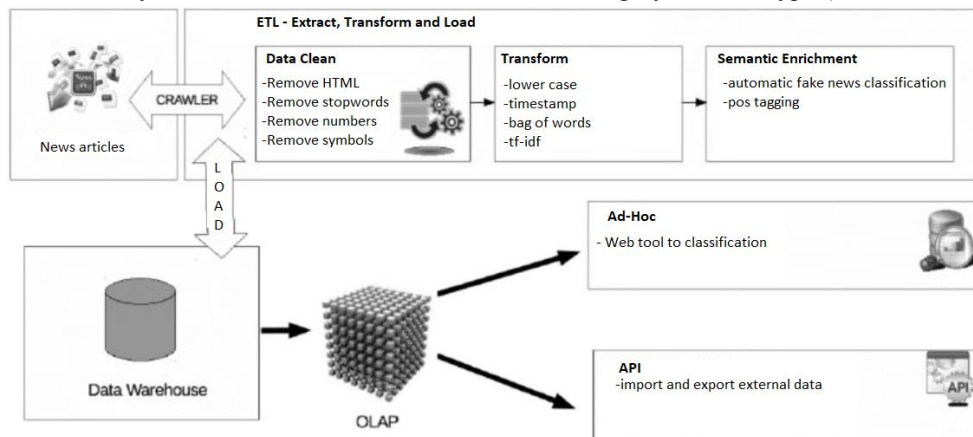


Figure 2 System Architecture

To perform the experiments, we developed a web crawler using a python language (MITCHELL, Ryan, 2018.). Including a library, beautiful soup for an initial data collection. A set of data was constructed by 1744 titles and fake corporations collected from the sites <boatos.org> and <g1.globo.com/fato-ou-fake>, and 3185 titles and body of real news collected from the site brasil.elpais.com. Initially will be tested the tests applied only to news, afternoon and body titles with the title and make a comparison between both. For this, the algorithms of machine learning, Logistic Regression, AdaBoost, Naive Bayes and SVM are used.

From the creation of a collection system, with an algorithm coupled to the ETL step, it will automatically classify the collected data, thus increasing the accuracy of the classifier, and generating a larger data base for future work to combat fake news. Also, a web interface was built, where the user will be able to submit a link and verify if this is true news, serving as a prototype before being submitted to ETL stage (this being the general purpose of this work).

#### 4 Results and Discussions

The data obtained received treatment of null values, noise (special characters such as commas, periods, parentheses, etc.) and transformation to lowercase letters. Each dataset received a new column, called label, where Boolean value 0 was given for true news, and 1 for fake news. With this, the data was combined into a single dataset. Initially, the dataset used only contained the news headlines, being then divided between training and test, in the proportion of 75% and 25% respectively.

The first portion serves to train the algorithm, while the second, to verify the accuracy of the algorithm. Afterwards, they received tokenization treatment, using the NLTK package, with the bag of words in Brazilian Portuguese. Tests performed using the algorithms Logistic Regression, AdaBoost, Naive Bayes and SVM (linear kernel), obtained the accuracy of 88.85%, 81.37%, 86.22% and 87.45%, respectively, in the model of tests. As a technique for evaluating the models used, cross-validation was used with the k-fold = 10 method.

Again, the dataset was divided between training and test, joining now the headings to the news body. They received the same treatment mentioned above, obtaining the accuracy of 90.88%, 84.23%, 91.19% and 91.16% in the Logistic Regression, AdaBoost, Naive Bayes and SVM algorithms, respectively. The application of the cross-validation method revealed an overfitting in some cases. Finally, the dataset was broken down to use only the news bodies.

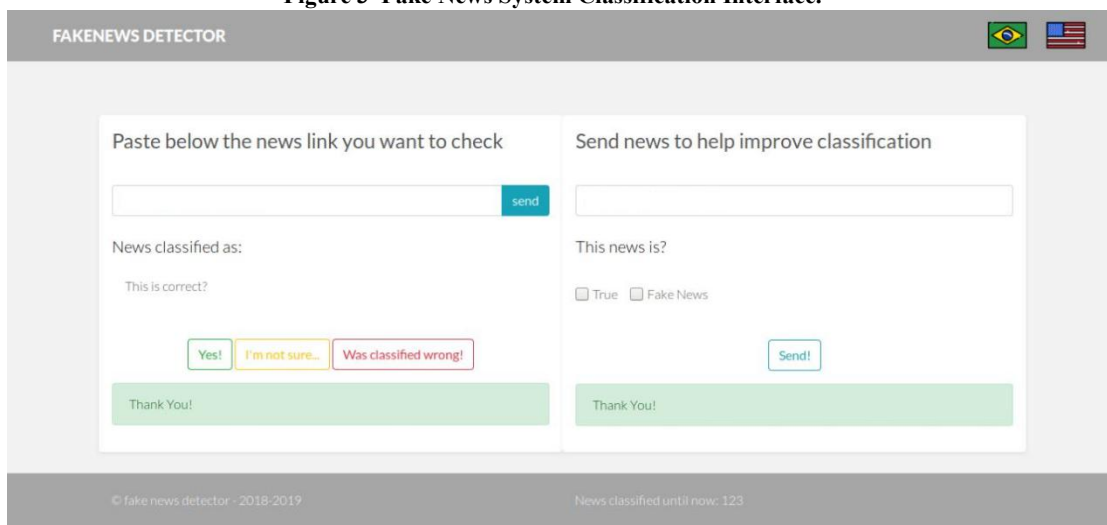
The same methods used previously were used in relation to the treatment and cleaning of the data. The application of the algorithms resulted in 90.88%, 94.23%, 91.19% and 91.16% accuracy in the algorithms Logistic Regression, AdaBoost, Naive Bayes and SVM respectively.

**Table 1 Experiments Results**

	Regressão Logística	AdaBoost	Naive Bayes	SVM(kernel Linear)
Titulo	88,85%	81,37%	86,22%	87,45%
K-fold	0,88	0,75	0,86	0,55
Corpo	97,40%	95,12%	97,80%	98,62%
K-fold	0,97	0,95	0,97	0,64
Titulo+Corpo	90,88%	84,23%	91,19%	91,16%
K-fold	0,90	0,84	0,91	0,54

From the results analysis, the Naive Bayes method was selected as the best method, due to its high accuracy, complemented by being an incremental learning method (online). After the coupling, the fake news classification interface was developed, the Figure 2 shows the system interface and is available on the server <https://detectorfakenews.herokuapp.com/>. The tool expects as a parameter the link of a news site, and returns whether or not it is a fake news (fake news).

**Figure 3 Fake News System Classification Interface.**



## 5 Conclusion

Fake news has existed since the beginning of human civilization and has always generated problems in our society. This fake news spread slower in the past, today we have the Internet that makes it easier to share this news to the world in less than a minute. This news causes a great evil to our society, generating deaths and traumas.

People are accused of crimes they never committed. There are innumerable cases of people being charged without having committed at least one crime, and in many cases these charges have been made without any basis, thus making the victims of such charges innocent. These false accusations can end up causing damage, aggression, trauma, death and even suicide. People also fail to take vaccines and make medical treatment, in addition to the policy.

In this paper we developed a system for automatic classification of fake news, which obtained a result of 97% efficiency. It still becomes necessary to test with larger databases, as well as to put the system to be validated in the real world.

Overfitting is a recurring problem on a textual basis. Some algorithms have achieved very relevant results, but when we applied cross-validation with  $k = 10$ , we noticed a large overfitting in some cases. Thus, it was observed that the Naive Bayes algorithm obtained besides the high accuracy, tolerance to overfitting.

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## **The Sixth Wave of Innovation: Artificial Intelligence and The Impacts on Employment**

Marcelo Augusto Vieira Graglia, Patricia Giannoccaro Von Huelsen, José Arnaldo de Hoyos Guevara  
Pontifical Catholic University of Sao Paulo, Brazil  
(E-mail: mgraglia@pucsp.br, phuelsen@pucsp.br, arnoldodehoyos@yahoo.com.br)

**Abstract:** The beginning of the 21st century presents a scenario of profound transformations for human society. Technological innovations will enable significant advances in various areas and aspects of human society, such as health and longevity, energy efficiency and urban mobility. There will be economic prosperity within the logic of the process of creative destruction, with products and businesses being replaced by others. The sixth wave of technological innovation probably has severely impact the logic of interaction between technology, society and work. The new wave of innovation, based on digital and intelligence technologies that combine with information and communication technologies born in the second half of the 20th century, presents specific characteristics that differentiate it structurally from previous waves, such as high propagation velocity and maturation of technological innovations, convergence between several disruptive technologies and with high potential for the replacement of human labor.

**Key words:** Artificial intelligence; Industry 4.0; Technological innovation; Labor and employment

### **1 Introduction**

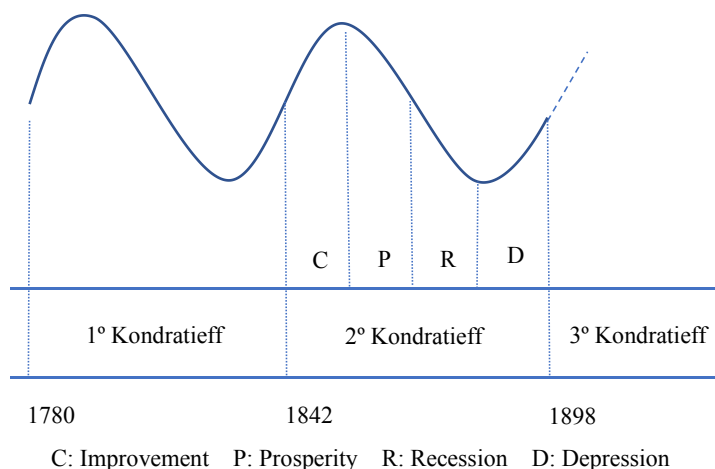
The development of technology throughout the history of mankind has generated significant advances and its benefits are absolutely tangible, relevant and intrinsically linked to the own civilizational development (Castells, 2006). Already in the field of human work, the fear of the potentially destructive effects of technology on jobs is symbolically represented by the Luddism movement in England in the early nineteenth century, where groups of workers used the destruction of machines as a means of pressing the employers against the precarious conditions to which they were subjected: exhaustive days, unhealthy working environments and low salaries. It was a historical period marked by economic turbulence, mass unemployment and hunger, in a scenario that was aggravated by the introduction of machines that caused layoffs and replaced more qualified and better remunerated functions by others with few technical demands and worse remunerated, generating conflicts between small producers (Robsbawm, 1952).

The emergence of a new technological revolution rekindles controversy with debates between opposing visions: those that envision a bright future, where technology releases humanity from the obligation of hard, repetitive and discouraging work, eliminates diseases, promotes longevity, comfort, allows new playful and sensory possibilities brought about by digital devices and environments and where older workers can work more and healthier - which would be a strategic possibility in the current demographic context, where several countries are facing a reduction of their workforce due to the aging and their deleterious effects on their economies (Vogler-Ludwig, Düll, & Kriechel, 2016). In an antagonistic position, those who fear the potentially harmful consequences of the intense proliferation of technology by sensitive fields of human society, such as work, genetic medicine, control over information and reckless application in the military field. There is also a risk of the dehumanization of relations and human consciousness in a cybernetic post-humanism scenario (Fukuyama, 2002). Although computerization has historically been confined to routine tasks involving activities based on explicit rules, artificial intelligence and big data algorithms are now rapidly entering into patterns-dependent domains and can readily replace work in a wide range of cognitive tasks not routine. Adding to this, advanced robots are gaining enhanced senses and dexterity, which allows them to perform a wide variety of manual tasks. This will likely change the nature of work in companies and professions (Brynjolfsson & McAfee, 2011). Some changes are already perceived: advances in user interfaces, for example, already allow computers to respond more efficiently to customer requests, reducing the need for human intervention in some service and service activities. With the expansion of computer capacity, tasks that were once considered too complex to be coded are being converted into well-defined problems treatable through digital solutions (Osborne & Frey, 2014). New high-performance applications in speech recognition and word processing allow simultaneous interpretation, automatic creation of complex standard texts, as well as analysis of large volumes of text for legal purposes. In medicine, intelligent image recognition software can significantly improve the diagnosis of many

diseases and generate increased productive capacity for physicians and affect the class of general practitioners. In the area of health care, interactive systems are being tested that can promote the psychological and emotional well-being of the elderly, partially replacing the work of assistants and caregivers. In sum, whether in relation to industrial, service or knowledge work, digitization is changing the entire sociotechnical system of people, organization and technology (Graglia & Lazzareschi, 2018). In its effects there are clearly positive aspects and others that inspire more reflection.

## 2 The Economic Cycles and Technological Innovation

The cyclical behavior of the world economy, alternating moments of growth and crisis has been studied by several authors (Hayek, 1933; Kondratieff, 1935; Mises, 1953 and Modis, 2017). Kondratieff (1935) affirms the existence of long waves that are not originated by random causes, but by inherent causes to the essence of the capitalist economy. The mechanisms that explain the existence and behavior of long waves are derived from the emergence of major technical changes, wars, revolutions and assimilation of new countries within the world economy. The technical changes in production play an influential role in the development of capitalism, and the development of techniques is itself part of the longwave rhythm (Kondratieff, 1935). Schumpeter (1939) argues that the disturbance motivating the beginning of a cycle is given by an innovation. According to his theory, there is a periodicity of long cycles, or long waves, of about fifty or sixty years. John Maynard Keynes (1883-1946) recognizes the existence of economic cycles, including the regularity of occurrence and duration, justifying it as the result of a cyclical variation in the marginal efficiency of capital. The marginal efficiency of capital (profit rate) is related to the expectation of an investor's return when acquiring a given capital asset, and the expected return will be the result of a flow of future incomes generated by the sale of the products. Keynes highlights the phenomenon of crisis as a typical feature of the economic cycle, where the inversion of an ascending to a descending phase usually occurs abruptly and violently - crisis - whereas the passage from a descending phase to an ascending one used to occur gradual and smooth. Therefore, both Keynes and Schumpeter believed that the understanding of the cyclical movements of the economy was in the fluctuation of the level of investment (Lima, 2011). In his work *Business Cycles*, Schumpeter emphasized the importance of innovations as a determining factor of economic development. He also coined the term "Kondratieff cycle" and thus linked the name of the Russian economist to the phenomenon of long waves. For Schumpeter, the periods of economic expansion are related to the fact that the innovative entrepreneur, when creating new products, breaks certain economic inertia by establishing a new technological paradigm, which is followed by other entrepreneurs, who apply resources to produce goods similar to the one created by the first. Thus, a wave of capital investment leverages the economy, generating prosperity and expansion of production and employment levels. As technological innovations are absorbed by the market, the rate of economic growth slows and a recessive process begins, resulting from the reduction of investments and even consumption, affecting the level of employment. A new cycle depends on the occurrence of another wave of technological innovation. This alternation between prosperity and recession is seen as part of the larger process of economic development (Schumpeter, 1997).



**Figure 1 Cycles of Kondratieff, according to Schumpeter.**

Source: Schumpeter (1939). Adapted by the authors.

From the work of Kondratieff, Schumpeter proposed in the 1930s that some important innovations were the root of the strong economic waves that began approximately in 1785. His hypothesis eventually led to an influential work in 1979 led by Gerhard Mensch. In the book *Stalemate in Technology: Innovations Overcome the Depression*, Mensch cataloged over one hundred innovations that made significant contributions to industrial society between 1750 and 1950. When he plotted the frequency of major innovations against the year in which they were invented, he discovered that a cluster of innovations arises once every fifty or sixty years, the same period observed in Kondratieff's work (Poire, 2011). The fundamental impulse that keeps the capitalist machine in operation comes from the new consumer goods, the new methods of production or transportation, the new markets, and the new forms of productive organization created by the capitalist enterprise. It is a process that incessantly revolutionizes the economic structure from within, incessantly destroying the old and creating new elements, from discrete explosions, separated by periods of relative calm. The process as a whole is continuous, since there is always a revolution or the absorption of the results of a revolution, forming a new economic cycle. It is from this process that capitalism is constituted and that every capitalist enterprise must adapt itself to survive. There is inherent tendency in the capitalist system for self-destruction and the idea of creative destruction highlights the disruptive character that characterizes the interference of major technological innovations over economies and their role as a fundamental agent in the process of economic development. The motivation of this phenomenon is explained by the entrepreneur's view on the possibility of earning profits from innovation. Over time, with every wave of investment in technology, a wave of innovation is generated (Schumpeter, 1961).

### **2.1 The first wave**

The first wave is marked by the first phase of the Industrial Revolution, which was boosted by new technologies such as the invention of the steam engine in 1712 by Thomas Newcomen (1664 to 1729) and his improvement by James Watt (1736 to 1819). Watt, in addition to adding a separate condensation chamber that allowed to reduce energy loss and thus generate significant gains in efficiency, later incorporated other modifications, such as a mechanism derived from the crank-crank system invented by Matthew Wasbrough (1753 to 1781) and patented in 1780 that allowed to transform the alternating rectilinear movement of the piston of the machine to steam in a rotating movement, which contributed to the expansion of its application (Tavares, 2008). The use of hydraulic energy expanded and the textile industry was one of the most representative economic sectors of this historical period.

### **2.2 The second wave**

The second wave has as motivating technologies and determining industries the modern facilities of transport and communication (emphasizing the railway system, the telegraph, the steamship), Portland cement. The discovery of new steel processes, such as the Siemens Martin (1865), Bessemer (1870) and Thomas (1888) processes, enabled steel to be obtained on an industrial scale and gave impetus to a new era of development. As productivity increased, production costs and prices dropped dramatically. Between 1882 and 1885 the average production cost of one liter of kerosene fell by 70%, the cost of steel rails was reduced by 88% and the cost of aluminum was reduced by 96% by the electrolytic refining process invented in the 1990s. 1880 (Jensen, 1993).

### **2.3 The third wave**

The third wave, characterized between the late nineteenth and the first half of the twentieth century, was a technological revolution that had among the main innovations the development of electricity, the internal combustion engine, chemical products and the first communication technologies, such as invention of the telephone and the radio and the diffusion of the telegraph. A set of macro inventions paved the way for the emergence of micro inventions in the fields of agriculture, industry and communications. A sudden and drastic increase in technological applications has transformed production and distribution processes, creating a flood of new products that has decisively changed the location of wealth and power, which has now been concentrated in the US and Germany (Castells, 2006).

### **2.4 The fourth wave**

The fourth wave, marked by the beginning of the second half of the twentieth century, is marked by the first computer, ENIAC, developed in 1946 by Mauchly and Eckert, the invention of the transistor by physicists Bardeen, Brattain and Shockley, Bell Laboratories, by the invention of the printed circuit in 1957 by Jack Kilby of Texas Instruments and the microprocessor in 1971 by Ted Hoff of the Intel Corporation. Significant changes in the speed of innovations can already be noticed. The so-called Moore's Law advocates that the number of transistors on a chip doubles every eighteen months, while



maintaining the same cost. The set of these inventions paved the way for the emergence of personal computers, such as the Altair 8800 developed in 1975 by Ed Roberts, Apple 1 (1976) and Apple 2 (1977), PC - Personal Computer by IBM (1981). In 1984 Apple released the Macintosh. The development of optoelectronics (fiber optic and laser transmission) and digital packet transmission technology have promoted the expansion of transmission line capacity. This technology, combined with advanced switching and routing architectures such as ATM (asynchronous mode of transmission) and TCP / IP (transmission control protocol and interconnection protocol) formed the basis for the emergence of the Internet. (Castells, 2006). Other innovations of this period include the control and development of nuclear power, the expansion of commercial aviation, the development of satellite production and the space race. Robotics is based on the development of microelectronics and is applied in industrial automation, initiating a new cycle of replacing human work in industries such as the automobile industry.

### **2.5 The fifth wave**

The fifth wave, beginning in the 1990s, is heavily based on information and communication technologies - generating the expansion of digital cellular telephony, the explosion of digital social networks, the growth of the software industry, the development of the UHF (Ultra High Frequency) RFID (Radio Frequency Identification) by IBM, the development of geolocation technologies such as GPS (Global Positioning System), AGPS (Assisted Global Positioning System), GSM (Global System for Mobile Communications) and the emergence of new digital social media. This period was called by Manuel Castells (2006) of the Information Age, characterized by an informational, global and networked economy.

### **2.6 The sixth wave**

Every wave of innovation lasts approximately until the profits generated by it fall back to the level of other older and more traditional sectors. It is a situation where technology, having reached its limits in terms of economic stimulus, needs to be replaced by another new technology in order to overcome those limits. Every wave converges, at its end, to a typical economic crisis and stagnation. The crisis in 2007-2010 is the end of the wave of the information technology and telecommunications revolution. The end of the fifth wave. Long cycles were originally described as having a frequency between 45 and 60 years. What some authors have pointed out is an apparent reduction in the interval between cycles due to the acceleration of scientific progress. In this new wave of innovation, the diffusion of digital technology has been driven mainly by two factors: the extraordinary pace of technical progress, expressed in Moore's Law (which deals with the exponential shrinkage of transistor sizes that can be applied to an integrated circuit and which can also be understood as a relation that deals with the continuous reduction of costs of these components and related equipment in relation to time) and the convergence of the marginal cost of information dissemination to zero. These factors have reduced hardware prices to an extraordinary degree. Intel co-founder Gordon Moore predicted in 1965 that the number of integrated circuits would double annually in relation to the cost of microprocessors over the next decade (Moore, 1998). This prediction, as a principle, proved to be correct. Supercomputer performance doubled every year between 1990 and 2012, disk efficiency increased 67% per year and the number of transistors in microchips increased 47% per year (Brynjolfsson & McAfee, 2011). While Moore's Law provides for the annual doubling of memory capacity in electronic chips in relation to their cost and thus cutting hardware cost fast, the zero marginal cost hypothesis points to the decreasing cost of inputs and related services the information (RIFKIN, 2016). Even though these are not laws in the strict sense, they describe one of the key features of digital versus analog technology: not only is it better, faster, and cheaper, but it will also continue to become better, faster, and cheaper in the future. This explains the high growth rates of the digital economy and its ubiquity. The fall in prices of hardware, software and especially the approach to the marginal costs of obtaining information close to zero, is making the demand for information goods grow at exorbitant rates, while digital technology more and more replaces the traditional mode of information production (Vogler-Ludwig, Düll, & Kriechel, 2016). The acceleration of the process of developing new technologies and the speed of expansion of their application in the market and adoption by a larger number of consumers may not only depend on an assumption of the continuation of Moore's Law but on models which show that the changes exponentially and not linearly (Kurzweil, 2001).

The comparison between the times spent to reach 50 million users, used as a reference to evaluate the speed of propagation of a new technology, serves as indicative manifestation for the issue of acceleration. Comparatively speaking, while the phone needed seventy-five years, the radio thirty-eight years and television fourteen years to reach fifty million users, the phone needed five years, the internet

four years, Skype two years, the mobile technology required only fifty days and it is estimated that new digital technologies need only thirty-five days to reach fifty million users. The report "Surfing the Sixth Wave: Exploring the Next 40 Years of Global Change" finds that the permanently high levels of commodity prices, as well as the worsening of environmental tensions, are indicative of the emergence of a new wave. The productivity of resources is the main driver of technological, economic and even social changes and part of the technologies that make up this new cluster that will impact the economy and society is already known. The sixth wave may have as artificial technologies artificial intelligence, biomedicine, hydrogen engine and robots (Shimula, 2009). Its effects will be leveraged by the digitalization and exponential increase of computational power, both legacies of the previous wave, which created favorable circumstances for the development of new products and services. The digitization will bring transformative possibilities in the field of virtual reality, which will be present in many common situations of common life. New business models will increase the flow of communication and interconnection between different groups and will provide the development of new forms of collaboration, business and social ecosystems. Robots will be able to do trivial things done by humans, from picking flowers to producing art. Information and communication technologies will continue to dramatically reduce transaction costs (Wilenius & Kurk, 2012). The set of transformations driven by the application of new technologies have also been called the "Fourth Industrial Revolution" (WEF, 2017) or "Industry 4.0". From the technological point of view, it is not possible to explain the complexity of the current phenomenon considering only those technologies directly involved with the industry and its effects. In fact, no segmentation from economic sectors can broadly represent the technological, economic, and social phenomenon that is unfolding. The technologies themselves are being applied indiscriminately in all sectors of the economy, combining, reaching and transforming factories, banks, farms, builders, schools and governments. The terminology "Industry 4.0" seems more appropriate to identify the transformation that is occurring in the factories and in the industrial sector specifically, symbolized by the application of cyberphysical systems (Kagerman, Wahlster & Helbrig, 2013; MGI, 2015), which have the function of connecting the world with the physical world because they are mechanisms that associate information and communication technology with sensors, controllers, robots, etc. There is no doubt that, from a technical point of view, they are a very important part of the constitution and viability of Industry 4.0, and from a sociological point of view their function is discrete, since it is only a technological device among so many innovations and disruptive models. In the Sixth Wave, the new technological arrangement opens the expected possibility of economic expansion, but it exacerbates one of the fundamental aspects of capitalism: productivity will certainly make a leap from the integration of technological potentialities. This productivity gain will be obtained from the simultaneous action on the two components that define it. Productivity, as a concept, is the relation between value produced and value consumed for a given production. Taking intelligent factories as example: on the one hand, they are able to produce in large volumes and at greater speed by using a higher level of integration between systems, intelligent machines and artificial intelligence. On the other hand, the same systems, machines and new technologies will generate a huge reduction in the need for human labor (Kagerman, Wahlster & Helbrig, 2013). High productivity gains will increase the financial profits of many companies and investors, to the detriment of others that for some reason do not have access to new technologies, affecting competition and the economic logic of price regulation. If there are no changes in the tax system and in the policies of income distribution, there will be a deepening of the historical phenomenon of concentration of wealth and social inequality, especially the impacts on employment and labor. The history of job recovery, in the growth and prosperity phases of economic cycles, still fuels the hope of new jobs, in the logic of creative destruction (Schumpeter, 1961); however, such phenomena should not function as in previous cycles. One of the reasons is demographic: previous technological revolutions occurred at times of strong population growth, that is, the demand curve had a positive growth both by the increase of populations and by the insertion of gigantic parcels of people in the consumer market. Other differences should also be considered, such as the expressive amount of new technologies emerging in the same time window, combining, converging and generating other innovations at an exponential speed that cannot be matched by traditional institutions such as governments and universities and the potential of the human labor that some of the new technologies bring.

### **3 Science, Employment and Work**

In the twentieth century, mechanization affected manual and repetitive labor, triggering a cycle of

substitution of human labor in factories around the world. On the other hand, it collaborated for economic development and opened space for the growth of the services sector, which expanded to the point where it currently represents the largest share of the gross domestic product of the main developed and developing nations (BLS, 2017, IBGE, 2018; DW, 2018). The service sector, in this way, has become the largest generator of jobs and income for the populations of these countries. However, even intellectual services, such as those performed by engineers, teachers and researchers, tend to be affected by new emerging technologies, especially with regard to replacing human work with systems and software (Osborne & Frey, 2013). According to World Trade Organization studies, 80% of job losses in advanced economies are linked to technological innovation. This phenomenon tends to be even stronger in developing countries, causing structural unemployment crises (WTO, 2017). Employment lost during short-term economic crises is partly reestablished in later periods of economic growth. It is clear that this reestablishment, even if partial, occurs in an uncontrolled and random manner: there is no guarantee that a resumption of growth will reverse a certain unemployment rate that was generated on a region, country or individuals. This job, because of the mobility of capital and labor, can migrate from country or continent, in search of greater efficiency and advantage. Structural unemployment, so called by its characteristic of irreversibility, is the result of productivity gains obtained by companies from the application of technology in their processes, whether those generating physical goods or services. The influence of technology on productivity and the consequent substitution of employment has been accelerating with the evolution of digital technologies. Digital innovation changes more radically the way the economic pie is distributed and accentuates the concentration of wealth, while destroying jobs for middle-class workers. New jobs generated in this context require more sophisticated skills that are not inaccessible to most workers (Brynjolfsson & McAfee, 2011; Osborne & Frey, 2013). Developing competencies through training strategies does not guarantee the insertion of the worker in the labor market, either because of the shortage of labor, or because the training programs often fail to sufficiently develop the necessary skills, generating an "apparent" training, by its superficial character. The advancement of digital technology over these functions can repeat the effect that automation, mechanization and robotization have generated on industrial jobs. Despite fears about these possibilities, what is certain is that artificial intelligence and other technologies such as synthetic biology, computer science, nanotechnology, quantum computing, additive manufacturing, autonomous vehicles and robotics will have fundamental impacts on the nature of work, on the economy and society in the coming decades. One of the critical points in the discussion about the expansion of the use of the new technologies in their diverse applications by individuals and organizations is the urgency of a deep restructuring of the policies, structures and mechanisms of social protection, of stimulating the generation of work and income and the systems educational, to support the transformations that are already taking place and that in a few years will reach new heights of complexity and power. Such restructuring also depends on an exceptional collaborative effort and enormous capacity for political articulation to involve countless actors, in many cases with distinct and contradictory interests. Even countries structurally well-prepared and organized to cope with this transformation depend on a combination of complex factors to succeed. If socioeconomic systems do not fit into a scenario of technological acceleration, integration and digitized globalization, then much of the global mass of workers may be unemployed by 2050 (Glenn & Florescu, 2016). The possibilities of generating new jobs from new functions and professions that emerge must be viewed with caution, since they can demand levels of impediment of competences for workers from functions of low complexity. What's more, they tend to be in absolute numbers to accommodate the mass of affected workers. Consultant McKinsey estimates that the career transition needs will be enormous - considering where it is feasible - and will involve at least 375 million workers who will need to develop new skills - in case of success in the rapid adoption of the digitization by the countries. If the transition is slow, unemployment will increase and still cause depreciation of wage values (MGI, 2017). The emergence of new businesses will also occur, but with higher levels of productivity and less need for human labor (Rander, 2016). The new business models will demand a lesser relation between the necessary labor and their productive capacity, whether of manufactured goods or services. The growth of companies that become automated will also occur in a lower standard of job creation. Personnel costs are usually significant for most companies; thus, the technology will be used to reduce personnel, with the objective of increasing operating margins and financial results.

According to Osborne and Frey (2013), 47% of jobs fall into the high risk category, ie jobs that can be automated in a relatively short period of time over the next decade or two decades, including jobs in numerous service sector activities, whether of an administrative or knowledge nature. In Germany, the

services sector accounts for about 70% of GDP and in Brazil for about 75%, where it also accounts for most jobs.

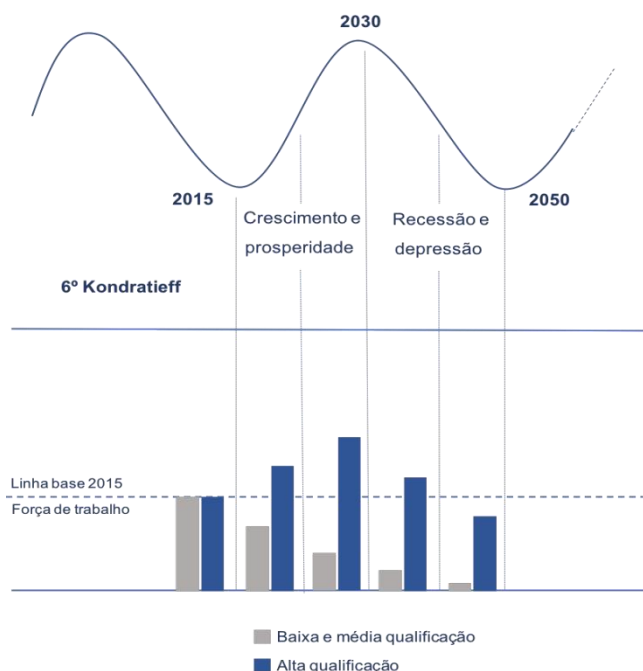
In Germany it comprises 72% of jobs and in the United States 80.1% (BLS, 2017, IBGE, 2018, DW, 2018). The adoption of process automation robots, electronic document recognition technologies and artificial intelligence opens up many optimization possibilities (Vogler-Ludwig, Düll, & Kriechel, 2016). Various occupations of the service sector will be impacted, involving transportation and logistics activities, office workers and administrative support, as analysts. Also factory workers will be affected (Osborne & Frey, 2014) and the digitization will significantly affect the public service. Reduction forecasts are already consolidated in some countries, such as Germany and the United States, where a reduction of 15% of occupations is expected in federal public services only until 2024 (BLS, 2017). The automation of knowledge work is being done from a new approach, which involves not only the question of information but also all the theory and modes of reasoning necessary to perform a task or task. Emerging solutions deal with large-scale knowledge bases, complex forms of situation assessment, sophisticated modes of reasoning based on values, and autonomous system behaviors. Some law firms, for example, are already using computers that can examine thousands of clarifications and legal precedents to aid in the preliminary research work that may involve hundreds or thousands of hours of work. Symantec's Clearwell system uses language analysis to identify general concepts in documents and present the results graphically and is able to analyze and classify more than 570,000 documents in two days. In financial services, artificial intelligence has played an important role in the analysis and financial transaction processes for some time. Banks are using machine learning to detect scams and identify situations like charges or claims outside the normal behavior of a person buying. Even services like Future Advisor use artificial intelligence to offer customized financial advice in a cost-effective and scalable way. It is estimated that by 2025, productivity gains of 45-55% can be achieved for 25 million knowledge workers in this sector, which would lead to the economic impact of \$ 600- \$ 800 billion per year (MGI, 2013) . Even in the field of programming services, the use of artificial intelligence applied to self-repair codes reduces the need for human programmers. Voice-enabled systems and ever-increasing personalization are expected to drastically reduce the demand for Call Centers to which India has become famous. About 69% of jobs in India are at risk of displacement due to artificial intelligence and automation. In India's top five IT service companies, job growth is down by as much as 40 percent, and the country faces huge challenges from the ongoing technology revolution: if nothing is done, about 69 percent of jobs will be lost for automation (Singh, 2017). The negative effects on employment also arise for medical health professionals, especially nursing and laboratory professions (Vogler-Ludwig, Düll, & Kriechel, 2016). The automation of knowledge work can have important effects on health care services. Oncologists at Memorial Sloan-Kettering Cancer Center in New York are using IBM's Watson Artificial Intelligence system to provide diagnoses of chronic treatment and cancer treatment by accessing the knowledge of 600,000 reports of medical evidence, two million pages of scientific literature from 42 medical journals and 1.5 million patient registries and clinical trials in the field of oncology, plus clinical and genetic data for each patient. With this, the AI system compares individual patient symptoms, vital signs, family history, medications used, genetic structure, diet and exercise routine to diagnose and recommend a treatment that is most likely to be successful. Wellpoint has adopted this technology to support decision-making and accelerate the process of approving medical applications, which took days before and are now completed in a matter of seconds. This was only possible because the system was trained with 25,000 historical cases, to which techniques of hypothesis generation and evidence-based learning are applied, to generate recommendations that aid in decision making. Cognitive computing in health can also help reduce costs and increase the efficiency of organizations by crossing data that allows for more efficient management (IBM, 2017). The benefits that such technologies can bring are undeniable, however, their side effect on jobs needs to be considered.

The retail sector is one of the great generators of employment, both because of its size in the world economy and because of its labor-intensive character. In the United States, it is the 4th largest generator of jobs, accounting for about 15 million eight hundred and twenty thousand jobs in 2016. Retail has a complex cost structure, based on two main factors: cost of goods sold and cost of the hand of work. The challenges and investments needed to improve the customer experience will entail automating tasks and processes that have remained unchanged for decades. By applying technologies such as AI and robotics, retailers want to use intelligent process automation to identify, optimize, and automate intensive, repetitive activities. Many retailers are already applying the automatic checkout process in their stores (Gartner, 2017a) and others are experimenting with robotic solutions with virtual assistants for customer service. The retail sector in the US has already presented a reduction of 3% in its annual jobs as a result

of the digitization. (Vogler-Ludwig, Düll, & Kriechel, 2016). It is estimated that by 2020 the top 10 retailers will apply advanced algorithms that will cut up to one-third of merchandising teams and digital chat and answering applications that will process 50% of customer service requests, impacting on the need for professionals for these activities (Gartner, 2017b). Another aspect that deserves attention when assessing the phenomenon of the threat of structural unemployment in the services sector is that this sector - historically - has absorbed a large part of the labor force that has been eliminated from the agricultural and industrial sectors, due to its own automation and increased efficiency. Because it encompasses a variety of activities that require low qualification, the services sector has generated job and income opportunities for industry and rural graduates (Osborne & Frey, 2013). The possibilities of migration of workers from the industrial and agricultural sectors to sectors of greater aggregate knowledge do not seem so possible with the new technological revolution.

#### **4 Essay on the Sixth Wave of Innovation and Work**

Schumpeter (1961) dealt with the concept of creative destruction, highlighting the disruptive and revolutionary character that characterizes the interference of technological revolutions in the economic structure: from within, intensely destroying the old and creating the conditions for the new. As technological innovations have emerged, from time to time, the investment of entrepreneurs in entrepreneurial actions have caused waves of economic growth. The sixth wave, or the sixth Kondratieff, is beginning, and like any great wave of technological innovation, it will last approximately until the profits of the new innovation fall to the level of other older and more traditional sectors, reaching its limits in terms of stimulus economic. In addition to entrepreneurial entrepreneurship, the new wave is also receiving stimulus from governments, which have been making huge investments to support initiatives that prepare the infrastructure of their industries and economies for the oncoming digital transformation, as has been happening in the US with the creation of advanced manufacturing institutes - Manufacturing USA - and in Germany, with the Industrie 4.0 program (Holdren & Lander, 2011; Vogler-Ludwig, Düll, & Kriechel, 2016; BMAS, 2017). Typically, waves of innovation are composed of four phases. The first phase is growth, when investments are boosted and innovations begin to impact on the economy and the labor market. The second phase is prosperity, when the degree of utilization of the innovations brings marked gains in productivity and causes wealth growth. The third and fourth phases are movements of economic decay: recession and depression (Schumpeter, 1961). The behavior of the labor market and employment used to follow this cycle, progressing in the phases of growth and prosperity and falling in the phases of recession and depression. However, the new wave suggests a behavior different from the previous ones. In the initial stages the employment will grow, but only the one based on higher qualification and for certain occupations. The employment of medium and low qualification, for the most part, may already decline in the first phase. Even high-skilled jobs tend to regress after the apex - which is characterized by the depletion of the effects of the high levels of investment that have driven the economy and the full adoption of innovations by companies. From the available studies and forecasts (Shimula, 2009; Holdren & Lander, 2011; BLS, 2017; BMAS, 2017) we can suggest a temporal configuration for the sixth wave of innovation and a trend in terms of the evolution of the workforce. Figure 26 represents this assay and suggests a setup for the sixth innovation wave.



**Figure 2 The 6th Wave of Innovation and the Evolution of the Workforce.**  
 Source: Prepared by the author. Dates are just references. The charts suggest trends.

## 5 Conclusion

New technologies will enable significant advances in various areas and aspects of human society, such as health and longevity, energy efficiency, reduction of environmental impacts and risks, food production, mobility in major cities, reduction of traffic accident rates and loss of life, new learning systems. There will be economic prosperity within the logic of the process of creative destruction, with products and businesses being replaced by others. The impacts that new technologies can generate on the 21st century workforce are of an order of magnitude similar to the great changes brought about by earlier waves of innovation. The changes that have taken place have not resulted in long-term mass unemployment because they have been accompanied by the creation of new types of work. However, we can not say with any certainty that this historical relationship between economic growth and employment and job creation will be maintained. The sixth wave of technological innovation has determinant characteristics that differentiate it structurally from previous ones. The speed with which transformation is occurring, the accelerated scalability of new technologies, the number of disruptive technologies emerging or maturing simultaneously, the massive potential for replacing human labor, the relevant impact that will occur in service sector jobs, and the different demand for qualification for workers - which favors some occupations as it excludes others - are some of the differences from the past that will dramatically affect the structure and the labor market. Imagining the future perspectives of work without considering these differences would be a misnomer. There will be an imbalance in the generation of jobs in terms of the functions of higher and lower qualification, being the second category impacted from the beginning of the process, in the phases of growth and prosperity of the new wave of technological innovation. After 2030, approximately, the decline of part of the most qualified workforce necessary for the operation of companies and organizations will also begin. The second phase of the sixth wave of innovation, with its typical stages of recession and depression, may be particularly critical for combining the degradation of economic conditions and the reduction of jobs in a society whose transformation to a new model of income generation and way of life has not yet is fully consolidated, given the speed with which all change must occur. The wealth that will be generated by economic growth in the prosperity stage of the sixth wave can be captured in a concentrated way by a few countries, corporations and individuals, accentuating inequality conditions.

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## Does Viral Marketing create *Brand Awareness*? An Exploratory Study with University Students

Rafael Taino, Rafael Rodrigues Cardoso, Alexandre Luzzi Las Casas, Arnaldo Jose de Hoyos Guevara  
Pontifical Catholic University, São Paulo, Brazil  
(E.mail: rtaino@gmail.com, rrcardoso@pucsp.br, alascasas@terra.com.br,  
arnoldodehoyos@yahoo.com.br)

**Abstract:** Viral Marketing has attracted the attention of many schoolers and people from the field of marketing because of the broad reach the message it shares can get. Recent studies investigated what leads people to share viral content and which content is most likely to become viral. However, there is no proved correlation between *viralization* and brand awareness generating. Considering that the main purpose of any Marketing is make the target audience identify and remember a brand, the current study investigated through an exploratory survey whether the videos that went viral on 2016 were able to generate brand awareness in a group of students of the Pontifical Catholic University of São Paulo-PUC / SP. The results showed limited impact on the creation of brand awareness, because of previous experience of the public in recognition of the brand displayed on the video. In addition to the results the study also contributes by questioning the content displayed in viral videos and shows how the time of exposure of a brand on a video influences directly in the creation of brand awareness.

**Keywords:** Viral marketing; Brand awareness; *Viralization*

### 1 Introduction

The term "viral marketing" has existed for more than two decades, but it only became famous in digital media due its use on a previously established social media, that aims the contribution to the dissemination and sharing of information using word-of-mouth (WOM), or *boca a boca* in Portuguese (Almeida, Costa, Coelho and Scalco, 2016). The seek for viral content got a lot of attention from companies that, instead of spending money on media services, allocated efforts and resources to use free media in which customers are active as the main channel of communication (Corcoran, 2009<sup>1</sup>).

As far as *viralization* and content sharing are concerned, recent studies have investigated users behavior when sharing online content, the impact of different subjects shared influences how viral it will get, creating different values of those subjects to companies interested in Brand Awareness. (Berger, Akpınar, 2017; Dafonte-Gómez, 2014; Almeida et al., 2016; Berger, Milkman, 2012; Nikolinakou and King, 2018; Tellis et al., 2019).

Those studies brought meaningful contributions to the academic and managerial field by identifying that:

- (i) videos that generate a type of positive reaction are more likely to become viral compared to videos that induce negative reactions (Nikolinakou and King 2018, and Berger, Milkman, 2012);
- (ii) videos that have as their only goal to present a particular brand have more credibility among the audience (Berger and Akpınar, 2017) and
- (iii) the presence of a brand in videos with emotional content does not reduce the amount of share (Tellis et al., 2019).

However, despite the contributions mentioned, there are still dimensions that weren't explored that identify how viral videos are contributing to the generation of brand awareness in the audience reached by its message. Tellis et al. (2019) describes a literature review that shows that only 2 articles which analyzed video sharing have some kind of analysis regarding the presence of the brand on a video, but none evaluated how the presence of the brand on a video has created a memorable impact of the brand to the costumers.

Understanding the importance of brand awareness is primordial because viral videos are not only reaching a large number of people, but are also ensuring that the people who view it have a relation to what they saw and recognize the brand or the company who created it. Tariq et al. (Bloch, Sherrell and Ridgway, 1986), describes that a costumer, when having knowledge about a particular brand or

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<sup>1</sup>Corcoran, Sean (2009), "Defining Earned, Owned and Paid Media". Sean Corcoran's Blog (December 16). Recuperado em 15 de abril de 2019, de [http://blogs.forrester.com/interactive\\_marketing/2009/12/defining-earned-owned-and-aidmedia.html](http://blogs.forrester.com/interactive_marketing/2009/12/defining-earned-owned-and-aidmedia.html).>

company increased, tends to speed up purchasing decision process.

In order to reduce this discrepancy, the study aims to improve viral marketing, by understanding how these viral videos contribute on the creation of brand awareness on an specific public. Our studie focus on exploratory research so that future studies can be done and get even deeper in the relationbetween viral videos and brand awareness.

In general, this study contributes to marketing research in two ways: (1) when evaluating whether branded videos create brand awareness; (2) by evaluating how the time spend on the brand or video content influences the generation of brand awareness.

## 2 Viral Marketing

Ogden e Crescitelli (2007)define viral marketing as a new style of marketing raised during Modern Communication of Marketing WOM, with the difference that it uses internet for propagation of message such as e-mail, video, audio, games, websites, social networks, photographs or documents, which, due to its quick transmission, can be compared to a contagious virus, using the means mentioned above.

The term Viral Marketing is a reinterpretation of the English expression “word of mouth”, created in 1997 (Knight, 1999). Sun et al. (2006) define viral marketing as a tool for establishing relations between communities, but online. The *Word of Mouth Marketing Association* (WOMMA) defines viral marketing as "the creation of entertainment or informational messages made to be passed on in a broader way, usually throw electronic means or email" (Freundt, 2012).

Regardless the definitions for viral marketing, Berger and Akpınar (2017), based on Berger (2014), describe that the success of any viral marketing action depends on two factors. The first factor is people's willingness to speak or share a particular marketing action, but to do so, one must investigate why people share some things over others. The second factor is that companies need to generate value for brands that are being used as advertising.

Berger and Milkman (2012) investigated what makes certain contents viral. Evaluating New York Times articles published over three months, the authors concluded that positive content is most likely to become viral than negative one. But this relation is more complex than it looks, since the authors have found that content that generates high positive excitement (eg, fascination or glamor) or negative (eg anger or nervousness) is more lkely to be shared than the ones that generate low excitement (for example, sadness).

Teixeira (2012) believes that, before attempting to make something go viral, a campaign must reach the goal of being seen. In addition, the author identifies factors that can positively impact on how viral a campaign can get, for example, the inclusion of emotional content already at the beginning of the subject and the creation of a roller coaster of emotions throughout the advertisement, in order to establish an emotional experience that goes up and down as a way to keep the public's attention.

Dafonte-Gómez (2014) evaluated a sample from 25 videos available on Unruly Mediadigital platform between 2006 and 2013 in order to identify the elements that stimulate the sharing of a particular video. The authors concluded that all those videos with emotional content, which contained elements such as surprise and joy, were more famous than the others.

Berger and Akpınar (2017) propose a categorization between the different types of advertisements, differentiating informational appeal from advertisements with emotional appeal. Advertisements with informative content are those where (i) there is greater emphasis on the product and the brand; (ii) the product and brand are the main focus; (iii) there is greater appeal in the characteristics and specificities of the product; (iv) the technical product information is provided. On the other hand, advertisements with emotional content are divided into Partially Emotional, where, in the course of advertising: (i) there is less emphasis on product and brand, (ii) the product and the brand are shown discreetly, as a complement to the message; (iii) there is musical, cinematographic, visual effects and / or famous artists appeal, and, (iv) there is no reference to the technical information of the advertisement. The other one is the Fully Emotional product, where: (i) there is medium / great emphasis on the product and the brand, (ii) the product and the brand are inserted with greater intonation as the central theme of the message; (iii) there are also musical, cinematographic, visual effects and / or famous artists appeals, but (iv) there is some references to technical information. The authors studied how these different types of content would impact *viralization* and two main conclusions were obtained. The first conclusion is that videos with emotional content are more shared than videos withto much information. The second conclusion is that the presence of the brand in the emotional videos does not negatively impactits fame. Thus, from

the managerial point of view, the authors suggested that companies should focus on creating videos with a meaningful presence of the brand.

Tellis et al. (2019) deepened the discussion on how the brand influences the amount of shares. The authors evaluated whether the presence of the brand at the beginning, middle, end or even absence of it would impact the results. In conclusion, it was identified that the presence of the brand at the end of the video is significantly better than the other options.

It is noticed that there is an evolution on the number of dimensions explored regarding viral videos. At the beginning the focus was what motivated the user to share a video, and currently there are articles analyzing how the moment of appearance of the brand will impact on the number of shares. However, as already mentioned above, there is no research that evaluates how viral videos have contributed to the creation and intensification of brand awareness.

### 3 An Exploratory Study on University Students

In this article, there was a research on students from PUC / SP. University students were chosen based on an article published by Berger and Akpınar (2017), in which a similar research was made on viral marketing with students from other universities in other countries. College students are the main users of many platforms from the Internet, therefore they are an essential audience to be evaluated. We based the exploration of labor in a very similar age profile, because we sought for the equalization of at least one of the variables among all the others present on the experiment, such as gender, race and socioeconomic level.

The foundations of the research involved a presentation of viral videos to the audience so that they could classify them as informational or emotional, identify the presence or absence of the brand and be able to tell which company is behind the video. The measurement of brand awareness took place through a numerical counting of how many could identify the brand involved in the advertisement. For each of the interviewees a file was delivered, containing a table identifying the advertisements in sequential order, plus two questions. The first question asked the student to classify the video as emotional or informative and the second one asked the interviewee to write the name of the brand or product related to each video.

Regarding the videos presented to the students, the similarities of the sources used were considered, just as Berger and Akpınar (2017) did, the initial proposal involved viral videos from the site *Unruly* (unruly.co), that is considered the most relevant platform in this field that evaluates and tracks video sharing. According to Berger (2016), since 2006 *Unruly* had mapped over 329 billion videos. However, the search for this content was not available, since *Unruly* no longer offers this service, making it impossible to obtain these advertisements.

As an alternative to overcome this obstacle, it was discovered, on the same website, an extensive list of other places where the main viral videos could be found, which were: *Campaign*, *the IAB*, *The Guardian*, *AdWeek*, *Werben&Verkaufen*, *Horizont*, *Contagious Magazine*, *Mumbrella Australia* and *Communicate*.

An individual research was made on each of those places, and on the *AdWeek*<sup>2</sup> website a 2016 report was found with the 20 most famous videos of that year. The choice of videos from a previous year had the purpose to minimize the impact of the seasonality of its content. In addition, the annual analysis brings a benefit that is the consideration of all stages of *viralization*, that is, the beginning, apex and decline, at local, regional and global level.

Ten videos were chosen from different countries spread around the world. The average time of the twenty videos is 2 minutes and 49 seconds. Regarding the number of shares, it varied between 544,585 and 1,949,387.

After defining the methodology and the data source used for the research, it was possible to collect results, on the morning of May 2<sup>nd</sup>, 2019, at Campus Monte Alegre, PUC / SP.

Before the experiment began, the students were given a brief explanation of the specialized literature, about how to define the informational and emotional contents, mentioning characteristics that distinguish each one of them and the importance of this study. Finally, the students were asked to answer the questions individually, avoiding the interference of a colleague.

<sup>2</sup> Adweek (2016). The 20 Most Viral Ads of 2016. Disponível em: <<https://www.adweek.com/creativity/20-most-viral-ads-2016-174885/>>

After that, the 10 videos were presented in sequence and, at the end of each one, the two questions in the questionnaire were answered.

#### 4 Preliminary Results

After the students took part of the research, each participant's answer was collected for evaluation and analysis. In total, 33 students participated in this activity. Considering that 10 advertisements were designed, a total of 330 responses were collected, which were analyzed from a quantitative and qualitative point of view. The first evaluation aimed to understand the distribution of the 330 responses between informational and emotional content.

The results showed that, out of the 330 evaluations carried out, 321 indicated that all 10 videos presented emotional content. This agrees with what other authors (Tucker, 2015 and Berger, 2014) have already found out about the fact that companies have prioritized the creation of videos with emotional rather than informative content, seeking for more and further reach.

Then, based on a series of emotional data a brand awareness assessment was made, questioning if the content that is fully emotional provides a more powerful generation of brand awareness than the partially emotional.

According to Keller (1993), a brand can be recognized by its name, term, sign, design or a combination of all these factors, creating Brand Knowledge, which is brand recognition through these symbols. The importance for brand recognition in the customer memory has been studied for many years to identify its effects on one's final decision (Alba, 1991).

The results are described in Table 1. It is observed that approximately 62% of the evaluations (n = 199) indicate the contents of the advertisements as fully emotional. In addition, approximately 38% (n = 122) of the evaluations classified them as partially emotional. Regarding the generation of brand awareness, it is observed that, for most videos (7 out of 10 videos), over 50% of all students recognized the brands behind it (RB), meaning that most videos are functional. The lack of other studies in literature has limited the comparison meaning that 50% index can be considered both good and bad index.

**Table 1 Time of Exposure of a Brand in Relation to the Total Time of the Advertising**

Ranking	Advertising	T.T.	T.E.B.	R.B.	E.R.P
10°	Mc'Donalds	01:01"	00:30"	91%	P. E.
9°	Cadbury's	00:46"	00:12"	24%	P. E.
8°	Ariel	02:18"	00:12"	79%	P. E.
7°	Doritos	00:30"	00:10"	94%	F. E.
6°	Nike	01:00"	00:05"	91%	F. E.
5°	S7 Airlines	03:22"	02:42"	64%	P. E.
4°	Vodafone	02:29"	00:13"	39%	P. E.
3°	Shell	03:03"	00:09"	76%	F. E.
2°	Channel 4	03:12"	03:12"	0%	F. E.
1°	John Lewis	01:30"	00:03"	67%	P. E.

T.T = Total Time of the advertising; T.E.B = Time of Exposure of the Brand; R.B = Recognition of the Brand

E.R.P = Evaluation of the Reserched Public (P.E. = Partially Emotional; F.E. = Fully Emotional).

Regarding the videos division between fully and partially emotional, the results obtained suggest that the generation of brand awareness does not depend on the type of content, since two videos had 91% of brand recognition, one being classified as fully emotional (video 6) and the other as partially emotional (video 10). Thus, it is suggested that brand awareness occurs regardless of the content.

As regards the time of exposure of the brand in the videos, we couldn't find similarities among them, which makes sense considering that the proposal and purpose of creating a video depends on the context and the results expected by the presented brand or product. Thus, the exposure time varied between 3 seconds and 2 minutes and 42 seconds.

These results suggest the absence of a proportion of brand exposure time in the total time of the video. For the most viral video (video 1), the brand exposure time was only 3 seconds of a 1 minute and 30 seconds total. In this case, the brand exposure time was approximately 3% of the total video time.

Regardless of the absolute or relative exposure time, the creation of brand awareness appears not to be impacted. In the video by *Nike*, used as an example above, the time of 5 seconds meant 3% of the total but indicated brand recognition from 91% of the responses.

In order to evaluate how exposure time of the brand or video content influences the generation of brand awareness, we analyzed these variables in all videos. The results obtained suggest the inexistence of a direct relation between each of the variables and the respective generation of brand awareness, as exemplified below.

The first example, referring to the video by *S7 Airlines*, obtained a brand recognition index of 64% although the logo is present in approximately 80% of the total time. This suggests that, because the company is not present in the students's daily lives, the generation of brand awareness is insignificant. On the other hand, there is the video by *Nike*, in which the company logo appears for only 3 seconds, but the brand recognition rating was 91%.

The second example, refers to the video by *McDonald's* company. The presence of the logo was approximately 50% of the total time, it is fully emotional, but the students classified it as partially emotional. The video, which takes part inside a company's franchise, has emotional appeal and the story created for the campaign appears to have impacted the public much more than the presence of the logo, suggesting that brand awareness is generated regardless of the emotional aspect. On the other hand, there is the video by *Channel 4*, in which the students got the content of the video right, however, the brand recognition index was 0%, even with the logo being present during the entire video.

## 5 Final Considerations

By the results obtained and the analyzes made, we identify and suggest that additional studies should be done with the intention of deepening the relationship between Viral Marketing and brand awareness. Although the results showed that *viralization* is generating brand awareness and that the type of content (fully or partially emotional) does not impact directly on brand awareness (measured by the correct index of responses), the analysis indicates the need of exploration in future researches. In this section we will discuss some of the observations made.

In this study, 40% of the videos were classified as fully emotional. In the study by Berger and Akpınar (2017), these authors indicate that only 20% of the emotional advertisements could be classified as fully emotional. They also mention that the companies responsible for creating these advertisements believe that the presence of the brand could negatively impact the amount of shares and views, thereby reducing brand exposure in the video. The present research, therefore, obtains different results from those published by Berger and Akpınar (2017) in which 40%, almost half of the students, classified the videos as fully emotional.

Additional studies are suggested because of our different results, as a way to understand and establish the most adequate classification of fully or partially emotional video, for example the already discussed *Channel 4* and *McDonald's*, since, regardless of the emotional aspects, the *viralization* could happen.

Regarding brand exposure time and the generation of brand awareness, we identified that the brand recognition most related to a previous knowledge, like it is seen in *Nike's* case, that presented low exposure time and a high index of correct answers. The reverse situation occurs with the companies *Channel 4* and *S7 Airlines*, where the exposure time was high, however, was not able to generate brand awareness. Thus, we suggest that future studies should be done to explore the relation between Viral Marketing and brand awareness, because the results show that if a company is already highly recognized in the market, *viralization* will only reinforce the existing brand awareness. While a company that has low brand awareness will not directly benefit from a viral video.

These observations have an important managerial impact, since, is not a good decision for a company with low brand awareness to allocate investments on the development of viral videos. In this case, companies should initially invest on brand awareness campaigns with tactical activities and initiatives that will ensure longer brand exposure.

These recommendations, however, are also related to one of the limitations of this study, which is the low number of respondents. The sample of 30 students is relatively low and, therefore, it is necessary to conduct new studies with a wider and more diverse sample. The choice of students in a single discipline does not consider the influence of other aspects, such as demographic and regional factors. Although all companies used were multinational, some have a greater presence in the Brazilian

market than others, which brings the need to carry out this study to other parts of the world.

## 6 Conclusion

Viral Marketing has always attracted the attention of companies and schoolers. Word-of-mouth marketing worked in a period when there was no internet and even today with the use of digital platforms it is used to reach a wider public and ensures brand exposure. This research explored Viral Marketing in order to understand whether making a video go viral generates brand awareness and whether the presence of a company logo and exposure time impact brand awareness.

We conclude that viral videos create brand awareness, but in a limited way, since the previous knowledge on a particular brand also influences on the identification of it in advertisements or future videos, as seen in *Nike's* case. Thus, companies that have *viralized* videos but are not recognized do not fully benefit from its fame.

We also conclude that there is no direct relation between the presence of a logo or its exposure time and the generation of brand awareness. As an example, there is the case of *Channel 4* in which the brand was exposed throughout the entire video, however the brand awareness was not obtained in a significant way.

Considering everything that was said, we understand that this practical research contributes to the academic field by showing that the *viralization* of videos involves several factors and that the correlations found need a deeper study. It also contributes to the management field by proposing that investments on viral video as a form of brand awareness require a greater strategy in the process of content creation and a prior assessment of the level of audience knowledge of the brand, considering the platform in which the advertising will be placed, the heterogeneity of the target audience and the adherence of this public to the techniques used in the advertisement, since the expected results may not be achieved due to limitations in the use of this field and the underutilization of the information obtained in the advertisement data collection stage.

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# Improved Genetic Algorithm for Solving TSP

Li Yigao<sup>1</sup>, Han Hua<sup>2</sup>

1 NO.1 Middle School Affiliated to Central China Normal University, Wuhan, P.R. China, 430223

2 School of Science, Wuhan University of Technology, Wuhan, P.R. China, 430070

(E-mail: 365186597@qq.com, hanhua@whut.edu.cn)

**Abstract:** In this paper, principles and solving process of basic genetic algorithm are firstly summarized. Considering that in view of TSP, basic genetic algorithm is likely to converge to the local optimal solution and often converges with low speed, we absorb advantages of other intelligent algorithms, with the purpose to enhance performances of genetic algorithm for solving TSP. The crossover operation in the genetic algorithm is improved by the colonial assimilation in the discrete imperialist competition algorithm, and to enhance the diversity of the population variation, we improve the mutation operation of the genetic algorithm by combine it with the Levy flight method. Finally, we test the performance of our proposed algorithm with some typical instances in the internationally commonly used library of TSP (TSPLIB), and the results are compared with performances of basic genetic algorithm and discrete flower pollination algorithm over the same instances set. The experiment results show that our improved genetic algorithm has high quality and fast convergence speed.

**Key words:** Traveling salesman problem; Genetic algorithm; Imperialist competitive algorithm; Levy flight

## 1 Introduction

The Traveling Salesman Problem (TSP) is one of the well-known combinatorial optimization problems in the field of operations research and has been proven to be a NP-hard problem, which means that no polynomial time algorithm that solve TSP with exact solution can be found unless NP=P. Our target in this problem is to find the shortest circular path that traverses all destinations once in a complete graph. TSP is rather close to real-life backgrounds and has a wide range of engineering applications. Instances that utilize thought of TSP include car-frame procedure scheduling, logistics distribution, aircraft routing arrangement, printed circuit board welding, etc. Many problems can be abstracted and transformed into TSP for simplification. Therefore, solving TSP effectively and quickly has high practical value.

There are mainly two types of methods for solving the TSP. One type is deterministic algorithm based on search, such as exhaustive method, branch definition method (Carpaneto G,1980), dynamic programming method (Bellman R,1962) and so on. All algorithms of this type have exponential complexity. The other type is intelligent algorithms that solve TSP approximately, such as genetic algorithm, ant colony algorithm, annealing algorithm, immune algorithm and so on. With the deepening of research, new algorithms with higher accuracy or/and lower complexity emerge. In *A fast Ant colony optimization algorithm for traveling salesman problems* (Ji J Z, Huang Z, Liu C N, 2009), an ant colony algorithm for solving traveling salesman problem was proposed; Marinakis et al. (Yannis Marinakis, Magdalene Marinaki, 2010) proposed a hybrid multi-particle swarm optimization algorithm; in Development a new mutation operator to solve the traveling salesman problem by aid of genetic algorithms (Murat Albayrak, Novruz Allahverdi, 2011), the greedy search algorithm was introduced into the genetic algorithm mutation operation to design a new greedy sub-path mutation operator; Yang Xinshe et al. (Li Qian, He Xingshi, Yang Xinshe, 2016) proposed a discrete flower pollination algorithm to solve the TSP problem.



This paper analyzes the genetic algorithm and the principle of solving the TSP, and then improves the genetic algorithm with absorption of other intelligent algorithms' advantages to strengthen its search ability. Experiments were carried out with TSPLIB data set, consequence of which verifies that our newly proposed genetic algorithm significantly improves the quality of the solution compared to basic genetic algorithm and pollination algorithm.

## 2 Basic Problem Description

### 2.1 Overview of TSP problem

The earliest description of the TSP was Cavalier travel problem researched by Euler in 1759, that is, for 64 squares in a chessboard, a knight is required to visit each square once and only once, and finally returns to the starting point (Baidu Baike, 2014). The general description of TSP is: there is a graph in which all cities are connected to each other with known distance between each city. Our target is to help a traveler wants to go over each city once and only once, and finally comes back to the starting city, to find the circular path with the shortest distance he can follow. Its mathematical model can be expressed as follows:

Let  $G = (V, E)$  be the weighting graph,  $V = \{1, 2, \dots, n\}$  be the vertex set,  $E$  be the edge set, the distance between the vertices is  $C_{ij}$ , and  $(C_{ij} > 0, i, j \in V)$  is known, and set:

$$x_{ij} = \begin{cases} 1 & \text{on the optimal path} \\ 0 & \text{other} \end{cases} \quad (1)$$

Then the mathematical model of the entire TSP problem is expressed as follows:

$$\min Z = \sum_{i \neq j} C_{ij} x_{ij} \quad (2)$$

$$s.t. \begin{cases} \sum_{i \neq j} x_{ij} = 1, j \in v \\ \sum_{j \neq i} x_{ji} = 1, j \in v \\ \sum_{i, j \in s} x_{ij} = |K| - 1, k \subset v \\ x_{ij} \in \{0, 1\}, i, j \in v \end{cases} \quad (3)$$

Where  $K$  is the total non-empty subset of  $V$ , and  $|K|$  is the number of vertices contained in  $K$ .

### 2.2 Introduction to genetic algorithm

Genetic algorithm is a stochastic parallel search algorithm based on the principles of natural selection and genetics, and is an efficient optimization method that seeks for global optimal solutions without any initialization information (Ren Z W, San Y, 2006). The genetic algorithm expresses the solution set of the problem in the form of the individual's genetic code in a population which is compromised by multiple individuals. In genetic algorithm, the quality of the solution is enhanced through continuous selection, crossover, mutation and other genetic operations. This intelligent algorithm has few restrictions on the properties of problems or the search space. It is also often easily combined with other algorithms, and has strong global search ability as well as strong robustness for solving nonlinear problems, which makes it to be widely applied into the fields of automatic control, function optimization, pattern recognition, image processing and other engineering fields. Genetic

algorithm is also one of the commonly used methods for solving NP-hard problems.

### 2.3 Genetic algorithm solves the principle of TSP problem

The genetic algorithm evolves from generation to generation based on fitness values to find the optimal solution of the problem. The main calculation process for a simple genetic algorithm to find a secondary TSP problem is as follows:

Step1: According to the coding mechanism, the route is encoded by the city serial number, and the composition codes are sorted according to the order of visiting the city to generate an initial population.

Step2: Calculate the fitness value of each individual in the initial population. In TSP, our purpose is to find solution circular path with the shortest distance (least cost), so the fitness function is designed as  $fit(i) = D / f(R_i)$ . The constant D can prevent the cost of path from being too large which will cause the fitness function value to be close to zero.

Step3: Selection operation. The selection in population is usually done using roulette or elite retention strategies, so that individuals with higher fitness values also have greater probability to be selected. The formulas for calculating the probability for an individual to be selected and the corresponding cumulative probability are as follows:

$$P_i = fit(i) / \sum_{i=1}^n fit(i), \quad Q_i = \sum_{j=1}^i P_j \quad (4)$$

Step4: Cross operation. Similar to mating and breeding process in reality, in the genetic algorithm, we select the parent individuals to perform the cross-operation to generate the offspring according to the crossover probability. The commonly used methods of cross-operation include single point intersection, partial mapping intersection, and cyclic intersection.

Step5: Mutation operation. In order to maintain the diversity of the population and avoid the local optimization in the early stage of evolution, in the genetic algorithm, genes of individuals are randomly determined to be mutated or not according to the mutation probability. Commonly used mutation operations include reverse order mutation and direction learning.

Step6: Evolutionary termination. When the preset maximum evolution algebra is reached, the iteration process is stopped and current solution will be returned as the best solution we achieve in this algorithm. Otherwise, we'll return to Step2 to calculate the fitness value of the new population, and the next round of evolution will be performed.

Simple genetic algorithms often have shortcomings such as slow convergence speed, trappings in local optimum, and low optimization accuracy. In order to improve the convergence rate of the algorithm while ensuring the diversity of the algorithm and making the algorithm result as close as possible to the optimal solution, we combined the advantages of other intelligent algorithms with the basic genetic algorithm and try to improve its performances.

### 3 Improvement on Basic Genetic Algorithm

Procedure of basic genetic algorithm includes crossover operation, mutation operation, and selection operation. And improvements on genetic algorithm mainly focus on three aspects:

1. Mixture of strategies. For instance, strategy of elite selection can be utilized in crossover operation, with the purpose to prevent negative crossover which will pollute genes of whole population.

2. Replacement of steps in genetic algorithm with methods coming from other intelligent algorithms. We can replace crossover, mutation or selection operation in genetic algorithm by optimization strategy of other algorithms, so that shortages of genetic algorithm can be made up.

3. Combination of multiple intelligent algorithms. For instance, we may employ algorithm that converges fast as our initial strategy, in order to obtain a good solution. Based on it, we utilize genetic algorithm to further enhance the accuracy of our final solution. This method decreases calculation time of genetic algorithm while ensuring quality of solution.

This paper modifies genetic algorithm at aspects of 1 and 2. We replace crossover operation by colonial assimilation in imperialist competition algorithm, and introduce strategy in Levy flight into mutation operation to increase diversity of mutation. In this paper, algorithms focus on solving discrete optimization problem, with possible linear or nonlinear restrictions, and variables range in all real numbers.

Compared to tradition intelligent algorithm, this algorithm employs advantages of other algorithms to make up for the shortcomings of basic genetic algorithm. Compared to greedy algorithms and annealing algorithms, our improved genetic algorithm has less dependency on original population. Compared to ant colony algorithm, it requires less calculation time, under the condition that solutions of equal quality are guaranteed.

## **4 Improved Crossover Operation based on Imperialist Competition Algorithm**

### **4.1 Overview of the imperialist competition algorithm**

Inspired by the imperialist colonial competition mechanism, Atashpaz Gargari and Lucas proposed a new intelligent optimization algorithm, the Imperialist Competition Algorithm (ICA), in 2007. The algorithm was mainly used to solve continuous optimization problems when it was initially proposed, and has been gradually applied into complex discrete combinatorial optimization problems later. Mohammadi et al. (Mohammadi-ivatloo B, Rabiee A, Soroudi A, 2012) applied ICA to the location problem of the hub station and achieved desirable results. Seyedmohsen et al. (Hosseini S, Khaled A, 2014) pointed out that ICA can be introduced to solve the TSP; Ardalan et al. (Ardalan Z, Karimi S, Poursabzi O, 2015) tried to solve the generalized traveling salesman problem by using ICA. (GTSP).

Different from other intelligent algorithms, ICA is created with inspiration from social behavior, and it is an optimization method formed by simulating colonization assimilation mechanism and imperial competition mechanism. The solution space is composed of a few countries. According to the size of power, these countries are divided into two types: the empire and the colony, and then the colonies are assigned according to the power of the empire. In the evolutionary stage, the empire conducts local search through colonial assimilation, revolution, and empire enhancement. The empire exchanges information through empire competition and conducts global search. When the maximum number of iterations is reached or there is only one existing country, the iteration stops. And the current best solution will be returned as the local optimal solution we search for.

### **4.2 Improvement based on colonial assimilation**

Colonial assimilation refers to the process that the inner colonies of the empire approach to the colonial state (a better solution). Here we use the alternative reconstruction method to replace the crossover operation in the genetic algorithm to generate new individuals. The specific steps are as follows:

Step1: Randomly generate a number between 0 to 1 at coding position of each city in a generation.

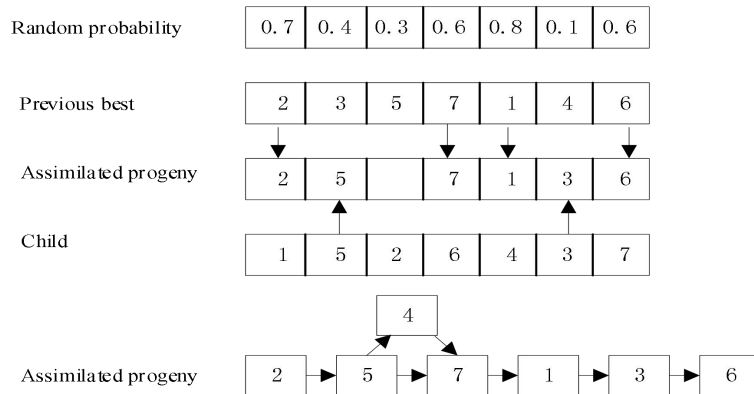
Step2: According to the assimilation probability  $P_a$ , if the random number of a city is greater than or equal to  $P_a$ , the city at the corresponding position of the best individual in previous generation is used as assimilated progeny.

Step3: For a position which has probability less than  $P_a$ , if the code of city the position does not appear at other positions of the assimilated progeny, the city code at this position is used as the code for assimilated progeny. Step 2 and Step 3 are collectively referred to as the replacement process.

Step4: The reconstruction process. For the city code that does not appear in the assimilated progeny, calculate the increasing distance of inserting all possible positions in the assimilated progeny, and insert the city code into the position that brings minimum increasing distance according to the greedy strategy. The formula for calculating the increasing distance is as follows:

$$Add = dis(a,i) + dis(i,b) - dis(a,b), \tag{5}$$

Where  $dis(a,i)$  represents the distance from city to city  $i$ , and  $Add$  represents the distance between cities coded as  $i$  and cities coded  $a$  and  $b$ .



**Figure 1 Assimilated Progeny Generation Process**

The specific generation process is shown in Figure 1. The progeny is assimilated according to the random probability sequence and the best individual of previous generation. Here  $P_a$  is set as 0.5. It can be seen from the figure that the code 2716 of the best sequence of the previous generation is directly used as the coding of the assimilated progeny. The positions which have probabilities less than 0.5 are coded as 523. Since the code 2 has appeared in the assimilated progeny, only 5 and 3 is placed in the assimilated progeny position. Since least increasing distance will be brought if the code 4 is inserted between 5 and 7, the assimilated progeny is 2547136.

Compared with the crossover operation of simple genetic algorithm, the colonization assimilation process changes genes of individuals at the overall level, which diversifies the whole population. And each generation is assimilated according to the best individual of the previous generation. Therefore, global search range is expanded while the convergence speed is ensured.

## 5 Improved Mutation Operation based on Levy Flight

### 5.1 Levy Flight Overview

Levy flight is essentially a random movement process with variable steps, which can move a

random step in different directions with a certain probability at the starting point to achieve the effect of local search. In recent years, there have been many studies on Levy flight. Michael (Michael F Shlesinger, 2006) combined Levy flight with the group intelligence algorithm, using large-step global search in the early stage of algorithm and local search with small step in the later stage. Shlesinger (Zhang Y, Wang L, Wu Q, 2012) employed Levy flight to increase population diversity and jump out of local optimum in intelligent algorithm. Therefore, we'll utilize Levy flight in the genetic algorithm to increase the search ability of the algorithm.

The Levy distribution function can be transformed into following probability density function:

$$Levy(\beta) \sim \mu = t^{-\beta} \quad 1 < \beta \leq 3 \quad (6)$$

We calculate the Levi random number using the following formula:

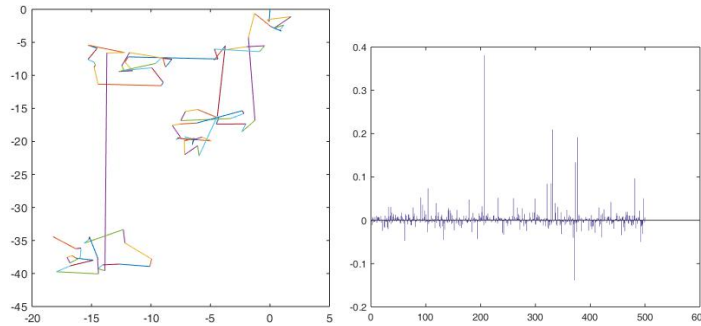
$$Levy(\beta) \sim \frac{\phi * \mu}{|v|^{\frac{1}{\beta}}} \quad (7)$$

Where  $\mu, v$  obey the standard normal distribution:  $\beta = 1.5$

At the same time, the formula for  $\phi$  is as follows ( $\Gamma$  is the gamma function):

$$\phi = \left( \frac{\Gamma(1 + \beta) * \sin(\pi * \beta / 2)}{\Gamma(\frac{1+\beta}{2}) * \beta * 2^{(\beta-1)/2}} \right)^{1/\beta} \quad (8)$$

The effect diagram of Levi's flight from 100 steps to 1 trajectory is shown in Figure 2:



**Figure 2 Levy Flight Path Map Figure 3 Levy Flight Wave Diagram**

Until now we discuss the application of Levy flight in continuous problems. Here we'll use Levy flight to perform discrete processing and apply it to the solution of TSP. According to the study of Aziz Ouaraab (Ouaraab A, Ahiod B, Yang Xin-she, 2014), the Levy flight is controlled in  $[0, 1]$ . According to the maximum value of the moving step  $n$ ,  $[0, 1]$  is equally divided into  $n$  intervals. The moving step size is defined by at which interval the value of Levy flight falls. However, search ability is limited in this algorithm and it is easy to fall into the local optimal solution. Therefore, we use the gradient transform step size to maintain the diversity of the population. It can be seen from Fig. 3 that the Levy flight is mainly distributed in the vicinity of 0 in the interval  $[0, 1]$ , and the frequency is decreasing as

the step size increases. Therefore, the transformation rule is determined as follows, where  $m$  is the number of cities traversed (rounded according to nearest integer):

Levy at  $[0, 0.1]$ , the individual performs  $m*10\%$  mutations;

Levy at  $(0.1, 0.3]$ , the individual performs  $m*20\%$  mutations;

Levy at  $(0.3, 0.5]$ , the individual performs  $m*30\%$  mutations;

Levy is greater than 0.5, the individual performs  $m*40\%$  mutations;

Through the above analysis, we can know that the random step size of Levy flight takes both global search and local search into account, so the mutation operations of other genetic algorithms are combined to ensure the population diversity in the iterative process.

## 6 Flow Chart and Pseudo Code of Improved Algorithm for Solving TSP Problem

In this paper, we use the pseudo-code and flow chart to describe the solution process of the test function by Colonial assimilation and Levy flight mutation operator based Genetic Algorithm (CLGA). The pseudo code of the main program of the CLGA algorithm is as

```

Procedures of the proposed CLGA algorithm
Begin
   $t = 0$ ;
  Initialize  $P$ ;
   $P(t) = \{X_1(t), X_2(t), \dots, X_n(t)\}$ 
  Evaluate  $P(t)$ ;
   $f(P(t)) = \{f(X_1(t)), f(X_2(t)), \dots, f(X_n(t))\}$ 
  While ( $t < t_{\max}$ ) do
     $P_s(t) = \text{Selection } \{ P(t) \}$ ;
     $P_a(t) = \text{Assimilation } \{ P_s(t) \}$ ;
     $P_L(t) = \text{Levy-Mutation } \{ P_a(t) \}$ ;
    Evaluate  $P_L(t)$ ;
    if  $t < 1$  then
      do  $X = \min \{ P_L(t) \}$ ;
    else
      if  $X < \min \{ P_L(t) \}$ 
      do  $X = \min \{ P_L(t) \}$ ;
    end
  end
   $t = t + 1$ ;
end
follows:
end
end

```

In the above pseudo code,  $t$  represents the number of iterations of the algorithm,  $t_{\max}$  represents the maximum number of iterations, *Initialize* represents the initial population,  $P(t)$  represents the  $t$ -th generation, *Evaluate* represents the fitness value, and *Selection*, *Assimilation* and *Levy-Mutation* are selection operation, colonization assimilation, and Levy flight variation operations respectively. The corresponding  $P_s(t)$ ,  $P_a(t)$  and  $P_L(t)$  are new populations produced by selection, assimilation, and Levy

mutation;  $X$  represents the optimal solution in the evolutionary process.

The specific flow chart of the CLGA algorithm is shown in Figure 4.

It can be seen from the flow chart that CLGA is the same as the basic genetic algorithm in the overall algorithm structure. Our improvement focuses on the crossover and mutation operations. The usage of colonial assimilation and Levi's flight to replace crossover and mutation operations increases the diversity of population evolution and avoids falling into local optimum.

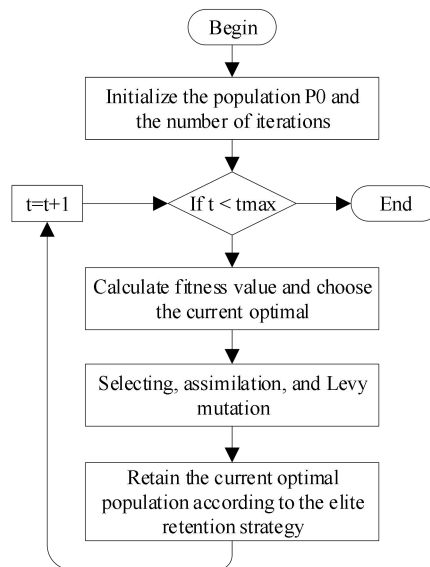


Figure 4 CLGA Solves the TSP Problem Flow Chart

## 7 Algorithm Experiment and Analysis

### 7.1 Experiment result analysis

To further verify the performance of the improved genetic algorithm, we choose the data set in the TSPLIB standard library for experimental testing. Experimental environment: The operating system is Windows 10, the CPU is i7-6498DU, the memory is 4G, and the programming software is MATLAB.

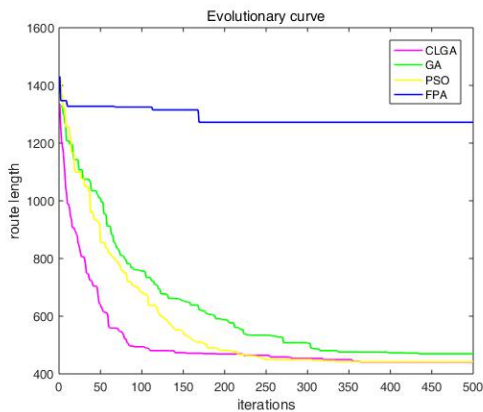
We compare the CLGA mentioned in this paper with genetic algorithm (GA), particle swarm optimization (PSO) and pollen algorithm (FPA), and analyze its computational accuracy, time consumption and convergence speed. The population size is 100, the evolution frequency is 500 generations; the assimilation probability of CLGA is 0.5; the crossover probability of genetic algorithm is 0.9, the mutation probability is 0.1; the conversion probability of pollen algorithm is 0.8;

We selected 5 sets of TSPLIB data (Ulysses16, Bayg29, Att48, Eil51, rat99) for experiments. The experimental data shown in the following table:

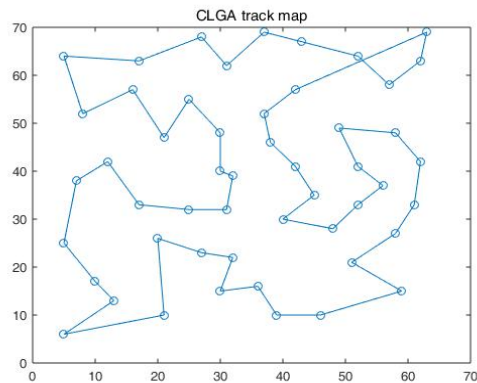
**Table 1 Comparative Analysis of Experimental Results**

Instance	TSPLIB	CLGA		GA		PSO		FPA	
	Value	Value	Time	Value	Time	Value	Time	Value	Time
Ulysses16	74.1087	74.1087	6.997	74.1087	5.348	74.1087	2.026	89.1189	1.42
Bayg29	9074.1	9074.1	9.633	9280.9	10.124	9309.3	2.223	18099	1.905
Att48	33523.7	34327.7	15.811	34781	11.767	35550.5	2.95	107100	3.209
Eil51	426	441.3	12.576	469.9	11.562	442.5	2.869	1272.2	2.879
rat99	1211	1308.0	25.614	1421.9	20.236	1391.5	5.417	6738.7	6.514

It can be seen from the above table that although the calculation time is increased compared with the GA, CLGA improves the calculation accuracy, especially when the number of cities is large. Compared with the other two intelligent algorithms, PSO has higher calculation accuracy and shorter calculation time. It can find solution of high quality quickly in small size data set. However, when the amount of data increases, its calculation accuracy is not as high as CLGA. Although the FPA has least calculation time, it has obvious calculation error and is required to be improved before it can be used in practical applications. Taking the calculation of Eil51 as an example, the convergence graph of each algorithm and the path diagram of the optimal result shown in Figures 5 and 6:



**Figure 5 Convergence Curve**



**Figure 6 Eil 51 Path**

The pink, green, yellow, and blue curves in Figure 5 represent the convergence trends of CLGA, GA, PSO, and FPA, respectively. It can be seen from the graph analysis that the convergence speed of CLGA is increased and the accuracy of the solution is also improved compare with GA. On the other hand, the quality of solution generated by FPA is not good. Both figure and table tell that the intelligent algorithm CLGA in this paper improves the convergence speed and calculation accuracy of the TSP problem compared with the basic genetic algorithm, and has advantages compared with other group intelligent algorithms.

**7.2 Advantages and disadvantages of algorithm**

The experiment consequence analysis indicates that improved genetic algorithm has favorable performances on solution accuracy over other algorithms while solving small-sized TSP. Nevertheless,



corresponding to the increasing number of cities in TSP, this favor decreases, though it still has advantages at aspect of calculation time. In analysis of convergence curve of algorithm, we can tell that its convergences fast at the early stage of calculation, due to the diversity brought by colonial assimilation operation, and randomness brought by Levy flight. On the other hand, this paper verifies the compatibility between genetic algorithm and other intelligent algorithms. Hence, on solving other problems in operational research field, we may also be able to absorb advantages of other algorithms into genetic algorithm to achieve some enhancement on its performances.

## 8 Conclusion

This paper designs an improved genetic algorithm for solving the TSP problem, introduces the colonial assimilation operation of the imperial competition algorithm to replace the crossover operation, and combines the Levy flight to enhance the mutation operation. The strong mutation ability of imperial competition algorithm and Levy flight is utilized to increase the diversity of the population and enhance its global search ability. The experiment results show that the improved algorithm can guarantee satisfactory calculation accuracy and improve the speed of the algorithm in solving the small-scale TSP. However, when the data size increases, the calculation time grows and the convergence capability is reduced. In the latter study, research concerning to improvements during local search can be conducted to increase the convergence speed in case of large data set.

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## How Does Leader’s Support for Eco-Innovation Promote Corporate Environmental Responsibility in Organization?

Goli Yao Sidoine<sup>1</sup>, Ye Jianmu<sup>1</sup>, Ye Yongling<sup>2</sup>

<sup>1</sup> School of Management, Wuhan University of Technology, Wuhan, P.R. China, 430070

<sup>2</sup> Business School of Yulin Normal University, Guangxi, P.R. China, 537000

(E-mail: golikid2@hotmail.com, jianmuye@126.com, 56083231@qq.com)

**Abstract:** This paper explicates the way a Leader’s support for eco-innovation promotes corporate environmental responsibility (CER) in the organization. As established in the paper, the leader’s support is seen to provide the resources and promoting innovative environments where employees can come up with an efficient means of production. Examples such as the leader’s direct statement of environmental commitment are also demonstrative of the support for eco-innovation hence promoting CER to avoid resource wastage. The secondary and primary methods using a quantitative design are used to collect the results. There is the demonstration that there is increasing leadership support for innovative approaches to the environment and this has also led employees to preserve resources available in the organization. It is recommended that smart processes should be encouraged by leaders to achieve even better CER in the organization.

**Key words:** Leader; Eco-innovation; Corporate environmental responsibility; Organization; Employee

### 1 Introduction

Companies have always been encouraged to uphold the highest standards of environmental protection in the course of their operations. Eco-innovation entails the incorporation of technology into the company to produce products and services are friendly to the environment (Aguado and Holl, 2017). More so, it focuses on aspects such as the reduction of emissions and resource consumption in the organization. A leader’s support of eco-innovation is always a big advantage because it directly promotes corporate environmental responsibility (hereinafter, CER) performance in these organizations. For developing economies, it is even more important than the leader plays an instrumental role in supporting eco-innovation hence leading to even more actions of CER in the organization (Weng, Chen and Chen, 2015). A leader’s support for eco-friendly innovation is always bound to have a positive impact on the CER of the organization because it influences employees toward the direction of seeking sustainable options for the organization.

### 2 Examples

The examples of the outcomes of a leader’s support for eco-innovation to promote CER are presented below. The involvement of leaders is a direct representation of the actions that employees and the company will take regarding the proper protection of the environment (Amitrano et al, 2018). Thus, the examples are as showed below;

**Table 1 Leader Support of Eco-innovation and Employee Support**

Variable(s) Entered	Dependent Variable: green product innovation practices			
	Hypothesis	Main effects	Interaction	Result
Innovation orientation		0.342 ***	0.371 ***	
Employee conduct		0.366 ***	0.412 ***	
Innovation orientation × Employee conduct	H8a		0.343 *	Supported
<b>R<sup>2</sup></b>	0.40	0.50		

Note: \* indicates  $\rho < 0.05$ , \*\* indicates  $\rho < 0.01$ , \*\*\* indicates  $\rho < 0.001$ .

PLS Results for moderation effects (green process innovation practices).

Variables (s) Entered	Dependent Variable: green product innovation practices			
	Hypothesis	Main effects	Interaction	Result
Innovation orientation		0.143	0.145	
Employee conduct		0.498 ***	0.513 ***	
Innovation orientation × Employee conduct	H8b		0.041	Not supported
<b>R<sup>2</sup></b>	0.35	0.35		

Note: \* indicates  $\rho < 0.05$ , \*\* indicates  $\rho < 0.01$ , \*\*\* indicates  $\rho < 0.001$ .

Source (Weng, Chen, and Chen, 2015)

In Table 1 above, there is a demonstration of innovation orientation regarding green production in the organization. When there is support from the leaders for eco-innovation, employees are also highly motivated to adopt innovative ideas to the production process (Tseng, Chang and Chen, 2019). However, if there is no such support, then there is a challenge with the realization of CER. There is the demonstration that the first action that is undertaken by managers is the recipe for CER in the organization especially if employees are influenced in the same direction (Buhl, Blazejewski, and Dittmer, 2016).

**Table 2 Leader’s Support for Eco-Innovation and Sustainability**

Vb	ERAD	%
c1	Openly states having implemented an EMS (ISO 14000 and/or EMAS)	62,82%
Environmental Information available		44,23%
c2	Openly states environmental commitment and/or policy	66,67%
c3	Openly shows details about the company’s environmentally related activities	39,10%
c4	Openly delivers a Sustainability/environmental/CSR report	26,92%
Environmental accounting available		4,17%
c5	Openly presents environmentally related economic data (expenses, provisions etc.)	8,33%
c6	Provides details information about environmental accounting in largest accessible financial database (SABI)	0,00%

Source: (Fondevila, Moneva, and Scarpellini, 2018)

In Table 2 above, there is also the presentation of the adoption of environmental management systems (EMS) that encourage eco-innovation within the organization (Calza, Parmentola and Tutore, 2017). The open declaration of the information related to the impact of the manager’s openness in supporting eco-innovation on the attainment of CER (Jo et al., 2015). The realization of CER is represented by the declaration of the sustainability goals of the organization through the corporate social responsibility (CSR) report as shown above (Tsai and Liao, 2017).

### 3 Data and Methodology

The identification of a specific method is vital for the collection of the data to be used in answering the questions in the study. A methodology needs to be clear enough to show the steps that will be followed in the collection and presentation of data in the study (Williamson and Johanson, 2017). For this research, it will be important to identify a specific method that will simplify the collection and the presentation of data.

The specific approach for this study will be the quantitative approach. The quantitative study approach entails the presentation of statistical information in the research. A quantitative approach is

chosen because it helps in the presentation of numerical data that is easier to comprehend through the subsequent discussions (Waring, Hedges and Arthur, 2017). More so, the quantitative approach is also preferred in this research because of its flexibility with data, in the sense that it could be used for a large population. However, the biggest downside is that the data collected through the quantitative approach cannot be easily generalized to the population.

The fundamental research question that is posed for this study is, How Does a Leader's Support for Eco-Innovation Promote Corporate Environmental Responsibility in Organization? Based on the research question, the independent variable is the leader's support for eco-innovation while the dependent variable is corporate environmental responsibility (CER). In tandem with the question, it should be noted that organizations are noticing the need to protect the environment and leaders are taking a leading initiative through the support of eco-innovation.

The first key gap in the literature is that there has been an insufficient explication of the approaches that show a leader's support of eco-innovation technologies in organizations. There are only general explanations about how organizations are transforming themselves to be environmentally friendly, but there is no clear discussion on the role that leaders are playing in this direction (Kumar and Kumar, 2017).

The second gap is that there has been insufficient utilization of quantitative methods to explore the link between the leader's support for eco-innovation and the promotion of CER (Sarkar, 2014). Most of the studies have explicated these variables differently, and this poses a challenge in understanding the link. More so, it is challenging to link the same to individuals such as employees.

The third gap is that there has been an only limited focus on countries when explicating the leader's role in adopting eco-innovation technologies. Most of the focus has been on developed economies in the analysis. There is no wider perspective on the aspect of developing countries (Gunaratne and Peiris, 2017). A wider focus on countries including companies in the stronger economy and the developing economy is key to understanding the benefit of leader impact on eco-innovation and the promotion of CER.

### **3.1 Method one**

The first method that will be followed will be a critical review of existing literature (Neumayer and Plümper, 2017). In this method, the previous studies that have been done on the impact of a leader's support for eco-innovation promote CER for the organization.

#### **3.1.1 Discussing Method One**

As noted above, the first method is a critical review of the literature. In this method, various journal articles and even CSR reports that talk about the leadership support of eco-innovative technology will be considered (Sekaran and Bougie, 2016). It will be important to get articles that directly discuss the topic and present findings that have been gathered. The method is helpful because it consumes less time especially because the article is readily available online (Hair, 2015). The researcher does not have to take much time to retrieve the article. More so, the method is helpful because it offers the opportunity to critically compare the results that have been found before across various studies hence setting the ground for the generation of conclusions and recommendations in the study. The key limitation of the method is that it lacks first-hand data that could help improve the reliability and credibility of the study's findings.

### **3.2 Method two**

The second method is quantitative research design. This is the approach that uses statistical approaches to present the data in the study. The method mainly entails the collection of data from human participants hence providing the opportunity for the presentation of first-hand data in the study.

#### **3.2.1 Discussing Method Two**

Method two is quantitative research design. The quantitative research design will be attained through the collection of findings using online questionnaires. The questionnaires as an approach to the collection of data are vital because they help the researcher gather a large amount of data from a large sample of the population (Fielding and Lee, 2016). The intention of the researcher is to make sure that there is independence in the study's course; thus, there will be a focus on the use of a positivist philosophy that separates the researcher from the sample population. The quantitative research design is also chosen because of the capacity to illustrate the real situation of the phenomenon through statistical numbers. This makes it easier to present data and explains hence reaching key conclusions and recommendations for the study. The researcher knows that there is a limitation of the quantitative

approach especially in terms of generalization. Thus, a larger sample will be included.

#### 4 Results

The results are key in illustrating the impact of a leader’s support of eco-innovation on CER. The two key variables include the leader’s support for eco-innovation technology (independent variable) and CER (dependent variable). These two variables are shown in the results that are presented below.

**Table 3 Result 1**

Variable Code	Definition of Question Items for the Analyzed Measure
<i>Technological eco-innovation (during last 3 years as compared to key competitors)</i>	
TEI-1	We usually were the first on the market to introduce new eco-innovative products
TEI-2	We have introduced more products that are eco-innovative
TEI-3	We have introduced products that are more eco-innovative
TEI-4	We usually were the first to introduce new, environment friendly methods of manufacturing, maintenance and logistics
TEI-5	We have introduces more or significantly improved processes bringing environmental benefits
TEI-6	We have been improving environmental parameters of our processes more effectively
<i>Operational performance (during last 3 years as compared to key competitors)</i>	
OP-1	Product quality
OP-2	Customer satisfaction
<i>Financial performance (during last 3 years as compared to key competitors)</i>	
FP-1	Increase in market share
FP-2	Profit growth
FP-3	Return on sale
FP-4	Return on investment

Source: (Ryszko, 2016)

In the diagram above, the key element that is illustrated concerns the leadership support for eco-innovation in companies. The key aspects that reflect leadership support are presented. One of the key aspects that are represented is that the management of organizations is always to support eco-innovative products (Dyllick and Muff, 2015). This is important because it gives employees the ability to be innovative and come up with products that have a less negative impact on the environment. The production of eco-innovative products is anchored on the resources that are provided by the members of the leadership within the organization (European Commission, 2014). The more resources there are, the more the focus of employees is on the production of environmentally friendly products.

More so, as showed in the table above, leadership support for eco-innovative technologies is seen through including processes that are highly innovative within the organization (Mocan et al., 2018). This entails the elimination of traditional means of production to introduce clean strategies that make sure

resources are well-used for the benefit of the organization. The proper use of resources from the environment and the subsequent replacement of those that have been taken for the completion of the production process show the support of the innovative strategy. It is through these improved processes that employees are also challenged to innovate and move the organization in the right direction.

Regarding the link between the leader's support for eco-innovation and CER, it is showed that there is better handling of the resources available in the environment (Ryszko, 2016). The product quality is of the highest standards and it does not harm the environment. More so, there is a focus on protecting the environment against harms such as dumping. All these processes are critical to ensuring that the environment is safe and hence long-term CSR.

**Table 4 Result 2**

Constructs	Scale items	Standardized Factor Loadings	Cronbach's $\alpha$	AVE	Composite Reliability
<b>Environmental Innovation Capability (EIC)</b>	EIC1	0.70	0.79	0.63	0.78
	EIC2	0.94			
	EIC3	0.70			
	EIC4	0.90			
	EIC5	0.92			
	EIC6	0.71			
<b>Strategic Orientation (SO)</b>	CU1	0.78	0.87	0.62	0.87
	CU2	0.84			
	CU3	0.82			
	CU4	0.70			
	CO1	0.94			
	CO2	0.92			
	CO3	0.70			
	TO1	0.70			
<b>Inter-Functional Coordination</b>	TO2	0.89	0.84	0.57	0.85
	TO3	0.73			
	TO4	0.70			
	IF1	0.91			
<b>Buyer Value Added</b>	IF2	0.81	0.92	0.68	0.91
	IF3	0.94			
	BVA1	0.70			
	BVA2	0.94			
<b>Environmental Sustainability Performance</b>	BVA3	0.88	0.77	0.67	0.79
	BVA4	0.74			
	ESP1	0.81			
	ESP2	0.97			
	ESP3	0.91	0.94	0.83	0.94
	ESP4	0.93			

**Note: Average Variance Extracted: AVE**

Source: (Tseng, 2019)

From the table above, when illustrating the link between approaches to innovation as supported by leaders, there is also the reflection of the view that the environment gains (Jang et al., 2014). For instance, environmental sustainability performance has been high with the emphasis on organizational processes that protect the dignity of the environment by protecting aspects such as the dumping of wastes into the water resources. The environment also gains to a great extent because there is the protection of resources that have been traditionally wasted by companies (McNally et al., 2015). When leaders in the organization take the initiative and support eco-innovation technologies, there is always the opportunity that employees will also get into the practice based on the influence of their leaders (Fondevila, Moneva, and Scarpellini, 2019). As part of CER, consumers always stand the chance to get the best quality of products that have been generated through innovatively sustainable means encouraged by their own leaders (Rizos, Behrens, and Taranic, 2015). Thus, innovative practices in the process of production and implementation of processes in the organization should always be a priority as it helps lead to a better environment.

## 5 Conclusion

Overall, there is a significant impact on CER when leaders support eco-innovative technologies in companies. The influence of leaders trickles down to employees who use innovation to protect the environment through the environment.

Thus, there are three key recommendations regarding the innovative points as per this research. There should be an encouragement of smart processes in the production processes that help to protect environmental resources. The excessive reliance on resources such as trees is undesirable because it only hurts the environment further. The second aspect of innovation concerns the mitigation of greenhouse gases that are released to the environment through improved means of production using new technology rather than old machines. The technology that could be encouraged is technology flue gas cleaning. This further protects the environment by making sure that there is no form of pollution that hurts the environment. The third aspect of innovation is to utilize wind turbines where possible to mitigate the pollution of the environment through undesirable gases from fuels. Thus, there are many points of innovation and organizations should pay attention to the points that favor them and their processes.

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# Research on the Impact of High-tech Enterprise Technology Diversification Development Strategy on Enterprise Performance

Mou Jiongxu, Liu Ying

School of Management, Wuhan University of Technology, Wuhan, P.R.China, 430070

(E-mail: 463730589@qq.com, 961980755@qq.com)

**Abstract:** This paper selected some high-tech enterprises in China from 2011 to 2017 as samples, and empirically analyzed the relationship between technology diversification strategy and enterprise performance of enterprises which are taking artificial intelligence projects as an example by a method of using data envelopment analysis (DEA). The research results of this paper show that the development of artificial intelligence projects on high-tech enterprises to carry out technology diversification strategy has a positive role; Technology diversification will have a negative impact on the financial performance of enterprises, but it will improve the market value of enterprises. The conclusion of this paper has a certain reference value for the high-tech enterprises in the development period to implement the diversified strategy.

**Key words:** Artificial intelligence; Diversified technology; DEA model; Enterprise performance

## 1 Introduction

High-tech enterprises are knowledge-intensive economic entities engaged in the scientific research, development, production and sales of high-tech products, the commercialization of scientific and technological achievements, and related technology development, service and consultation, with innovation as the development mission and the main means of survival. It plays an important role in our national economy.

Under the background of "Internet plus" and supply-side structural reform, economic growth has gradually entered into the stage of knowledge innovation driven by previous investment and production factors. Meanwhile, rapid economic growth has given birth to some high-tech "unicorn" enterprises. At the same time, the continuous development of Internet technology and the increase of market purchasing power also provide a good foundation for the development of high-tech enterprises, and enterprises have adopted the diversification strategy to open up new markets. Relying on the competitive advantages of their core technologies, they have expanded their technical activities or research scope to a variety of fields, such as artificial intelligence, autonomous driving and cloud computing and so on.

Technology has always been regarded as the power pillar of high-tech enterprises. Some scholars use resource utilization theory to view technology as a special resource for enterprises, which is conducive to improving the competitive advantage of enterprises. If enterprises only have a single technical capability, it is difficult to meet market demand and achieve sustainable development, so technology diversification becomes the important technological innovation strategy. However, with the continuous implementation of the technology diversification strategy, the cost of searching, screening, evaluating and integrating external knowledge, as well as the cost of integration and communication, will also increase, dispersing the technology accumulation and work energy of the company in its main field, thus limiting its long-term development in the main field. Moreover, when the cost involved in a new market exceeds the resource utilization and management capabilities of the enterprise, it will result in excessive diversification, weakening the synergy between businesses, and even negatively affecting corporate performance (Jansen J P, 2006; Nelson R R, 1959; Granstrand, 1998; Shin J, 2010).

Technological diversification and corporate performance have always been the focus of research in the field of corporate management. Williamson(Williamson,1994) have shown through empirical research that only the relevance of diversified enterprise technology strategic assets can be fully reflected in the market, and the performance of related diversified enterprises will be higher than non-Performance of related diversified companies<sup>6</sup>. Chinese scholars Lin Xiaohui (Lin Xiaohui,2008) and JinXiaobin (Jin Xiaobin,2002) believe that there is no obvious correlation between the degree of diversification and performance of enterprises, but because diversification can bring about the scope of economic effects, the high cost caused by diversification is offset to some extent. For non-diversified companies, technology diversified companies have better performance. In terms of research methods, the existing research mostly uses enterprise performance as the basis for evaluation and the index of asset input efficiency. Therefore, regression analysis, data envelopment analysis (Liu Yiquan, 2017), entropy index model (Zhao Qi,2016), factor analysis (Zhou Wenqi, 2007) and other research methods are often used to supply performance to conduct an evaluation.

As an emerging economic and technological catch-up country, China's high-tech enterprises are the main innovations of the country's development, but they have problems such as low degree of globalization, low ability to integrate technical resources, and high research and development costs. Is the diversification of high-tech enterprises' technology diversified for the healthy development of enterprises? Will this strategic choice bring about the improvement of technology and performance for high-tech enterprises? Based on this, this paper attempts to explore the practical effects of high-tech enterprises implementing technology diversification strategies from the perspective of input and output. Exploring the relationship between corporate technology diversification strategy and corporate performance, it is hoped that it will be an important reference and reference for enterprises to calmly respond to the new situation and take strategic decisions with caution.

## 2 Research Methods

### 2.1 Model establishment

The DEA method is an evaluation method that uses a mathematical programming model to calculate the relative effectiveness of several decision units (DMUs) with the same inputs and outputs. Using DEA for efficiency evaluation actually uses the linear programming method to find the envelope surface of the efficiency frontier input-output relationship, and finds the difference by comparing the evaluation object with the efficiency frontier, and then measures the efficiency. Determining whether a decision unit is effective depends on whether it is on the production frontier of the production possible set. Comparing different enterprises under certain technical conditions, how much the input can be effectively used in the production of output. If the decision-making unit is non-DEA, the original input-output vector can be adjusted by solving and calculating. The latter point is the "projection" of the decision-making unit on the production front (Li Qi,2016). This paper also makes use of this advantage of the CCR model to obtain the relative efficiency value of the input and output of the enterprise. Based on the evaluation results, the projection analysis is carried out to provide an improved solution for the invalid DEA unit. Differences and characteristics of corporate performance levels after smart projects. Then, the adjustment analysis of the invalid DEA unit is aimed at finding a reasonable path to solve the related problems existing in the implementation of the technology diversification strategy, and provide feasible measures for the healthy development of the enterprise.

The enterprise performance system is regarded as an input-output system with multiple inputs and outputs, and there are no similar evaluation units. For the evaluation unit DMU ( $i=1, 2, \dots, m$ ), the  $m$  input indicators are composed. input vector  $x_i=(x_1, x_2, \dots, x_m)^T$ ,  $t$  output vector  $y_i=(y_1, y_2, \dots, y_m)^T$ ,

then all input and output indicators evaluation unit consisting of input The matrix  $X = (x_1, x_2, \dots, x_m)$ , the output matrix  $Y = (y_1, y_2, \dots, y_m)$  The CCR model thus established

$$\begin{cases} \min \left[ \theta - \varepsilon \left( \sum_{i=1}^k Si^- + \sum_{r=1}^m Sr^+ \right) \right] \\ s.t \sum_{j=1}^n \lambda_j x_{ij} + Si^- = \theta x_{ip}, i = 1, 2, \dots, k \\ \sum_{j=1}^n \lambda_j y_{ij} - Sr^+ = y_{rp}, i = 1, 2, \dots, m \\ \lambda_j, \theta, Si^-, Sr^+ \geq 0, j = 1, 2, \dots, n \end{cases}$$

In equation,  $\theta$  ( $0 < \theta \leq 1$ ) is the comprehensive efficiency index, and  $\lambda_j$  is the weight variable.  $Sr^+$  is a relaxation variable, and  $\varepsilon$  is a non-Archimedean infinitesimal amount. The larger the value of  $\theta$ , the higher the operational efficiency of high-tech listed companies.  $\theta = 1$  indicates that the company's operating status is on the production frontier, and its output is optimally integrated with respect to the input. At this time, the evaluated DMU is valid for DEA, and  $\theta < 1$  indicates that the evaluated DMU is invalid for DEA.

**2.2 Data analysis**

This article selects new artificial intelligence to carry out projects of high-tech enterprises in 2015-2018 identified national listed companies as the initial sample. In order to make the conclusions true and reliable, this paper tries to exclude the influence of relevant factors on the data in the sample selection. So, consider the following points when choosing a sample:

- (1) Select the company issuing A shares only, to avoid the difference between the B shares or H shares.
- (2) Excluding each year ST, ST\* and PT companies and extremes company.
- (3) Excluding the listed companies before and after the three-year strategy for turning several times.
- (4) Excluding the listed company cannot obtain complete data.

Taking full account of the characteristics of listed companies' operation management and high technology, and based on the availability of data, in order to build a comprehensive performance evaluation index system, this paper selects three financial indicators as input indicators: fixed assets, main business costs, Total operating costs. The two main business incomes of total profit are selected as output indicators (Yu Wang, 2019).

**Table 1 Input and Output Indicators**

	symbol	name
	X1	Total assets
INPUT	X2	Main business cost
	X3	Period cost
OUTPUT	Y1	Total profit
	Y2	Main business income

**Table 2 CE , VE, SE of 2016 High-tech Enterprises**

firm	crste	vrste	scale	
300288	0.95	1	0.95	irs
300017	1	1	1	-
300066	0.873	1	0.873	irs
002415	1	1	1	-
000725	0.807	1	0.807	drs
603019	0.861	0.882	0.977	irs
002405	1	1	1	-
600699	0.857	0.88	0.974	drs
002824	0.882	0.911	0.968	irs
002373	0.984	1	0.984	irs
002055	0.814	0.827	0.984	irs
300020	0.746	0.769	0.97	irs
002465	0.881	0.89	0.99	drs
600271	1	1	1	-
mean	0.904	0.94	0.963	

**Table 3 CE , VE, SE of 2017 High-tech Enterprises**

firm	crste	vrste	scale	
300288	1	1	1	-
300017	0.94	0.955	0.984	irs
300066	0.754	0.829	0.909	irs
002415	1	1	1	-
000725	0.974	1	0.974	drs
603019	0.946	0.958	0.988	irs
002405	1	1	1	-

600699	1	1	1	-
002824	0.943	1	0.943	irs
002373	1	1	1	-
002055	0.91	0.922	0.987	irs
300020	0.75	0.782	0.959	irs
002465	0.812	0.815	0.996	irs
600271	1	1	1	-
mean	0.931	0.947	0.981	

**Table 4 CE , VE, SE of 2018 High-tech Enterprises**

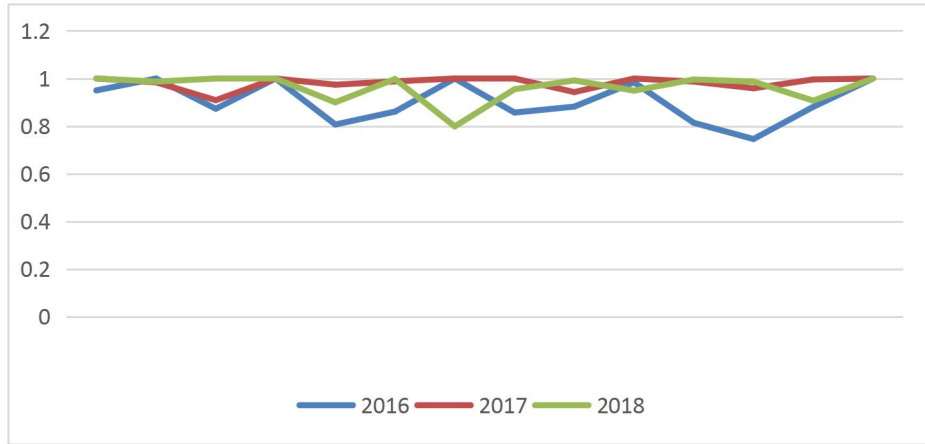
firm	crste	vrste	scale	
300288	1	1	1	-
300017	0.987	1	0.987	drs
300066	1	1	1	-
002415	1	1	1	-
000725	0.9	1	0.9	drs
603019	0.926	0.928	0.998	irs
002405	0.523	0.655	0.799	drs
600699	0.955	1	0.955	drs
002824	0.921	0.929	0.992	irs
002373	0.942	0.993	0.949	drs
002055	0.905	0.909	0.996	irs
300020	0.72	0.73	0.987	drs
002465	0.843	0.93	0.907	drs
600271	1	1	1	-
mean	0.902	0.934	0.962	

Note: The overall efficiency value is 1 , indicating that the infrastructure supply performance is optimal; the overall efficiency value is less than 1 , indicating no efficiency. CE stands for overall efficiency, VE stands for

technical efficiency, and SE stands for scale efficiency. Irs means increasing returns to scale; drs means declining scale returns; - means that scale returns are constant.

**2.2.1 Comprehensive efficiency analysis**

The comprehensive technical efficiency is a comprehensive measurement and evaluation of the multi-faceted capabilities of the decision-making unit's resource allocation ability and resource use efficiency.

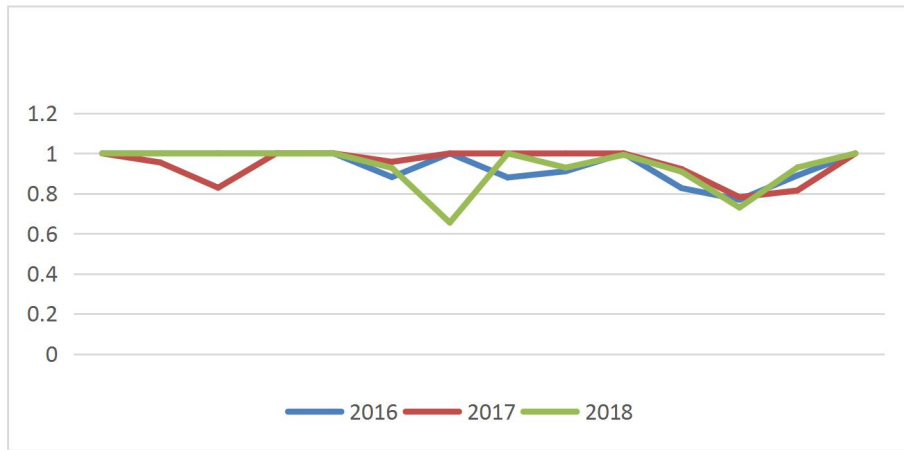


**Figure 2 Three-year High-tech Enterprise CE Value**

In the year prior to carry out the project (2016), different high-tech enterprises overall efficiency, average efficiency value of 0.903, 42% above this value the efficiency of enterprises, description of each business year starting point is slightly different. In the mean while maintaining production based on constant change, China's high-tech industry listed companies still have an investment saving potential of 9.7%. In the year of the project, 28% of listed companies experienced a decline in overall efficiency, and most companies' overall efficiency increased slightly, so the overall on the up, it has improved the efficiency of listed companies. After one year of mergers and acquisitions, 50% of enterprises have reduced their overall efficiency, but 71% of them have slightly improved their overall efficiency level compared to 2016. However, the comprehensive efficiency level in 2018 is lower than the comprehensive efficiency level in 2016, so we can conclude that most enterprises will significantly improve the market value when they carry out the technology diversification strategy, but because of the individual management level and input-output ratio of the individual enterprises. When the operation level is different, most enterprises can improve their performance level through artificial intelligence projects, but a small number of enterprises will deteriorate. It needs to strengthen financial budget control, control costs and optimize internal organizational structure to reduce input waste.

**2.2.2 Technical efficiency analysis**

Technical efficiency reflects the influence of the equivalent factors of enterprise's production technology and management level on enterprise's operating efficiency. The closer the pure technical efficiency value is to 1, the more effective the enterprise's management level and technical level are.

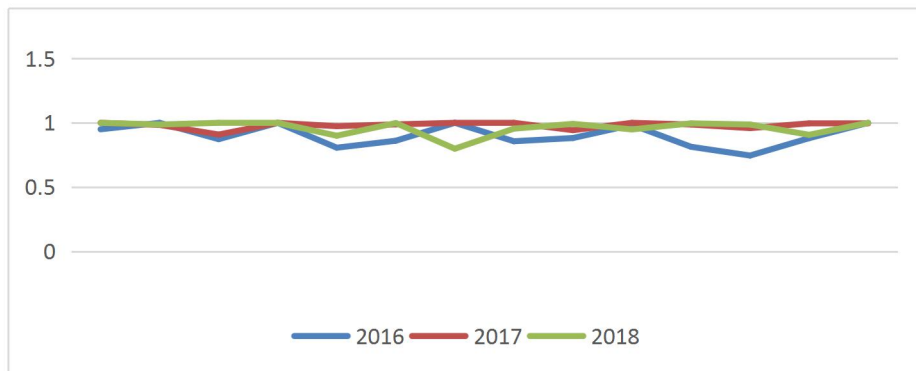


**Figure 3 Three-year High-tech Enterprise VE Value**

It can be seen that there are 4 and 6 in three years. Four companies reached a technology effectively, accounting for 29% , 43%, 29%, three-year arithmetic of the total sample mean technical efficiency of the sample companies is 0.94, and 6% of advances in space technology, companies still need to Increase investment in research and development funds to promote the production of results, and enhance the company's own competitiveness in the industry. A three-year standard deviation are 0.08, 0.07, 0.08, indicating that the company's overall technical efficiency of these little difference. In the year before the launch of the project and in the year of the project, the efficiency was relatively stable. However, in the first year of the project, the technical efficiency changed greatly. In the second year after the war, the technical efficiency showed a downward trend, and the technical efficiency of listed companies increased overall.

**2.2.3 Scale efficiency analysis**

The scale efficiency is equal to the ratio of the overall efficiency value to the technical efficiency value.



**Figure 4 Three-year High-tech Enterprise SE Value**

It can be seen from the calculation results that the average value of the three-year scale efficiency is 0.96 , indicating that the scale of these listed companies has not yet reached the maximum. 14 listed companies, the artificial intelligence to carry out the project, in 2018 there are seven companies in the state of increasing returns to scale, indicating that after this stage eight companies continue to expand their production scale. This shows that if the company wants to achieve DEA effectiveness, on the one



hand, it will increase the production efficiency of its input factors, on the other hand, it will increase its scale of production to increase its scale efficiency. On the whole, the average scale efficiency of listed companies is more stable overall. In 2017, the scale efficiency of listed companies increased. After the occurrence, some enterprises showed a downward trend and overall stability.

### **3 Results Analysis**

There are two main reasons for affecting the performance of listed high-tech enterprises: First, the scale efficiency problem is prominent; second, the pure technical efficiency needs to be improved. Among them, the unsatisfactory scale efficiency is mainly related to the number of enterprise technicians and corporate assets. Some listed companies have fewer technicians and less obvious economies of scale. The greater the capital advantage of enterprises, the stronger the supply capacity, and the more advantageous the number of technicians employed. On the contrary, it will affect the investment. The overall technical efficiency is not high, which is mainly affected by factors such as the technical level of the enterprise, the quality of human capital, and the ability to learn. The stronger the learning ability, the higher the number of high-quality talents, the higher the technology, the stronger the technology research and development, the less the investment is redundant, the better the supply effect can be achieved with less investment, and the performance is more dominant. .

### **4 Conclusion**

The diversification of technology by enterprises can make full use of the core capabilities of enterprises, and reduce the internal transaction costs while improving the economies of scale of enterprises. However, when the technology diversification strategy is carried out, the production factors such as capital, talents and technology are excessively dispersed. It is easy for enterprises to lose the competitive advantage of their original main business. Enterprises should consider whether to adopt a technology diversification strategy based on their actual situation.

In the process of implementing the technology diversification strategy, it should be noted that the implementation of technology diversification can enable enterprises to search and learn knowledge in multiple fields, consolidate resources, generate strong innovation vitality, and also obtain synergies between technologies. In turn, achieve innovation results and improve corporate performance. However, excessive technical diversification will increase the company's research and development costs, and the company's ability to absorb and transform is limited, which will inevitably result in waste of resources, which is not conducive to high-tech enterprises to play the core technology's competitive advantage, while excessive technology. Diversification can also hurt a certain level of performance of the company, leading to the out-of-control ability of the company. Therefore, when implementing the technology diversification strategy, the company should consider the input-output ratio to maintain the technical diversification at an appropriate level.

Enterprises should rationally optimize the allocation of technical resources, ensure the rationalization of product structure, increase investment in innovation, focus on improving the ability of enterprises to absorb new knowledge, enhance the core technology competitiveness of enterprises, and thus promote the output of scientific and technological innovation. Enterprise managers should further deepen the reform of the enterprise science and technology research and development system, develop science and technology while paying attention to the assessment of corporate performance, enhance the company's innovative main position and maintain excellent operational standards.

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# Research on the Development Trend of Global Face Recognition Industry Based on Patent Analysis

Yang Fangjing

Library of Wuhan University of Technology, Wuhan, P.R. China, 430063

(E-mail: 906816342@qq.com)

**Abstract:** The paper made trend analysis on global patent in the field of face recognition by taking advantage of retrieval and analysis tool of INNOGRAPHY, conducted specific comparison on high-intensive patents of three countries, China, America and Korea which were top three in number of global patent applications, and analyzed existent advantages and gap in patent application and layout in China. Although our country started later in the field of face recognition, it had been prosperous development trend on number of patent applications due to technology innovation and policy support. In terms of high-intensive patent, there was a certain gap with the United States. Accordingly, this paper proposed suggestions for face recognition technology in China: To improve quality of patent application; to strengthen cooperation among enterprises, universities and other scientific research institutions in order to realize a win-win situation; To fully cultivate the talents of face recognition and artificial intelligence.

**Key words:** Face recognition; Facial identification; Artificial intelligence; Patent analysis; High-intensive patent

## 1 Introduction

Face recognition technology, also known as facial identification technology and affiliated to the field of artificial intelligence, was a kind of identification technology which made use of inherent feature of human face for status identification, such as human face and iris recognition, etc. (Bankar P V, Pise A C, 2015). Face recognition technology captured face image by using computer, camera and other devices, automatically located and tracked face, and then processed image so as to achieve identity authentication (Bleumeur P N, Hespanha J P, Krieman D J, 1997). What was different from general recognition technology was that biological characteristic had its own unique property: uniqueness, irreproducibility, convenience and reliability (Li Yaodong, Cui Xia, Xiao Baihua, Dai Ruwei, 2002). Precisely due to aforementioned advantages, face recognition technology got more and more extensive application which predominantly was applied in finance, judicature, education, military and other fields (Xiao Jun, 2016; Hu Datao, 2010; Shen Chenyu, Yin Mei, 2018). Emerging field mainly included several types as follows: access control management, cell phone face recognition unlocking, face-scanning check-in in station, video monitoring and other fields (Li Xue, 2018). Although face recognition technology was applied extensively, patent trend analysis aimed at the technology was relatively deficient. Therefore, the paper made deep research for it, and provided background support for researchers in the relative field and its industry.

## 2 Trend Analysis on Global Patent

In order to study status quo of patent application for global face recognition technology, key words, "face recognition" or "facial identification" or "face identification" or "facial identification" in innography patent database were used to conduct retrieval. Retrieval scope was confirmed in abstract, right requirement and title of invention with retrieval deadline January 7, 2019. total of 37,457 patent applications involving face recognition technology were retrieved around the world (Including invention

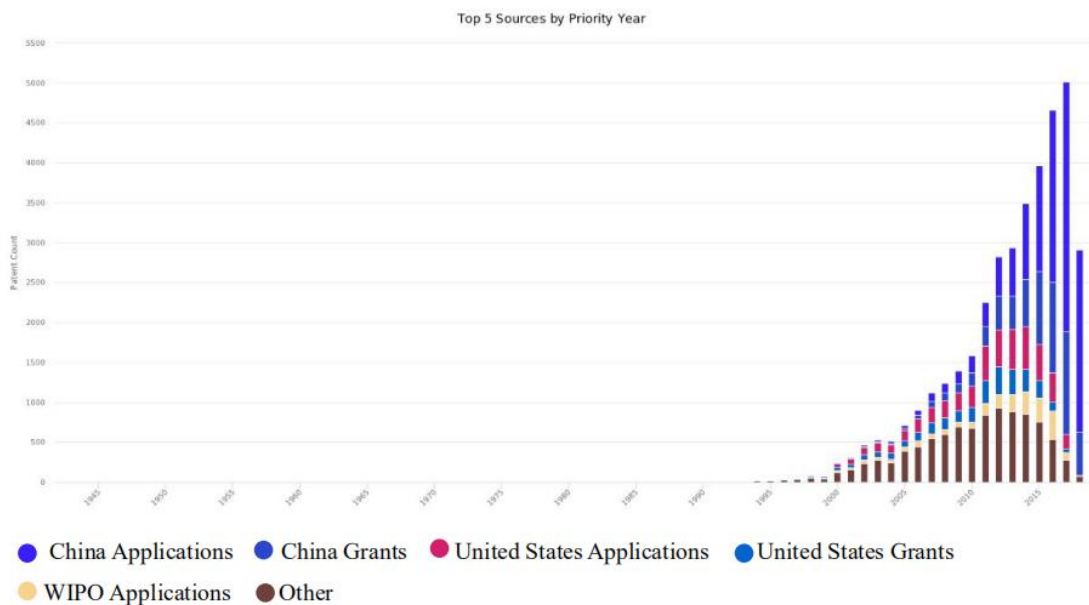
patent, utility model and appearance design). In which there were 11,891 patent grants in quantity, accounting for 31.7% granted patents and 23,505 valid patents in quantity, accounting for about 62.8%, as shown in Table 1. On this basis, the technology was elaborated in the development trend, regional layout and other aspects around the world.

**Table 1 Patent Application Situation in the Field of Face Recognition around the World**

Country or Region	Total Number of Patent Applications	Number of Patent Grants	Proportion of Granted Patent	Number of Valid Patents	Proportion of Valid Patent
The World	37457	11891	31.7%	23505	62.8%

### 2.1 Trend of patent application

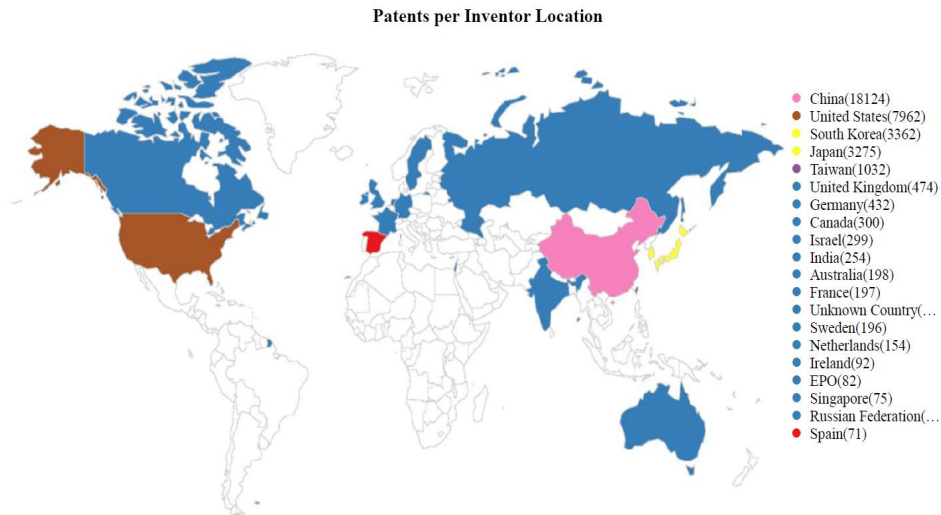
37,457 retrieval results were made statistics in accordance with Priority year of patent, and trend Figure 1 of global patent applications for face recognition technology was obtained. Since 1975, global patent application in face recognition technology had begun to emerge in succession. From 1991 to 1992, number of annual global patent application enhanced from single digit (8 pieces) to double digits (twelve pieces). From 1999 to 2000, number of annual global patent application enhanced from double digits (81 pieces) to triple digits (248 pieces). From 2006 to 2007, number of annual global patent application enhanced from triple digits (903 pieces) to four digits (1,114 pieces). In terms of application trend, number of patent application before 2000 was very few, rapidly rose after 2000, and later was roughly in a progressive increasing trend year by year. In 2017, number of patent application was up to top with 5,013 pieces. Due to examination on age limit, part of patent applications in 2018 had not made public in temporary, data in 2018 had decreased.



**Figure 1 Trend of Number of Global Patent Application on Face Recognition Technology**

## 2.2 Analysis on country/regional distribution

Application source for 37,457 patents was made statistics and country distribution Figure 2 was obtained.



**Figure 2 Country Distribution for Patent Application of Facial Identification Technology**

By Figure 2, analysis on patent application source of face recognition technology could understand strength of computer visual technology in countries and regions throughout the world. China was on the top with 18,124 patent applications. Besides China, there were 7,962, 3,362 and 3,275 patent applications respectively in the United States, Korea and Japan.

Number of patent grants and number of valid patents for the world and China, the United States, Korea and Japan four countries, were made induction and summary and then Table 2 was concluded.

**Table 2 Comparison between Number of Patents and Legal Status for Face Recognition in Top-ranking Countries**

Countries or Regions	Total Number of Patent Applications	Number of Granted Patent	Proportion of Granted Patent	Number of Valid Patents	Proportion of Valid Patent
The World	37457	11891	31.7%	23505	62.8%
China	18124	5974	33.0%	14292	78.9%
The United States	7962	2431	30.5%	3944	49.5%
Korea	3362	1223	36.4%	1476	43.9%
Japan	3275	1002	30.6%	1485	45.3%

After the proportion of granted patent was made analysis and comparison in the Table 2 , it could be concluded that the proportion of granted patent in China, the United States, Korea was all higher than average proportion of granted patent throughout the world, in which Korea took a leading place with 36.4%. Thus, Korea was superior to other three countries in emphasis on novelty, creativity and practicality of patent application and technical content in the field of face recognition.

After the proportion of valid patent was made analysis and comparison in the Table 2, just only China was higher than global average level in the proportion of valid patent, and other three countries all did not reach global average level. It could be seen that China attached importance to patent maintenance in the field of face recognition, on the other hand, number of valid patents included valid granted patent and valid pending review patent at the stage of review. However, in recent years a series of policy to encourage patent application issued by China, which led to great growth in number of applications, was a reason which gave rise to the proportion of valid patent in a leading position in the field of face recognition throughout the world, thus, it could be seen that enterprise and scientific institution had been in rapid upward stage for patent layout awareness in the field of face recognition.

### 3 Comparative Analysis on the Development of Chinese, American and Korean facial Identification Industry Based on Patent

Chose countries or regions with top three global ranking in number of applications in the field of face recognition, that was, China, the United States and Korea were made analysis.

#### 3.1 Comparative analysis on overall situation of patent application

Comparative situation for number of patents and legal status of face recognition in China, the United States and Korea three countries were shown as Table 3.

**Table 3 Comparison on Legal Status of Face Recognition in China, the United States and Korea Three Countries**

China			The United States			Korea		
Legal Status	Number of Patents	Proportion	Legal Status	Number of Patents	Proportion	Legal Status	Number of Patents	Proportion
Valid grant	4894	27%	Valid grant	2197	27.6%	Valid grant	1011	30.1%
Pending Review	9398	51.9%	Pending Review	1747	21.9%	Pending Review	465	13.8%
Expired	3832	21.1%	Expired	4018	50.5%	Expired	1885	56.1%
Total	18124		Total	7962		Total	3361	

As shown in Table 3, in terms of total number of patent applications, China's total number of patent applications in the field of face recognition was conspicuously more than that of the United States and Korea. But total number of patents included valid granted patent, pending review patent and invalid patent. According to three parts of valid grant, pending review and invalid patent, after analysis and

comparison were conducted for patent in China, the United States and Korea three countries, it could be seen that though China had advantages in total number of patent applications, it accounted for 27 percent in valid granted patent, slightly lower than that of the United States (27.6%) and Korea (30.1%). Therefore, China still needed to make improvement in quality of patent application so as to enhance rate of authorization.

Furthermore, invalid patent was made analysis in which most of them belong withdrawn patent, rejected patent and automatically invalid patent without paying annual fee. For rejected and withdrawn patent, either they did not conform to novelty, creativity, practicality and other review standards accredited by the patent bureau or they did not meet external conditions owned by patent grant. For the patent without paying annual fee which led patent right to automatically be invalid, most of them had not brighter market prospect. Therefore, number of invalid patents to some extent presented quality of patent application. The ratio of number between valid granted patent and invalid patent in China was 1.27, higher than that of 0.55 in the United States and that of 0.54 in Korea, which instructed that patent quality in the field of face recognition was relatively high and relevant enterprise or institution attached importance to late maintenance of patent in China. the other reason was that patent in China started late and a good deal of patents had all been in an initial stage.

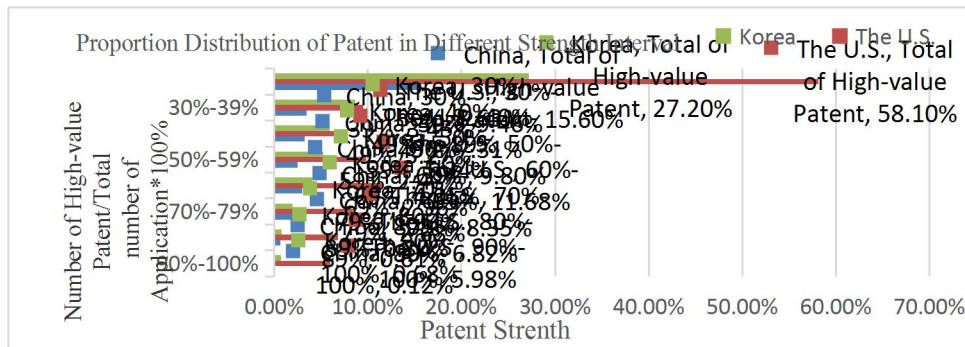
### 3.2 High strength patent analysis

"Patent Strength" was one of critical functions of Innography and comprehensive index for judgment of patent value (Luo Xuemei, 2019; Zheng Meiyu, 2018). Patent strength was influenced by number required by right, citation times or cited times, whether involving case, time span of patent, number of patent families and other factors. Patent strength could reflect literature value of the patent. We believe that patent strength between 30% and 100% are high strength patents. Interval of patent strength could be subdivided into 10% sub-intervals, and 30%-100% high-intensive patents in China, the United States and Korea could be screened and subdivided in order to acquire Table 4.

**Table 4 Patent Distribution in Different Strength Interval of Face Recognition Technology in China, the United States and Korea**

Patent Strength	China	The United States	Korea
90%-100%	22	476	23
80%-89%	111	543	27
70%-79%	485	665	65
60%-69%	537	930	136
50%-59%	449	780	176
40%-49%	592	582	198
30%-39%	625	753	290
Total Number of High-intensive Patents	2821	4629	915
Total Number of Patents	18124	7962	3361
The Proportion of High-intensive Patent	15.6%	58.1%	27.2%

As shown in Table 4, Analysis was made respectively for 18,124 patents in China, 7,962 patents in the United States, and 3,361 patents in Korea in which there were 2,821 patents in line with high strength patents in China, 4,629 patents in line with high strength patents in the United States and 915 patents in line with high strength patent in Korea. In order to analyze differentiation of application quantity in different intervals of patent strength in these three countries at greater length, number of patents with intervals of Patent Strength in China, the United States and Korea were normalized as 30%-39%, 40%-49%, 50%-59%, 60%-69%, 70%-79%, 80%-89%, 90%-100%, and final result was formed into histogram. Thus, Figure 3 was concluded.



**Figure 3 Proportion Distribution of Patent in Different Strength Interval of Face Recognition Technology in China, the United States and Korea**

Figure 3 respectively made use of gray, orange and blue dark-colored histogram to represent proportion distribution of patent in different strength interval in Korea, the United States and China, in which patent strength was two intervals of 80%-89% and 90%-100%. The United State had absolute advantages, especially in 90%-100% interval of patent strength, there were a few patents in Korea, and patents in China could basically be negligible. Table 4 could be analyzed that most of high strength patent in the United States focused on interval of 60%-69%, but it in China and Korea mainly focused on interval of 30%-39%.

In conclusion, among three countries, quality of patent application in the United State was the highest, then followed by Korea. The United State, as first-rate technology power in the world, had always led the world in computer, internet and even emerging AI and other aspects. While as a branch of AI technology, the development of face recognition technology was positively correlated with overall development of AI technology. However, China started late in the field of AI, continuous reinforcement of scientific strength and measures to encourage patent application had made China become an up-rising star in the field of AI, especially in the field of face recognition which was as a branch of artificial intelligence. China had controlled half of application quantity, but still had a long way to go for improvement on strength of patent application.

#### 4 Statistics and Analysis on Important Applicants

Through analysis on patent applicants, it could be found that enterprise or institution which had entered into or planned to enter into the industry reflected market share competition in the field from one side aspect.

##### 4.1 Global important applicants

Global important applicants represent enterprises or institutions which have the maximum number



of patents and leading technical strength in the field.

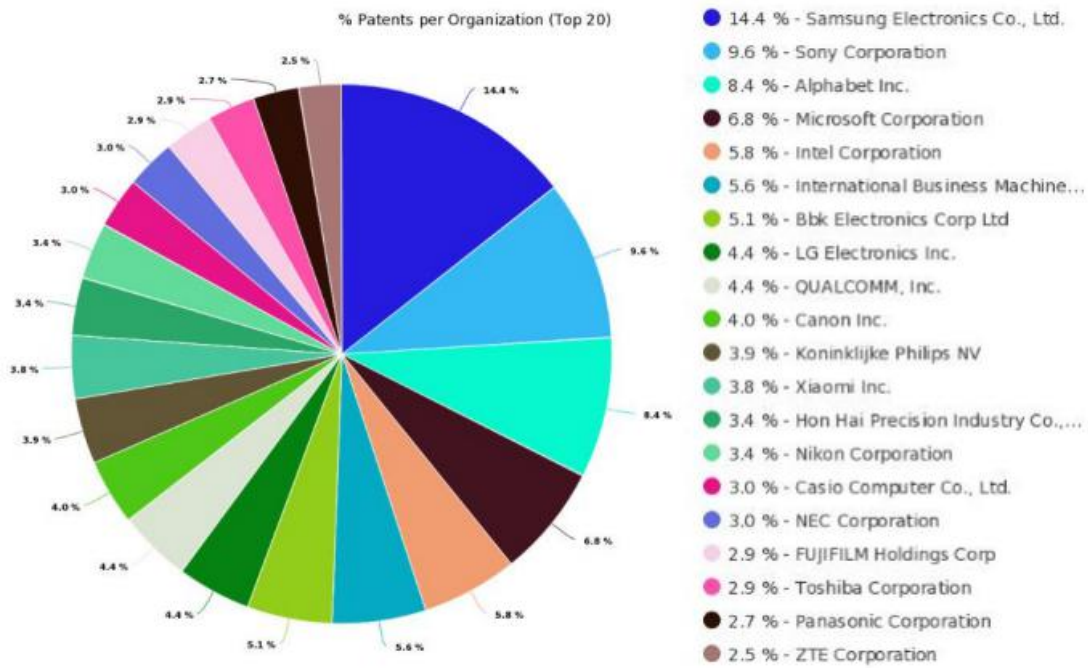


Figure 4 Top 20 Important Applicants in the World

From Figure 4, it could be seen retrieval deadline. Top 20 patent applicants in the field of face recognition around the world were all enterprises, among which there were no lack of applications of enterprises in China, for instance, Bbk, Xiaomi, Hon Hai, ZTE and other enterprises made patent layout in the global market in order to seek for a place in the international market in future.

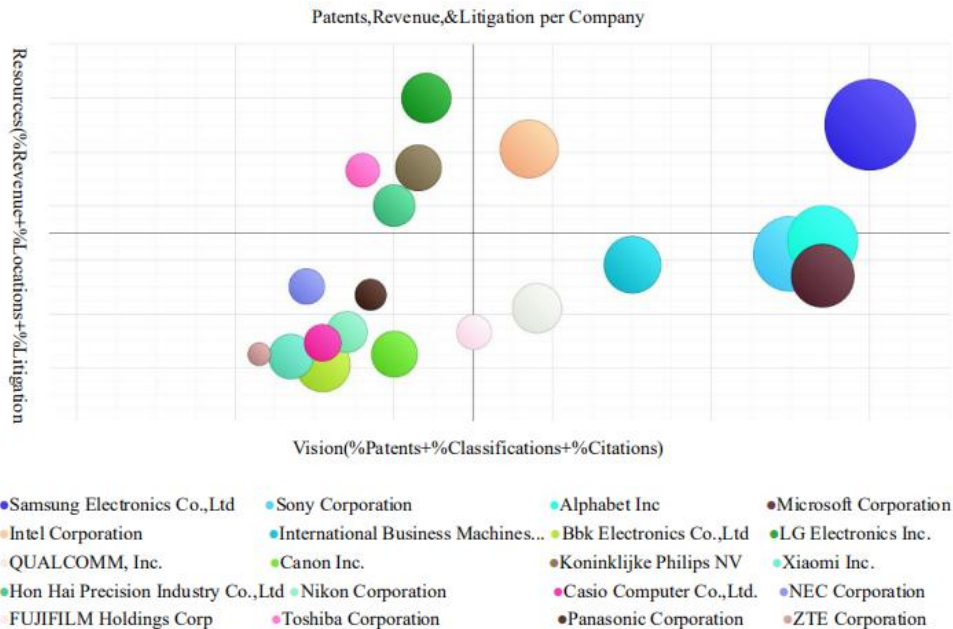


Figure 5 Bubble Diagram of Global Patentees

In combination of Figure 5, the color of the bubble could distinguish patentees with the size of the bubble on behalf of number of patents. horizontal axis represented technical strength in combination with three critical factors: number of patents, classified number of patents and cited number of patents, the further right-side the bubble was, the stronger technical strength of company was. Vertical axis represented comprehensive strength in combination with three important factors: income of patentee, resided geographical location, and litigation case and the more upwards the bubble moved, the stronger comprehensive strength of company was (Deng Xin, Mei Shiyong, CHEN Xiaojun, Xiao Qingming, Li Yu, 2018). Thus it could be seen that Samsung and Intel took absolute advantages in this field with strong economic and technical strength who were leaders in the field of face recognition. Technical strength was relatively strong in Microsoft, Sony, Google and Qualcomm Inc. who were potential technical sellers in the field of face recognition. Economic comprehensive strength was relatively strong in LG, Panasonic and Hon Hai who were potential purchasers in the field of face recognition.

#### 4.2 Important applicants in China

Important applicants in China represent enterprises or institutions in the field of recognition which have the maximum number of patents and leading technical strength in China.

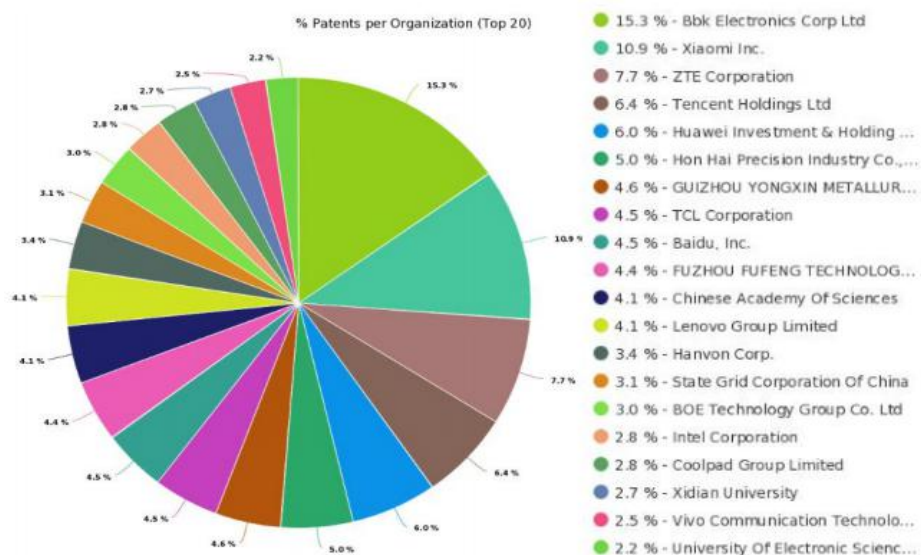


Figure 6 Top 20 Important Applicants in China

As shown in Figure 6. Top 20 patent applicants in the field of face recognition in China, besides most of enterprises, also admitted part of universities, such as Chinese Academy of Sciences, Xidian University, University of Electronic Science and Technology of China. All global important applicants were oriented by enterprise. Technical innovation was more closely to market demand so as to promote continuous development of AI industry. However, there were great differences between universities' own goals and positioning and enterprises oriented by economic interests, which led to its technical innovation in deficiency of effective combination with market. Therefore, it was still necessary for patent of the universities to improve on the AI industry.

Among top 20 applicants in China in the field of face recognition, application quantity in Bbk was

the highest, accounting for 15.3% of total number of patent applications, then followed by Xiaomi which accounted for 10.9%. It indicated that in the field of face recognition, these enterprises attached importance to patent application, and was actively making patent layout. However, number of patents could not absolutely represented comprehensive strength of intellectual property for company or institution, therefore, it was required to resort to bubble chart of patentee for specific analysis.

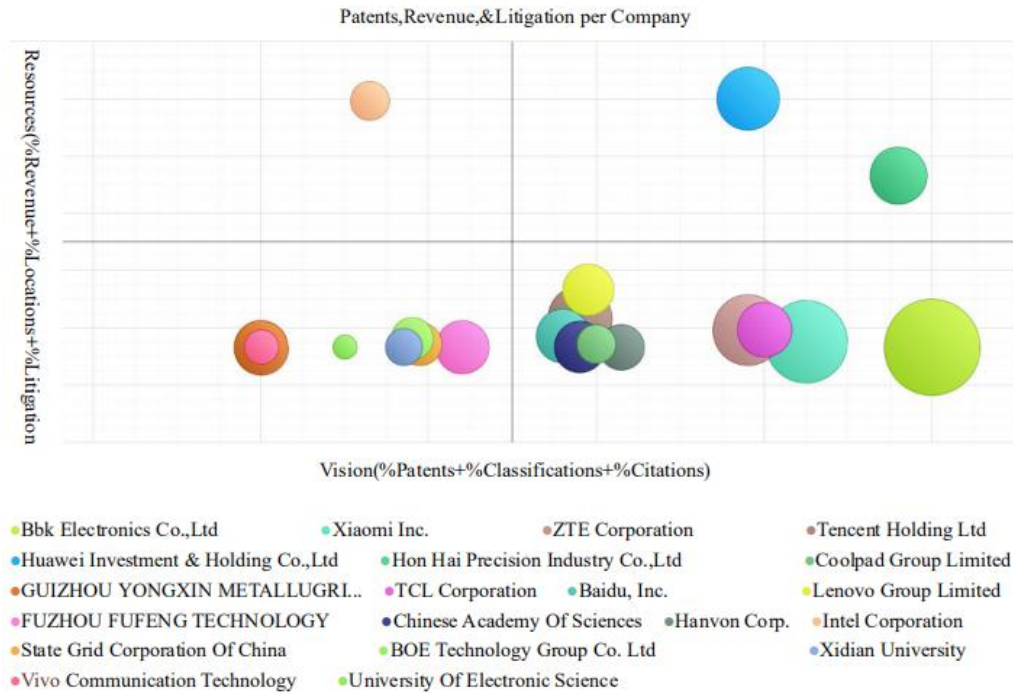


Figure 7 Bubble Diagram of Global Patentees in China

In combination of Figure 7, it could be seen that Huawei, Hon Hai. took absolute advantages in China with relatively strong economic and technical strength who was leaders in the field of face recognition. Technical strength in Bbk, Xiaomi, TCL and other companies was relatively strong who was potential technical sellers in the field of face recognition. Economic comprehensive strength in Intel who was potential purchaser was relatively strong in the field of face recognition.

### 5 Conclusion

The paper took data of global patent in the field of face recognition as an example and analyzed trends of global patent application as well as distribution in countries and regions. Analysis was concluded that countries or regions which were top three in total number of global patent applications were China, the United States and Korea. Also, patent application situation and high strength patent in these three countries were put emphasis on comparison. Global important applicants and important applicants in China was made analysis, thus, conclusion and suggestion were as follows: (1) Along with the rise of AI, more and more powerful enterprises had involved in the field of face recognition. And many enterprises had established AI laboratory, while universities had made deeper and more cutting-edge research and tended to basic theory. It was suggested that enterprises and universities jointly coordinate integrated resources, reinforce application research oriented by market demand, improve

pertinence and applicability of research, compensate for drawback which universities or enterprises brought into lack of market guidance quality or insufficiency of basic research for individual research. (2) According to analysis of important applicants, potential purchasers were mainly enterprises with strong comprehensive strength and they could cooperate with potential technical seller with strong technical strength and to achieve a win-win situation. (3) Universities should reasonably set up course scheme in the field of artificial intelligence. Enterprises should provide better practical platform for talents. Government should provide certain policy support for talents introduction and cultivation of enterprises.

### **Acknowledgement**

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# An Analysis Of The Transformation of Mega-pharma Business Model Toward the Indian Market

Yaeko Mitsumori  
Osaka University  
(E-mail: dt4y-mtmr@asahi-net.or.jp)

**Abstract:** The Trade-Related Aspects of Intellectual Property Rights (TRIPS) requires all member countries of the World Trade Organization (WTO), including advanced countries and developing countries, to introduce a TRIPS-compatible patent law into their countries. Due to the enforcement of TRIPS in 1995, India revised its patent law and enacted the Patents (Amendment) Act, 2005. The 2005 Act included product patents in the pharmaceutical field. Due to the new patent law with product patent protection, large foreign capital pharmaceutical companies re-entered the Indian market one after another and started engaging in both R&D and production, targeting the Indian market. However, recent data show that the number of patent applications has been declining over the past several years and the number of patented drugs launched in India has not increased so rapidly. This study analyzes the transitions of business models of foreign pharmaceutical companies in India based on the patent application data and the trend of patented drugs in the market.

**Key words:** Intellectual Property; WTO/TRIPS; Developing Countries/Newly Developing Countries; Pharmaceuticals; Evergreening

## 1 Introduction

As a result of the implementation of the World Trade Organization's (WTO's) Trade-Related Aspects of Intellectual Property Rights (TRIPS), which took effect in 1995, all members of the WTO, including advanced countries and developing countries, are required to introduce a TRIPS-compatible patent law, including product patents, in their countries. India, a member of the WTO, introduced product patent in 2005 in the pharmaceutical field. When India decided to re-introduce product patent, large foreign capital companies, so-called mega-pharma companies re-entered the Indian market one after another, targeting the country with the world's second-largest population. These mega-pharma companies applied patent to Indian Patent Office (IPO) and started engaging in research and development (R&D) and manufacturing their patented products. However, the number of patent applications in the field of pharmaceuticals has been declining over the past several years and the number of patented drugs in the Indian market has not significantly increased since 2005. This study analyzed the mega-pharma companies' strategies toward India – one of the phar-merging countries and the No. 3 pharmaceutical country in the world on volume – based on the Intellectual Property Rights (IPR) data and marketing data.

## 2 The Current Economic Status of India

### 2.1 Indian economic development

India has achieved rapid economic development, and according to the Japan External Trade Organization (JETRO), India achieved 7.0% GDP growth in 2018 (MUFG, 2019). The United Nations World Economic Situation and Prospect stated that the Indian economy expanded by 7.2% in 2018 and the report projected that the Indian economy would expand by 7.0% in 2019 and by 7.1% in 2020 (United Nations, 2019). In addition, the Organisation for Economic Co-operation and Development (OECD) Economic Outlook reported that India achieved economic growth of 7.0% in 2018 and is expected to grow by 7.2% in 2019 and by 7.4% in 2020 (OECD, 2019).

**Table 1 India's Economic Indicators**

Item	2015	2016	2017
Real GDP growth rate	8.2%	7.8%	7.1%
Nominal GDP	2,103(USD bn)	2,288(USD bn)	2,644(USD bn)
Per capita nominal GDP	1,639(USD)	1,762(USD)	2,009(USD)
Industrial production	3.3(%)	4.6(%)	4.4(%)
Wholesale price index	△3.6(%)	1.8(%)	2.9(%)

Source: MUFG

### 3 Pharmaceutical Industry in India

#### 3.1 History

When India won its independence from Great Britain in 1947, there was no pharmaceutical industry in India. This is one of the reasons the Indian pharmaceutical market was dominated by large foreign capital companies, so-called mega-pharma companies (Government of India, 2005). Having started in the 1970s, the Indian domestic pharmaceutical industry achieved rapid growth because the country's patent law then (The Patents Act, 1970) did not have any product patent protection for medicines (Government of India, 1970).

**Table 2 Indian Pharmaceutical Market**

	1950-51	1960-61	1970-71	1980-81	1990-91	2000-2001
Manufacturers	200		2300	6400	16000	20000
Investment(Rs.Mil)	50	560	2250	6000	9500	30000
R&D Expenditure(Rs.Mil)			100	290	800	4000
Production(Rs.Mil)	100	1130	4000	14400	45700	228870
Exports(Rs.Mil)		16	85	463	7848	87290
Imports(Rs.Mil)		176	243	968	4075	29800

Source: Bhojwani (2005:7)

In the 1970s, the entry barriers into the Indian pharmaceutical industry were very low, such that many companies rushed to enter the Indian pharmaceutical market. As a result, the prices of pharmaceutical products decreased significantly in India (Minato, 2007).

India has a long history in the study of chemistry and chemistry research has been one of India's strengths. This is one of the reasons India was able to produce qualified pharmaceutical products. With the very low prices and high quality, Indian pharmaceutical products were selling very well and the Indian pharmaceutical industry grew very rapidly (Mitsumori, 2010).

#### 3.2 Current market in India

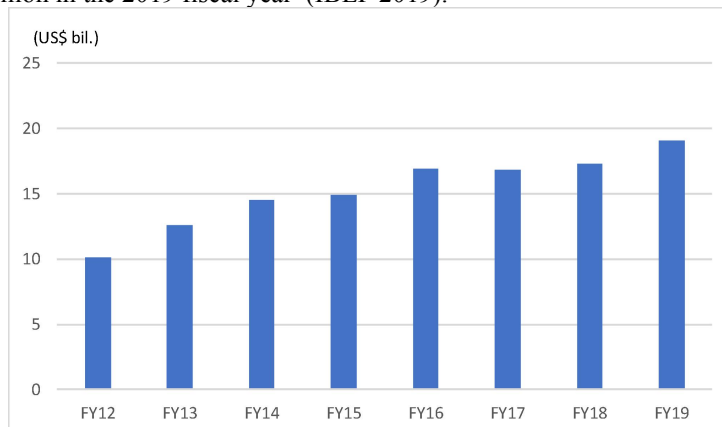
According to the India Brand Equity Foundation (IBEF), the current Indian pharmaceutical sector was valued at US\$ 33 billion. The IBEF expected that the sector would reach US\$ 50 billion by 2025 (IBEF 2019). According to the IBEF, the Indian pharmaceutical industry has many strong points:

- Cost advantage;
- Skilled manpower;
- National Health Policy 2015 of India;
- Reduction of approval time for new facilities; and
- Increasing penetration of health insurance (IBEF 2019).

Today, the Indian pharmaceutical industry is ranked the world's No. 3 in volume and No. 11 in value. IQVIA, an information services company specializing in the medical industry, predicted that the Indian pharmaceutical industry would be No. 9 in the world by 2023 (IQVIA, 2019).

#### 3.3 Exports and imports

One of the features of the Indian pharmaceutical industry is that it is an export-oriented industry. Pharmaceutical exports from India, which include bulk drugs, intermediates, drug formulations, biologicals, Ayush and herbal products, and surgicals reached US\$ 17.28 billion in the 2018 fiscal year and US\$ 19.14 billion in the 2019 fiscal year (IBEF 2019).



**Figure 1 Pharmaceutical Exports from India**



Source: IBEF Pharmaceuticals May 2019:11

The biggest export destination for Indian pharmaceutical products is the U.S. In the 2018 fiscal year, 31% of India's pharmaceutical exports went to North America, followed by 19.4% to Africa and 15.9% to the EU (IBEF 2019).

### 3.4 Market by classification

In the Indian pharmaceutical sector, generic drugs occupy the largest share (70%), followed by over-the-counter (OTC) drugs (21%), and patented drugs (9%) (IBEF 2019).

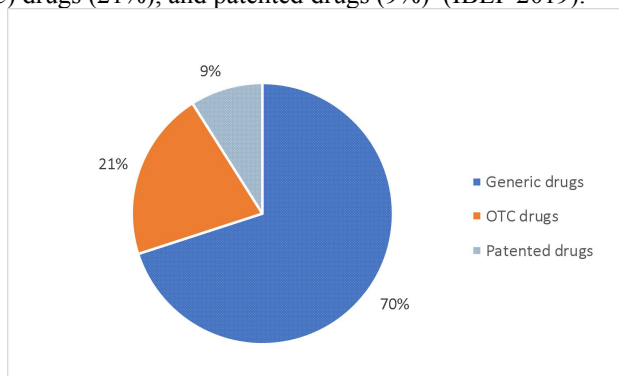


Figure 2 Indian Pharmaceutical Market by Segment

Source: IBEF Pharmaceuticals, May 2019:10

### 3.5 Pharmaceutical market by indication

India is a developing country. When pharmaceutical products were classified by disease, the so-called acute disease drugs occupied large shares. However, recently, the so-called lifestyle diseases, such as diabetes, have been prevalent in India. As of 2018, anti-infective drugs, cardiac disease drugs, and gastrointestinal disease drugs are the top three segments in India.

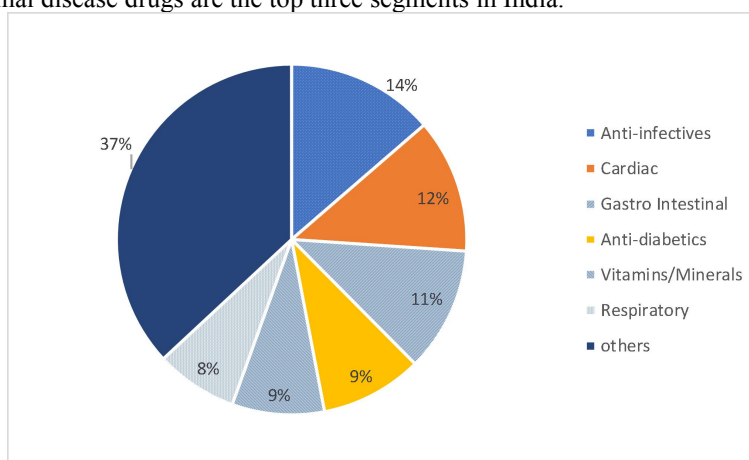


Figure 3 Pharmaceutical Market by Indication

(Source: IBEF Pharmaceuticals, May 2019:10)

## 4 IPR in India

### 4.1 Patent system in India

India has a long history of patent protection. In 1911, when India was a colony of Great Britain, the Indian Patents and Designs Act, 1911 was enacted. The Act had both process and product patent protection in the pharmaceutical field (Mitsumori, 2010), (Government of India, 2005).

### 4.2 Transition of patent law

When India won its independence from Great Britain, there was no pharmaceutical industry in the country. This is why the Indian market was dominated by foreign capital companies; the so-called mega-pharma. Indira Priyadarshini Gandhi, the then prime minister of India, disliked seeing the Indian pharmaceutical market being occupied by foreign capital companies. Therefore, she scrapped the 1911 patent law and compiled a new patent act, the Indian Patents Act, 1970. However, the Patents Act, 1970

did not have any product patent protection in the field of medicine (Mitsumori & Nagahira, 2016), (Yamanaka, 2007).

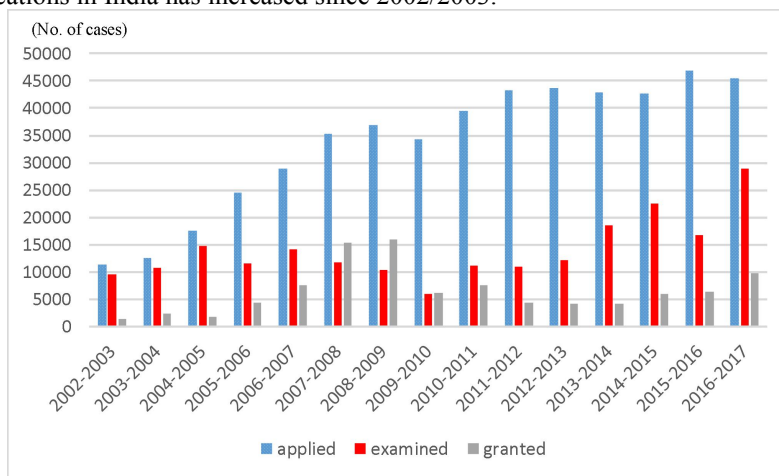
Under the Indian Patents Act, 1970, the Indian pharmaceutical industry has been flourishing (Minato, 2007).

However, due to TRIPS, India was required to introduce product patents by 2005 (Kubo 2007). In 2005, India introduced the Patents (Amendment) Act, 2005, which protects both process and product patents in the field of pharmaceuticals (Government of India, 2005).

#### 4.3 Patent application and granting

The Indian Patent Office (IPO) is administered by the Office of the Controller General of Patents, Designs and Trade Marks. India has four patent offices in Delhi, Mumbai, Chennai, and Kolkata. Each year, the IPO compiles and releases an annual report that contains all the data on IPRs (Anshul Saurastri & Uma Bhaskaran 2018),(Government of India 2016/2017).

Fig. 4 shows the number of patents applied for, examined, and granted between 2002/2003 and 2016/2017 (Government of India 2002/2003 - 2016/2017). Although there are fluctuations, the number of patent applications in India has increased since 2002/2003.



**Figure 4 Patents Applied for, Examined, and Granted in India (2002/03–2016/17)**  
 Source: IPO Annual Reports 2002/2003–2016/2017

### 5 Strategies of Mega-pharma Companies toward India

Table 3 shows the top ten pharmaceutical companies in the world (Nikkei Bio Tech, 2018).

**Table 3 Top Ten Pharmaceutical Companies in the World**

		Sales Revenue(US\$ bil.)
1	Pfizer	46.1
2	Novartis	43.0
3	Roche	41.9
4	Sanofi	39.6
5	Johnson&Johnson	36.3
6	Merck	35.4
7	GSK	28.9
8	AbbVie	28.2
9	Gilead Sciences	25.7
10	Amgen	21.8

Source: Nikkei Bio Yearbook, 2019

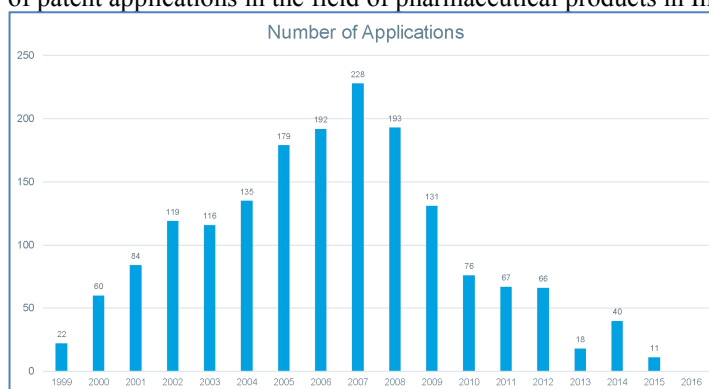
These mega-pharma companies re-entered the Indian pharmaceutical market one after another once India decided to re-introduce a product patent in the field of pharmaceuticals. Some companies set up their own R&D centers, while other companies set up their offices in major cities of India, such as New Delhi, Mumbai, and Hyderabad (Mitsumori, 2014).

Under the Patents (Amendment) Act, 1999, the Indian government set up a mailbox and started accepting product patent applications. Under the Patents (Amendment) Act, 2005, India re-introduced product patent and started examining these applications (Government of India, 2005).

Once a mailbox was set up, mega-pharma companies started applying their patents to IPO. Fig. 5



shows the number of patent applications in the field of pharmaceutical products in India (IQVIA, 2017).



**Figure 5 Number of Patent Applications (1999 - 2015)**

Source: IQVIA

According to IQVIA, almost all of the patent applications for these pharmaceutical products were submitted by foreign capital companies, including mega-pharma companies.

## 6 Two Landmark Incidents in India

### 6.1 Section 3(d)

In 2005, India revised its patent law and introduced product patent protection. However, the Indian Patents (Amendment) Act, 2005 includes a special safeguard article – Section 3(d), quoted below:

*(d) the mere discovery of a new form of a known substance which does not result in the enhancement of the known efficacy of that substance or the mere discovery of any new property or new use for a known substance or of the mere use of a known process, machine or apparatus unless such known process results in a new product or employs at least one new reactant.*

*Explanation—For the purposes of this clause, salts, esters, ethers, polymorphs, metabolites, pure form, particle size, isomers, mixtures of isomers, complexes, combinations and other derivatives of known substance shall be considered to be the same substance, unless they differ significantly in properties with regard to efficacy.*

Based on Section 3(d), the Indian patent office and courts have rejected “major” patents whose patentability had been approved in many other countries.

Two remarkable events regarding Section 3(d) occurred in India. The first one was the Swiss pharmaceutical company Novartis’ Gleevec lawsuit, and the other one was India’s first compulsory license issuance against the German pharmaceutical company Bayer’s Nexavar.

### 6.2 Novartis’ Gleevec lawsuit

Novartis submitted a patent application for Gleevec (general name: Imatinib), one of the most common anti-cancer drugs, through a mailbox set up by the Indian Patent Office. However, in 2006, the Indian Patent Office rejected Gleevec’s patent based on Section 3(d). Novartis, unsatisfied with the rejection, brought the case to court. Both the High Court of Madras and the Intellectual Property Appellate Board (IPAB) dismissed Novartis’ claims. The litigation was brought to the Supreme Court of India. In April 2013, the Indian Supreme Court dismissed Novartis’ patent application based on Section 3(d) (Yamana, 2007), (Fujii, 2013), (Miyagi, 2014).

### 6.3 India’s first compulsory license issuance

In March 2012, the Controller General of Patents Designs and Trademarks of India granted Natco Pharma Limited (an Indian generic drug manufacturer) a compulsory license for Bayer AG’s Nexavar (general name: sorafenib), which is an oncology drug. Due to the order, Natco was allowed to manufacture and sell a generic version of Nexavar (general name: sorafenib) but had to pay 6% royalty on the net sales to Bayer. In addition, Natco was able to charge Rs 8800 for a monthly dose (120 tablets) of the drug.

Since India’s very first compulsory license issuance, no other compulsory license has been issued in India (Kubo, 2012).

### 6.4 Impact of the two landmark incidents

The repercussions of these two incidents were widely divided. Regarding the Supreme Court ruling against Novartis, Médecins Sans Frontières (MSF), an international NGO working for access to

medicine in the Third World, released a press release on April 1, 2013 saying, “This is a huge relief for the millions of patients and doctors in developing countries who depend on affordable medicine from India” (MSF, 2013). On the other hand, Ranjit Shahani, the vice president of Novartis India stated, “Companies like Novartis would invest less money in research in India as a result of the ruling” (Harris, 2013).

Chip Davis, the executive vice president of advocacy at the Pharmaceutical Research and Manufacturers of America said, “It is another example of what I would characterize as a deteriorating innovation environment in India.” Meanwhile, Anand Grover, a lawyer working for the Cancer Patients Aid Association in India, said, “The ruling confirmed that India has a very high bar for approving patents on medicines” (Harris, 2013).

## 7 Discussion

Due to TRIPS, in 2005, India revised its patent law and introduced product patent protection. The new Indian Patents (Amendment) Act, 2005 was supposed to be an international TRIPS-compatible patent law. However, this Act contains a unique safeguard article – Section 3(d). Based on Section 3(d), the Indian government and Indian courts rejected internationally recognized patents such as the Gleevec patent.

Once India had decided to re-introduce product patent protection, mega-pharma companies re-entered the Indian market. These mega-pharma companies started applying product patents to IPO. This is one of the reasons the number of pharmaceutical patent applications in India increased rapidly since the late 1990s. The number reached 228 in 2007; however, since then, the number has rapidly declined. This trend suggests that these mega-pharma companies changed their strategies for the Indian pharmaceutical market.

As described above, two landmark incidents occurred in 2012 and 2013 in India. One of them was the Supreme Court’s decision on Novartis’ Gleevec in 2013 and the other one was compulsory license issuance in 2012. Both incidents were a huge blow to the mega-pharma companies. It is considered that through these incidents, these mega-pharma companies might have reviewed their strategies toward the Indian market.

When these mega-pharma companies re-entered the Indian market, they considered it one of the most prospective markets. However, through these two incidents, they found that IPR enforcement in India was weak and that IPR was not fully protected in the country; thus, they eventually decided not to apply patents to IPO.

Dr. Mitsuo Fujii, head of the IPR division of the Japan Pharmaceutical Manufacturing Association (JPMA), pointed out that foreign capital companies became cautious toward the Indian market. He said, “In around 2005 we looked for Indian market as a prospecting market.” He added, “However, several incidents occurred in India since then. Through these incidents we became to think we had better take a wait-to-see position at the moment toward Indian market”<sup>3</sup>.

These foreign capital firms may still seek several business opportunities in the Indian market and may find their contract manufacturing partners or contract research and development partners, out-licensing partners, or voluntary licensing partners.

## 8 Conclusion

The pharmaceutical industry of India is the world’s No. 3 in volume and No. 11 in value. With high quality and low prices, Indian pharmaceutical products are popular, not only in the Third World, but also in advanced countries.

India revised its patent law in 2005 and introduced product patent protection. Taking advantage of the revision of the patent law in India in 2005, almost all of the so-called mega-pharma companies re-entered the Indian market, targeting the huge consumption market. These mega-pharma companies launched R&D, manufacturing, and marketing in the Indian market. Thus, the number of patent applications by these mega-pharma companies shot up in India.

However, two land-mark incidents occurred in India – the Gleevec lawsuit and compulsory licenses. Due to these events, the mega-pharma companies seem to have changed their business model in the Indian market. The number of patent applications dropped significantly. Foreign capital

<sup>3</sup> An interview with Dr. Mitsuo Fujii, head of IPR division of Japan Pharmaceutical Manufacturing Association (JPMA) in December 2018

companies may find some opportunities in India as the bases for contract manufacturing sites or clinical studies sites.

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# Application of Artificial Intelligence Technology in Legal Practice

Ma Nan

School of Law, Humanities and Sociology, Wuhan University of Technology, Wuhan, P.R. China,  
430070

(E-mail: mn1025960479@qq.com)

**Abstract:** The rapid development of artificial intelligence technology has changed the operating mechanism of the current legal system, which has a certain impact on the traditional legal system, but also brings opportunities. This paper analyzes and compares the current situation of the combination of artificial intelligence technology and law at home and abroad, and points out the advantages of the combination of artificial intelligence technology and law. This paper enumerates the application of artificial intelligence technology in legal practice, such as legal reasoning, information retrieval, intelligent trial, auxiliary legislation, and analyzes the problems and challenges of artificial intelligence technology in legal practice. It is hoped that readers can think more about this field and do more deep research.

**Key words:** Artificial intelligence; Legal services; Legal reasoning; Information retrieval; Legal documents; Auxiliary legislation

## 1 Introduction

Informatization is the historical process of making full use of information technology, developing and utilizing information resources, promoting information exchange and knowledge sharing, improving the quality of economic growth and promoting the transformation of economic and social development. In recent years, the state has been promoting judicial reform and legal information, "Internet + law" has become an important direction of innovation and entrepreneurship. And with the rise of artificial intelligence technology, some legal artificial intelligence products are gradually coming into everyone's field of vision and under the influence of super computing power, big data and continuously improving algorithms, make "Internet + Law" change to "Artificial Intelligence + Law". The deep integration of artificial intelligence and law can promote and perfect the development of the two subjects. With the help of artificial intelligence technology, the legal profession will undergo more profound and radical changes.

### 1.1 Domestic research status

The integration of disciplines is beneficial to the interpretation of the essence of the issue from multiple perspectives. Only by looking back on the law after jumping out of the law, can jurisprudence obtain a stronger vitality (Bai Jianjun, 2008). With the integration of disciplines, artificial intelligence and law will have more vitality. Many scholars have realized the unique advantages that the combination of the two brings to the research of law, artificial intelligence and logic, and more people have been or are engaged in the research of artificial intelligence and law.

Chinese professor Qian Xuesen put forward a general idea about the combination of artificial intelligence and law in 1981. However, it is a pity that there has been no further research on it in China for more than 20 years. In 2001, Zhang Baosheng analyzed the theoretical and practical value of the research and development of the legal system of artificial intelligence, as well as the jurisprudence basis of the application of artificial intelligence in jurisprudence (Zhang Baosheng, 2001); in 2007, Tang Haolai further discussed the connotation, research contents and possible impacts and challenges of the combination of artificial intelligence and law, and in 2012, we set up the judicial discretion model of artificial intelligence with the example of spiritual damage compensation.

China also has a small number of forward-looking institutions that specialize in quantitative research in law. For example, the Southwestern University of Finance and Economics has set up the key laboratory of rule of law quantification and information engineering in Sichuan Universities. Conduct relevant research on the rule of law indicators and legislative informatization. The Law School of China University of Political Science and Law has established a research center for big data and artificial intelligence law in 2017. Generally speaking, the research results of artificial intelligence and law in our country are not abundant, and it is still in the initial stage of research.

### **1.2 Overseas research status**

In the early 1950s, Lucien Mehl began to study the combination of artificial intelligence and law, because he was keenly aware that artificial intelligence would have a great influence on the study of law. In the 1970s, Anthony D. Amato argued that human judges should be replaced by robotic ones to remove legal uncertainty (Anthony D'Amato, 1977). But the question of whether it is right and feasible has been debated in American academia, sometimes philosophically. As J. C Smith points out, the idea that computers can or should replace judges is based on Descartes's "spiritual dualism" and "Leibnitz's fallacy." Both make the mistake that intelligence can exist independently of the human body and that all human thought can be expressed in a universal language (J. C Smith, 1998).

Legal Scholars in the United States and Europe have paid more attention to the study of rules and cases. The disciplines are relatively intensive, and artificial intelligence and law have received more attention. There are special departments and centers under the government or scientific research institutions for researchers of artificial intelligence and law, specializing in the theoretical and practical research of the combination of artificial intelligence and law. A joint effort of the United States government, academic institutions and companies has established modern technology and law related research centers, such as the Stanford Law Information Center, to study how modern information technology can be used to improve the quality and efficiency of Legal Systems At the same time, it reduces the operating cost, and its research not only includes the related theoretical research, it also includes practical research related to better understanding and compliance with relevant rules, enforcement agency monitoring of enforcement rules, and Regulatory Agency analysis of costs and conflicts of regulations. The Leibniz Centre for Legal Studies has been established in Amsterdam to integrate computer and legal personnel and to apply artificial intelligence for empirical research in legal theory, legal knowledge management and other legal fields.

### **1.3 Literature review**

As soon as the emergence of artificial intelligence technology, the world's hot discussion and research, and at present this technology has been skillfully applied in practical production and life, and artificial intelligence technology also has a huge potential of untapped, it can be combined with any other disciplines, will also promote great changes in other disciplines. In terms of the research results related to the combination of artificial intelligence technology and law, scholars have put forward the positive impact that artificial intelligence technology can bring to the field of law. For example, Dymitruk et al. believe that artificial intelligence will greatly reduce human and material resources and improve work efficiency. Kathrani and others believe that intelligence artificial will not only improve efficiency, but also be more fair and equitable. However, according to statistics, most of the relevant research results are produced by computer scholars, and the deep integration of computer science and law has not been realized yet. Many problems still need to be discovered, and these problems need to be solved by scholars in the two fields.

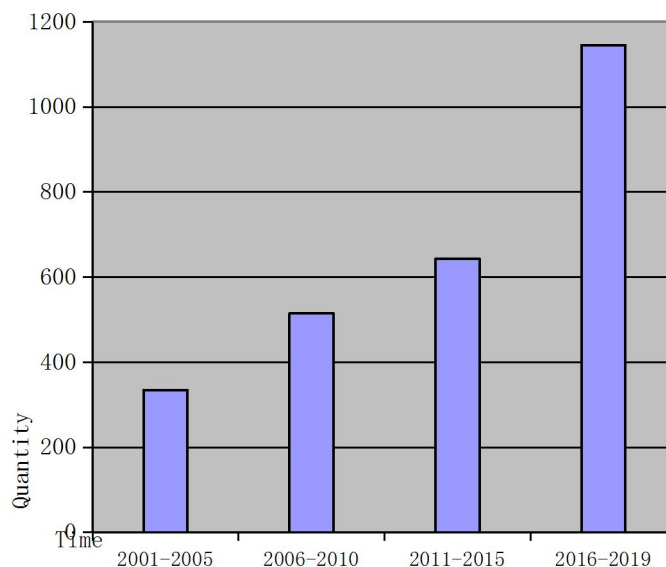
## 2 Artificial Intelligence and Law

### 2.1 Overview of artificial intelligence

Human activities often need intelligence, such as computer programming, mathematical problem-solving, car driving and so on need to use "intelligence". If the computer can simulate human thinking activities, like human thinking, then it can be considered that the computer has a certain sense of "artificial intelligence". Artificial intelligence system is a kind of system which can accomplish some intelligent tasks by using its software and hardware in various environments, such as judging, reasoning, proving, explaining, thinking and learning (Berman MD, 2016). In recent years, artificial intelligence has been highly valued all over the world. In 2014, 180 European companies and research institutions launched the world's largest civil robotics research and development program; in the same year, South Korea launched its second five year plan for the development of intelligent robots; in 2016, the White House reports and discusses the impact of smart and autonomous technologies on the economy and strategies to deal with it; in 2016, smart courts were included in China's national development strategy; in March 2017, the term artificial intelligence appeared for the first time in China's government work report, and the Central People's government issued a plan for the development of a new generation of artificial intelligence in July of that year China will strive to build an intelligent industrial chain in the field of image and speech recognition. In 2017, Alpha Go defeated the world's top Go player, Lee Sedol, and put artificial intelligence in the spotlight (Holcomb SD, Porter WK, Ault SV, et al, 2018), it also makes the application of artificial intelligence technology in the field of law become a new hotspot. In fact, artificial intelligence has been used to efficiently resolve online disputes, accurately retrieve and interpret legal information, accurately interpret and generate legal documents autonomously, comprehensively collect evidentiary information, and accurately conduct legal reasoning. Nowadays, more and more researchers study the application of artificial intelligence in law. Because combining artificial intelligence with law is a far-reaching task.

In the context of the country's vigorous promotion of intelligent legal services, from legal retrieval and preparation of legal documents, to contract review and legal consultation, to case outcome prediction and litigation strategy selection, legal Technology marked by intelligentization is stirring up the legal service market. Since 2013, under the leadership of the State Supreme Court on the application of artificial intelligence technology in intelligent legal services, the informatization and openness of legal documents has become a key direction of judicial reform (Fu Zitang, 2015). At present, China adjudicative document network has become the world's largest open judicial document library, open more than 60 million documents, a total of 20 billion visits. At the same time, the construction of smart courts continues to push forward and fall to the ground. The Zhejiang e-commerce Internet court began to operate on a pilot basis in 2015, and the "Internet + Smart Court" Information 3.0 era has been opened; in 2016, the Supreme Court and the China Power Science and Technology Corporation jointly established the Tianping big data company to explore applications such as big data and artificial intelligence (Luo Shuzhen, 2016); in 2017, President of the Supreme People's Court of China Zhou Qiang stressed at a meeting of the Supreme People's Court that the vigorous application of Strong AI technology in the field of justice will inject new impetus into Supreme People's Court Modernization.

On a global scale, the combination of artificial intelligence technology and law has attracted more and more computer scholars and law scholars to participate in research. In order to understand the research status and trends of the combination of artificial intelligence and law, the author chose to analyze the relevant research results data in the SCI database, using the "artificial intelligence and law" as the key words, select the SCI database to retrieve the relevant data. The horizontal axis is the time and the vertical axis is the number of research results. This paper analyzes the data in five years as a



time period.

**Figure 1 Data of Research Results in Artificial Intelligence and Law**

As we can see, since 2001, the number of research results combining artificial intelligence and law has steadily increased every year, especially in the less than four years from 2016-2019, the number of research results in this field has nearly doubled. It can be seen that more and more scholars are engaged in related research in the field of artificial intelligence and law.

## **2.2 The advantages of artificial intelligence in the legal field**

### **2.2.1 Increase efficiency**

It is inevitable for judicial personnel to engage in a great deal of repetitive work in their professional career. Statistics show that in the first half of 2017, the total number of cases handled by the courts in the whole of mainland China was ten thousand, ten thousand cases were finally concluded, the judgment rate was 60.9%, and the number of outstanding cases was ten thousand. Compared with the same period in 2016, the number of cases accepted by the courts nationwide increased by 11.2%, of which 14.8% were new cases, 9.88% were closed and 13.54% were not. There are about ten thousand judges in the country, 121.4 cases per person, 74.0 cases per person. As you can see, the workload of the judges is enormous. In fact, a judge is required to review a large number of relevant materials to conclude a case, and after careful consideration, to write a final judgment and so on. This is for the judge, whether professional ability, or physical quality, are under great challenge. If the application of artificial intelligence to deal with these cases, you can save most of the human and material resources, greatly improve their work efficiency and reduce the pressure that smart applications contribute to the reduction of more than 30% desk work (Kathrani P, et al.).



### 2.2.2 Improve quality

Artificial intelligence not only helps to improve efficiency, but also ensures that the fairness of the law is not affected by human factors and regional differences (Dymitruk M, et al., 2018). In reality, the quality of the judicial handling of cases is uneven, and sometimes there may have some cases that abuse of judicial power by the adjudicators, leading to many unjust and false cases, and even to such serious unreasonable situations as one case with two conclusions. Greatly shaken the majority of the People's confidence in the artificial adjudication. Moreover, judges in different regions may decide different cases of the same nature, which may not be fair to the sentenced parties and is not conducive to the construction of the legal system of the whole country. Therefore, it is necessary to use the scientific light of artificial intelligence to illuminate the black hole of handling cases at will, so as to make justice more just and careful, and truly achieve the goal of joint adjudication.

### 2.3 Feasibility analysis

Artificial intelligence is constructed by reverse engineering human brain function, so it can simulate human thinking well. Therefore, the logic operation of artificial intelligence justice and human justice has a high degree of commonness. However, artificial intelligence system can mine and integrate judicial data through machine language and digital code, thus breaking the limitation of human legal data processing Beyond Man's ability to recognize and integrate legal information and knowledge in natural language. Human rational thinking is not only limited, but also under the influence of psychological factors, the perception and judgment of empirical facts are often biased. As a result, legal persons may misjudge because of their own cognitive limitations, physical and emotional state. For example, a judge may be more or less personally involved in a case, and the outcome of the trial may differ from the strict provisions of the law. And artificial intelligence systems can use its powerful data storage, analysis and mining capabilities, not be disturbed by human emotions and external public opinion (Du Jin, Du Yanhui, Zhao Xin, 2013). Accurately identify the types of criminal behavior, quickly and accurately find the applicable legal provisions from hundreds of legal provisions, and realize the accurate connection between the types of behavior and legal consequences on the basis of constructing and optimizing the decision-making model, the accuracy of the legal trial has been greatly improved.

Artificial intelligence judicature can be built on judicial data, which can provide sufficient and effective evidence, precedent, standard and scale for most cases. As long as the continuity of the history of a particular social life is recognized and the abrupt nature of social evolution is not overemphasized, AI Justice is in line with social trends and legal beliefs. That is to say, the artificial intelligence judicature is the conformity, the continuation and the compliance to the numerous, the legal, the valid case logic. The artificial intelligence judicature also includes the case-based legal knowledge and the rule-based legal knowledge, which is a great contribution to the mixed system theory of legal knowledge. Therefore, whether from the perspective of the new natural law, or from the perspective of the application of law in reality and sociology, it is undoubtedly legitimate.

## 3 The Specific Application of Artificial Intelligence in Law

Early research on artificial intelligence and law is often scattered in computer and law journals. Since the publication of "Artificial Intelligence and Law" in the University of Pittsburgh Law School in 1992, it has been paying attention to the latest developments in artificial intelligence and law. Research topics include the application of artificial intelligence, cognitive psychology, jurisprudence, linguistics, philosophy and other knowledge for the establishment of legal knowledge, legal reasoning, court judgment models, as well as other ethical, social artificial intelligence and legal related research, publishing academic papers, book reviews, technical reports of technical systems or products, research notes, etc., has become the spiritual home of research scholars of artificial intelligence and law. The

following table is obtained through the statistics of related papers published in the journal in recent 15 years.

**Table 1 Research Content and Quantitative Analysis**

Sector	Legal reasoning	Legal information retrieval	Analysis of legal concept	Agent research	Norm revision	Policy making	Evidence	Review
Quantity	160	100	62	60	40	20	24	18
Proportion	33.06%	20.66%	12.81%	12.40%	8.26%	4.13%	4.96%	3.72%

According to the analysis of the research results published in the “Artificial Intelligence and Law” magazine in the past fifteen years. Firstly, the research theme of artificial intelligence and law is far more abundant than our imagination. Secondly, the research on artificial intelligence and law adopts the latest artificial intelligence. Related technologies and achievements; Thirdly, from the perspective of published articles, the use of artificial intelligence for legal reasoning, the establishment of judicial discretion models, and expert systems have always been the focus of artificial intelligence and legal research.

This paper enumerates four specific applications of the combination of artificial intelligence and law, which are elaborated and analyzed as follows.

### 3.1 Application one: Legal reasoning

Reasoning is a kind of rational thought activity, that is, the process of deducing the unknown proposition (conclusion) from many known proposition (precondition). In the field of law, reasoning plays a decisive role, because in the law-making, implementation, and even the daily People's knowledge of the law, law-abiding, need to reason. For example, when investigating a crime, the police will protect the original state of the scene, the purpose is to be able to deduce the case when the scene of the crime, the perpetrator's physical characteristics and psychological and so on. In court, legal reasoning is actually carried out in the form of dialogue. This dialogue is reflected in the fact that the parties and the accused are debating their conflicting claims, at which point the judge has to ascertain the truth of the facts from their reasoning in the dialogue, that is, in a criminal trial, a judge or jury needs to reason about a case that has already happened based on the evidence available to them.

The goal of the artificial intelligence system of legal reasoning is to provide human lawyers with a standard legal scale to measure the value of the arguments they make in their reasoning. The working principle of artificial intelligence system imitating legal reasoning is to create mathematical model and implement corresponding running program on computer that is to transplant the thinking process of human reasoning into intelligent system (including robot). For such a system to simulate a court system, the developer must not only have a basic knowledge of the law, but also a complete knowledge of legal reasoning. Such as the practical application of legal reasoning and theoretical development process, the norms and methods of legal reasoning, and so on.

### 3.2 Application two: Legal information retrieval

The value of legal information retrieval is obvious. Law Novices, experienced lawyers, judges, judiciary, and the general public all need to search for legal information from time to time (H Prakken, 2017). Nowadays, more and more judicial documents, such as legal texts, judicial documents and other legal materials appear on the Internet, which strongly supports the market of large-scale legal databases. However, most of the daily judicial databases search by the inherent keywords, which is time-consuming, laborious and expensive, so it cannot meet the demand of the legal information market well. An artificial intelligence retrieval system with powerful natural language processing capabilities can not only increase the work efficiency of lawyers by 500 times, further reduce the cost of litigation by 99%,

but also perform fast and accurate database searches Even better than humans. The working principle of legal artificial intelligence retrieval is that it can understand the fact of an event and identify the conflict with the law, and then accurately retrieve the best solution. The whole work does not need human intervention, and can even replace some lawyers' trivial work, thus freeing lawyers from the tedious retrieval work. Thus, the legal information retrieval system in the era of artificial intelligence is a very large and far-reaching research.

### **3.3 Application three: Handling of legal documents**

The artificial intelligence of legal document processing will give legal workers more and more powerful external brain aid. At present, researchers are keen on artificial intelligence processing of various contracts. This is because, on the one hand, routine exchanges of goods and services often require contracting (in contracts, the parties establish common rules to meet the expectations of the parties) and, on the other hand, because of the size and complexity of the contract, so it is a time-consuming and error-prone task to input and detect the contradictions and conflicts in the contract manually.

Drafting a contract is one of the main tasks of an enterprise legal consultant, which is time-consuming and laborious. However, artificial intelligence systems with deep learning capabilities can generate highly accurate, complex and context-specific contracts by learning a large number of actual contracts. The contract it drafted was far better than the result of copying the model contract, and better than the work of many experienced law firms. Silicon Valley firms have now adopted such a contract-generation system to help start-up companies create the legal documents they need, cutting hours from several days to a few hours. There are a number of similar companies in China, such as Baidu and iFLYTEK, that use their own patchwork methods to generate the required legal documents. A new era of intelligent systems to help draft legal documents is coming (perhaps in the next decade or so), with most trade contracts and the rest of the legal literature and even litigation and trial documents to be drawn up by Artificial Intelligence Systems. The role of judges and lawyers will shift from that of drafters to that of revisers and signatories. We still have a lot of work to do to prepare for this new era, because legal documents don't just include contracts.

### **3.4 Application four: Subsidiary legislation**

Law is a barrier to maintain social order, so when the existing law is incompatible with the new things, the law often needs to be re-customized or updated, that is, legislation is needed. Legislation usually refers to the process of making laws and regulations in strict accordance with specific procedures (H Luiten, 1999) (proposal of law, approval of law, agreement of law, promulgation of law). Legislation requires not only professional legal knowledge, but also keeping up with the changes of the times, paying close attention to the speech of the network society, based on data, and widely collecting people's opinions (Chen Yongmei, 2017). Relying solely on artificial frequency to innovate legislation or reform original legislation would not only add huge workloads to the departments concerned, but would also put great pressure on them. Therefore, it is necessary for the legal circle to use artificial intelligence to support legislation, because artificial intelligence not only has the powerful ability to deal with massive data, but also has the efficient learning ability. Legislation is in fact based on the reality of the problem, the development of a solution to the problem. This requires the legislature to find the crux of the problem, which is a great challenge for lawmakers, but for artificial intelligence system is very easy. In fact, artificial intelligence is the most appropriate tool for making legislative decisions based on the analysis of practical contradictions.

At present, all countries in the world have responded positively to the artificial intelligence assistance legislation. Wooldridge, a professor of computer science at the University of Oxford, says the

UK's work on artificial intelligence legislation is influenced by two factors: first, Britain's international standing in the field of artificial intelligence; and second, precautions against the possible dangers of artificial intelligence. Tianjin, China, has used an intelligent platform to review cases and is trying to use the platform's review work to advance the NPC's legislative work. This intelligent platform includes legislative project management, public legal documents, legal documents review, legal documents self-cleaning, legislative data analysis and so on. Although the rapid development of artificial intelligence symbolizes the coming of a new era, there are still some defects in the technology, such as the use of artificial intelligence for image recognition will reveal personal privacy.

#### **4 Problems and Challenges**

There are two major problems in the application of legal artificial intelligence: natural language understanding technology is far from mature, and case data are incomplete and lack of labels. Complex cases require lawyers to communicate with their clients over a long period of time to gain a comprehensive understanding of the case. With current technology, it is difficult for machines to perform similar functions. The deep application of artificial intelligence needs the unity of data, but the system docking needs strong coordination and high cost. In addition, legal AI applications face two major challenges: In terms of supervision, the legal services provided by AI systems are currently black boxes, and lawyers have no way of knowing the factors that influence their decisions and cannot supervise them; and in terms of confidentiality, artificial intelligence applications will be provided by third parties, and data storage and protection will not be controlled by lawyers, but by third party companies.

#### **5 Conclusion**

Discipline integration is beneficial to explain the nature of the problem from multiple perspectives, artificial intelligence and law as a new research discipline will have more vitality, many scholars have realized the combination to the law, artificial intelligence, logic and semantics, the unique advantages of more and more people have been or are in the research in artificial intelligence and law. In general, the cross-research results of artificial intelligence and law in China are not abundant. There are few research results combining theory and practice, and the research is not deep enough. The research on combining technology, case and jurisprudence is not enough, and it lacks practical investigation.

Because of the isolation and barriers of disciplines, there is a big difference between the research methods and the evaluation of academic achievements. The lack of mutual understanding between disciplines also restricts the growth of interdisciplinary subjects. Computer scholars mainly pay attention to the efficiency of computer computing methods, but lack of attention to legal theory and judicial practice. Legal scholars pay more attention to legal logic, legal concept itself, and pay attention to legal timeliness. Therefore, it is necessary for computer scientists and legal scholars to conduct related research.

Artificial intelligence technology has already begun to transform the entire legal profession, and the scale and speed of the transformation will depend not only on the pace of technological development and progress, but also on the degree of acceptance of new technologies and models by the entire legal community. This requires policy support and development orientation (Hao Tiechuan, 2018). Legal person needs to adjust the mentality, embrace the new technology and the new pattern positively, and persist in the idea and the belief to the law in this process, to prevent legal artificial intelligence from weakening and undermining the ideas and values upheld by the legal community and the legal system, and to allow legal artificial intelligence to promote justice rather than prejudice and discrimination, or go in the opposite direction, demeaning justice.

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## Monitoring Node Selection in Wireless Sensor Networks Based on Fuzzy Logic Scheme

Hammad Mushtaq<sup>1,3</sup>, Syed Nouman Ali Shah<sup>2</sup>, Naveed Ahmad Faraz<sup>1</sup>

1 School of Management, Wuhan University of Technology, Wuhan, P.R. China, 430070

2 School of Computer & Information Technology, Beaconhouse National University, Pakistan

3 Department of Information Systems (SBE), University of Management & Technology, Lahore, Pakistan  
(Email: Hammadmushtaq@hotmail.com, nouman.ali@bnu.edu.pk, naveedahmadfaraz@outlook.com)

**Abstract:** Security is a vital issue for wireless sensor networks (WSN), lately significant research is focused towards resolving these issues. The nature of wireless sensor network applications requires confidentiality in intrusion detection system (IDS) that can provide ability to identify and control intrusions. The sensor nodes of wireless sensor networks are prone to be attacked by invaders. Several researchers have suggested light weight security modules which are either signature based or rules based for securing sensor nodes. However, the overhead of even the light weight modules on sensor nodes is challenged by limited battery life and compromising the life time and communication of the network. Similarly, assigning sensor node IDS on static nodes is vulnerable to be identified by invader. A dynamic node selection IDS is proposed that can counter the vulnerability. Fuzzy logic scheme as suggested for cluster head selection to be employed on DSIDS node selection.

**Keywords:** Dynamic sensor IDS; Leach; Monitor node selection; WSN

### 1 Introduction

Wireless Sensor Networks are implemented in real world solutions including highway traffic, military surveillance, data attainment about livestock activities on the planes, under the sea and in remote areas (Hosseini, 2011). In a typical WSN, there are many accumulation points (sensors) that collect information from their neighboring nodes, aggregate and broadcast the information toward base station where data is processed. WSN issues include safety of sensors, vulnerability of wireless channel for data distribution and shared broadcast communication, employment in unapproachable and open setting, involuntary and autonomous nature and restricted properties make WSNs vulnerable (Akyildiz, 2002).

This paper proposes dynamic monitoring node selection process & algorithm using fuzzy logic for WSN that will be executed by CIDS. The article is organized into 4 parts: part 2 focuses on exploring state of the art literature in node selection for WSNs as limited literature is available in dynamic WSN-IDS node selection this section is focused on cluster head selection mechanisms proposed as it closely relates to dynamic monitoring nodes selection. Section 3 explains proposed monitoring node selection that will hold WSN-IDS light weight version for WSN. Finally, section 4 concludes the article and provide impending path in WSN-IDS research.

### 2 Related Work

Security eruptions are categorized into two types in WSN: Active and Passive. In active attacks, attacker disturbs the operations in the targeted network. For example, the networking services may be terminated as a result of these attacks. There are many types of attacks for example flooding, Denial-of-Service (DoS), hole attacks and Sybil types attacks on WSN, further discussed by (Cayirci, 2009; Wang, 2006; Padmavathi, 2009). Resolutions to vulnerable securities in Computer Infrastructure (wireless and/or wired) involve three focal techniques (Fuchsberger, 2005) prevention, detection and mitigation.

In this issue (Zhang, 2003) describe intrusion as: “any set of actions that attempt to compromise the integrity, confidentiality, or availability of a resource”. The avoidance mechanisms are the frontline security against such intrusions that include identity confirmation for accessibility, encoding and secured routing. An Intrusion Detection System is to support the identification, assessment, and reporting the

intrusions. Intrusion detection is normally an element of holistic defense mechanism deployed on a system or device making it an integrated defense line (Ngadi, 2003).

IDS for WSN requires designing efficient software that suits the constraints of wireless sensor nodes, head nodes and central base station such as power consumption to extend the lifetime. Several possible arrangements of WSNs (Hosseini, 2011; Reis, 2002) may exist that comply to the specific application requirements, so it is difficult to define standard and predictable performance as IDS for a specific WSN needs to be rearranged in accordance to the unique application type of WSN.

Similarly, while designing a sensor node level IDS is challenged by limited battery life and probability of compromising the life time and communication of the network. Proposed a light weight rule based IDS which will reside on first level of WSN i.e. Sensor nodes. However, keeping in view the nature of WSN applications and its constraints, activating IDS on all of the sensor nodes is not practical. To solve this issue some selected sensor nodes that now onwards will be referred as monitoring node (MN) can be designated to have activated light weight rule based IDS. The primary issue is to deal with selection of these nodes.

This research proposed rules based multi-layer IDS architecture that is enabled on both misuse and anomaly detection. Different approaches of intrusion detection at all WSN layers i.e. sensor nodes, cluster heads and base station taking into consideration the constraints and vulnerabilities at these layers. On sensor nodes the threat of physical abduction and penetrating intrusions was proposed to be dealt by light weight rule based system and encryption. The architecture directs to perform detection and prevention mechanisms from physical threats for the WSN allowing cluster heads IDS (CIDS) to periodically perform dynamic selection of monitoring nodes (sensor nodes containing IDS). CIDS will further identify and perform active response such as detach compromised sensor nodes in their cluster whenever anomaly reported by the monitoring nodes. Initially (Wang, 2006) and later on (Noman, 2011) proposed specializing nodes (watchdogs) to contain intrusion detection module that decreases overhead on all nodes. Other than these nodes act as conventional sensor nodes to sense and transmit data. Furthermore the cluster head node IDS may take necessary action as it receives threat alerts from the watchdogs.

Following a static intrusion detection node all the time creates vulnerability in the sense that attacker can trap the monitoring nodes (MN). Extra energy may be consumed in electing the cluster heads thus (Saranya, 2015) suggested IDS without cluster but contain overhead for sensor nodes as they have to maintain data about neighboring nodes resulting in more power consumption.

Data gathering from MN proposed by (Silva, 2005) continuously pay attention to data series being communicated and filter data required for analysis and design of rules. After that the detection is performed using the "rules base" as elevated by MN. It is good scheme but not without demerits such as the process of determining the monitoring nodes is not well defined. The limitation in its algorithm makes it difficult for practically implementing it in WSN.

Several authors (Krontiris, 2008; Chi, 2006) highlighted the overhead present in most of the schemes. Being informed of that, the collaboration overhead is usually several orders of magnitude higher than the computation overhead (Akyildiz, 2002), this drawback is highly critical for WSN. Keeping in view emphasis can be found in the WSN research about selection of sensor nodes to be used as cluster heads (CH). The representation design is low energy adaptive clustering hierarchy (LEACH) protocol (Heinzelman, 2002; Heinzelman, 2000) a probabilistic model for CH selection and focus on rotating the CH for energy efficiency. This protocol has limitations of selecting an inefficient node as it depends solely on probabilistic model and do not consider other factors critical for selection of nodes such as distance between selected nodes and energy level. Clustering approach presented by (Lee, 2012) for fuzzy logic focus on energy prediction named as LEACH-ERE it is very influential in designing

our process for monitoring node selection. However, Lee et al. work is focused on selection of cluster heads whereas our work is towards selecting a collection of candidate nodes to act as monitoring node with active IDS enabled on them.

Solving the node selection issue (Qi, 2012) presented input linguistic parameters: Remaining Power of Sensor (RPS) Sensor Speed (SS) for cluster-head decision. They have considered the moving speed of the sensor thus to predict if the node will leave the cluster. Trust mechanism in WSN sensor node selection is important especially for hostile environments where malicious nodes are well disguised enabling them to attack the whole network using natural transmission over WSN (Mushtaq, 2017).<sup>4</sup>

### **3 Proposed MN Selection Approach**

Following sections describe the monitoring node selection approach proposed based on the data observation and its priority to become a MN.

#### **3.1 MN selection model**

Focus of this study is on network applications where sensor nodes are casually deployed and uninterruptedly observe the surroundings. The data collection is done on the sensor nodes and sent to the base station through cluster heads, base stations are usually situated outside of the ad hoc network.

Sensor node gather data from the atmosphere and send back to its related cluster head through monitor node, or as monitor node to gather data from sensor node and pass it through the rule base and take appropriate actions and after compressing transmit it towards the base location through CH. Assumptions adapted from Lee for this study:

1. Base station and sensor nodes are considered as stationary after deployment.
2. Every node has same energy initially, and the network is considered as homogeneous.
3. Through received signal strength distance can be calculated between two nodes.

Focus of this study is on handling probabilities and uncertainties, for the calculation of possibility of each node to act as Monitor node. As shown in fig 1.0, two inputs for fuzzy inference system (FIS) are the remaining energy (RE) and the projected remaining energy (PRE), and the only output variable is the possibility of a node to be selected as a Monitor Node, named Possibility. The higher possibility shows that the selected node has more probability to act as Monitor Node.

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<sup>4</sup>[www.wikipedia.org/](http://www.wikipedia.org/) wireless sensor networks, intrusion detection system[W].



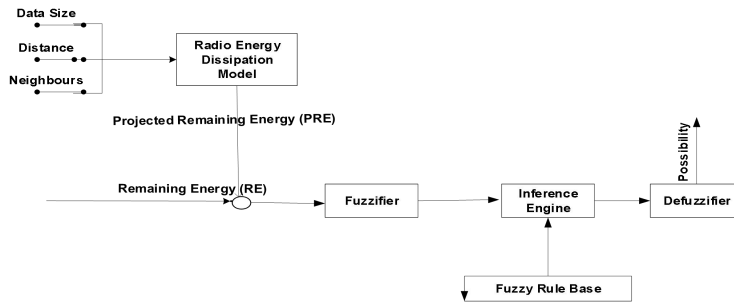


Figure 1 Proposed MN Selection Model Adapted from (Lee, 2012)

### 3.2 Fuzzy Inference System: Handling Uncertainties

In Fuzzy Inference System (FIS) the input variable is named remaining energy's (RE) fuzzy set, in this fuzzy set six different linguistic variables used are high, pretty high, moderate, precisely low, low, and v low. The "trilateral participation function" is assigned for language based parameters as pretty high, moderate, pretty low, low, while "trapezoidal function" is assigned for high and precisely low. Second fuzzy input is projected remaining energy (PRE) of the Monitor Node aspirant and the fuzzy set that elaborate projected remaining energy (PRE). The linguistic variables are high, medium and low for this fuzzy set. A membership function triangular is used for medium, whereas trapezoidal membership function used for high and low. The only fuzzy output is the possibility of a Monitor Node aspirant. To handle uncertainty fuzzy if-then rules mapping for the possibility calculation of node used to act as monitoring node. In all 18 rules for fuzzy mapping are defined based on two input variables as shown in table. The resultant variable possibility can be deduced from these two fuzzy input variables. This fuzzy variable is translated into a single crisp number which we can use generally. In this study, defuzzification is attained through center of area method for possibility. Normally, fuzzy rules can be created from experimental data or heuristic. This study determines "heuristic fuzzy rule generation method" as it has relatively high remaining energy (RE) and high expected remaining energy has higher possibility to become as Monitoring Node.

### 3.3 Dynamic Monitoring Node Selection Algorithm

The WSN have various routing protocols for node selection SPIN, HEED, SAR and LEAC Hare some of the popular routing protocols that vary in the services provided and techniques followed. Out of all these protocols LEACH and HEED are highly efficient protocols (Shio, 2010).

We determine the dynamic monitoring node selection algorithm to be based on LEACH protocol as it is the first cluster based routing protocol that distributes the energy load evenly over the network in a randomized manner. This approach is a first step is "Setup up phase" that returns the collection of MN within the cluster after single time execution at Cluster-IDS

(CIDS). The IDS MN selection has similarities in cluster head (CH) selection.

Accordance with LEACH algorithm standards first step is about calculating energy to direct transmission of node with formula

$$E_{ampk}(3d_1 + d_2)^2$$

Where “d1” is the first sensor node and d2 is the next transmission node

$$T(n) = \frac{P}{1 - P \times (r \bmod P^{-1})} \quad \forall n \in G$$

$$T(n) = 0 \quad \forall n \notin G$$

Here n is a random number between 0 and 1, P is the Monitor Node Possibility and MN that were not present in the completed rounds is denoted as G (set of nodes), If  $n < T(n)$  is true it leads to designate it as a MN. This way algorithm ensures that each node is made MN minimum once that makes it energy efficient. The second step is called “steady phase”, sensor nodes send their data to the monitoring node. The member sensors in each IDS cluster may transfer security data only with the MN via a single hop transmission. The figure 2.0 is not an optimum scenario however the second is better because the MN are spaced out and the network is more properly sectioned.

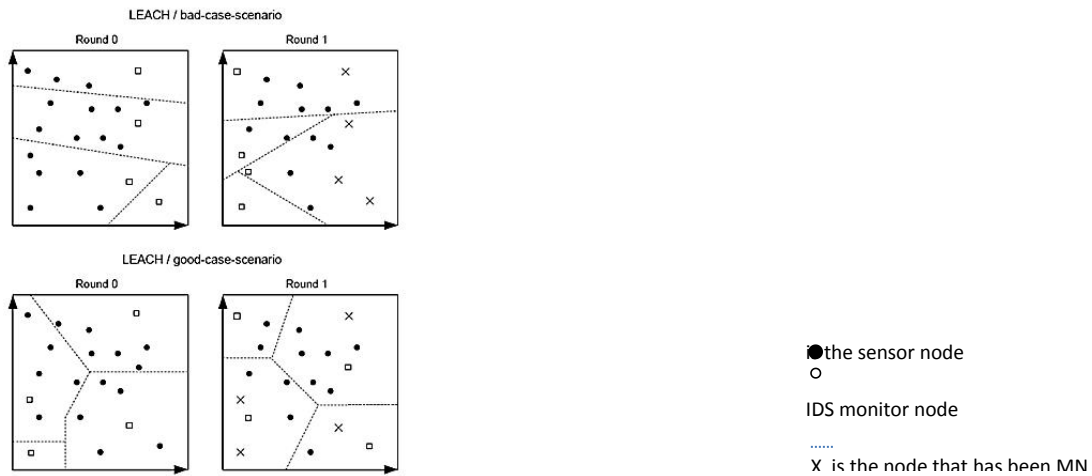


Figure 2 MN Selection Using LEACH Sample Scenario

#### 4 Conclusion

Considering the nature of wireless sensor network applications which are mostly deployed in critical environments such as military application require protection. In this paper monitoring node (node contain light weight IDS) selection problem in the WSN is focused. The paper proposes process of dynamically selecting to be handled by CIDS at different repeating cycles. Further, we suggest an algorithm build inspired from fuzzy logic cluster node selection that takes into account the resources (energy level) of the sensor nodes and

rank its possibility to be a monitoring node. This Approach targets to maintain the collections of all candidates node making it more efficient as the next round of MN selection can be done considering the possibility.

The proposed dynamic IDS monitoring node selection is expected to supplement the overall IDS architecture in WSN. In future research we propose to simulate the process and measure its performance.

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# Exploring the Ethics of Innovation Education in Artificial Intelligence

Wang Xiumei

School of Computer Science and Technology, Wuhan University of Technology, Wuhan, P.R. China,  
430070

(E-mail: 14926500@qq.com)

**Abstract:** Innovation education in artificial intelligence combines the core technology of AI technology and practice of education, integrates innovation education, experience education, project-based learning and other concepts of education, and plays an important role in the New Era in enhancing students skills in research practice, combining science and humanities and developing students' innovative thought and international vision, thus further developing high-level personnel and building the atmosphere of "science & technology prospering education". However, with the technological progress and development of AI technology, human subjectivity has become vague during the implementation of innovation education, and the bias for AI technology in education practice may be intensified, which has raised concern for problems of orientation to education and developing innovative students. Based on the above, this paper summarizes the significance, advantages and existing problems of current innovation education under the background of artificial intelligence through literature research and investigation, and puts forward corresponding thinking. This paper holds that: from the technological perspective, the rapid development of AI technology, along with its advanced nature, instability and its gap from traditional education, has impacted the development of innovation education; from the perspective of subject, the fact that the concept of humans as subject has not been well developed and a lack of morality cultural literacy constitute the major factors; from the perspective of institution, the flawed legal system, regulations and policies, as well as the outdated ethics have resulted in the lack of ground for innovation education in artificial intelligence, and thus have caused various ethical problems. Therefore, supervision and protection of technology, strengthened international exchange & cooperation and scientific innovation are necessary in the sense of technology; ideas of humanities shall be integrated into AI technology; in terms of subjects, the participants shall enhance their sense of moral responsibility and moral & cultural literacy, and hold a clear sense of subject; from the institutional point of view, the sound legal system shall be established with relative ethic principles and regulations made, thus constructing the moral ethics that correspond the innovation education in artificial intelligence.

**Key words:** Artificial intelligence; Innovation education; Ethic exploration; Embedded values

## 1 Introduction

The cultivation of students is the common concern of the society. Using artificial intelligence technology to carry out innovative education is gradually moving towards colleges and society. On May 16, 2019, International Conference on Artificial Intelligence and Education was held in Beijing, and President Xi Jinping sent a congratulatory letter to the conference, noting that artificial intelligence (AI technology) is an important driving force to lead the new round of technological revolution and industrial transformation, which is now deeply changing people's way of production, life and study. Meanwhile, it pushes human society to embrace the smart era of humans - machine synergy, cross-industry integration, joint creation and sharing and it is an important mission for education to follow the

trend of global AI technology development, find and focus on the point of breakthrough, and foster ranks of high-level personnel in this regard who have both creative capabilities and teamwork spirit. An article on Guangming Online also notes that AI technology drives a new round of technological revolution, industrial revolution and social progress, and is changing people's way of study, production and life everyday subtly and directly, which imposes both opportunities and challenges on us. For us, promoting AI technology education is our responsibility and mission (Guangming Online, 2019). Nowadays AI technology + big data in education have been implemented in various pilot cities, and education institutes have already shared the dividend of education in AI technology. On one hand, it enables teachers to prepare for better-directed and more efficient classes, and releases them from heavy work on examination papers so that they could have more time and energy to improve their teaching. On the other hand, AI technology-empowered study could expand student's time and space for study, so that it could be anytime and anywhere. High-fidelity simulation could visualize the concepts difficult to understand and make abstract process figurative, improving students' understanding and application of knowledge. Various smart technologies can pave the way for students for links to vast information, thus making vast resources accessible and illuminating real problems and data for students. Visual technology could connect different human associations of shared-interests, such as teachers, students, parents and experts, promote mutual assistance and study, provides tools and frameworks of study, help students in representation, organization, construction, sharing, management, expression and reflection on knowledge, and thus enhance their learning capacities.

Introducing artificial intelligence tools to assist innovation education could strengthen the building of smart learning environment, help students adapt to such environment, and enhance their customized study with the smart technology, which follows the new requirement for educational method, educational concept and talents under the background of the current scientific and technological revolution. Meanwhile, it is of great significance to focus on ethics & morality education in the development of artificial intelligence, aware of both sides of technological development and discusses how to play the positive role to promote innovation education better serve students' whole process growing up in the context of artificial intelligence.

## **2 Difficulties in Innovation Education in Artificial Intelligence**

It is a long process to put forward the concept of artificial intelligence and then to enrich it. It was first invented by John McCarthy in 1956, and through the implementation. Nowadays, it commonly defined by the academics as an emerging science, the theory, method, technology and applied system of extension, simulation and expansion human intelligence.

### **2.1 The subjectivity researches of AI technology**

Researches on the ethics of AI technology are mainly conducted from subjectivity. ZHAO Yunfeng holds in Artificial Intelligence Shall not be the Subject of Criminal Liabilities that artificial intelligence is machine in essence that exerts the intention of humans, and thus as machine without emotion shall not be treated as subjects of liabilities (Zhao Yunfeng, 2019). Yet CHEN Quansi expresses different view in The Tortuous Liability and Fixation System of Artificial Intelligence that AI technology could make decisions and judgments on its own with the fact that the humanoid robot Sophia has obtained the Saudi Arabian citizenship, and thus as to any tortuous behaviors by AI technology, the liabilities shall come to the users, producers, managers and AI technology itself (Chen Quansi, Zhang Hao, Luan Qun, 2019). Meanwhile Nick BOSTROM points out in Superintelligence: Paths, Dangers, Strategies that orthogonality of goals are the cause of ethical problems of AI technology, namely the goals and methods

of AI technology are mutually independent and any algorithm (whether ethical or not) might be used to achieve the goals (Bostrom N, 2014).

## **2.2 The solution to ethical problems of AI technology**

On the solution to ethical problems of artificial intelligence, researchers are paying more attention to the guiding role of technological ethics and emphasizing the boundaries of artificial intelligence. CAO Jianfeng points out in *Urgent for In-Depth Research in Ethics of Artificial Intelligence* that development of artificial intelligence shall be guided by ethics of science, or researches for evil purposes would be inevitable, such as the genome-edited babies, so while promoting the cross-discipline cooperation, we should strengthen the research in ethics to guide technological development for good purposes (Cao Jianfeng, 2019). DANG Jiayu believes in *Research on the Ethical and Legal Risk of Artificial Intelligence* that while AI technology has promoted the network of information technology, it has also blurred the line between physical reality, numbers and individuals, and also spawned many complex legal and ethical problems, and therefore AI technology development must follow three principles: 1 to guarantee the security of human beings and pursuit public interests; 2 to be transparent and traceable; 3 to respect the individual privacy (Dang Jiayu, 2017). Wendell WALLACH asserts in his work *Moral Machines: Teaching Robots Right from Wrong* that in the near future, the ethical aspect of algorithm will be determined by the values embedded by engineers to the system, yet they have not decided how to embed them into their products, so the group of moral agents could be enlarged to include not only humans but also AI technology systems, namely the autonomous moral agents (Wendell Wallach, 2017). Once the design of AMAs is completed, it will be more convenient to morally guide smart robots. He also mentions that though AMAs can help manage the ethical behaviors of algorithm machine, the vital problems of embedded value have not yet been solved. Frodo PODSCHWADEK analyzes AMAs in *Do Androids Dream of Normative Endorsement? On the Fallibility of Artificial Moral Agents* and he believes that the faults of ethics of AMAs are different from those of humans, as they result from the flawed moral system (Podschwadek F. Do androids dream of normative endorsement? On the fallibility of artificial moral agents [J]. *Artificial Intelligence & Law*, 2017). He asserts that such faults could be avoided by real-time embedding ethic principles and accepting that AMAs could sometimes ignore the ethical guide, yet such measures might also turn good behaviors into bad ones.

From previous research, we can find that under the background of advancing the artificial intelligence, innovation education at the same time has its concern. Scholars have not come to a clear conclusion on whether artificial intelligence could be agents of liabilities and are still discussing and exploring the final methods of ethical problems of artificial intelligence. Targeting these two points, this paper also puts forward the ethical discussion of innovative education in the context of artificial intelligence.

## **3 Strengthening the Construction of Morality to Avoid the Risks of Lack of subjectivity**

### **3.1 The matter of human subjectivity in AI**

As to the matter of human subjectivity in artificial intelligence, this paper believes that from the perspective of human-technology relation, humans as subject can research on and reform technology, while technology as object has been improved and works as the effective tool to achieve the goals of humans. By pushing the progress of science and technology, humans have improved their livelihood and achieved happiness. However, the industrialization resulting from technological development has

restricted our performance of human agency in social production, and the coming smart age makes human labour being replaced by robots to a large extent. With the application of AI technology replacing humans for certain AI technology tasks, such automation and smart age have emancipated production capacity but also raised concerns for human unemployment. Meanwhile we found that new jobs are also coming out which are more demanding (Guangming Online, 2019). Just as Herbert MARCUSE put it, humans exist under the control of technology and society, and individuals are gradually assimilated in the social environment, resulting in the impacted subjectivity (Herbert Marcuse, 2008). With the technological progress, AI technology has been improving mentally and physically, and humans are being controlled by machines. Some smart robots can even make moral choices on its own, which indicates the enhanced subjectivity of AI technology. However, the existing ethical problems of AI technology are inevitable. The fundamental task of education is to cultivate people, human beings should always play the dominant role in its relation with AI technology in education industry, and make use of human agency, individual choice and interpersonal differences, thus properly controlling AI technology rather than being controlled.

### **3.2 The solution to avoid the ethical risks of AI**

To avoid the ethical risks of AI technology, measures shall be taken from the rational perspectives of function designers, subjects and objects of education, so that AI technology could be properly applied and thus benefits human beings who should never become totally dependent on the technology. The research & development of AI technology must always serve humans and be considered from human desires, so the ideas of humanism should be integrated into artificial intelligence. Albert EINSTEIN once remarked on science and technology that it completely depends on human beings rather than tools how it is being used and whether it brings happiness or disaster to humans (Albert Einstein, 1978). The ethical problems of AI technology are largely related to the moral pursuit of developers and users. AI products in the daily life are figurative outcome of technology and reflect human wisdom. Human-machine relation is still the relation between human beings and objects, yet it could reflect interpersonal relations. Education practitioners and education audiences should also clarify the primary and secondary relationship between education content and education methods, reasonably locate the role of artificial intelligence in long-term education activities, organically combine various methods, give full play to the assisted role of artificial intelligence tools, and use artificial intelligence technology to help the educated better understand the world and change the world. Human potential of value creation could be tapped by artificial intelligence technology, which frees humans from physical labour so that we could further perfect and promote ourselves, which is the meaning of human-technology relation in the real life.

## **4 Embedding Values to Block the Direction towards Intensified Bias**

### **4.1 The value orientation of algorithm**

In the beginning of AI product design and education, the objects of education might be directed towards intensified bias and thus be limited to the previous stereotype. Some scholars simply compare algorithm to tools and hold that the influence of it on people actually derives from themselves, while algorithm as tools does not imply any value, so when seeking for the solution to ethical problems of algorithm, we only need to discuss from the moral agents rather than embedded value. To them, algorithm does not involve value, and technology could not be categorized as good or evil. In this sense, all that needs for discussion is whether it could achieve the goals of users, and whatever the goals are, technology itself shall not be labeled good or evil. These scholars further believe that algorithm is in essence certain technology, and thus remains neutral while being applied in big data or AI technology. Therefore, people only need to be concerned with whether it has fulfilled its function of dealing with



and using data, or whether the design of driverless cars is flawless. Algorithm frees people from natural limits and enables them to accomplish what they were not able to do. After the big data technology was invented, people began to use it, and therefore algorithm further expanded the scope of human activities and provided people of more choices. Consequently, behaviours guided by different values emerge, which shows that algorithm also has its value orientation.

#### **4.2 The way to block the direction towards intensified bias**

Blocking the direction of intensified bias from the source of developers is of great significance to the formation of the starting point of innovation education under the background of artificial intelligence. In order to block the direction towards intensified bias, embedded value based on consequentialism, namely value sensitive design, which emphasizes more the control of algorithm result, i.e. it will adjust the embedded value according to the result of the algorithm whatever good or evil. The first step is to collect the behavioral data of all the algorithms, rate them and classify them by values; then the algorithm will be improved based on the values of behaviors, and praise and promote the algorithm that results in good behaviors while ban those resulting in evil ones; finally all the algorithms resulting in good behaviors will be concluded for the ethic standard which will be included in the algorithm as the code of conduction. To regulate algorithm by embedding values, we should focus on the ethics themselves, but still we cannot guarantee the standards could cover all the ethic problems. Therefore, problems of algorithm discrimination and unfairness remain to be explored for solution by embedding algorithm.

### **5 Conclusion**

Artificial intelligence is a very important aspect in today's information society, and AI education is indispensable nowadays when "morality education" is emphasized in advanced education, information technology is being popularized among students and the sense of IT application being enhanced. The sound AI education relates to the equal, proper, and lifelong education for individuals, as well as their competitiveness in the future and national talent strategy. As an emerging industry, artificial intelligence is more and more closely connected with human life. By now AI technology has achieved highly self-adaptive nature, self-learning and self-analysis. The development of AI technology has brought more bonuses of development of human and human society. But while enjoying those bonuses from technological progress, we should be careful not to be dependent on it, and always check the flaws so that the problems could be found and solved. The development of AI technology has been generally progressive, but each coin has two sides. If properly applied, it will be infinitely beneficial, otherwise the unprecedented crisis might be caused. In any case, AI technology is meant to serve human beings, and if humans cannot take charge of its development, the results might be unpredictable. Therefore, reasonable regulations and restrictions must be carried out.

Undoubtedly the history of AI technology, from its emergence to education, and then to our daily life, is a process of gradual progress, during which we should base on human ethics and reflect on it so that we will not be dissimilated by the technology but properly development and apply it. This is essentially the matter between humans.

Widespread entrepreneurship and innovation are the trend of the time, and thus colleges and universities have already get prepared ahead of time by introducing innovation and entrepreneurship education. Artificial intelligence - assisted innovation education could actively enhance college students' information literacy and innovation capability, so as to meet the needs and promote the development of The Times. The constant maturity of artificial intelligence needs the injection of

humanistic spirit. This is the point of the article. Based on ethics, this paper holds the “people oriented” idea and explains the possible ethic problems involved in the popularization and application of AI technology to innovation education, analyzes the reasons and raises the countermeasures and solutions, thus providing suggestions how AI technology better fits innovation education and further develop personnel in this regard.

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# Prospect for the Development of Artificial Intelligence in the Core Business of Libraries

Yuan Xueqing, Liu Lin

Library, Wuhan University of Technology, Wuhan, P.R. China, 430070

(E-mail: vvfl@qq.com, 19582560@qq.com)

**Abstract:** The era of Artificial Intelligence is coming. The relationship between Artificial Intelligence and each of us is becoming more and more intimate, and it constantly challenges our perception and cognitive limits. It will also bring new changes to all aspects of the library field. This paper combines development of Artificial Intelligence and the status quo of Artificial Intelligence in the field of libraries to analysis the prospect of Artificial Intelligence in the future development of the core business of libraries. It may provide academic discussion to promote the library to become a more important education center and cultural center.

**Keywords:** Artificial intelligence; Library; Core business; Prospect

## 1 Introduction

### 1.1 Background Information

Artificial Intelligence (AI), from the concept of "Artificial Intelligence" at the 1956 Dartmouth conference, to the "deep blue" draw chess champion Kasparov in 1997, and the AlphaGo victory over Go World champion- KeJie in 2017, Artificial Intelligence technology has entered a new stage after 60 years of development, which has aroused widespread concern of Artificial Intelligence in the whole society, making it an important driving force for global technological innovation and social transformation. Various fields are experiencing the baptism of Artificial Intelligence technology.

The "Guidelines on Actively Promoting Internet + Actions" issued by the State Council in July 2015 and the "13th Five-Year Plan Outline" issued in March 2016 all proposed to vigorously develop Artificial Intelligence. In 2017, it was written in The Government Work Report, and in July of that year, promulgated the "New Generation Artificial Intelligence Development Plan of the State Council", whereby Artificial Intelligence entered a stage of substantive development in China.

### 1.2 Literature Review

I reviewed the literature on the application of Artificial Intelligence in library in recent years. In the full text database of CNKI, I have retrieved 680 articles on the topics of "Artificial Intelligence" and "library". After the advanced retrieval, 130 papers with high correlation were obtained after eliminating duplicate and irrelevant papers. As early as 1985, scholar Xie Yuantai mentioned the application of Artificial Intelligence in libraries (Xie Yuantai, 1985). In terms of the distribution of authors, except Zhang Xingwang, Jiang Kang, Yin Hanxiong and Ren Shuoshi, who have published 2-3 papers, other authors have published 1 paper. They have not yet become the core author in the field.

Combined with the publication trend and specific research content, the application research of

Artificial Intelligence in library can be roughly divided into four stages. The first stage: from 1985 to 2000, the annual publication volume was less than 4 articles. The research in this stage mainly discusses the subject characteristics of Artificial Intelligence and the application of new technology in library, which is the enlightenment stage of the application of Artificial Intelligence in library. The second stage: from 2001 to 2010, the annual publication volume generally shows a steady growth trend, mainly discusses the application of Artificial Intelligence technology in digital library, which belongs to the preliminary development stage. The third stage: from 2011 to 2016, the annual number of published papers is stable, which is a stable development stage. It mainly studies more deeply some specific technologies such as intelligent retrieval technology and data mining technology, and continues to introduce the newly developed application of Artificial Intelligence technology in the library. The fourth stage: the publication volume increased sharply in 2017, which is a rapid development stage. The main research contents in this period are information resource construction, intelligent retrieval, personalized service, barrier-free reading, application of Artificial Intelligence in intelligent library, etc.

The research of Artificial Intelligence technology in library has the following characteristics: the research subject changes from traditional library to digital library, and then develops into Smart Library and even Intelligent Library. Research contents have been focused on intelligent retrieval, ontology, data mining, model construction, text classification, resource construction, personalized service, etc. The research features are obvious stages, strong technicality, wide research scope and strong continuity. The research direction shows the characteristics of emphasizing technology and neglecting humanities (Wang Shengang et al., 2018), most articles are about Artificial Intelligence, few articles mentioned how libraries view the development of Artificial Intelligence and how librarians should deal with the development of Artificial Intelligence.

## 2 Cognition of AI

### 2.1 Development stage of AI

The development of AI is divided into three phases (Warwick, 2011):

- 1) Machine learning phase - intelligent system uses a series of algorithms to learn from experience;
- 2) Machine intelligence phase - the machine uses a series of advanced algorithms to learn from experience (such as deep nerve Network), some areas of AI have now progressed to this second stage;
- 3) Machine awareness stage - it can learn from experience without external data.

Accordingly, AI research is divided into three types:

- 1) Narrow AI or Weak AI - which can perform and complete basic, role-based tasks, such as tasks performed by chat bots and personal assistants, e.g. Apple's Siri;
- 2) General AI or Strong AI - it can perform and complete human level tasks. It involves continuous learning of the machine, e.g. Tesla's self-driving car, and then Google's Alpha dog is the first to defeat the human profession Go players, the first AI program to defeat the world champion of Go, its main working principle is "deep learning";
- 3) Super AI - Super AI machine is much smarter than the most intelligent human brain in almost all fields, including science Innovation, general knowledge and social skills.

## 2.2 Concepts and characteristics of AI

AI technology is a kind of science and technology that computer system can reason, learn and solve problems according to people's thinking and behavior.

AI technology presents new features such as deep learning, cross-border integration, human-machine collaboration, group openness, and autonomous control<sup>5</sup>.

## 2.3 Importance of AI in the development of library

In the literature review of the IFLA Trend Report, AI is listed as one of the four major technology trends, and it is proposed that there are three main aspects of the impact of AI on the future of the library<sup>6</sup>:

- 1) The whole new beyond search Browser and the semantic analysis of web content;
- 2) Integrated speech recognition, machine translation, and speech synthesis to support real-time multi-language translation;
- 3) Cloud service crowdsourcing translation and recognition of diverse and complex web content.

In addition, the American Library Association's Top 10 news in 2016 also ranked the development of AI as the fifth place<sup>7</sup>. This shows that AI has entered the agenda of library development.

## 3 Application of AI in the Field of library

### 3.1 Application technology

With the formation and promotion of the information technology ecosystem represented by mobile Internet, big data, cloud computing, and the Internet of Things, especially the widespread application of big data and the rapid improvement of computer computing capabilities, AI technology is developing rapidly, it also contributed to the development and innovation of technologies such as big data, cloud computing, and the Internet of Things. At present, from the perspective of application and research, AI mainly focuses on the following areas: machine learning, problem solving, logical inference, neural network, natural language processing recognition, robot, and intelligent retrieval and so on.

In general, the form of AI applied to libraries is mainly reflected in the two aspects of Subjectivity and Assistive. Subjectivity refers to intelligent tools built and developed based on AI technology, for example, intelligent retrieval systems for library applications, intelligent consulting systems, user evaluation systems, etc.. Assistive means that AI is embedded into other systems, tools or programs as a assistive technology to realize some functions of the system, tools or programs, such as the user's adaptive learning system, the information literacy training system, the system supporting the library decision-making, and the library performance evaluation system.

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<sup>5</sup> Notice of the State Council on Printing and Distributing a New Generation of Artificial Intelligence Development Plan [EB/OL] .[2017-11-22].[http://www.gov.cn/zhengce/content/2017-07/20/content\\_5211996.htm](http://www.gov.cn/zhengce/content/2017-07/20/content_5211996.htm)

<sup>6</sup> IFLA. Technological Trends [EB/OL] . [2017-08-18] .<https://trends.ifla.org/literature-review/technological-trends>.

<sup>7</sup>ALA. Ten Stories That Shaped 2016 [EB/OL] . [2016-12-15] .[http://lisnews.org/ten\\_stories\\_that\\_shaped\\_2016](http://lisnews.org/ten_stories_that_shaped_2016).

### 3.2 Application status

In fact, AI technology has long entered the field of library and information. From the early bibliographic retrieval system to the full-text retrieval of electronic documents, the essence of information retrieval embodies AI. Without intelligent retrieval, it is not thorough retrieval. Nowadays, information retrieval has become more and more intelligent, and it is getting closer to the needs of searchers. At the same time, more and more relevant information is associated with it. It is AI technology that gives this kind of learning ability.

Research and application of AI in the field of libraries have long focused on several branch technologies of AI, such as expert systems, pattern recognition, natural language processing, robotics, machine learning, and some or several related fields in the library including information retrieval and cataloging, classification, book selection, procurement, subscription, circulation, reference consulting and library automation applications. Basically, the concept of AI and these branch technologies was combined with the latest computer technology at the time to design and develop some new systems or experimental models for libraries. Some models and systems have been continuously researched, improved, developed and commercialized. In recent years, with the development of AI technology and computer technology, AI research and application in the field of libraries has begun to get involved in strong AI technologies such as biometrics, intelligent chat robots, artificial neural networks, and deep learning.

There are already many successful cases in which libraries use AI. For example, two students from Aberystwyth University in the UK have developed a directory query and location-guided robot to provide readers with enquiries and guidance services for the library's 800,000 collections<sup>8</sup>. The Westport Library in Connecticut, USA introduced robots to provide information service to readers from September 2014<sup>9</sup>.

### 3.3 Problems

Although library academics and industry have given high expectations to AI's library applications, AI technology itself is constantly evolving and changing, and AI's library application is still in its infancy. From the current situation, the main problem faced by the AI library application is the lack of integrity, showing obvious fragmentation and dispersion.

First of all, AI research and application mainly focus on a specific field of library management and service (such as personalized consulting solution system and smart inventory robot), but neglected the improvement of users' technological literacy (the ability to recognize and use AI)

Secondly, The AI library application scenario is mainly limited to a certain activity of the library, such as intelligent retrieval system, intelligent library decision support system. In fact, such research is still in the scope and field of previous research.

In the end, the existing AI focuses more on a single application of the library, but does not pay enough attention to the training of readers and special group services, and does not play its due role and effect. In general, the scope of current library application AI is not wide enough, and a set of extensive, efficient, and systematic application systems has not yet been established and formed.

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<sup>8</sup>Pasi William Sachiti and Ariel Ladegard. Meet Hugh, the robot librarian [EB/OL] . [2016-02-26] .<https://www.aber.ac.uk/en/news/archive/2016/02/title-181095-en.html>.

<sup>9</sup>Westport Library. Robotics at the Library [EB/OL] . [2017-03-22] .<http://westportlibrary.org/about/news/robotics-library>.

## **4 Development Prospects of AI for the Core Business of the Library**

For libraries, basic business needs revolve around resource construction and reader service. No matter how modern technology develops and to what extent, these two aspects are always at the core of the library business (Yuan Xueqing,2016).

### **4.1 Information resource construction**

#### 4.1.1 Intelligent book purchase

Libraries and users, publishers, booksellers, resources, electric power business, logistics, etc. based on the Internet for the connection of business, data sharing. AI can accurately analyze user needs based on big data, assist librarians to accurately purchase paper and online Electronic literature resources, and then automatically complete ordering business management, acceptance registration, fund management, resource gift exchange and statistical analysis related to resource construction.

#### 4.1.2 Intelligent document organization

AI can automatically perform document cataloging and checking, cataloging, cataloging query, exporting catalog products and cataloging statistics according to machine-readable catalogue standards and related specifications. Based on the metadata center, standardized database and other automatic identification acquisition, update MARC, DC and other metadata, the library can automatically import OPAC, to provide uniform metadata management and resource discovery services for paper documents and electronic resources. Intelligent technologies such as image recognition, speech recognition, machine translation and natural language processing can be used to organize the knowledge content in the literature, such as intelligent semantic indexing, intelligent abstracting, subject navigation and knowledge base construction. Knowledge computing engine technology can realize the automatic acquisition of knowledge, capable of concept recognition, entity discovery, attribute prediction, knowledge evolution modeling and relationship mining, and form multi-source, multi-discipline and multi-data type cross-media knowledge mapping.

Libraries can learn from the experience of Google and Baidu, use the technology of knowledge computing engine to extract knowledge from the collection resources and Internet information, and build a knowledge network with its own characteristics through semantic organization and mining.

#### 4.1.3 Intelligent document management

In the management of the library, it is possible to realize the whole process unmanned book library, from the paper documents into the library, put on shelves, sort and locate, take books, and the whole frame and inventory, all of which are identified and automatically operated by the robot. It can realize the whole process and the whole system intelligent and unmanned. The intelligent analysis which based on big data can realize the intelligent sub-library and reasonable layout of collections. It can also realize real-time monitoring and intelligent early warning.

### **4.2 Reader service**

#### 4.2.1 Intelligent service inside the library

AI can be based on image recognition, speech recognition technology to assist the library intelligent user identity authentication and management. It also includes navigation, seat-selection,

retrieval, and borrowing/returning. The intelligent consulting robot system is used to carry out reference and knowledge consultation based on natural language understanding in the library to enhance the level of interaction with users. It can carry out intelligent express literature service outside the library and extend the scope of services.

#### 4.2.2 Intelligent service outside the library

It can integrate scattered and heterogeneous digital resources, realize semantic retrieval based on intelligent technologies such as voice, picture and natural language understanding, and provide personalized search in combination with user based on big data analysis.

It can be integrated with paper collection resource retrieval system and external library resource retrieval system to provide unified retrieval service. Based on dynamic big data analysis, users' demands and behavioral characteristics of the library can be mined, and digital resources can be reorganized and aggregated by means of intelligent knowledge organization technology. Carry out multi-dimensional personalized customization (subscription) services and personalized push services for different user groups to improve the accuracy of digital library services and user satisfaction. Mobile Internet, Internet of things and other technologies can be used to develop intelligent perceptive reading services outside the library, providing knowledge services based on the real-time situation of users.

According to the literacy level of different users, we can provide personalized intelligent education programs, and carry out multi-literacy online education for all kinds of users. It can gather library resource data, service data, user behavior data, system log data and other data to set up library big data center, extract user portrait and resource characteristics through data intelligent analysis, and provide accurate information retrieval and recommendation, comprehensive analysis and evaluation and other services.

Data interface can be developed to facilitate the application development of other institutions and individuals; Based on existing resources and intelligent organization and analysis technology to make knowledge mining and production, thematic analysis, intelligence analysis, etc..

## 5 Conclusion

By combining the development of AI and the analysis of the current situation of AI in the field of library, this paper looks forward to the development of AI in the future of library core business, the prospect of resource construction and reader service namely. In the intelligent construction of information resources, including intelligent interview, intelligent document organization, intelligent document management, etc., and in the intelligent service of readers, including intelligent inside and outside library services, etc., to promote the library becomes more important academic centers and cultural centers provide academic research.

From the perspective of library function, like other technologies used in library applications, the purpose of AI library application is still to focus on libraries and users, both to improve library performance, to promote user development, and to realize the value of libraries. The value goal of the library determines the direction and method of application of the AI, and the core of the successful use of the AI is still the wisdom of the librarian. By analyzing the historical process of library technology, it can be seen that technology will never replace real person. Even if the library uses a large number of



intelligent robots in the future, it will not shake the librarian's dominant position. Otherwise, the library will deviate from its essence.

The development of Artificial Intelligence will also change the employment pattern of librarians and the redivision of their operational modules. The importance of librarians gaining competence through experience will gradually decline, and the urgency of developing new core skills is growing, especially in the human-machine symbiosis environment, the accomplishment demand of complementary ability with Artificial Intelligence machine is prominently. Librarians should pay more attention to the emotional communication with readers, strengthen the connection with readers through various ways, optimize their own work and business model, enhance the innovation ability, make the library move forward in the new business model.

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# Construction and Management of MOOCs Platforms for Business English Translation Course

Tang Lijun

School of Foreign Languages, Guizhou University of Finance and Economics,

Guiyang, P.R. China, 550025

(E-mail: 183849791@qq.com)

**Abstract:** The reform of College English teaching in China, especially business English translation teaching, should grasp the historical opportunity of the current MOOCs education trend sweeping the whole world. We can take MOOCs online learning as a platform to vigorously deepen the reform of business English translation teaching with the core of improving business English translation skills. We should take an effective series of measures to promote the combination of business English translation theory and practice, such as strengthening the construction of MOOCs platforms for business English translation course, changing learners' concepts, improving the quality of educators and actively responding to the impact of MOOCs on business English translation classroom. Moreover, we can further upgrade the overall improvement of Chinese higher education, promote "going out" strategy of Chinese culture and enhance the soft power of Chinese culture.

**Key words:** MOOCs platform; Business English; Translation course; The curriculum reform

## 1 Introduction

In the past some years, MOOCs have entered the mainstream of educational sources via the establishment of several high-profile MOOCs platforms, such as primarily Coursera, EdX, and Udacity etc., offering free courses from a range of elite universities and receiving a great deal of media attention (Daniel, 2012). 2012 has been referred to as 'the year of the MOOC' (Siemens, 2012). Later, many elite universities all over the world are joining this "smoke-free" education revolution, and MOOCs have showed blowout growth. China's first MOOCs platform, *TopU.com*, founded by Educational Science and Technology Group, was created in October 2012. Tsinghua University and Peking University joined EdX platform, and Shanghai Jiao tong University and Fudan University joined Coursera platform in 2013. And the MOOCs self-study room of Guokr.com was changed to *MOOC College*, and *Coursera Zone* operated by NetEase Corporation was officially established, Xuetangx.com, developed by Tsinghua University and based on EdX source code, was successfully launched online in 2013. Later CNMOOC independently developed by Shanghai Jiao tong University was officially launched, and *MOOCs of Chinese Universities* developed by Love Course Network and NetEase Cloud Classroom, was launched in 2014, marking the MOOCs time in China's higher education circle.

There are various studies on MOOCs and related teaching modes and reforms both at home and abroad. Some scholars explored different dimensions of MOOCs, such as the changing roles of the professor (instructor) and learners on MOOCs (Cormier & Siemens 2010; Masters 2011); the benefits and requirements of MOOCs in practice (Koller, Ng, Do & Chen 2013; Emanuel 2013); the discussion specific problems and proposed effective methods, such as student retention, feedback (Singh, Gulwani, Solar-Lezama 2013; Clow 2013; Lewin 2013); the evaluation of learning effects on MOOCs platform

(Li, Link, Ma, et al. 2014). From the above studies, the achievement on MOOCs are plentiful with few studies on constructing and managing MOOCs platform. So this paper tries to explore the construction and management of MOOCs platform in China.

## **2 Analysis of MOOC Platform Construction Model for College English Translation Course in China**

### **2.1 Major current teaching model of college English translation course**

Every reform in the history of educational development has always brought about the reorganization and reconstruction of various educational elements. MOOCs, which are deeply shaking the foundation of China's education development, bring positive development opportunities to Chinese education. On the other hand, they also bring severe challenges to Chinese universities, especially ordinary colleges and universities. It has become an important issue for Chinese universities on how to effectively build MOOCs platform and accelerate integration into this MOOCs wave. Just as some researchers have said, the development and application of MOOCs platform will actively promote domestic universities to improve their curriculum quality and explore innovations in university teaching modes (Lu Fang, 2013). Even some researchers believe that online courses will promote universities to speed up educational reform and improve their teaching quality, otherwise our universities will easily degenerate into the teaching laboratory and guidance classroom of the first-class university (Du Yang, 2013). However, no matter how MOOCs develop in the future, it's their fundamental aims are to develop and share high-quality curriculum resources. Only by adhering to the aim of high-quality curriculum development, responding positively and participating in the construction of MOOCs platform, can we master the discourse initiative and effectively integrate into the development process of MOOCs in this educational revolution.

For a long time, the teaching mode of College English translation course in our country has based on the behaviorism theory---- the teaching process of demonstration (stimulation) - imitation (reaction) - repetition (reinforcement). Although this teaching mode is beneficial to learners' reinforcement of words, sentence patterns and phrases, it neglects learners' emotional cognition and transformation between the two languages. And it separates the relationship between teaching, learning and translation, so it is impossible for learners to apply translation theories and skills flexibly to specific translation practices and discourse situations, which can not achieve unexpected translation effects with too profound theoretical studies. Later, the translation teaching mode are based on the theory of constructivism to break through the teaching dilemma of overemphasizing theory or skills. The constructivist theory holds that students are required to construct mathematical knowledge actively in their minds by exploring, discussing and other different methods in the whole learning process to give full play to the subjective initiative of students. In the process of meaningful construction of knowledge, students' abilities of analyzing, solving and creative thinking have also been trained.

In our view, the translation teaching mode based on the constructivist theory breaks through the shortcomings of the teaching mode based on behaviorist theory, emphasizing the learner's practice, it aims at requiring learners to transcend the stage of imitation and reinforcement so as to construct the practical stage of translation on the basis of mastering translation theory, rules and techniques. In this way can learners truly appreciate the integrity of the whole translation process, and the real purpose of translation teaching can be achieved. In a sense, constructivism perfects the limitations of behaviorism, that is, it constructs the integrity of translation teaching from the theoretical stage to the practical stage, and achieves the ultimate goal of education. However, from the process of educational activities, the

process of education is a two-way interaction processes between learners and educators with particular emphasis on the interaction and feedback between the two sides. Therefore, there are still drawbacks in the translation teaching modes based on these two theories. In today's mobile Internet era, it is imperative to give full play to the advantages of Internet plus to constantly improve the translation ability of learners through online and offline learning. So, it is important to make full use of Internet and MOOC platform in the translation course to facilitate the learner's translation competence and efficiency.

## 2.2 Overview of the construction of MOOCs platform for English translation in China

Currently, there are two main types of English translation courses on MOOCs platform in China, namely general education courses and professional courses. General education courses mainly include *Listening and Speaking of Daily English* (Tsinghua University), *General Course of College English Self-study* (Beijing University of Science and Technology), and *College (Oral) English* (National University of Defense Technology), and so on. These courses are mainly for all English learners in the world with the characteristics of large-scale opening and low assessment requirements. On the other hand, *Principles and Practice of Computer-Aided Translation* by Yu Jingsong in Peking University, a type of professional course, is suitable for MTI students, advanced undergraduates majoring in foreign languages, translators and learners of foreign language. Course contents include various aspects of translation, such as information and translation technology, Internet search engine or information service and translation practice, corpus and translation research, e-book dictionary, reference book and translation practice, translation memory research, practice on translation memory software, terminology management in translation practice, practice on computer-aided translation software project, translation service, localization service and quality control, introduction to machine translation and localization engineering, the systematical explanation of the principles and practices of computer-aided translation, etc.

With the high attention and rapid development of MOOCs in China, more and more MOOC network platforms are constantly emerging. At present, the main MOOC platforms in China are as follows:

**Table 1 The Main MOOCs Platforms in China**

Platforms	Theme	Founders
MOOCs of Chinese Universities	let every user who has the desire to improve learn the courses of the best schools in China	NetEase, Higher Education Press
CLMM-TVET	policy consultation, information exchange, etc. for micro-courses in vocational education	Tongji University
NetEase Open Course	disseminate the knowledge and wisdom of all mankind	NetEase
Hujiang Community	make education fairer through Internet and build the ecosystem of Internet education	Hujiang Network
MOOCs College	Discover excellent online lessons in the world	Guoke Network
Xuetang Online	make MOOC study serve the practical purpose.	Tsinghua University
GLR	Promote fairness in education, explore educational innovation and help young people to find	Guo Laren Education and technology Group

	employment	
Chinese MOOCs	collect excellent courses to benefit Chinese all over the world	Peking University and Alibaba Group
CNMOOC	let everyone go to the best university	MOOC Research Institute of Shanghai Jiaotong University
Ewant Network Platform	let all Chinese enjoy free access to high-quality educational resources and free lifelong education	Five Jiaotong Universities on both sides
Wisdom Tree	realize student-centered discussion of online autonomous learning, cross-university classroom live interaction, credit certification and degree support	Shanghai Excellent Ruixin Digital Technology Co., Ltd.
UOOC Alliance	Constructing large-scale open online courses to provide course learning choices and services for League college students and social learners	local universities under the advocacy of Shenzhen University

Source: Collecting Internet data

At present, online education platforms in China are growing throughout the current construction of major MOOCs platforms, but there exists the following problems. Firstly, each platform has its own system and interface, so the functions are different. And the platform is mainly composed of micro-lesson video, document, in-class test, discussion, final examination and other modules with few activities designed for students to participate in (Ji Fujun, Li Licong 2014). Secondly, there are some shortcomings in various platforms, such as single curriculum, few online courses and low utilization, which cannot provide effective services and public sharing for learners (Hu Quintai, Lin Xiaofan 2015). Last, these platforms generally lack feedback mechanism of learning effect and intervention function after learning. Furthermore, interaction function of some MOOCs platforms are weak, their curriculum content and interaction system are separated with few test questions of many courses (Wang Yingjie, Feng Ze, Nie Yunming, 2015).

### 3 Implementation Way of College English Translation Course Reform in MOOC Era

#### 3.1 Applying MOOCs teaching model in college English translation

##### 3.1.1 Course construction

A complete making process of an online MOOCs courses involves nine links, such as course topic selection, course planning, course design, course shooting, recording and editing, course online, problems solving in course-based forum, homework correction and certificate issuance, etc. The first three links are very important because they are the key factors to the success of the curriculum development, the degree of social attention and the reactions of the learners after the release of the curriculum. Therefore, the current designers of MOOCs courses are basically the masters of the world's key universities, monopolizing the MOOCs curriculum, and the general universities are still in a weak position. The course of college English translation can make use of the MOOCs of the world's key

universities, such as interpreting course in Guangdong University of foreign studies, Wang Xiaodong's the introduction of translation of Central South of China Yao Yuan's the translation in practice course in Nanjing University in the platform of Chinese University MOOCs.

These MOOCs can transform the traditional teaching mode of translation course by the way of introducing advanced translation theories and foster comprehensive translation skills. They can enable students to understand translation comprehensively, the basic theoretical and practical issues involved in translation, as well as understand the nature of translation, the process of translation, the object of translation, the subject of translation, various factors affecting translation, contradictions in translation, the function of translation. It also has a systematic understanding of the spirit and mission of translation in the context of multi-social and cultural background, forms a correct view of translation, constructs the necessary background knowledge for translation practice, and lays the foundation for a more in-depth translation course offered in the later stage. Alternate Interpretation is a core course in the interpretation teaching. It focuses on the training of cognitive skills of interpretation. It helps learners to master various sub-skills by explaining principles and practicing exercises, aiming at comprehensively applying it to interpreting practice and accomplishing the task of consecutive interpretation.

### 3.1.2 Course features

We can introduce the characteristics of MOOC courses into our translation teaching. First, MOOCs courses can provide whole-course assistance, such as systematic learning, answering questions within 24 hours, homework correction, interactive live lesson, matching vocabulary field, etc. Second, they can supply learners with all kinds of excellent class service. Third, they can help learners learn with half the effort through original systematic method of B2A translation and training system. Fourth, they can provide high-quality teaching materials and training materials. Fifth, they can teach learner translation theories and skills by famous translators with professional knowledge and practical experience. Sixth, learners can get the certificates without leaving their home. Seventh, learners can use Apple and Android mobile terminals to learn more freely.

Translation consists of two parts: translation and interpretation. The translation teaching should take "translation" as the center, integrating various factors, such as internal and external factors, macro and micro factors. So students can think and discuss all important aspects of translation so as to enable them to grasp the key points and difficulties in a short time and guide them to think and explore translation problems purposefully so as to prepare for later study. The courses of interpreting can cover five core skills: listening, memory, note taking, expression and evaluation, and pay more attention to after-class exercises and interactive discussions. The Chinese English competence scale that is Interpretation Competence Scale is introduced to provide learners with a scientific measurement tool to effectively monitor the learning effect and progress.

### 3.2 Increasing the construction of MOOC Platform for English translation course

With the in-depth development of mobile Internet and the further understanding and widespread use of MOOCs by universities all over the world, more and more universities will develop and build their own MOOCs platforms. Overlooking the current situation of MOOCs platform curriculum construction, the English courses of general education are more than that of professional knowledge. Therefore, we should actively seize the opportunity and join the university alliance organizations to give full play to the advantages of the groups and seek common development. It is inevitable for the era development to actively develop and construct suitable English translation courses for learners at different levels. For example, we can actively introduce various technical MOOCs platforms such as TopU.com, and develop MOOCs platforms for our translation course team to provide live video service. Moreover, we can participate in the global MOOCs process to build an exclusive MOOCs platform with

our own curriculum characteristics and styles. Therefore, we can provide the most convenient learning service for our students, as well as learners from other brothers colleges or even all over the world, and better expand strong radiation and influence of our curriculum construction.

The aim of MOOCs platform construction MOOCs platforms is mainly to solve the problems that the teachers and students don't know how to use the platform, or are not willing to use the platform. Therefore, the MOOCs platform of translation course will take the simple and easy to use as the principle and user's computer operations at primary level as the orientation. And we can introduce the mature operation mode of Internet. On one hand, we should take the market need as the orientation, especially the combination of the teachers' teaching and scientific research in order to stimulate their interest in MOOCs platform construction and application and improve their translation teaching quality. On the other hand, we can enable students to perform their individual talents and achieve excellent scores and improve their translation competence and skills to promote the application of MOOC platforms.

Many universities and college can combine the integration of resources to construct a MOOC platform of translation curriculum according to the demands of MOOCs application as well as introducing excellent translation courses into this platform. Moreover, we can provide some compulsory and optional courses that allow students to make their credit certification and tailor the translation programs to suit their different interest. After the construction of MOOCs platforms, different universities can introduce their own corresponding translation courses into the platform according their own teachers' qualification and teaching resources. The function of the platform mainly includes five aspects of basic translation service. First, online study system includes many various functions, such as videos of translation teaching, homework and self-test, online course discussion, translation Wiki, course syllabus, course announcement, course progress tracking, expanding translation learning materials, network share, etc. Second, the system of course management includes is to provide all-round services for translation teachers and adaptation of translation course, such as creating translation course, translation custom settings, the management of translation course, the establishment of evaluation and assessment methods and some common teaching tools. Third, theme or service setting is to customize and build user's own theme interface or domain name service according to the different need of translation course. Five, translation mutual evaluation system can provide function module to evaluate translation competence in order to facilitate the evaluation of translation courses and the mutual learning and communication between learners and translation platform.

### **3.3 Transforming learners' concepts and improving the quality of educators**

Under the background of the rapid updating of current knowledge, it is necessary for English learners to constantly improve students' basic English ability, especially in English listening, speaking, reading and writing by the means of actively studying general education courses in College English through MOOCs platforms, so as to lay a solid foundation for learning English translation theory and skills. At present, most of the current domestic learners who can complete MOOCs courses come from key colleges and universities. On the one hand, most of the current courses on MOOCs platforms come from countries all over the world, especially the US-led developed countries, whose MOOCs courses are mainly in English, so it is difficult for learners to complete the course without good basic English. On the other hand, some key universities in China first introduced and expanded MOOCs courses, such as Peking University, Tsinghua University, Shanghai Jiao tong University and Tongji University. Under this learning background, the students of these universities were the first to understand and participate in learning on MOOCs platforms. In order to follow MOOCs development trend and enable Chinese students to enjoy high-quality MOOCs resources, Chinese universities should not only take efficient actions to construct MOOCs platform and strengthen cooperation and exchanges among universities, but

also constantly improve<sup>10</sup> the quality of educators and make innovations in course selection, development and design.

### **3.4 Actively dealing with MOOC impacts on English translation classroom**

The wide spread of MOOCs is highly related to the leading participation of famous universities in the construction of MOOCs courses. These MOOCs courses introduced by famous universities worldwide has won wide popularity for these universities, and also enabled the students of ordinary universities and the general public to enjoy high-quality learning resources. However, it also has brought about unprecedented changes and impacts on the history of Chinese educational development. All educators have joined in the education battle in an all-round way from Government Department of National Education to university teachers. MOOCs have broken through the barriers of University campuses, making the boundaries between the educational and service functions of universities blurred gradually. Huang Gang, a professor in Shanghai Jiao tong University, once said MOOCs made all learning resources, whether at home or abroad, immediately appear in front of us (Fan Liping, Jiang Peng, 2014). Such advantages of MOOCs mean that current higher education has gone into the process of internationalization, and some countries and regions, especially western developed countries, regard MOOCs as an important way to export and enhance cultural soft power. Therefore, Chinese universities should strengthen the development of local MOOCs courses to integrate into the world online education platform, finally further promote Chinese culture to the world and enhance the national cultural soft power in order to actively respond to Western cultural hegemony.

## **4 Conclusion**

There are many inevitable reasons for MOOCs to becoming the main force of course construction, such as the curriculum team, massive teaching resources and timely online interactive learning methods of world-class universities. As MOOCs were first taken place in western developed countries, such as USA and Europe, and these English-speaking countries have a strong position of in the world, many MOOCs courses are mainly in English, which brings about both a rare historical opportunity and a severe challenge for China. Therefore, we should seize this historical opportunity to vigorously deepen the English translation teaching mode, taking MOOCs online learning as the platform and the promotion of English translation skills as the core. And we should take a series of effective measures to promote the combination of English translation theory and practice and constantly improve the English translation level of Chinese students, such as constructing MOOCs platforms, changing the concept of learners, improving the quality of educators, and actively responding to MOOC's influence on English translation classes. Only by this way can we keep up with the pace in the process of educational reform, give full play to the online educational function of MOOCs platforms and promote the overall improvement of Chinese higher education.

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## Relationship between Big Data Analytics and Decision Making: A Cluster Analysis

Gustavo Grander<sup>1</sup>, Luciano Ferreira da Silva<sup>1</sup>, Arnoldo José de Hoyos Guevara<sup>2</sup>,  
Paulo Sérgio Gonçalves de Oliveira<sup>3</sup>, Alan Tadeu de Moraes<sup>1</sup>

<sup>1</sup> University Nove de Julho, São Paulo, Brazil

<sup>2</sup> Pontifical University Catholic of São Paulo, São Paulo, Brazil

<sup>3</sup> Universidade Anhembi Morumbi, São Paulo, Brazil

(E-mail: grandergustavo@gmail.com, lf\_silvabr@yahoo.com.br, arnoldodehoyos@yahoo.com.br,  
psgoliveira@hotmail.com, alant.moraes@gmail.com)

**Abstract:** This article aimed to understand the relationships that Big data analytics have with decision making. So, to achieve this goal a search in the Scopus database was performed. As a result, we identified the relevance of the topic according to the frequency of publications, the most profitable Journals of the period analyzed and through VOSviewer software we performed a co-citation analysis of keywords and identified 5 network groupings, some more topics recent research results and a density map indicating the strongest relationships among the keywords used in the 93 papers analyzed. We also suggest at the end of the paper a systematic literature review as a way to seek a deeper understanding of the research area and to validate the results found in this study.

**Keywords:** Machine learning; VOSviewer; Artificial intelligence; Bibliometry

### 1 Introduction

Big data can be defined as a generic term for any collection of large, complex datasets that are difficult to store, process, analyze, and understand using traditional database processing tools (Huang & Chaovaitwongse, 2015). Big data has emerged as a paradigmatic shift on how organizations make decisions (Mortenson, Doherty, & Robinson, 2015). There is a common acceptance that Big data can be adopted at strategic, tactical, and operational levels, thus improving existing decision-making practices (Wamba, Ngai, Riggings, & Akter, 2017).

The term “Big Data” has become hugely popular in the business world in recent years (Gupta, Chen, Hazen, Kaurd, & Gonzalez, 2018). Its use is either to support decision making or to make automated decisions (Davenport & Kirby, 2016). Through decision support systems (DSS), it is possible to process large volumes of data using output models and outputs with interfaces that increasingly permeate the professions with a high level of knowledge (Constantiou & Kallinikos, 2014).

From this context, we try to understand what relations Big data analytics have with decision making. Our goal was to understand how the use of Big data analytics contributes to decision making processes in different aspects of use, given its great applicability. To do this a literature mapping was performed, this being a variation of systematic literature review, used in this study to understand the interaction between keywords and to answer the question of research that guided this study: what Big data analytics relationships have with decision making?

We performed a search in the Scopus database and analyzed the data of 93 articles through the VOSviewer software. We identified 5 clusters through network analysis, recent studies with 'machine learning' and 'sustainable development' terms related to Big data analytics and decision making, and a strong relationship of the term 'artificial intelligence' to the search terms used in this research.

Our study is organized as follows: We present a brief theoretical basis in item 2, then we describe the methodological procedure and data collection in item 3, then we present the results in item 4, and finally the conclusion in item 5 along with suggestions of future research opportunities in depth to confirm our findings as well as to increase the understanding about the topic that has been presented as very relevant for society.

### 2 Theoretical Background

As highlighted by Laney (2001), Big data has three primary characteristics: volume, velocity and variety, and later complemented by SAS<sup>11</sup> with the characteristics of variability and complexity. These dimensions required more powerful computers, an ubiquitous network, and algorithms capable of

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<sup>11</sup> SAS disponível em [https://www.sas.com/en\\_us/insights/big-data/what-is-big-data.html](https://www.sas.com/en_us/insights/big-data/what-is-big-data.html)

connecting datasets in order to make possible analyzes that would not be possible until then, and this convergence made possible the commercial application of data Science (Provost & Fawcett, 2013).

According to Manyika et al. (2011), Big data can play a significant economic role for the benefit not only of private trade, but also of national economies and their citizens. The authors also highlight the value generated by the use of Big data in five domains: health, public sector administration, retail, manufacturing and global personal location data.

For Fayyad, Piatetsky-Shapiro, and Smyth (1996), computational theories and tools help humans extract useful information from the ever-increasing volumes of digital data. And efficient information management is critical to value creation because the amount of data is quickly generated, hampering decision-making processes (Fredriksson, 2018).

### 3 Data and Methodology

For this study, we used the Scopus database because it is one of the main databases in the area of Social Sciences. We performed the research on 05/30/2019 with the Boolean term: "Big data" AND ("Decision Theory" or "decision support system\*" or "decision-support system\*"). The use of the '\*' symbol was so that plurals, gerunds or nouns were also identified in the search. As an initial restriction, we limited the search so that the words were contained in title, abstract, or keywords.

As a result, we obtained 1,031 results that were reduced to 243 results after the filtering of areas (limiting to Business, Management and Accounting, Decision Sciences; Social Sciences) and after a new filter was limited to articles only, we obtained 93 results. These papers underwent an individual exploratory analysis with title reading, summary and when necessary, reading directed to the article to identify the possible contributory character to answer our research question.

To help us with the research question, we use the grouping technique using the VOSviewer software. Grouping techniques play a prominent role in bibliometric research by providing clusters of authors, publications and related keywords (Van Eck & Waltman, 2017). This analysis conditioned us to understand the most relevant connections between the articles identified in the research through the relationship between the keywords of the works.

This method is described by Župič and Čater (2015) as useful in a phase prior to a literature review, for example, as it guides the researcher to the fields of research by reducing subjective bias. Thus, we perform co-occurrence analyzes of keywords through three ways of visualization via VOSviewer: network, overlap and density. The methodological procedures followed in this study can be visualized in Figure 1.

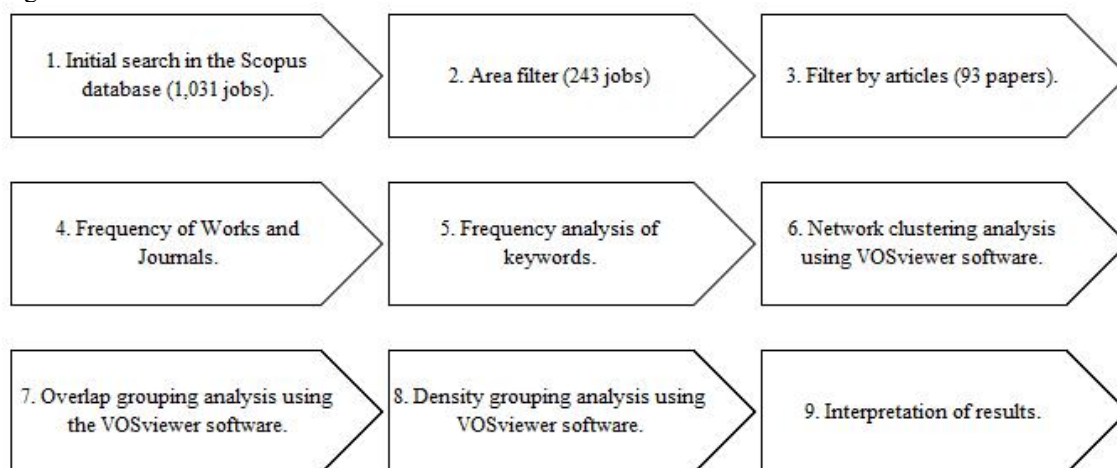
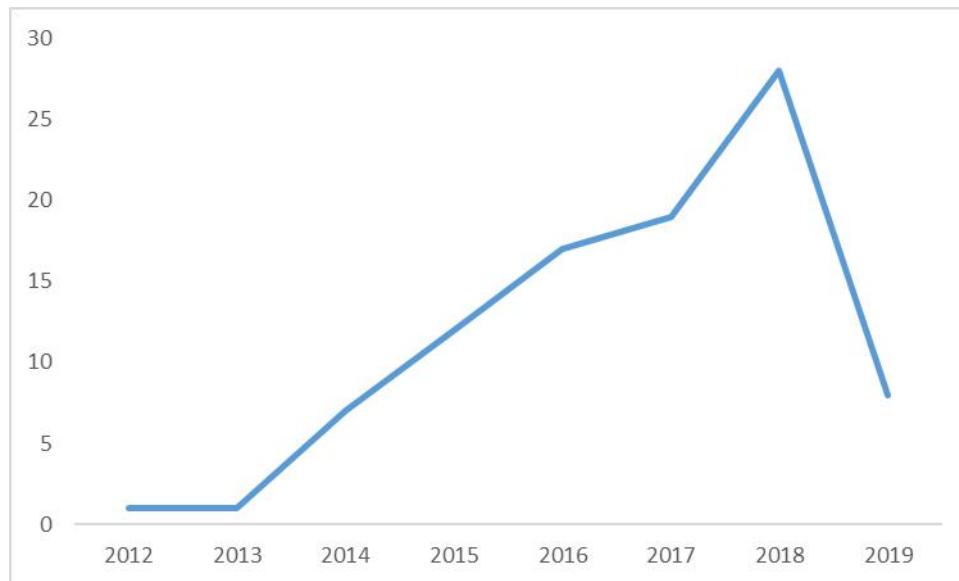


Figure 1 Methodological Procedure of this Work

## 4 Results

### 4.1 Descriptive analysis

Initially, we analyzed the frequency of publications of the 93 selected papers, as can be seen in Figure 2. Note that in the first two years (2012 and 2013) only one publication per year occurred and from 2014 there was an exponential growth of publications, including with the year 2019 already with 8 publications, a year that is still partially counted due to the period of research. Due to our research question, we decided to keep the year 2019 even if we did not have the total of publications for the year.



**Figure 2 Publications by Year**

We also analyzed which Journals were most profitable in this period, as presented in Table 1 and we can verify that they were "Journal Of Decision Systems" and "Decision Support Systems" with 9 and 7 papers, respectively. Of the total number of Journals with publications registered in the research, 13 represented 48.39% of the sample (these with more than one registered work), the other Journals had only one work registered, thus representing 51.61%, and were not mentioned in the table.

**Table 1 Most Profitable Journals**

Journal	Frequency (n)	Frequency (%)	Cumulative frequency (%)
Journal Of Decision Systems	9	9,68%	9,68%
Decision Support Systems	7	7,53%	17,20%
Lecture Notes In Business Inf. Processing	4	4,30%	21,51%
Sustainability Switzerland	4	4,30%	25,81%
European Journal Of Operational Research	3	3,23%	29,03%
Information Sciences	3	3,23%	32,26%
Knowledge Based Systems	3	3,23%	35,48%
Computers And Operations Research	2	2,15%	37,63%
Computers Envir. And Urban Systems	2	2,15%	39,78%
Dili Xuebao Acta Geographica Sinica	2	2,15%	41,94%
Information And Management	2	2,15%	44,09%
Technol. Forecasting And Social Change	2	2,15%	46,24%
Transportation Research P. Emerg. Technol.	2	2,15%	48,39%

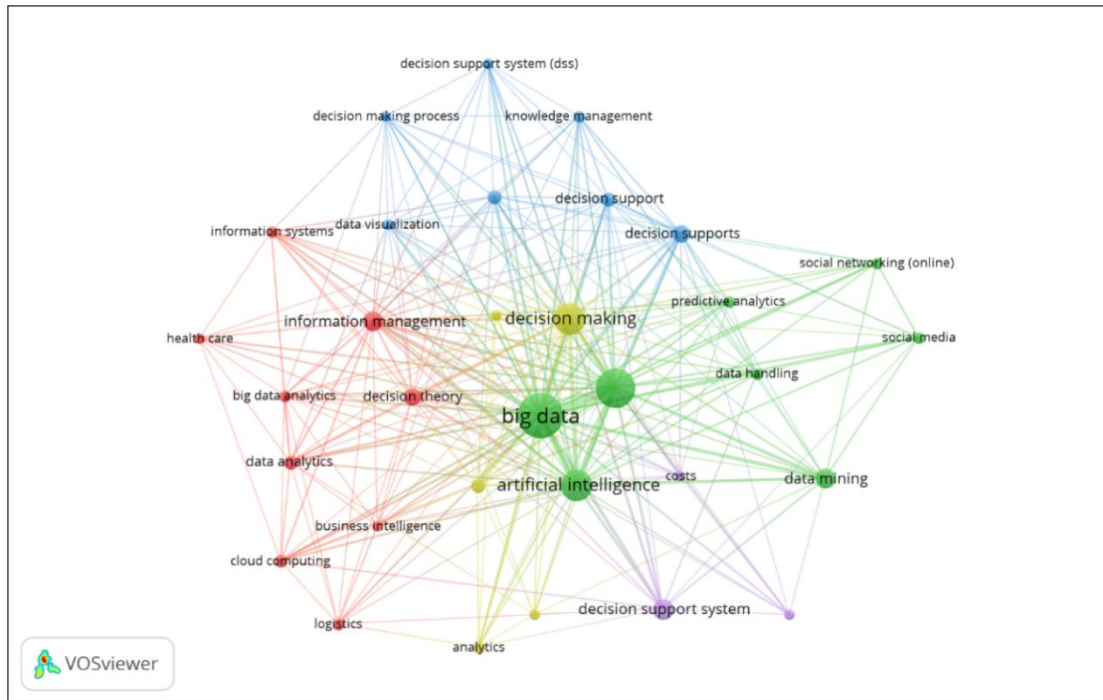
Table 2 shows the frequency that the keywords were cited in the analyzed works. As an exclusion criterion, we chose to filter out keywords that had been quoted at least four times, and as a result 32 keywords from a total of 931 were recorded, which were cited 389 times out of a total of 1,400, representing 27.79% of total citations.

**Table 2 Most Cited Keywords in the Analyzed Database**

ID	Keywords	Frequency (n)	Frequency (%)	Cumulative frequency (%)
1	big data	74	5,29	5,29
2	decision support systems	58	4,14	9,43
3	decision making	36	2,57	12,00
4	artificial intelligence	35	2,50	14,50
5	decision support system	17	1,21	15,71
6	information management	15	1,07	16,79
7	data mining	14	1,00	17,79
8	decision supports	12	0,86	18,64
9	decision theory	11	0,79	19,43
10	decision support	8	0,57	20,00
11	digital storage	8	0,57	20,57
12	data analytics	7	0,50	21,07
13	information analysis	7	0,50	21,57
14	cloud computing	6	0,43	22,00
15	analytics	5	0,36	22,36
16	big data analytics	5	0,36	22,71
17	data handling	5	0,36	23,07
18	information systems	5	0,36	23,43
19	knowledge management	5	0,36	23,79
20	logistics	5	0,36	24,14
21	predictive analytics	5	0,36	24,50
22	social media	5	0,36	24,86
23	social networking (online)	5	0,36	25,21
24	business intelligence	4	0,29	25,50
25	costs	4	0,29	25,79
26	data visualization	4	0,29	26,07
27	decision making process	4	0,29	26,36
28	decision support system (dss)	4	0,29	26,64
29	health care	4	0,29	26,93
30	machine learning	4	0,29	27,21
31	strategic decision making	4	0,29	27,50
32	sustainable development	4	0,29	27,79

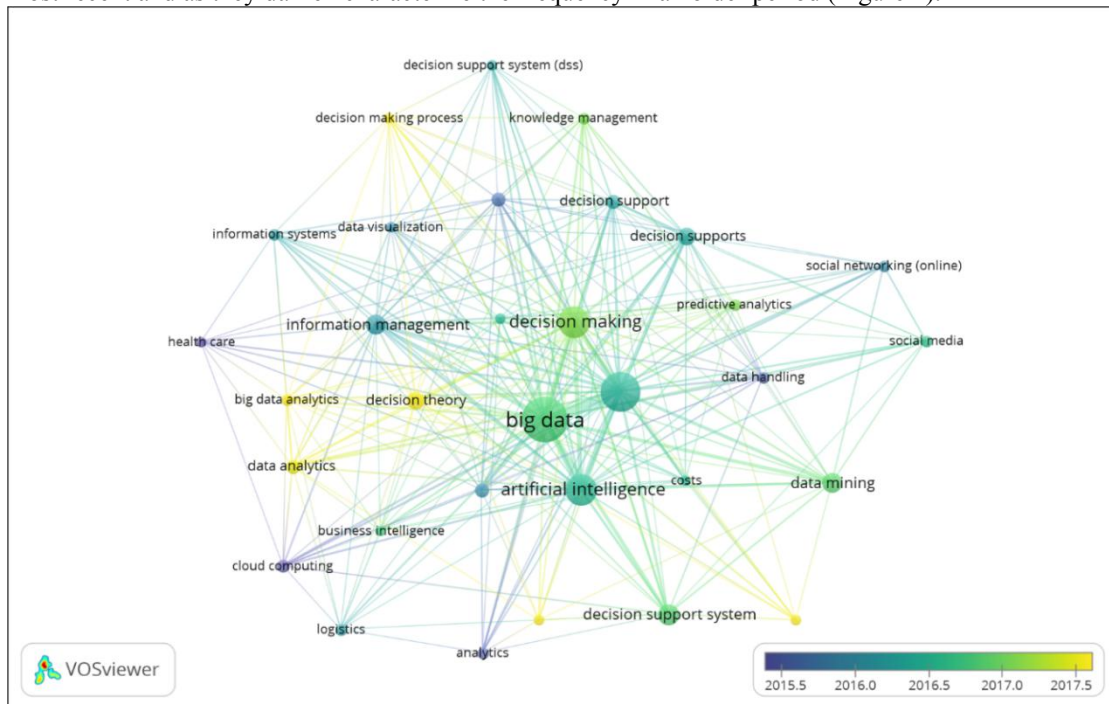
It should be considered that the keywords identified with IDs 2 and 5 are separated only by the fact that the first one is in the plural and the second in the singular, but could be considered as the same keyword and in this case it would be the most frequent word (n = 75), the same occurred with the keywords in ID 8 and 10, but we opted to maintain the originality of the data extracted from the software. The 32 most frequently used keywords in the papers therefore represent 27.79% of the total frequency of keywords.

From the analysis of frequency of keywords, we analyze the grouping of these by means of the network visualization as shown in Figure3. From this verification, we can notice the formation of 5 groupings discriminated, these identified with the colors red, blue, green, purple and yellow.



**Figure 3 Networking of Keywords**

After the network visualization, we perform the keyword overlapping visualization, which organizes them according to the frequency identified in a time horizon so that the yellow words are the most recent and as they darken characterize the frequency in an older period (Figure 4).



**Figure 4 Keyword Overlay View**

Finally, we perform density analysis, which intensifies color (with warm colors) according to frequency and relation to other words (Figure 5).

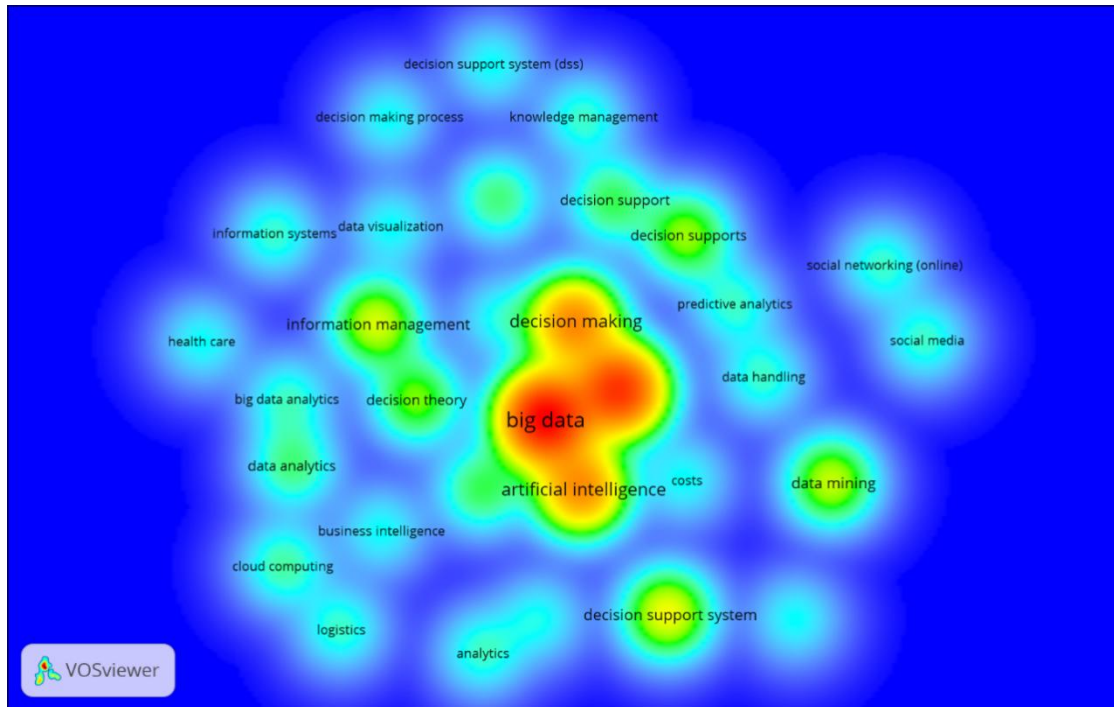


Figure 5 Keyword Density View

#### 4.2 Interpretation of the analysis

From the descriptive analysis, we can verify that for the search term used 5 groups were identified that can characterize study areas: the cluster identified with red color suggests studies directed to environments such as health, logistics and IT with decision support by means of business intelligence mechanisms. The cluster identified with the blue color suggests studies directed to the systems/processes of decision making and knowledge management. The grouping identified with the green color suggests studies directed to the mining of data through artificial intelligence to guide decision making processes. The cluster identified with the color purple suggests studies directed to decision support systems oriented towards sustainable development. Finally, the cluster identified with the yellow color suggests studies directed to the strategic decision making via machine learning.

We can also highlight that recent studies can be directed to sustainable development, machine learning, Big data analytics and decision making, as well as highlighting the strong relationship through density analysis that the keywords artificial intelligence, Big data, decision making and decision support systems have, and may indicate a strong relation in the studies, just as we can assume some opportunities of studies with peripheral relations in the density map.

#### 5 Conclusion

This article aimed to understand what Big data analytics relations have with decision making and to achieve this goal a search in the Scopus database was performed and interpreted through VOSviewer software. We initially analyzed the frequency of publications of the search conducted as well as the most profitable Journals as a way of understanding the relevance of the research area and where more works are published. As a result, we see exponential growth starting in 2014 from publications such as "Journal Of Decision Systems" and "Decision Support Systems" as the most profitable Journals.

Then, we identified 5 clusters of keywords that suggest different areas of study (Figure 3), as well as a more recent incidence of studies targeting sustainable development, machine learning, Big data analytics, and decision making (Figure 4). An important contribution that should also be highlighted was the strong relationship of the keywords Big data, artificial intelligence and decision making (Figure 5), thus suggesting studies involving the three terms.

As a limitation to the study we can highlight that the combination of the term Boolean directs the frequency of keywords extracted from the database, so a different combination can result in different relationships between the keywords, so we cannot gauge that the results found in this research truly reflect the relationships between surveys. To mitigate this uncertainty, as a suggestion of future studies,



we propose an extension to this preliminary bibliometric analysis by means of citation and co-citation analyzes of the works.

Citations, according to Župič and Čater (2015) are used as a measure of influence, so that if an article is very quoted it is considered important based on the assumption that the authors cite documents that they consider important for their work. Co-citations, defined as the frequency with which two units are cited together (Small, 1993) indicate that the more items are quoted together, the more likely the content is related to them (Župič & Čater, 2015). Thus, it would be possible to support the findings of this work, to relate relevant authors to the identified areas and also to condition a systematic review of the literature for a deepening of the identified factors, as suggested by (Župič & Čater, 2015).

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# The Influence of Digital Presentation on Consumers' Perceived Value Based on Evidence from Eye Movement Experiments

Li Jiang, Liu Chun, Jiang Yushi

School of Economics and Management, Southwest Jiaotong University, Cheng Du, P.R. China, 610031

(E-mail: LIJ929@foxmail.com, 906375866@qq.com)

**Abstract:** In this study, eye movement experiments were conducted to observe consumers' gaze time on creative materials, and to study consumer information processing fluency and consumer perceived value. The research results show that the digital presentation form in the slogan positively affects the perceived value of consumers, and also has a significant impact on the fluency of information processing of consumers; the fluency of information processing of consumers in the slogan digital presentation form and consumer perceived value There is a clear intermediary role; product involvement has a regulatory effect between the digital presentation form and the consumer perceived value in the slogan, the higher the product involvement, the perceived value of the consumer in the proportional and descriptive digital presentation. The lower the perceived value of emotions and the higher the perceived value and emotional value of the percentile consumer.

**Key words:** Advertising slogan; Digital presentation form; Consumer perceived value; Product involvement

## 1 Introduction

Figures are intuitive, easy to read and easy to understand, so they are favored by advertising copywriting. In the advertising works, the number of appearances has been very high (Ma Yaqiong, 2015). In social life, whether it be a bow stick to the road or volley hung giant advertising signs, as the newspapers and propaganda in the streets and widespread transmission of radio, film and television, advertising, at any time can be filled with the number in the eyes and ears, digital is an integral part of life, advertising plays an important role in the information society (Wang, 2006). Digital can shorten the distance with consumers, help consumers understand advertising information, and enhance the persuasive power of advertising. The advertisement USES digital to convey the practical meaning of the product, artistically reflects the symbolic meaning of the product, and highlights the target object of the product (Ning Limei, 2010).

Figures can make the objects described precise, clear, real and sensible. These characteristics can enhance the credibility and recognition of advertisements to improve the efficiency of information transmission, and make the information transmission more readable and sensible (Wang Xiya, 2014). Number is usually used to record and describe information of things, the best is the fact that the abstract in the form of specific figures show before the eyes of consumers, has appeared and hidden two kinds, fixed usage, by the score, the multiple forms, from the written form, such as Arabic numerals and Chinese capital, Chinese characters, to help consumers establish a range of easy to measure (Wu Yuyao, 1993), accurate convey of referred to objects of the objective conditions, to guide consumers to have more specific cognitive mentioned things.

At present, digital presentation is A critical consideration in both advertising creativity and

communication in theoretical research and practice (Baroody A J, 1985). Advertising more than the number in the present form for the number and unit used in combination, there is also a research from the aspects of font, size, number present form, also have the digital form, from a digital source to enhance digital effects, consumer awareness and consumer decision-making, to explore the Numbers after the research of digital rendering, advertising effectiveness, etc. However, in the reality of advertising communication, there is another form of digital presentation -- digital proportion, which can more directly reflect the advertising appeal and brand attitude. In marketing and consumer behavior literature, although the researchers have recently begun to research the accomplishment and ability of digital consumer problems in market (Adkins N R, Ozanne J L, 2005), mostly with individual cognition, digital effects, information processing and the consumer behavior research, but few slogan form Numbers appear in studies of the impact on consumers' perceived value, such as the percentage information (Chatterjee S, et al, 2000), it is a very notable research direction.

In the real advertising communication, there are many classic digital proportion of the form of advertising, to the majority of the audience left a deep impression. Golden arowana advocates balanced dietary fatty acids and puts forward the concept of 1:1:1 blended oil. Although consumers do not know what is fatty acid, they will perceive its scientific rationality when they see such a ratio. Maotai-flavor liquor is one of the two major Maotai-flavor liquors. Every 10 range hoods sold in China have 6 are the Boss brand, tell the consumer the boss range hoods are very popular, you are worth buying; Feihe milk powder's high-end sales grew 200 percent in 2017, giving consumers a sense of its quality and popularity in the market. These forms of presentation enhance the persuasiveness and perception of its advertising, so that consumers can have trust, accuracy and stability, forming a purchase decision. Although the form of digital presentation in the above advertising slogans can have an impact on consumers' attitudes, it will be the focus of this study to find out what effects it can have and the mechanisms of these effects.

The figures are presented in different forms in advertising creativity. Previous studies have shown that the digital effects produced by different forms of numbers can affect consumers' brand perception. These studies are mostly based on the size, positive and negative, digital sources of digital, etc. The proportional form has a more intuitive advantage and a perceived experience than other types of digital forms.

## 2 Literature Review

### 2.1 Digital presentation form

The numerical value information of Numbers will be processed automatically. As another carrier of digital information, Chinese digital words will also affect the processing of Numbers, resulting in typical digital effects (McCrink K, Wynn K, 2007). There are differences between Arabic and Chinese characters in the encoding and representation stage (ZhaoHui et al., 2008), while Chinese lowercase Numbers (such as "five"), Chinese uppercase Numbers (such as "five") and Arabic Numbers (such as "five") all have symbolic effects (Cao Bihua et al., 2010). The processing performance of Chinese uppercase Numbers, Chinese lowercase Numbers and Arabic Numbers is improved step by step. Digital SNARC effect is separated in size information and order information, and the order information of Numbers has a greater impact on SNARC effect than the size information of Numbers (Jin Guichun et al., 2016). The processing of pure decimal adopts the method of parallel access, which causes the SNARC effect of attention, and the attention transfer of the pure decimal space is affected by the pure decimal itself and the corresponding natural number (Sun Yueliang et al., 2017). The subjects in the task

repetition group showed a classic SNARC effect in numerical cognitive processing (Wang Qiangqiang et al., 2018). Digital size can significantly influence consumers' attitudes towards products and brands (Feng Wenting, WangTao, 2017). Fraction is an important mathematical concept mastered by individuals after integer. Integer can only represent Numbers discretely, and the representation of fraction is orderly and continuous. Therefore, fraction is more accurate than integer (SunYu et al., 2016).

Perceptual processing level when different digital context number the number of symbol and the symbol processing and space represent significant differences (Matthews P G, Chesney D L, 2015), the size of the abstract information and quantitative information can also be characterized space, and the information in the space structure of occupied space information resources, with digital symbols in occupied space representation of spatial information resources are the same (Yang Jinqiao, 2011). Negative Numbers are composed of symbols and Numbers, and there are two possible representations of negative Numbers. There is a stable correspondence between time and digital information (Zhang Jie, 2016). In the digital parity context, the spatial representation of Ordinal Numbers in the vertical dimension is affected by the context, and the spatial representation of Numbers in the vertical dimension is dynamic and regulated by specific and abstract situations (Qiao Fuqiang et al., 2016). In the odd-even judgment of Arabic numerals 1-9(except 5), brightness activates or inhibits the spatial representation of numerals, which may be related to the ratio of brightness to power and the amount of cognitive resources consumed (CaoBihua et al., 2017). When individual interpretation of the stimulus of numerical attributes, with different Numbers and the unit will not only represent the same number of deviation, also affected by the digital launch (Pinel P, Dehaene S, 2001), with different Numbers of the same goods have different requirements, or even make decisions to violate the economic utility maximization (Wu Yinghao, Jiang Jing, 2018).

The above literatures mostly studied the influence of Numbers from the perspective of digital effect and representation. Both visual channel presentation and auditory channel presentation (Nuerk H C, et al, 2005) have found consistent SNARC effect, but there are few studies on digital proportion. Numbers are often presented in proportion, such as proportion, percentage and description. Proportion refers to the proportion between Numbers to express an advertising appeal, such as golden arowana 1:1:1. Percentile refers to the comparison between a number and a certain parameter, and the difference between the number and the parameter is directly reflected by the percentile type, such as 100% of HuiYuan juice. Descriptive type refers to the creative appeal of using the proportion of Numbers in the form of text description, such as the advertisement slogan of the boss's range hood. Starting from the inhibitory control model, there are significant differences in the negative start measures under different numerical ratios (JiangRonghuan, LiXiaodong, 2017). The digital presentation forms in advertising language are mostly used for the expression of advertising appeals, which can accurately reflect the advertising appeals, form distinct differentiation characteristics and improve the advertising effect. This study will take three digital presentation forms and conduct experimental research through eye movement experiment.

## 2.2 Perceived Value of Consumers

Perceived value is the preference or evaluation of certain attributes of a product or service after weighing the advantages and disadvantages between consumers' perceived performance and consumers' perceived cost (Sersland D R, 1987; Woodruff R B, 1997), and make an overall evaluation of the benefits obtained and costs paid (WuYonghong, FanXiucheng, 2004). Perceived value has a seven-dimensional structure of cognition and emotion, among which self-satisfaction, price, quality, transaction and characteristic dimensions have a significant direct positive impact on consumer satisfaction (Mohammed Ismail el-adly, 2018). Value will be perceived value is divided into five dimensions model function, social, emotional, cognitive and situational value five value dimensions,

these dimensions respectively in terms of brand, products and purchase affect consumers' buying behavior (Sheth J N, Newman B I, Gross B L, 1997), found in the study of durable goods, cognitive value and situational value no significant influence on consumer purchase intention, so it is concluded that the three dimensions of durable goods are functional value, emotional value and social value respectively (Sweeney J C, Soutar G N, 2001). Through the formative evaluation of perceived value on a multi-dimensional scale including functional, emotional and social value dimensions, the study shows that perceived value has a great positive impact on consumer satisfaction (Rasoolimanesh S M, 2016). With the increase of perceived differences, consumers are more likely to turn to better quality choices (Adaval R, 2013). The commodity attribute number will initiate consumers' perception of quantity, metaphorical association of related concepts, and different information processing methods, and affect subsequent consumption behavior through spillover effect, so that consumers' decision-making is no longer based on the tradeoff of commodity attributes, but more dependent on the consumption situation (Wu Yinghao, Jiang Jing, 2018).

### 3 Theoretical Basis and Research Hypothesis

#### 3.1 Digital presentation form and smoothness of digital processing in advertising language

Digital processing is a process in which consumers process digital stimuli to form corresponding mental representations of Numbers and use them for corresponding cognitive processing, such as quantitative comparison and mathematical operation (Zhang Hongchuan et al., 2005). Based on theories such as limited memory capacity, easy access to information extraction and smooth information processing, this paper studies the psychological mechanism of the influence of Numbers on consumer behavior. In addition to the size of Numbers, the presentation of Numbers may also influence consumer behavior (Wu Yinghao, Jiang Jing, 2018). When dealing with digital-related information, consumers will make a trade-off between seeking the optimal result and spending the least cognitive effort. The digital presentation form can make consumers' digital processing more smooth (Bettman J R, Luce M F, Payne J w., 1998). Digital presentation forms also influence consumers' perception of the degree of target achievement and the power of target pursuit (Bagchi R, Li x., 2011). Accurate digital presentation will initiate different information processing methods of consumers and make them process accurate Numbers more smoothly (Dan K, Janiszewski C, 2011). Integer makes consumers more inclined to rely on sensory processing information, while precise number makes consumers more inclined to use cognitive analysis to process information (Wadhwa M, Zhang K, 2015). When consumers are in the situation of relying on sensory processing information, expressing commodity attributes as integer can improve consumers' positive attitude towards this commodity. Arabic Numbers, Chinese Numbers and English Numbers are spatial representations of Numbers and numerical properties, and have an impact on the smoothness of digital processing (Wang Jin, 2011). The three forms of digital presentation have different degrees of influence on the information processing fluency of consumers. Compared with the equivalent oral information, the proportional digital presentation is faster in identifying and comparing the digital processing speed of consumers (Childers T L, Viswanathan M., 1996). It is better to use percentage discount than to describe the effect of discount (Chen H, Rao A R, 2007). Consumers can intuitively see the discount ratio and make further decisions more easily. When evaluating the impact of a series of percentage changes, the sequential percentage discount generates more sales, revenue and profit for buyers than the economically equivalent single percentage discount (Zolmajd-haghighi Z, Hanley Q, 2014). Accordingly, the following hypotheses are proposed in this study:

**H1: Digital presentation has a positive impact on digital processing fluency. Descriptive digital presentation has better information processing fluency than percentile and proportional**

**digital presentation.**

### **3.2 Digital presentation form, information processing fluency and consumer perceived value in advertising language**

Figures presented in the AD copy, strengthened the AD copy of the appeal of the use of force to make advertising information to convey a clear, clear, digital proportion in daily consumer goods ads, frequent is actually a rational consumption for modern consumers complex relieve and release (Ning Limei, 2010), a clear and objective impression to consumers, prompt consumers to cognitive and emotional transformation towards the direction of the favorable advertising information. Digital cognitive studies have shown that proportion compared with the single number with greater fluency (Dan K, Janiszewski C, 2011), whether the generation of perception (Bornstein R F, D 'Agostino P R, 2011), or the distribution of the meaning of the event, when cognitive activities more fluid than expected, people make attribution is the cause of the fluency, including the increase of perceived credibility, accuracy, ability (Schindler R M, Yalch R F, 2006). Helps research product perception, number recognition, and persuasiveness (PenaMarin J, Bhargave R, 2016). Digital processing fluency plays a mediating and guiding role in consumption context, and can stimulate consumers to respond to functional value and emotional value. Therefore, the following hypothesis is proposed:

**H2a: Digital presentation positively affects consumers' perceived functional value;**

**H2b: Digital presentation forms positively affect consumers' perceived emotional value;**

**H3a: Digital processing fixation duration positively affects consumers' perceived functional value;**

**H3b: The duration of digital processing gaze positively affects consumers' perceived emotional value;**

**H4: Information processing has an intermediary effect between digital presentation form and consumer perception.**

### **3.3 Involvement regulation effect**

Is involved in the consumer in the process of consumer information search, product evaluation, brand choice when the effort put into the amount of time and degree (Liu F, Cheng H, Li J, 2009), also reflects A stimulus or task that is associated with consumer needs and current life ideal degree (Palanisamy R, Wang S. A, 2003), and per unit time, the audience in their own life and to stimulate the building can be realized between experience, contact, or the number of associated (Krugman H E, 1965). Product involvement refers to the degree to which the audience pays attention to the information the advertisement is trying to convey based on their inherent needs, values and interests, and the importance of such advertising information to consumers (Wu Shuilong et al., 2017). No matter what kind of involvement it is, involvement is the relevance and importance of something perceived by individuals based on their inherent needs, values and interests (Zaichkowsky J L, 1985).

Products involved in high degree of audience information processing motivation, they pay close attention to AD the core content, fine processing of advertising information, to explore the different rhetorical forms of advertising information contains the advertising message, in the in-depth and systematic understanding established on the basis of advertising in an attempt to convey the real meaning of attitude (Wu Shuilong, 2017). When consumers receive advertising information, they have different paths to information processing due to their different ability to process information and motivation (Cacioppo J T, et al., 1986). When the information processing ability and motivation are high,

consumers will process the information in the central path, while low, they will process the information according to the peripheral path (Hu Xiaoyun, XuFang,2006). When browsing advertisements with high product involvement, consumers can obtain more advertising information (Jiang Yushi, 2013), and high involvement will further refine the advertising information.

Products involved in the audience's attention in the product information (Wright, P L, 1973), from a personal situation in perspective, the product is involved in an individual's core issues to advertising, product information content showed a certain strength and sustainability of internal awakened state (Reimann M, et al., 2010), the audience of the products involved in that contains both the importance of product information to the audience and other cognitive relevance and interesting emotion correlation (XuYi, 2011). Involvement is an internal state of motivation, evoking or interest, so the degree of audience involvement will affect the motivation of consumers to process product information (Rayner K, et al, 2001). Compared with low involvement in degrees of goods, advertising can get consumers of high involvement in products longer browsing time, more to look at times, the average pupil is bigger, eye movement data shows that the consumers because of high degree of goods in the more elaborate processing of advertisement information, relatively also get more advertising information, the purchase intention is also more strongly (Garcia C, 2000). Consumers with high product involvement usually have higher perceived dimensions in information processing than those with low product involvement, and when the involvement is high, consumers will search for relevant information more actively, thus influencing consumers' functional value, emotional value and purchase decision, etc. (Richins M L, Bloch P H, Richins M L,1986).

H5: The product involvement has a significant moderating effect on the digital presentation form and the perceived value of consumers in the slogan. When the product involvement is high, the digital presentation form in the slogan has a stronger influence on the perceived value of consumers, and this positive adjustment affects the perceived value of consumers through the intermediary effect of information processing.

H5a: For consumers with high product involvement, the percentile presentation is superior to the proportional and descriptive class in terms of perceived functional value to consumers;

H5b: For consumers with high product involvement, the percentile form of presentation has higher perceived emotional value to consumers than the proportions and descriptors.

To sum up, the research model is shown in figure 1:

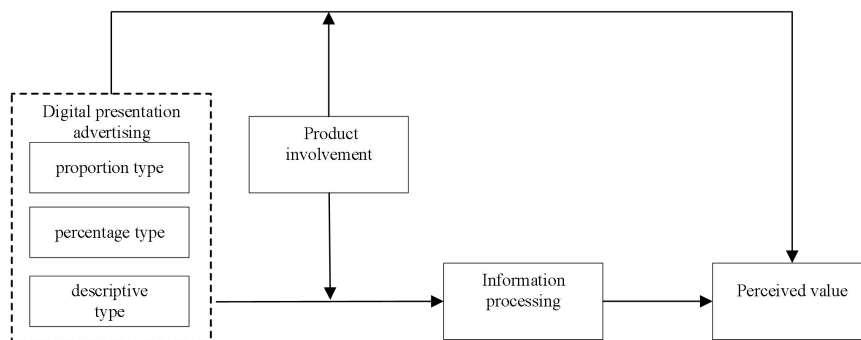


Figure 1 Conceptual Model of This Study

## 4 Research Methods

### 4.1 Variable measurement

#### 4.1.1 Eye movement index

Information processing is largely dependent on vision, and about 80% ~ 90% of external information is obtained through the eyes (Jacob R J K, Karn K S, 2003). Eye movement is the subjects of stimulus information processing and a reflection of the change of the inner (Song Zhijie, et al., 2017), in the eye movement index, looking time effectively reflects the participants of the stimulus information processing fluency (Li Baozhu, Wei Shaomu, 2018), this study selected looking time as the main eye movement examination index, information processing fluency (Landwehr J R, Labroo A A, Herrmann, 2011). Total fixation time, total fixation duration) refers to the fall in the interest of all combined fixation point of time, the index can reflect the cognition of stimuli and degree of processing difficulty or interested in, look at the longer (Guo Suling et al., 2017), the information processing depth is deeper (Lai M L, et al, 2013), the visual perception quality evaluation is higher (Guo Suling et al., 2017), therefore, to let the number of participants interested in their present form advertising effective subjective choices, It is necessary to analyze the process of consumers' perception of digital presentation form advertising together with multi-dimensional eye movement indicators.

#### 4.1.2 Perceived value

This study mainly investigated the influence of digital presentation form in advertising on consumer perception, and explored its influence mechanism according to the (s-o-r) model (Xu Xiaojuan et al., 2017). Stimulation (S) is the external motive force that affects the cognitive and emotional processes of consumers. Organism (O) refers to the internal process and structure of an individual between stimulation and ultimate behavior and reaction; Reaction I is the output or final behavior of consumers after reaction. The stimulus (S) in this study is a digital advertisement composed of digital, text, shape and color elements. Organism (O) refers to the smoothness of the processing of the digital information presented in the advertisement by consumers; Response I refers to consumers' perception score of advertisements in different digital presentation forms. Perceived value table adopts (Sweeney J C, Soutar scale, 2001), function (FV) value and emotional value (SV) two dimensions, a total of eight items, combined with the fine-tuning of this research: the product quality stable/the product well-made/the product craft is advanced, the product formula science/the product let me use the rest assured, the product benefit is/it is/let me get the product I like self-gratification, questionnaire in the form of likert scale, 1 (completely disagree with, 7 for complete agreement. Subjects for related item scores, Cronbach's  $\alpha = 0.929$ .

#### 4.1.3 Product involvement

Based on the personal involvement scale proposed (Vaughn R, Zaichkowsky, 1994), the degree of involvement of subjects in the product was examined from the perspective of individual characteristics, product nature and situational factors. The scale adopts the seven-point likert scale, in which emotional involvement refers to the individual's feelings and emotional state of the product, including five items such as attractive, exciting, interesting, engaging and charming. Cognitive involvement measures the activation degree of an individual to product information processing, including the degree of value, importance, need intensity, relevance and significance. Participants according to the above 10 dimensions determine their relations with the product and scoring, Cronbach's  $\alpha = 0.824$ .

## 4.2 Preliminary experiment

In order to avoid the interference of brands and products in advertisements on experimental results, brand familiarity in experimental materials needs to be pretested. Of this study is to present the number in the form of advertising involved cooking oil (golden dragon fish), milk powder (flying crane), lampblack machine (the boss), cosmetics, estee lauder, shopping platform (a lot of spelling), advertising and brand familiarity influence into consideration, this research subjects in the school for freshmen, the participants were recruited 30 undergraduate students ( $N_{boys} = 15$ ,  $N_{girls} = 15$ ) as participants, the participants need to "are you familiar with the brand in the advertising", "are you familiar with the product in the AD" two multi-item scale, 1 are not familiar with, 7 means very familiar (Dahl D W, Hoeffler S, 2010).  $M_{golden\ arowana} = 4.70$ ,  $M_{flying\ crane} = 4.30$ ,  $M_{boss} = 3.67$ ,  $M_{estee\ lauder} = 4.43$ ,  $M_{spelling\ more} = 5.70$ . In order to make this research experiment controllable, it is necessary to remove the spelling more ads with high brand familiarity. Eliminate high brand familiarity advertising,  $M_{type\ ratio} = 3.68$ ,  $M_{percentage\ type} = 3.08$ ,  $M_{description\ type} = 3.14$ ,  $t(29) = 15.53$ ,  $p > 0.05$  data analysis results show that all the participants of the brand advertising and the advertising, products are not familiar with, and various types of digital data results no significant differences between present advertising, this research of the brand advertising and the advertising, the factors influencing product control success.

## 4.3 Formal Experiment

### 4.3.1 Selection of subjects

This experiment for recruiting subjects of teachers and students in a university in Chengdu, with 95 subjects participated in this study, subjects standards for normal vision or corrected visual acuity, no color blindness, are right-handed (Yang Qiang, et al., 2019), there are five subjects do not accord with standard of the participants, 90 eligible subjects to participate in this experiment, finally the boy 38 (42.22%), girl 52 (57.78%), get a gift and after the experiment.

### 4.3.2 Experimental design

This experiment adopts 3 (digital presentation forms: ratio vs type percentage vs description) x 2 (product involved in degrees: high vs. low) experiment, proportion type as the control group, percentage and description as the experimental group, digital form as independent variables, the digital processing fluency as intermediary variables, products involved in degrees for regulating variable, customer perceived value of the dependent variable.

### 4.3.3 Experimental instruments and irritants

Experimental instrument: this experiment was carried out in the cognitive engineering laboratory of Southwest Jiaotong University. The eye-link2000 Eye tracker developed and produced by SR Research company of Canada was used in the experiment, and EB (experiment-builder) was used to compile the experimental program.

Experimental stimuli: in this experiment, golden arowana blended oil, flying crane milk powder and boss range hoods were selected as the stimuli of digital presentation form advertising, respectively representing proportional, percentage and descriptive digital presentation forms. In order to reflect the authenticity of the experiment, all the pictures used in the experiment were from the pictures on the official websites of the relevant companies. In order to effectively control the experiment, all the pictures were processed by the CDR drawing software to make all the stimulants consistent in terms of pixel (720X640), font, background, layout and other aspects, At the same time, no interference was ensured in the experimental environment.



4.3.4 Experimental process

In order to ensure the smooth success of this experiment and achieve the expected objectives of the experiment, the research team gave experimental guidance to the subjects before the formal experiment. The subjects' eyes should be kept at a distance of about 60cm from the screen, the eye tracker should be started, the experimental items should be selected, and the experimental instructions should be informed to the subjects. Afterwards, the appropriate test distance should be calibrated and confirmed. This experiment in the first group of proportion type, the second type for the percentage, the third group is descriptive, corresponding to the type of stimulus, each type of seven pictures, in turn, is presented to the subjects, play time setting for each stimulus 30 s, all the participants to participate in the corresponding type experiment, after the experiment, the subjects related to filling out a questionnaire.

4.3.5 Data processing and analysis

Eye-link2000 Eye tracker program automatically records the subjects' Eye movement data when browsing advertisements. With the built-in data processing program of Eye tracker, the original data can be preliminarily integrated and reduced, and the fixation duration, fixation point data files and fixation sequence files can be counted. The data can be output in the form of Excel and converted to SPSS24.0. The data were analyzed by single factor analysis, repeated measurement variance analysis and simple effect test.

(1) Digital presentation form and information processing fluency

In this study, eye-link 2000 eye-link Data Viewer was used for Data analysis, and statistical software SPSS21.0 was used for Data analysis. The results of Eye movement Data analysis were shown in the table. The results showed that (as shown in table 1), the *M proportional type* =20.637, the *M percentage type* =4.197, the *M descriptive type* =0.623, and the proportional fixation duration was the longest. There was a significant difference between the digital presentation form and the fixation duration in the advertising language,  $F=1006.290(P<0.001)$ , as shown in table 2.

**Table 1 Statistical Analysis of Digital Presentation Form and Description of Fixation Duration**

	Average (m)	Standard deviation	Standard error	95% Confidence interval for the mean		Minimum	Maximum
				Lower limit	Ceiling		
Proportion type	20.637	6.025	0.550	19.548	21.726	11.413	37.823
Percentage type	4.197	2.104	0.192	3.817	4.577	1.132	8.813
Descriptivetype	0.623	0.201	0.018	0.586	0.659	0.136	0.993
Total	8.486	9.470	0.499	7.504	9.467	0.136	37.823

*Comment: \*express  $p<0.05$*

**Table 2 Numerical Representation and Anova Analysis of Gaze Duration**

	Sum squares	Degrees freedom	mean squares	F	Sig
Between group	27345.170	2	13672.585	1006.290	0.000
Within group	4850.601	357	13.587		
Total	32195.772	359			

Comment: \*express  $p < 0.05$

Further analysis showed that the independent sample T test of proportional type and percentage type showed that the fixation duration of proportional type was significantly longer than that of the percentile group, and the  $M_{percentile\ type} = 20.637 >$ , and the  $M_{percentile\ type} = 4.197$  ( $t = 28.222$ ,  $p < 0.001$ ). The length of proportional fixation was significantly longer than that of the descriptive group, with  $M_{proportional\ type} = 20.637 >$  and  $M_{descriptive\ type} = 0.623$  ( $t = 36.372$ ,  $p < 0.001$ ). Compared with the descriptive advertising, the cognitive processing of proportional advertising was more difficult and the fixation duration was longer, as shown in table 3 and 4. In general, descriptive digital presentation of advertising information processing fluency, the shortest fixation time, followed by the percentile, proportional digital presentation of advertising information processing to understand the most time, the longest fixation time, hypothesis H1 is supported.

**Table 3 Independent Sample T Test of Viewing Time of Proportional and Percentage Ads**

		Levene poor Equality test		T test for mean equality				
		F	Sig	T	Degrees freedom	Sig(double tails)	Mean difference	Standard error difference
Fixation duration (m)	Assumed equal variance	112.047	0.000	28.222	238	0.000	16.440	0.583
	Don't assume equal variance			28.222	147.596	0.000	16.440	0.583

Comment: \*express  $p < 0.05$

**Table 4 Independent Sample T Test of Viewing Time of Proportional and Descriptive Advertisements**

		Levene poor		T test for mean equality				
		Equality test						
		F	Sig	T	Degrees freedom	Sig(double tails)	Mean difference	Standard error difference
Fixation duration (m)	Assumed equal variance	279.610	0.000	36.372	238	0.000	20.014	0.550
	Don't assume equal variance			36.372	119.265	0.000	20.014	0.550

*Comment: \*express p<0.05*

(2) Digital presentation form and consumer perceived value in advertising language

ANOVA analysis of single factor (digital presentation forms: proportional, percentage and descriptive) showed that there were significant differences in the perceptual function of digital presentation forms  $F=120.624(P=0.045)$ . Further analysis shows that the independent sample T test for proportional type and percentile type shows that the perceived functional value of proportional type is significantly greater than that of the percentile type group.  $M_{proportional\ type}=5.275 > M_{percentile}=4.158$  ( $T=6.976, p=0.036$ ). Independent sample T test was conducted for proportional and descriptive ads. The perceived functional value of proportional ads was greater than that of descriptive ads, and  $M_{proportional\ ads}=4.158 > M_{descriptive\ ads}=2.580$  ( $T=8.861, p<0.001$ ). That is, compared with descriptive ads, proportional ads had higher perceived functional value. In general, the value of the perceived function of advertising consumers in the form of proportional digital presentation is the highest, followed by the percentage, and the value of the perceived function of advertising consumers in the form of descriptive digital presentation is the lowest, hypothesis H2a has been verified.

Univariate analysis was continued, and the results showed that there was a significant difference in the perception and emotion of digital presentation form  $F=60.618(P<0.001)$ . Further analysis showed that the independent sample T test for proportional type and percentile type showed that the perceived functional value of proportional type was significantly lower than that of the percentile group, and that the  $M_{proportional\ type}=2.983$  Independent sample T test was carried out for proportional and descriptive ads. The perceived functional value of proportional ads was significantly lower than that of descriptive ads.  $M_{proportional\ ads}=3.717 > M_{descriptive\ ads}=4.517$  ( $T=-5.392, p<0.001$ ). Advertising consumers with descriptive digital presentation have the highest perceived emotional value, followed by percentile, and proportional digital presentation has the lowest perceived emotional value. Hypothesis H2b is supported.

(3) Information processing fluency and consumer perceived value

Through univariate analysis of digital processing and consumer perceived value, the results show that there is a significant difference between consumer gaze duration and perceived value  $M_{FV}=4.219$  ( $F=1.338, P<0.05$ ),  $M_{EV}=4.616$  ( $F=1.582, P <0.05$ ), the consumer's emotional perceived value is greater than the functional perceived value, as shown in Table 5, therefore, H3a, H3b are supported.

**Table 5 Univariate Analysis of Digital Processing Fluency and Consumer Perceived Value**

Dependent variable	Independent variables	Class III	Degrees freedom	Mean square	F	Sig
		Sum of squares				
FV	Fixation duration	417.624	564	0.740	1.338	0.032
EV	Fixation duration	790.613	564	1.402	1.582	0.011

*Comment: \*express  $p < 0.05$*

(4) The mediating effect of information processing fluency

Using the process plug-in of SPSS software, refer to the Bootstrap method proposed for the mediation effect test (Preacher, Hayes, 2004; Hayes, 2013). The sample size is 5000. Under the 95% confidence interval, the total effect of  $X$  on  $Y$  is 0.3108, 95%  $CI$ : 0.2162 -0.4054,  $P = 0.0000 < 0.05$ , so the total  $XY$  effect was statistically significant. The direct effect of the independent variable  $X$  (the digital representation in the slogan) on the dependent variable  $Y$  (consumer perceived value) is 0.1775, 95%  $CI$ : 0.0817 -0.2733, excluding 0,  $P = 0.0003 < 0.05$ , so the  $X$  pair exists directly Effect; the indirect effect of  $X$  on  $Y$  is 0.1333, 95%  $CI$ : 0.0925-0.1813, excluding 0, indicating that the influence of information processing fluency (gaze duration) on the digital presentation form and consumer perceived value in the slogan is an indirect intermediary. Models, therefore, the fluency of information processing plays a mediating role in the impact of digital representations on consumer perceived value in slogans, so  $H4$  is supported.

**Table 6 Media Processing Fluency Mediation Effect Test**

Model = 4Y = Perceived value X = Digital presentation M = Fixation duration Sample size 630						
Total effect of X on Y						
	Effect	SE	t	p	LLCI	ULCI
0.3108	0.0482	6.4497	0.0000	0.2162	0.4054	
Direct effect of X on Y						
	Effect	SE	t	p	LLCI	ULCI
	0.1775	0.0488	3.6389	0.0003	0.0817	0.2733
Indirect effect of X on Y						
	Effect	Boot SE	Boot LLCI	Boot ULCI		
Fixation duration	0.1333	0.0230	0.0925	0.1813		
Normal theory tests for indirect effect						
	Effect	se	Z	p		
	0.1333	0.0222	5.9941	0.0000		

Comment: \*express  $p < 0.05$

(5) The adjustment effect of product involvement

Through repeated measures analysis of variance for 2 (engagement: high, low)  $\times$  3 (digital representation: percentage, proportional, descriptive), the results (shown in Table 7) indicate: (1) product involvement The main effect is significant ( $F(2,628)=2884.599, p < 0.001$ ); (2) the main effect of the digital representation is significant ( $F(2,628)=2881.888, P < 0.001$ ); (3) product involvement The interaction between degrees and digital representations was significant ( $F(2,628)=2944.881, P < 0.001$ ).

**Table 7 Multivariate Test a**

	Effect	Numerical	F	Assumed degree of freedom	Error degree of freedom	Sig
	Pillai's Trace	0.902	2881.888 <sup>b</sup>	2.000	628.000	0.000
Digital presentation	Wilks's Lambda	0.098	2881.888 <sup>b</sup>	2.000	628.000	0.000
	Hotelling's Trace	9.178	2881.888 <sup>b</sup>	2.000	628.000	0.000
	Roy's Largest Root	9.178	2881.888 <sup>b</sup>	2.000	628.000	0.000
	Pillai's Trace	0.821	2884.599 <sup>b</sup>	1.000	629.000	0.000
Product involvement	Wilks's Lambda	0.179	2884.599 <sup>b</sup>	1.000	629.000	0.000
	Hotelling's Trace	4.586	2884.599 <sup>b</sup>	1.000	629.000	0.000
	Roy's Largest Root	4.586	2884.599 <sup>b</sup>	1.000	629.000	0.000
	Pillai's Trace	0.904	2944.881 <sup>b</sup>	2.000	628.000	0.000
Digital presentation * Product involvement	Wilks's Lambda	0.096	2944.881 <sup>b</sup>	2.000	628.000	0.000
	Hotelling's Trace	9.379	2944.881 <sup>b</sup>	2.000	628.000	0.000
	Roy's Largest Root	9.379	2944.881 <sup>b</sup>	2.000	628.000	0.000
	Pillai's Trace	0.904	2944.881 <sup>b</sup>	2.000	628.000	0.000

a. Design: intercept interior design: digital presentation + product involvement + digital presentation \* product involvement b. accurate statistics

Comment: \*express  $p < 0.05$

In the repeated measurement process, the main effect of the pairwise comparison in the main body adopts the LSD method, and all  $P < 0.001$  (shown in Table 8) indicate that the digital presentation forms are different in comparison, due to the digital presentation form and the product involvement degree. There is an interaction effect between them, and it is of little significance to study the main effect, so it is necessary to study the simple effect.

**Table 8 Pairwise Comparison of the Main Body of Digital Presentation in Slogan**

(I) Digital presentation	(J) Digital presentation	Mean difference (I-J)	Standard error	Sig <sup>b</sup>	95% Confidence interval <sup>b</sup>	
					Lower limit	Ceiling
1	2	6.873*	0.128	0.000	6.622	7.124
	3	4.216*	0.126	0.000	3.968	4.464
2	1	-6.873*	0.128	0.000	-7.124	-6.622
	3	-2.657*	0.042	0.000	-2.739	-2.574
3	1	-4.216*	0.126	0.000	-4.464	-3.968
	2	2.657*	0.042	0.000	2.574	2.739

Measurement: MEASURE\_1 Based on the estimated marginal average

\*. a.The significance level of the mean difference  $p < 0.05$ ; b. Multiple comparison adjustment: minimum significant difference method (equivalent to no adjustment).

c.1=proportion type; 2=percentage type; 3=descriptive type

Comment: \*express  $p < 0.05$

Further analysis of the simple effect of the degree of involvement in the digital representation (shown in Table 9), for the proportional digital representation, the perceived value (FV) of high involvement and low involvement is significantly different ( $P < 0.05$ ), the proportional digital presentation form of high-impactness is lower than the perceived value of low-involvement in the score of perceived function value ( $M_{high} = 4.186$ ,  $M_{low} = 4.354$ ); Form, high-impact degree of perceived functional value score is higher than low-involvement ( $M_{high} = 4.295$ ,  $M_{low} = 4.140$ ); descriptive digital presentation form, high-impact degree of perceived functional value score is lower than low The degree of involvement ( $M_{high} = 4.211$ ,  $M_{low} = 4.235$ ).

For the proportional digital representation, the perceived emotional value (EV) of high involvement and low involvement is significantly different ( $P < 0.05$ ), which is expressed as a high-impact ratio of proportional digital presentations in the perception of emotional value. The perceived functional value of the score below the low involvement ( $M_{high} = 4.606$ ,  $M_{low} = 4.774$ ); the percentile digital presentation, the score of perceived emotional value of high involvement is higher than the low involvement ( $M_{high} = 4.832$ ,  $M_{low} = 4.420$ ); Descriptive digital presentation, the score of perceived emotional value of high involvement is lower than that of low involvement ( $M_{high} = 4.661$ ,  $M_{low} = 4.635$ ), therefore, product involvement Degree has a significant adjustment effect on the digital presentation form and consumer perceived value in the slogan. The contours of perceived functional value and emotional value are shown in Figures 4 and 5. Therefore, H5, H5a and H5b are supported.

**Table 9 Analysis of the Simple Effect of Digital Presentation, Involvement and Perceived Value in Slogans**

Dependent variable	Group	Involved in degrees	Average	Standard error	95% Confidence interval	
					Lower limit	Ceiling
FV (Function Value)	Proportion type	low	4.354	0.120	4.118	4.590
		high	4.186	0.069	4.051	4.322
	Percentage type	low	4.140	0.089	3.965	4.316
		high	4.295	0.080	4.137	4.453
	Descriptive type	low	4.235	0.076	4.086	4.384
		high	4.211	0.098	4.019	4.402
EV (Emotion Value)	Proportion type	low	4.774	0.163	4.454	5.094
		high	4.606	0.094	4.422	4.790
	Percentage type	low	4.420	0.121	4.182	4.659
		high	4.832	0.109	4.617	5.046
	Descriptive type	low	4.635	0.103	4.434	4.837
		high	4.661	0.132	4.401	4.921

*Comment: \*express  $p < 0.05$*

## 5 Conclusion and Discussion

### 5.1 Research conclusions

This study combined with involved in degrees and slogan in digital form design and implementation of eye movement experiment, specific conclusions as follows: 1) the slogan of the digital representation of consumer information processing fluency (at time) have a significant impact, descriptive digital presents the best forms of advertising information processing fluency, looking at the shortest time and the second is the percentage type, proportion type digital advertising information processing to understand most time, looked at the longest; 2) the digital presentation has a significant impact on the perceived value of consumers in advertising language. The proportional digital presentation has the highest perceived value of consumers and the lowest descriptive value. In terms of emotional perceptive value, descriptive digital presentation is the highest, while proportional digital presentation is the lowest. 3) consumers' information processing fluency (duration of fixation) has a significant impact on consumers' perceived value. Consumers' emotional perceived value is greater than their functional perceived value; The information processing fluency of consumers plays an intermediary role in the influence of the digital presentation form on the perceived value of consumers. 4) products are involved in degree of AD appear in digital form and the consumer perceived value has significant regulation, consumer products are involved in degree is higher, the proportion and describes the digital presentation of advertising function, the lower the perceived value and emotional value perception, full digital presentation of advertising function value and emotional value, the higher the

perception.

## 5.2 Theoretical contribution

The theoretical contributions of this paper are mainly reflected in three aspects: 1) this study introduces the computational neuroscience model of information processing fluency, and introduces the new variable of information processing fluency into the creative research field of advertising language. Through interdisciplinary research, the research variables and content of advertising language creativity are further enriched. 2) the results of this study show that the interaction between the digital presentation mode of advertising language and the smoothness of consumers' information processing significantly affects consumers' perceived value of advertising language and advertising effect, which has an important enlightening effect on the creative research of advertising language, consumers' advertising attitude and advertising effect. 3) this study enriches the research foundation of digital presentation mode and digital effect of advertising, and provides the research foundation for further research on digital presentation mode and advertising creativity.

## 5.3 Management enlightenment

The practical significance of this study provides a reference for the advertising creativity of enterprises. As digital cognition is accepted by more and more consumers, digital elements are widely used in advertising creativity. Brand owners should fully combine product features to select appropriate digital presentation methods for advertising creativity. Type slogan in the percentage of Numbers of consumer perception, the best advertising effect is the most ideal, full digital presentation form both proportion and descriptive representations, the advantages of clear semantic contrast, can be described, with the universality of the obvious, such as "HuiYuan juice 100%", "FeiHe crane high-end sales growth of 200% milk powder", not only can accurately and clearly express product demands, more can promote brand essence and influence.

## 5.4 Research limitations and future research prospects

Although this study to further study of the AD in the digital presentation styles influence on consumer perceived value, the value and the research conclusion, but there are still some shortcomings, mainly has the following several aspects: 1) the subjects of this study are college students, they are willing to accept new things, but also to have certain limitations, their cognition of the product or demand will affect the popularized in other audience, this study will discuss other types of subjects in the AD digital presentation of sensory evaluation; 2) the experimental materials in this study were selected according to the product involvement, without taking into account the factors of product type. For example, the digital presentation of functional and entertainment products in advertising slogans will definitely have a significant difference in the perception of consumers. 3) the limited subjects and experimental materials in this study affect the accuracy of eye movement experimental data to a certain extent. In the future, the experimental materials will be enriched and the number of eye movement subjects will be increased, so as to further optimize and improve the conclusions of this study.

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## Study on Factors Affecting Continued Usage Intention of Mobile News Apps in India

Saurabh Sharma<sup>1</sup>, Cheng Yanxia<sup>1</sup>, Prashant Sharma<sup>2</sup>

1 School of Management, Wuhan University of Technology, Wuhan, P.R. China, 430070

2 Jaipuria Institute of Management, Jaipur, Rajasthan, India, 302033

(E-mail: sharma.saurabh02@gmail.com, chengyanxia221@126.com, prashantsharma1989@gmail.com)

**Abstract:** Mobile news apps are the latest technological innovation to keep users' abreast with latest news and trends. However, there has been sudden spurt of news apps in the market with every media organization bringing out their own mobile apps. Making users' to stick to one and keep them hooked for longer period has become a major challenge for each organization. Therefore, considering the attributes of news apps in the Indian context, based on UTUAT 2 model, this study suggests that effort expectancy, facilitating conditions and habit have a significant effect on users' continuous usage intention of news apps. Furthermore, these attributes have been empirically tested, proved and further discussed in the study. The study provides a theoretical contribution and practical implications that are relevant for the stakeholders working in the area of mobile news apps in India.

**Key words:** Mobile news apps; Continued usage intention; UTUAT2; India

### 1 Introduction

Rapidly increasing smartphone users have spurt the growth and rising use of mobile applications (apps). Mobile apps are now integral part of daily life, meeting our various needs for any plausible purpose (Kim et al., 2013). The use of mobile apps will continue to grow with the expansion of smartphone device users, estimated to reach up to 5.5 billion by 2022. India is no exception where apps are rapidly proliferating and have embedded into the daily lives of most Indians. The mobile app usage in India has outpaced the global growth. According to App Annie, an analyst and business intelligence firm, India has the second-largest number of mobile app downloads in the world, overtaking the US and trailing only China. The report further states that, the app downloads grew by 215% in 2017 and, on an average, Indians use more than 40 apps in a month, while having a total base of close to 80 apps.

Among all, mobile news apps remain one of the most popular applications. News apps deliver news and media firms, newspapers and news aggregators have created apps that facilitate access to information on mobile device. With the enhancement of mobile devices, users are more likely to receive information in fragments through these instruments (Wu et al., 2013). News, intrinsically, is a special form of information that is random, diverse, processed in real time and is relatively different from specific themes like learning material. Because of this nature, users do not have access to a common channel for searching their preferred news. The effective solution is to provide personalized recommendation systems based on their unique characteristics, preferences, interests and trading records (Ye et al., 2019). Daily Hunt, In shorts, News Dog, Flipboard are news recommendation apps based on data mining that provide personalized information to users.

However, this clutter of apps leads to the complexity in consumers' minds and reduces their loyalty towards mobile apps (Malik et al., 2017). For a user there are varied options available to switch or shift between different mobile apps. Downloading of an app is just a first step towards success of a service, attracting and retaining new users is the most critical (Chang et al., 2014). There are various ways to encourage user adoption of an innovation, the long-term sustainability of a new information system relies on users' continuance behavior than on their initial adoption decisions (Venkatesh et al., 2011). Therefore, it becomes important to study users' continuance intention and explore determinants of users' intention to continue using mobile news app. This study explores the factors that influence the continuous usage intention of the mobile news apps, proposes a conceptual model

and tested those dimensions empirically. In general, this study is exploring the critical antecedents in users' continuous intention in the context of mobile news apps in the Indian context.

The rest of the paper is organized as follows: Section 2 reviews existing literature relating to this study and based on that hypotheses are developed. Section 3 discusses the methods used in data collection analysis. Section 4 enumerates all the findings and it contains the discussion. Finally, section 5 concludes the study and lists some recommendations.

## 2 Literature Review and Hypotheses

Researchers have paid much attention in identifying and measuring mobile app users' behavior. Information System (IS) adoption theories such as Technology Acceptance Model (TAM), Theory of Reasoned Action (TRA) and Theory of Planned Behavior (TPB) have been used as theoretical basis. TAM was proposed by (Davis, 1989) in which he introduced two determinants, perceived usefulness (PU) and perceived ease of use (PEOU) that influences individuals' behavior to use a system. Due to its parsimony TAM has been widely used to explain apps adoption (Kang, 2014 , Kouser et al., 2014). TRA proposed attitude and subjective norms as the determinant that influences users' behavior (Fishbein and Ajzen, 1975) while in TPB, Ajzen (Ajzen , 1991) added perceived behavioral control as another determinant. However, both TRA and TPB being offline-based theories have limitation in their application to online context (Howard Chen and Corkindale, 2008).

By integrating eight most popular theories, including TRA, TPB and TAM, Venkatesh et al. (Venkatesh et al. , 2003) postulated Unified Theory of Acceptance and Use of Technology (UTAUT). It proposed four antecedents, performance expectancy, effort expectancy, social influence and facilitating conditions as the main factors determining user adoption. Several researchers, to explain the acceptance of mobile apps (Lee et al., 2012) empirically tested UTUAT including shopping apps (Chopdar et al., 2018). Later UTAUT model extended to UTAUT2 (Venkatesh et al., 2012), adding hedonic motivation, price value and habit as additional antecedents to study technology adoption from consumer perspective and is preferred due to high predictive power. Since UTUAT2 covers the constructs that are intrinsic to both utilitarian and hedonic apps along with applicability of it was shown in relation with shopping apps in India (Tak and Panwar, 2017), this theoretical model has been considered for our study. However, this study has, excluded price value construct as news apps are available free to download and has no price consideration involved.

Fig. 1 shows the six factors (performance expectancy, effort expectancy, social influence, facilitating conditions, hedonic motivation and habit), as suggested in UTAUT2 are proposed in our model.

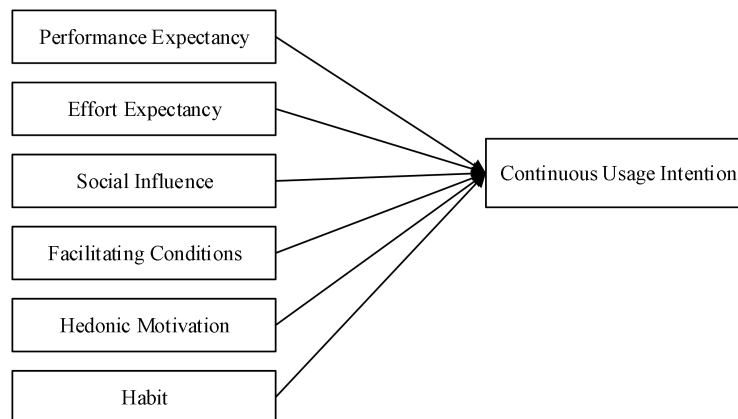


Figure 1 Conceptual Model

Performance Expectancy (PE) refers to ability of the news apps to help users' in achieving what they want in a more convenient and productive manner. Customers will have an intention to use a system, which they perceive will save time and effort than the traditional one. If news apps provides information more conveniently, users' will have a positive reaction to continue using it. Effort Expectancy (EE) defined as the degree of ease associated with the use of the technology under consideration. If users' find the news apps easy to handle without any help or assistance, they will be more inclined to use that app. Thus, customers' intention to continue using a news app will be shaped by an extent to which they find it easy and uncomplicated. Social Influence (SI) reflects the effect of important people's opinion on individual user behavior. Users' tend to comply with the other peoples outlook whom they consider are important. In using mobile news apps, people will follow voice of others that will shape their intention to use it. Facilitating Conditions (FC) means that users' have the necessary knowledge and resources to use the given technology. Since, mobile news apps are a software that run on smartphones and not very useful without proper internet connection. Moreover, FC also refers that users' can use the technology without any technical glitches combined with high quality of service care. All these factors effect user's intention to use news apps. Hedonic Motivation is a new construct introduced in UTAUT2 and is defined as the fun or pleasure derived from using technology. Feelings of pleasure and playfulness is also linked to the extent of innovativeness, creativeness and novelty in using mobile news apps. Hence, it argued that if news apps are creative, novel and bring joy, users' will be inclined in using it. Habit is the extent to which people tend to perform behaviors automatically because of learning. It is users' spontaneous response based on their previous experience. In the context of mobile news apps it refers, role of habit is crucial as consumers will use apps in future based on their on their experience which comes from regular using of apps. Thus, we hypothesize that

**H1: PE will have positive impact on users' continuous usage intention of mobile news apps.**

**H2: EE will have positive impact on users' continuous usage intention of mobile news apps.**

**H3: SI will positively influence user's continuous usage intention of mobile news apps.**

**H4: FC will positively influence users' continuous usage intention of mobile news apps.**

**H5: HM will positively influence the continuous usage of mobile news apps.**

**H6: Habit will positively influence the continuous usage of mobile news apps.**

### 3 Methodology

Data for this study collected from two major Indian cities, New Delhi and Jaipur through a standardized questionnaire distributed among 100 people. To find the continuous usage intention of mobile news apps, it was required that users' must have adopted news apps before, hence, survey included only those who have been using these apps. The statistical package for social science (SPSS) to carry out to achieve the objective of research. The reliability test, factor analysis and linear regression was used to find the relations between variables. Research model includes seven factors and each factor was measured with multiple items adopted from Venkatesh et al. (Venkatesh et al., 2012) This includes three for PE, SI, HM, HT and CUI and four for EE and FC.

### 4 Analysis and Discussion

#### 4.1 Factor analysis

The first stage involved explanatory factor analysis (EFA) of six independent variables to have an initial overview of the latent variables and delete or modify the redundant items. We used principal components analysis with Varimax rotation. The 20 items resulted in 6-factor solution with 14 items loading above 0.55 (Table 1). Based on poor loadings, we removed six items belonging to two constructs i.e. PE and HM. The internal consistency reliability (measured through Cronbach's Alpha) of remaining four factors were above 0.6 for the 20 items solution, confirming high correlation and reliability among each items under reaming four constructs.

**Table 1 Factor Loading and Cronbach's Alpha of the Variables**

Constructs/Items	Factor Loading	Cronbach's Alpha
SI1	.913	.943
SI2	.906	
SI3	.917	
EE1	.642	.862
EE2	.816	
EE3	.672	
EE4	.668	
FC1	.801	.848
FC2	.843	
FC3	.709	
FC4	.747	
HT1	.727	.749
HT2	.766	
HT3	.759	

#### 4.2 Correlation results

Bivariate correlations of four of the predictor variables with continuous usage intention (CUI) were statistically significant and in the hypothesized direction. As illustrated in table 2, Effort Expectancy was positively related to the continuous usage intention of mobile news app and highly significant ( $r = .506, p < .01$ ). Thus, the second hypothesis (H2) was supported by the research. Social influence, however, was found statistically insignificant as ( $r = .139, p > .05$ ). Hence, H3 was not supported in the research. Facilitating Conditions (FC) in the mobile news apps was also positively correlated with CUI having a significant value of ( $r = .427, p < .05$ ). Similarly, habit (HT) was also positively correlated with CUI with, although with significantly values at 90% ( $r = .252, p < .10$ ). It can be assumed that HT is a predictor even if not a very strong one and hence our H6 was supported in the research.

**Table 2 Correlation Results of the Variables**

Variable	SI	EE	FC	Habit	CUI
Social Influence (SI)	1				
Effort Expectancy (EE)	.000	1			
Facilitating Conditions (FC)	.000	.000	1		
Habit (HT)	.000	.000	.000	1	
Continuance Intention (CI)	.139	.506***	.427**	.252*	1

\*\*\*1%, \*\*5%, \*10%

#### 4.3 Regression Results

Regression analysis helps us to find the relationship among the variables. The process reveals us how dependent variables change when any one of the independent variables varied. In a bid to reaffirm the test on the behavioral factors on continuance usage intention, regression model was assessed using variance explained ( $R^2$  measures) and the level of significance of the beta coefficients. Equation used for the regression analysis between depended and independent variables is:  $CUI = a + \beta_1 \times w + \beta_2 \times x + \beta_3 \times y + \beta_4 \times z + error$ , (where 'w' represents SI, 'x' represents EE, 'y' signifies FC and 'z' is HT). Table 3 shows the results. The results indicate that effect of CUI on SI is insignificant ( $\beta = .11, p > .05$ ). While, effort expectancy ( $\beta = .41, p < .01$ ) and facilitating conditions ( $\beta = .35, p < .01$ ) were highly significant and have substantial effect on the CUI of mobile news apps. Factor HT ( $\beta = .20, p < .05$ ) also observed to be effecting CUI. The  $R^2$  of the variables indicates that the model explains 52.1% of the variance.



**Table 3 Result of Regression**

	<i>Coefficient</i>	<i>t-Value</i>	<i>P-Value</i>
(Constant)	3.660***	43.380	.000
SI	.115	1.349	.184
EE	.418***	4.901	.000
FC	.353***	4.142	.000
HT	0.208**	2.443	.019
Adjusted R <sup>2</sup>	0.478		
F-Statistics	12.24***		0.000

\*\*\*1%, \*\*5%, \*10%

## 5 Conclusion

This study was an attempt to explore and develop understanding the aspects that could shape Indian users' continued usage intention of mobile news apps. Based on the extant literature review, UTAUT2 model was found to be suitable theoretical foundation for the proposed conceptual model and carry out the research work. In this model PE, EE, SI, FC, HM and HT were predicted to have positive effect on continued usage intention of mobile news apps. The data was collected from actual adopters of news apps in India. The data was analyzed using SPSS and results confirmed that EE, FC and HT factors have influence on CUI of mobile news apps while SI was observed to be insignificant in our study. The two other factors PE and HM dropped from the analysis because of their poor factor loading in factor analysis. Thus, if news apps developers focuses on EE, FC and HT aspects of apps, it will enhance users' continuous usages of those apps. This study provides a theoretical and practical contribution to key stakeholders and practitioners working in the area of mobile news apps.

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# Research on Bio-Information Risk Identification Management under Big Data Environment

Chen Ruiying<sup>1</sup>, Zhang Haili<sup>2</sup>, Shen Jun<sup>2</sup>

1 College of Informatics, Huazhong Agricultural University, Wuhan, P.R. China,430070

2 School of Management, Wuhan University of Technology, Wuhan, P.R. China,430070

(E-mail: RuiyingChen@webmail.hzau.edu.cn, 1050251455@qq.com, sjarr@whut.edu.cn)

**Abstract:** Under the big data environment, standardized mass bio-information can provide useful resources for medical development, scientific research, and clinical treatment. However, there are various risks in the collection, classification, storage and application of standardized biological information. Therefore, it is necessary to identify the possible risks of bio-information in the big data environment, and then to propose targeted bio-information risk management strategies, including controlling the risk of collecting biological information, controlling the risk of biological information processing, controlling the risk of biometric information storage, and controlling the application of risk to biological information.

**Key words:** Big data; Bio- information; Risk identification; Risk management

## 1 Introduction

The White Paper on Standardization of Big Data (The White Paper on Standardization of Big Data,2018) jointly prepared by the China Electronics Technology Standardization Institute and other units pointed out that China is in the transition period of digital economic development, and the disclosure, sharing and service of information have become the theme of the development of the times. Establish a multi-level precision medical knowledge base system and a national biomedical big data sharing platform, and carry out research on key technologies of precision medical core such as next-generation gene sequencing technology, omics research and big data fusion analysis technology, and promote the transformation of medical diagnosis and treatment mode. The combination of biological information and databases will greatly promote the development of research in all areas of life sciences and therefore plays an important role (Stein, 2013). At the same time, the results of the bio-informatics database not only have important theoretical value, but can also be directly applied to industrial and agricultural production and medical practice (Chiappelli et al., 2018). The standardization of bio-informatics big data has become one of the main contents in the “scientific research” section of important application areas. Because with the opening of the era of precision medicine, more and more researchers use biological information for scientific research or medical clinical, they design and manipulate the collection, processing, storage, application of biological information for future research or clinical use (Nagai et al., 2018).

However, biological information is highly correlated with the privacy of the information provider, and it is susceptible to the objective environment and is likely to be subjective or objectively manipulated by information operators (Balenton et al., 2017). If it is managed improperly in any part of the bio-informatization process, there will be considerable risks. Although some problems caused by

unclear identification and mismanagement of bio-information risks have rarely been reported, the fears caused by them have already existed. Experts and scholars have also conducted some research. Some scholars believe that biological sample database information from the perspective of security management Safety management is a multi-faceted, multi-factor dynamic process (Lang Tao et al., 2014). Therefore, the author believes that adopting the ISO27001 standard and conducting information security evaluation is one of the important basic tasks for establishing a reliable biological sample library. Other scholars believe that the biological sample library safety management system plays an important role in the management of security incidents. Personnel safety, sample security and information security issues cannot be ignored (Ge Meiling et al., 2018). With the advent of the post-genome era, many aspects of the industrialization and sustainable development of biological sample banks should be re-explored clearly defined, content and scope of application (Man Qihong, 2018).

Therefore, from the perspective of personal information protection in biological databases, it is practical to study the dilemma and outlet of the principle of informed consent in the era of big data (Shanfang et al., 2019). Based on the concept of balance between protection and utilization, the new type of informed consent model that adapts to the needs of big data should be skillfully designed and transformed from a uniform agreement to a hierarchical consent based on information classification and scenario risk assessment (Peng et al., 2019). Based on the current research status of bio-informatics risk management, scholars have studied bio-safety issues, informed rights issues, and bio-informatics database construction from their respective research fields and perspectives (Végyári et al., 2011) (Vaught, 2016). The current research results are based on the systematic research of bio-informatics risk, especially bio-informatics risk identification in the big data environment. Bio-informatics risk management needs to start from the risk identification and propose the research plan in order to solve the bio-informatics risk systematically. Management and control issues, so the research in this paper is urgent and necessary.

## **2 The Status of Biological Information and Its Risk Management under the Background of Big Data**

### **2.1 Status of biological information management under the background of big data**

Biological information mainly refers to health and disease organs, tissues, whole blood, plasma, serum, body fluids or treated derivatives such as DNA, RNA, proteins, etc., as well as clinical, pathological, therapeutic, follow-up, and related to these biological samples. Informed consent, ethical approval and other information. Big data has the characteristics of large amount of data, various types, low value density, fast speed, and high timeliness. Since the concept was proposed, it has gradually applied in the fields of physics, biology, and environmental ecology. In the process of standardized collection, processing, storage and application of massive amounts of biological information in the context of big data, the development and management characteristics of biological information and its sample database are summarized as:

(1) The standardization of the biological information sample library has a long way to go. The standardization of the biological information sample library is essentially a rule for sharing and reusing the activities of the biological sample library, biological samples and their data information. The realization of the standardization construction of the biological information sample library must be carried out from the application before the sample collection, ethical review, informed consent, processing, annotation, storage during collection, to packaging, transportation, use, destruction, etc. after collection. Standard formulation and implementation.

(2) The operation and sharing of the biological information sample library has taken shape. In China, the operation and use of biological sample banks are closely linked. At present, there are three main methods for the operation of biological sample banks. The first is the establishment of a biological sample library led by specific project operation. The second one is the establishment of a biological sample library led by related institutions. The third is establishment of a biological sample bank. Regarding the sharing of bio-information sample libraries, an effective paradigm has not yet been formed, so there will be a certain extent that the bio-information sample library resources can be repeatedly constructed, the usage rate and the sharing rate can be improved.

(3) Sustainable development requires continuous investment. The construction and maintenance of the biological sample bank requires cost input, rationally formulate the paid use service value system of the biological sample, and reasonably collect the paid use fee of the biological sample resource for the operation and maintenance of the biological sample bank, which is the resource for realizing the biological sample. Value attributes and effective ways to ensure the sustainable development of biological sample banks.

## 2.2 Overall framework of bio-information risk management

In the context of big data, in the process of standardized collection, processing, storage and application of biological information, all aspects may encounter uncertainty and pose certain risks to users of biological information. According to the risk management theory, these risks are controllable to a certain extent and scope, and have the significance and necessity of risk management. Therefore, according to the classic risk management framework and path, the overall framework of bio-information risk management in the context of big data is designed (see Figure 1).

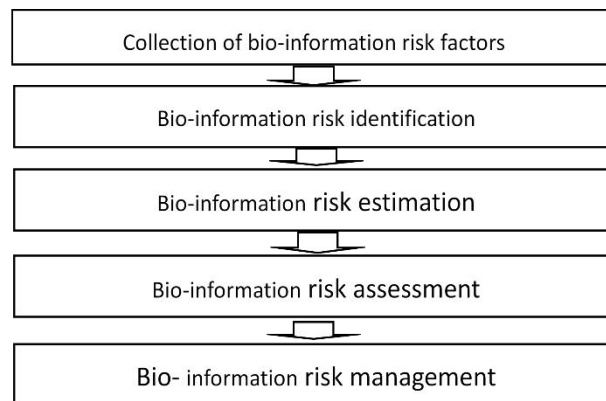


Figure 1 Overall Framework of Bio-Information Risk Management

## 3 Bio- Information Risk Identification Objects and Types

Under the big data environment, the main functions of the bio-information database include: informational biological sample resources, virtualized retrieval and remote monitoring, etc. Some scholars have classified the information of the biological information base as shown in Table 1.

**Table 1 Classification of Information in the Biological Sample Library**

classification	Contents
Sample data	Electronic data: biological sample information Paper data: medical history file
Data application	Stand-alone program: desktop system, office software Cloud data program: cloud data application, remote control program Program: executable program, biological sample library solution provider software
Equipment and facilities	Network facilities: wired or wireless router, LAN Office equipment: servers, desktops, laptops Mobile devices: mobile storage devices (U disk), digital cameras, voice recorders Security facilities: computer firewall, fingerprint authority system
Support and guarantee	Support staff: Biological sample library system support staff Network service: provided network connection service (telecommunications) Third-party services: services enjoyed by purchased products

Source of the table: Lang, T., Zhou, C. Z., & Xu, X. W. (2014). Information Risk Assessment of Biological Samples Database Based on ISO27001 System. *Chinese Medicine Biotechnology*, 6, 228-230 (In Chinese)

However, more scholars have been combined the research results of bio-information database, considering the research scope and research focus of the paper, this paper focuses on the information risks that may be generated in the process of obtaining “sample data” in Table 1, bio-information. Standardize the risks that occur during collection, processing, storage, and application.

(1) Risk of bio-information collection. After the bio-information big data standardization, the bio-information collection work bears the brunt, but in the process of bio-information collection, the biometric information collected may be unreal or polluted due to improper operation, instrument error and some people providing error information. This possibility is the source of a series of subsequent risks. If not handled properly, it will generate risk transmission along the use of biological information.

(2) Risk of bio-information processing. According to the ultimate goal of the use of biological information, the biological information processing process includes specific steps such as calculation, classification, and packaging. Each link may have uncertainty, and ultimately it is the risk of biological information processing.

(3) Risk of bio-information storage. Under objective conditions, biological information storage requires special temperature, humidity, and other environmental conditions. Under appropriate storage conditions, biological information is not easily destroyed. However, the occurrence of any microscopic factor in the storage process will change the nature or characteristics of biological information. In addition, the risk of biometric information storage also comes from human factors, such as the risk caused by the internal control system of the company or hospital.

(4) Risk of bio-information application. After obtaining the biological information, the information needs to be analyzed according to the final use. The precision of the analytical instruments involved in the analysis process and the professionalism of the analysts will have an impact on the final analysis results. Professional analysts use sophisticated analytical instruments, and the probability of bio-information analysis risk is not small or small; on the contrary, not very professional analysts use less sophisticated analytical instruments, the probability of bio-information risk occurrence will greatly increase.

## **4 Bio-Information Risk Management and Control Recommendations in a Big Data Environment**

### **4.1 Controlling the risk of collecting biological information**

Information on biological information samples and sample donor disease diagnosis and outcomes plays a very important role in research and clinical treatment. In the process of collecting sample information, firstly confirm the authenticity of the source of the biological information sample, including the basic information of the clinic. Second, to ensure the security, integrity, and legitimacy of the equipment, information systems, and operational processes used in the information gathering process.

### **4.2 Controlling the risk of biological information processing**

In the big data environment, the processing of biological information should establish a corresponding information processing system to improve processing efficiency and reduce the probability of occurrence of risks. Automatic acquisition of clinical information through the interface improves the collection efficiency, avoids errors caused by human factors, and makes the collected information more complete, accurate and effective. However, when the BIMS system is relatively independent or lacks a larger supporting platform, it will produce defects in which the biological information samples are incomplete. In order to avoid the risk of human information processing as much as possible, it is possible to control the occurrence of corresponding risks by formulating corresponding systems.

### **4.3 Controlling the risk of biometric information storage**

In view of the reasons for the risk of bio-information storage analyzed in the previous section, the risk source from objective physical aspects in the big data environment is gradually reduced, and the risk management should mainly focus on risk control from human factors, the most important of which is internal control. The company first established an internal control mechanism for bio-information control, optimized the internal control management system, and increased publicity to create an internal control culture and atmosphere.

### **4.4 Controlling the application of risk to biological information**

The sample library manager should first review the identity of the biometric information user for verification. After confirming the error, the sample transfer condition is notified in advance according to the storage conditions of the outbound biological information sample. When the biological information sample is released from the warehouse, an employee confidentiality agreement must be signed with the relevant staff to protect the privacy of the bio-information owner and user.

## 5 Conclusion

Biological information is not only an important resource for individual economic activities, but also a strategic resource of the country, which contains great application value. The standardization of biological information in the big data environment, as well as the collection, processing, storage and use of biological information, give it new features. While making full use of its massive data, convenient use, fast and cheap, it must be fully realized. It is of practical significance to propose various measures for the risk of bio-information. In the future, more quantitative research methods can be used to evaluate and classify various risks, and the research perspective of bio-information risk management will be expanded to form more systematic research results. There are various risks associated with the collection, classification, storage and application of standardized biological information. Therefore, it is necessary to identify the possible risks of biological information in the big data environment, and then propose a targeted bio-information risk management strategy. And this paper proposes to establish a biological information base and a corresponding information processing system to improve processing efficiency and reduce the probability of occurrence of risks. In future research, it is necessary to further strengthen the influence factors of different risk of bio-information. The reform of the governance system will improve the efficiency of risk prevention and control, and provide a necessary reference for the decision-making of relevant government departments.

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# Research on Grid Management Mode Application in College Student Management in New Era

Qu Shuaifeng

Automotive Engineering College, Wuhan University of Technology, Wuhan, P.R. China, 430070  
(E-mail: 104582674@qq.com)

**Abstract:** With rapid development of Chinese economy and society and deepening education system reform, new challenges and requirements college are emerging in college student management. This paper introduces grid management mode into college student management and proposes a relative concept in new era. It analyzes necessity and feasibility of college student grid management by taking Wuhan University of Technology (WHUT) as an example, and conducts research on grid management mode application in college student management in new era.

**Keywords:** Grid management; Student management; Information technology; Informationization

## 1 Introduction

General secretary Xi Jinping emphasized at National Education Conference that "we must deepen higher education system reform to establish a higher-level talent cultivation system, and to cultivate socialist builders and successors who are well developed in morality, intelligence, physique and aesthetics." College student management plays a key role in college talent cultivation system. With rapid development of Chinese economy and society and the deepening education system reform, traditional college student management mode cannot fully meet the requirements of the new era, and college's ideological, political, security and stability constructions are under great pressure. As an emerging concept in management practice in recent years, grid management is an effective mode for disposing complicated management affairs. It is of great significance both in theory and practice to be introduced into college student management exploration. Yu and Robertazzi (Yu and Robertazzi,2003) pointed out that grids own spatial characteristics, which can be divided and managed virtually. Friedrich et al. (Friedrich et al.,2007) held that the application of grid theory can improve government's serving ability and people's happiness. After comparing and analyzing community grid management practices in Beijing, Shanxi and Shandong, Chen and Xiao (Chen and Xiao,2015) explored to establish urban community grid management with service and democracy that based on science and technology. Qiao (Qiao,2018) conducted research on application of grid theory to student security management in independent colleges and analyzed its necessity and feasibility, and established a grid organization model of college student security management. Liu (Liu,2019) analyzed current situation of grid management in Qinhuangdao in Hebei province with suggestions on existing advantages and disadvantages.

At present, grid management has been deeply studied at home and abroad. Although the research fields are different, it is agreed that grid management is an efficient and advanced management tool and means. At present, grid management is mainly applied in urban governance. The study (Hong and Zhang, 2017) show that grid management can improve the ability of urban governance, while urban governance is similar to efficient student management. It is scientific enough to apply grid management to university student management. At present, there are few studies on the application of grid thinking in

university student management. It is of great theoretical value and practical significance to introduce the concept of grid management into the management of college students and explore the model of grid management of College students.

## **2 Challenges Faced by College Student Management in New Era**

### **2.1 Challenge from education system reform**

In September 2017, the instruction issued by General Office of the CPC Central Committee and General Office of the State Council pointed out that “the institutional mechanism for promoting development of higher education connotation shall be strengthened” . Compared with traditional extensional development mode, the connotative development mode focuses on talent cultivation quality, scientific research achievements and contribution to the society (Li et al. 2018). It highlights the dominant role of college teachers and students with more autonomy. With the deepening higher education system reform, traditional assessment system will be gradually replaced by new credit system and major-minor system, which will enable students to develop in a comprehensive way. They can select courses, teachers and dormitory independently. However, students cannot figure out direction if they are not guided by appropriate education, which put forward new requirements on college student management. Meanwhile, new management mode shall adapt to new education system, which will bring severe challenges to the traditional college student management.

### **2.2 Challenges brought by changing student characteristics**

Characteristics of college students in new era have undergone significant changes (Bao and Sun, 2018). In 2018, the “Post-2000s generation” students have entered college campus. At present, both “Post-1995 generation” and “Post-2000s generation” are dominant groups in college with common characteristics: strong sense of autonomy but weak independent living ability. With improved material life, they pay more attention to spiritual pursuit and autonomy to make their own decisions. However, affected by exam-oriented education system, some students are lack of independent living ability. They own strong self-confidence, curiosity, but poor psychological enduring capacity. The popularity of the Internet encourages them to express bravely, and get used to being praised. But they have weak determination and confidence to overcome difficulties. They become more utilitarian with strong capacity and intelligence. Influenced by the overall environment, college students in the new era are smarter and more capable. However, they are also more utilitarian due to the influence of the market economy. When they participate in some activities, they will consider what they can get first. As the object of the management, the changing characteristics of college students will also pose challenges to traditional college student management.

### **2.3 Challenges brought by "Internet Plus" era**

With rapid development of mobile Internet and information technology. On one hand, educational informatization, especially higher education informatization, lags behind other social public services. College student management Informatization is not fully realized in most colleges and universities (Feng et al. 2018). Some colleges have installed a closed student management system that only can record and check simple information. It cannot achieve real-time access and utilization analysis of all kinds of comprehensive information of students. On the other hand, as Internet aborigines, "Post-2000s generation" has realized deep Internet integration, especially the popularity of smart phones has completely changed their way of living, working and learning (Zhang et al. 2019). Therefore, "Internet Plus" era will certainly bring new challenges to college student management.

### **3 Related Concepts of College Student Grid Management in New Era**

#### **3.1 Grid and grid management**

Grid is an emerging technology that built on the Internet. It integrates high-speed Internet, high-performance computers, large databases, sensors, and remote devices together to provide more resources, functions, and interactivity for scientists and ordinary people (Wang et al. 2017). Grid enables people to use other resources such as computing and storage transparently to realize comprehensive sharing of computing resources, storage resources, data resources, information resources, software resources, communication resources, knowledge resources, and expert resources, etc.

Inspired by computer grid management, grid management divides objects into several grid units according to certain criteria. Modern information technology and coordination mechanism are used to realize effective information communication, resources organization to finally integrate organizational resources and improve management efficiency. The core idea of grid management is to reflect user submission simplicity and accuracy and grid responding speed.

#### **3.2 Community grid management**

Community grid management is the innovation of grassroots management mode. It divides community into several grid units according to geographical environment, population density and other conditions on the principle of convenient management. Advanced information technology is used as an auxiliary means to introduce new management concepts to community. The person in charge of the grid is responsible for providing services to the residents in the grid. Each grid will form a large network and realize community information sharing, high-class community management and public services.

#### **3.3 Student community grid and behavior grid**

Student community grid is a vertical physical grid formed by student parks, buildings, and dormitories that inspired by academy management system. It is an important carrier of self-management or administrative activities carried out for specific needs such as maintain order, satisfy material and spiritual demands inside student community (Zhang and Yan, 2017).

Student behavior grid is a horizontal information grid that based on student behavior characteristics, which inspired by grid management. It is an organic connection of students' information generated by learning, living, and working on campus as well as an important guarantee for realizing information sharing, analysis and utilization.

#### **3.4 College student grid management in new era**

The college student grid management in new era is based on rapid development of mobile internet and information technology. It utilizes basic principles and management methods of grid management to build student community and behavior grid. It achieves efficient student management and adapts to their growth and development by integrated information resources, improved organizational structure and optimized business process. Student grid management will facilitate efficient integration of college resources, smooth communication among student groups, and the implementation of “student-oriented, service-oriented, combination of education and management” philosophy. Management will be realized in service, while it will also reflect service and education accordingly. The Informa ionization, standardization, refinement and systemization of student management will provide students with personalized service and educational guidance.

## **4 Necessity and Feasibility Analysis of College Student Grid Management in New Era**

### **4.1 Practical demand of highlighting “Student-oriented” philosophy**

To form a higher level talent cultivation system, the "student-oriented" philosophy should be insisted firmly (Wu, 2016). Adhering to this philosophy in college student management can effectively cope with new challenges and promote comprehensive, sustainable, individualized development of students as well as the construction of a harmonious teacher-student relationship. It also meets the same requirements of humanized management advocated by grid management. The grid management mode can turn traditional student management into personalized management, which fully consider characteristics and personality of students and better serve them to grow and reach their prime.

### **4.2 The objective requirement to improve college managing ability**

At present, Chinese colleges adopt bureaucratization management mode, which based on rigid system that constraint by a single method. During this process, the constraint is emphasized from top to bottom while student personality and feedbacks are ignored. The existing management mode adopts "parental" thought to manage students, which will reduce students' satisfaction on college management, and neglect the cultivation of students' self-management ability and finally result in weakened college management. Nowadays, with stricter criteria in students' mental health education, safety and stability management, and risk prevention, a new management method is urgently needed to improve college management ability. While the grid management mode can divide college management affairs into grids. All information can be efficiently circulated, resources can be shared, and efficient management services for students can be realized. It is an important way to improve college comprehensive management ability.

### **4.3 Information technology development provides technical support for college student grid management**

Grid management collects necessary information by collection device, and transmit them to data center through network for storage and processing. Multiple information technologies are being utilized in the management. With rapid development of information technology and maturing big data analysis, "Internet Plus", cloud computing, 5G communication technology, face recognition technologies, instant messaging tools like WeChat, Weibo, QQ are gradually popularized. Colleges have established their own official website and a communication mechanism with society. The various departments in colleges have basically realized office automation and established their own management systems. They are also strengthening digital campus construction. The hardware infrastructure and software resources are constantly being improved in colleges. The continuous improvement of information technology and construction provide hardware foundation and platform guarantee for the implementation of grid management in college.

### **4.4 Successful application of community grid management provides experience for college student grid management**

The concept of grid management was put forward in 2003, it was first applied to community management in cities. It was the methodological innovation of urban management theory. It achieved desired result after being implemented in cities. For example, the “Grid Management, Group-type Service” information management platform in Zhoushan has been operated for 3 years, which have

disposed nearly 60,000 issues and integrated resources from 30 departments with 99% settlement rate. The people's safety index in Zhoushan has also been effectively improved with 8.9% year-on-year decreased mass petition rate (Pan, 2017). The grid management has enhanced public's sense of acquisition and happiness, and promoted social harmony and stability. There is a great similarity between urban management and college management because of the similar background and lifestyle of the people in cities and colleges (Huang, 2018). The summarized and optimized grid management cases in cities can provide useful experiences for college student grid management.

## **5 College Student Grid Management Platform Construction in New Era**

College student grid management can absorb successful experience from urban community grid management to a certain extent, but their significant difference must be taken into consideration. It shall stand at college talent cultivation height and to be systematically planned and promoted as a whole that combined with college Informationization basis and group characteristics of student. Wuhan University of Technology (WHUT) owns some outstanding characteristics such as scattered campus and large student scale, which brought difficulties in student management. This paper takes WHUT as an example to put forward an overall idea of college student grid management in new era.

### **5.1 Establishing a student grid management center**

The student grid management center is jointly established by party and government administration office, informatization office, network information center, student affairs department, youth league committee, academic affairs office, graduate school, security department, logistics support department, library and other departments. Five sub-centers such as student community grid management center, student behavior grid management center, student big data analysis center, student online one-stop service center and student grid management monitoring center are also established. With more than 50,000 students, 7 student parks, 71 student buildings, and 12,659 dormitories, WHUT established a 4-tier student community grid according to the "dormitory-building-park-college" principle. Student community grid management center is responsible for grid information reporting, the basic affairs processing and feedback. Student behavior grid management center is mainly responsible for acquisition, transmission and sharing of various information. Student big data analysis center carries out in-depth mining, analysis and prediction in massive student information with feedback. Student online one-stop service center processes students' various affairs online to save their time by information flowing. Student grid management monitoring center supervises operation process with assessment and incentives of college's student grid management.

### **5.2 Forming a dedicated grid management team**

After completing grid division, it is necessary to form a grid management team to facilitate the management of all grids. The entire college grid is divided into four tiers. The tier-1 grid managers are the vice president or deputy secretary who is in charge of student work, and heads of student grid management center. The tier-2 grids are 7 student parks. Corresponding schools will form a student park management center to coordinate various student affairs including academic guidance, life guidance, career planning, postgraduate examination guidance, scientific research counseling, second and third class teaching, etc. The tier-3 grids are 71 students buildings which led by full and part-time residential counselors and assisted by residence advisors and building party branches. The tier-4 grids are 12,659 dormitories which are specifically managed by the dormitory head. The tier-1 and tier-2 grid managers shall timely share and release all important student information and dispose their problems. The tier-3 and tier-4 grid managers shall upload and report student information with feedbacks in a timely manner

by a time-limited processing system.

### **5.3 Establishing a comprehensive student information platform**

The timely information with comprehensiveness and accuracy is the foundation of student management. It is necessary to fully integrate existing information and data platforms and realize free flow and real-time sharing of various information in college-level data center. The comprehensive student information platform is deeply connected to college data center. Assisted by grid technology, it solves problems of information acquisition, sharing and circulation to ensuring the accuracy of information acquisition, timeliness of transmission, and thoroughness of sharing. Grid managers can get all comprehensive student information timely according to their authority. For example, the platform can obtain students' curriculum selection, classroom performance and credit information from educational administration system, obtain logging and position information on students' campus network connection from network information center, obtain consumer information such as canteens and supermarkets, obtain students' book borrowing and entry-exit information from library, obtain dormitory and campus entry-exit information from security department, obtain student payment information from financial system.

### **5.4 Building an online one-stop student service platform**

The online one-stop student service center will integrate existing student-related service functions such as academic affairs, student affairs, finance, security, library, logistics together. Then put service items including curriculum selection, grade checking, award review, fund application, employment guidance, household administration, payment reimbursement, book borrowing, property maintenance, utility payment into online one-stop service platform. Meanwhile, a mobile phone client will be developed to facilitate students to handle various affairs online, and to coordinate with the existed one-stop service center to simplify process with improved efficiency. The traditional recursive mode has been turned into a flat management mode, which shortened the distance and achieved seamless communication between teacher and student.

### **5.5 Establishing a student big data analysis center**

After collecting a large amount of student information, it is necessary to establish a student big data analysis center (Xue and Meng, 2016). The center can create visual data mode and behavioral analysis prediction mode on students' learning levels, hobbies and personality characteristics from different dimensions and perspectives by means of data mining, data visualization, crawler algorithm. to analyze and utilize student information. It will draw a "student portrait" to depict his five aspects including knowledge level, learning ability, personality characteristics, psychological characteristics, and living status to achieve behavioral analysis, targeted funding, academic forewarning, crisis forewarning and growth leading and to better serve the individualized growth and development needs of students. During information analyzing and utilizing process, student privacy must be protected and classified into different categories. Grid managers who own permissions must sign confidentiality agreement.

### **5.6 Safeguards for grid management platform**

Safeguards are necessary to realize smooth operation of grid management platform. First of all, the overall management level of grid teams shall be improved. Because as a relatively new management method, grid management is developing constantly. While some managers may have unclear understanding and insufficient methods on their works. Secondly, college student grid management center shall dynamically utilize the resources from various departments to collect student data and information timely in order to achieve deep resource integration and improve management service

efficiency effectively. Thirdly, a thorough supervision and evaluation mechanism shall be established. Responsibilities and tasks of the entire grid shall be subdivided to each grid manager clearly. Thus all managers will fulfill their responsibilities and effectively solve the students' practical issues under supervision and regular assessment.

## 6 Conclusion

It is pragmatic and innovative to introduce grid management mode into college student management to solve prominent problems in new era. The paper takes Wuhan University of Technology (WHUT) as an example and puts forward overall design ideas for the application of grid management in college student management in new era. It conducts preliminary researches on college student grid management platform in following aspects: community grid division, grid team, student information platform, online one-stop student service platform, student big data analysis center, security system, etc. In the next step, in-depth study will be conducted on college student grid management information system, operation mechanism and resource sharing mode, management service process reengineering so as to realize the Informationization, standardization, refinement and systematization to better serve students to grow up to reach their prime.

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## Research on the Governance of Government Network Public Opinion in the Age of Big Data

Wang Chunjuan, Zhu Xiao

School of Management, Wuhan University of Technology, Wuhan, P.R.China, 430070

((E-mail: chunjuanwang882@hotmail.com, 541278340@qq.com))

**Abstract:** With the popularization of mobile terminals, information is becoming more and more unimpeded, along with the advent of the era of big data. It brings both opportunities and challenges to the governance of government network public opinion. Using the literature research methodology and the case analysis, combing the research results of domestic and foreign scholars, this paper analyzes the current situation of the network public opinion governance, concludes that having initially built a big data platform for network public opinion and realized the transformation from managing to governing network public opinion, the government strengthens the awareness of the rule of law of network public opinion gradually. Also, it is believed that the government has not fully grasped the opportunity brought about by the big data, with idea, technology as well as ethical dilemma remaining. Finally, from the three aspects it provides development strategies for the government to create a healthy and green network public opinion ecology.

**Key words:** Big data era; Network public opinion; Government governance; Public opinion management

### 1 Introduction

Compared with previous Internet, Internet of things and cloud computing, today's big data, as another emerging technology of the era, imposes a significant impact on the development of human society, daily life and work. According to the 43rd report on the status of Internet development in China, released by the China Internet Network Information Center (CNNIC), as of December 2018, the size of Internet users reached 829 million, with new Internet users as 56.53 million over the whole year, and the penetration rate as 59.6%, thus forming the world's largest public opinion filed.(as shown in the following picture). China's complicated network public opinion environment has been followed by a series of public opinion disturbances, which has imposed various adverse effects on the daily life of the public and the political stability of the country. Therefore, how to construct the optimal path of network public opinion governance in the era of big data is very important.

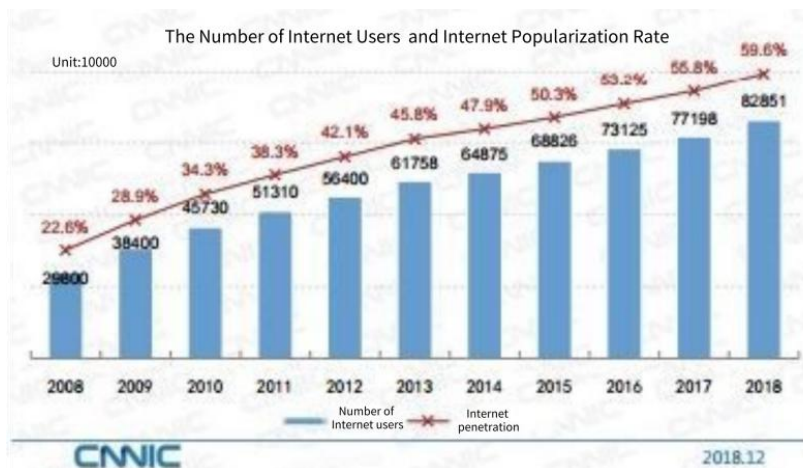


Figure 1 The Number of Internet Users and Internet Popularization Rate

Western public opinion is relatively open and stable, and the negative effect of public opinion is relatively low, thereby making the government adopt more liberal means. As far as network public opinion is concerned, Porten-Che P and Eilders C. (Porten-Che P and Eilders C.,2015) believed that network public opinion has the nature of "silent spiral". McQuailD (McQuail D,1997) believed that the communication revolution triggered by the Internet is essentially manifested in the transformation of audiences from passive information receivers as well as consumers to active information searchers, distributors as well as exchangers. In terms of the governance of network public opinion, James Allan(Allan,2003) found that Topic Detection and Tracking (TDT) technology has been applied in network public opinion data analysis as early as the 1990s. Kumaran(Kumaran,2004) suggested to promote the use of natural language processing techniques to aid statistical strategies for new event monitoring. Goncalves P And Benevenuto F (Goncalves P And Benevenuto F,2013) believed that we can use the Positive and Negative Affect Schedule-t (Positive And Negative Affect Schedule-t) to measure emotions in online media, to calculate standardized scores of various emotions, thus analyzing users' responses to specific events.

Chinese scholars and foreign scholars show a great difference in the research direction and emphasis. At present, network public opinion researches from the perspective of the government have been favored and pursued by abundant scholars who have put forward plenty of views worth discussing, which are reflected mainly in the following three aspects: network public opinion monitoring, guidance and response at big data age.

Big Data and network public opinion monitoring refers to the automatic detection of big data, functional separation, statistical analysis and so on. Ren Dejing (Ren Dejing,2016) proposed that the government should conduct correlation analysis of massive as well as disorderly network public opinion data before specific network public opinion crisis occurs by combining with big data in-depth analysis technology, to explore its value, and to contribute to early warning of public opinion crisis. Believing that the government's detection of network public opinion remains at the level of public security, Zhang Shuoyang (Zhang Shuoyang,2016) contended that it should collect, process and analyze information and manage public opinion through such devices as e-government private network and terminal storage based on cloud platform storage and calculation.

Big data and network public opinion guidance, that is, the government uses various network carriers to communicate with netizens, so as to develop in a healthy direction through guiding network

public opinion. Xu Jinghong and Jiang Qiulan (Xu Jinghong and Jiang Qiulan,2012),from the perspective of communication, analyzed the problems existing in the microblog of party and government institutions under the guidance of network public opinion, along with the proposal of suggestions for improvement: optimizing interaction, treating each other honestly, changing from indoctrination to participation; Zhang Dong and Liu Jianhui (Zhang Dong and Liu Jianhui,2008) analyzed the basic principles of agenda setting by taking the Hangzhou nanny arson case as an example to propose strategies such as strengthening the sense of responsibility, improving interactive mechanism and improving media literacy.

Big data and network public opinion response indicates that the government takes a series of measures to solve network public opinion crisis and establish a good image of government departments. Gao Hang(Gao Hang,2016), from the perspective of the system dynamics method, proposed that we can reduce the investigation on external factors such as supervision institutions and personnel quality, and increase the research on internal factors such as the degree of attention, hardware and software supporting conditions, which are closely correlated with government public opinion. Li Xueyan (Li Xueyan,2018) proposed to build a timely response system in the outbreak period of network public opinion, along with the promotion of the response as well as disposal in the diffusion period of network public opinion.

The research views of domestic and foreign scholars mentioned above are of considerable reference value, but there is still room for further improvement. First of all, the existing researches demonstrate that "big data" and "network public opinion governance" are not very closely linked. Even more, abundant researches are trapped in a circle of "old wine in new bottle", failing to apply big data fully, thereby making it difficult to seize the opportunity provided by big data to construct an effective and realistic path. Secondly, a large part of research is carried out based on certain socially hot events, followed by the analysis of the network public opinion. In other words, it still focuses on a certain "network public opinion crisis", without paying attention to "network public opinion governance", thus failing to dig out the characteristics of the current government's governance of network public opinion, and neglecting the governance effect achieved by the government.

## **2 The Current Situation of Government Governance under China's Network Public Opinion**

### **2.1 Initially build a big data platform for network public opinion**

China's e-government construction has laid a solid foundation for the establishment of China's big data platform for network public opinion. For example, the notion of "two nets, one station, four databases and twelve operation systems" was established in 2003. Subsequently, the e-government system developed rapidly. By December 2018, China have 394 million users of online government services, accounting for 47.5 percent of the total Internet population, along with 2,817,962 government websites. Moreover, it's not difficult to find that "Internet + e-government service" in our country has been further deepened, due to information technologies such as the Internet, big data and AI, have been applied by governments at all levels to further improve the efficiency of government services. Even more, it serves as the main source of information collection and the premise of data analysis.

### **2.2 Initially realize the transformation from managing to governing network public opinion**

The main task of management is to design and maintain an environment which is capable of achieving the maximum objectives with existing resources. The original intention of governance is to

serve, which is fundamentally different from that of the traditional government management. With the development of big data and the change of network public opinion, government departments at all levels have begun to actively seek more effective ways to govern network public opinion, and to strengthen the interaction between officials and people by establishing government affairs micro-blogs and releasing various government affairs information in real time. At the same time, the government has also strengthened the cooperation with the network media, requiring the microblog real-name authentication, and attaching importance to the improvement of the quality of Internet users. This is conducive to smooth public opinion expression channels, and can contribute to improving the credibility of the government and reducing online rumors.

### **2.3 Gradually strengthen the awareness of the rule of law of network public opinion**

At present, China attaches great importance to protecting the legitimate rights as well as the interests of citizens, legal persons and other organizations. *Regulations on the Administration of Microblog Information Services* was issued in February 2018, which aims to clarify the main responsibilities of microblog service providers, and achieve the authentication of real identity information as well as administrative management. Followingly, *Has the Attribute of Public Opinion and Social Mobilization Ability of Internet Information Services Security Assessment Rules* released in November aims to urge and guide information service providers with public opinion attribute or social mobilization ability to fulfill the security management obligations stipulated by law and guard against the harm caused by the spread of illegal information such as rumors and false information. In short, these laws and regulations have established a basic institutional framework, thus providing legal basis and legal protection for citizens in terms of safeguarding their legitimate rights and interests.

## **3 Government Governance Dilemma under China's Network Public Opinion**

### **3.1 Ideological Dilemma**

Ideas guide people to understand and transform the world through guiding their ability and activities. Mistakes and deviations will occur in the government's network public opinion management if the concept cognition of "big data" fails to keep up. China embraces a large number of Internet users, with the source of big data at the forefront. However, at present, China lacks the awareness of integrating, analyzing and utilizing big data, thus resulting in the final total data falling behind developed countries. For example, the heavy rain event in Xingtai of Hebei province on July 19, 2016, was very urgent, which, however, didn't attract the attention of the government until the spread of netizens and we—media on the 22nd. The state media, on the other hand, at the end of the chain, has been slow to respond natural and man-made disasters which constantly test the government's prediction ability. Thus, analyzing and mining big data over the years is of great positive significance to prevent malignant public opinion events.

### **3.2 Technical Difficulties**

"Science and technology are the first productive force", which also serves as an important guarantee and technical premise for the government to improve the ability of network public opinion governance in the era of big data. Big data is of rich connotation. To be more specific, only at the technical level, the fields intersecting with big data involve mining and analysis of association rules, pattern recognition, integrated learning, prediction model, regression statistics, time series analysis, cluster analysis and so on. After the big data era, the Chinese government's information processing level has achieved preliminary results, but there is still a lot of room for growth in terms of technology

application. More specifically, local governments at all levels, especially the local governments at the grass-roots level, lack strong consciousness of network public opinion forecasting technology, with a shortage of professional talents as well as technical processing system, which leads to screening of vast amounts of data network public opinion and timely judgement and warning, thus restricting the combing, guiding and handling of subsequent network public opinion.

### 3.3 Ethical Dilemma

At present, government departments, increasingly more superstitious, rely on science and technology to detect and manage network public opinions. Specifically, they pay one-sided attention to the intervention of public opinions, but ignore netizens, the main body of network public opinions. Even more, they lack the awareness of solving social problems reflected in network public opinion which, in essence, serves as a part of public opinion. Therefore, the most fundamental purpose of the government which carries out network public opinion governance should be to establish effective communication with the public and society by taking the network as a medium, so as to contribute to understanding public opinion, and releasing information more effectively. Otherwise, a new round of problems may be triggered if the fundamental problems and the underlying causes can't be identified, which is not conducive to strengthening the two-way and symmetrical communication between the government and the public, and to alleviating as well as eliminating the crisis of network public opinion.

## 4 Optimization and Improvement of China's Government Network Public Opinion Governance

### 4.1 Establish and spread the concept of "big data" for network public opinion governance

Traditional network public opinion governance concept means to conduct qualitative analysis, find the source, and finally take countermeasures after the occurrence of public opinion events. Obviously, this idea is not applicable to the big data era. Only by setting up the concept of "big data", starting from monitoring and prediction, carrying out quantitative analysis and finding out all relevant factors, can we prevent problems from happening and truly realize the open sharing of data. See figure 2 for details.

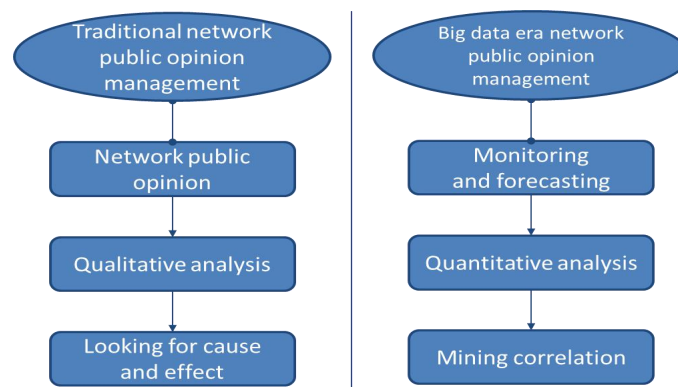


Figure 2 Comparison between the Concept of "big data" and Traditional Network Public Opinion Governance Concept

First of all, whether the concept of "big data" can really be implemented depends on the government and its managers in the final analysis. Therefore, it is necessary to implement the policy intentionally, to organize the learning and sharing of "big data" concept, and to render the atmosphere of "big data" concept.

Secondly, it is not feasible that data collection of network public opinion governance relies solely on the government to sing a "one-man show", which requires the participation of multiple social subjects.

#### **4.2 Develop and strengthen "big data" technology for network public opinion governance**

On the one hand, we should step up the application awareness of big data. Due to in the face of massive network public opinion information, Internet computer technology and big data analysis technology play an indispensable role in information identification and screening, it is essential for us to focus more on promoting research and development of disciplines and key technologies related to big data, such as artificial intelligence, mass data storage and management, real-time big data processing etc.

On the other hand, efforts should be made to cultivate professionals in relevant fields. At present, some Internet companies have been cooperating with universities to carry out related activities. However, the talent training mechanism for the subdivision of government network public opinion governance under big data has not yet emerged, thus making it a feasible way to build a long-term training mechanism of big data talents by introducing overseas talents in the field of big data and expanding the major of big data through universities.

#### **4.3 Establish mechanisms to promote "public interaction" for network public opinion governance**

"Emotional resonance" with netizens refers to giving the public an outlet to channel their emotions. Through this way, governments at all levels can set up interactive communication platforms for officials and citizens by setting up government micro-blogs, portal websites and official accounts, so as to promote electronic government office, to open and transparent government affairs, and to step up the communication between the government and the public.

Facts have proved effectiveness of establishing information release mechanism, releasing information timely, initiatively, openly and transparently, letting Internet users know what they want to know, winning the favor of public opinion, timely eliminating the negative impact exerted by incorrect information in society, and achieving "emotional resonance" with Internet users.

## **5 Conclusion**

Research review: Based on existing literature on Internet public opinion governance in the era of big data, this paper further analyzes the current situation of Internet public opinion governance, as well as the achievements and shortcomings of the government in the governance of Internet public opinion. Followingly, combined with the historical background of big data, the paper puts forward suggestions on establishing and disseminating the concept of "big data", developing and strengthening the technology of "big data", and establishing and promoting the mechanism of "public interaction".

Research deficiencies and prospects: due to the author's lack of relevant practical experience, the suggestions on the governance path of network public opinion are inevitably inadequate and idealistic. At the same time, the author's analysis and demonstration on the governance of government network public opinion combined with big data is not profound enough. Thus, the author will understand and

analyze this topic in the future practical researches deeply, and try to make his argument more scientific and powerful, so as to contribute to the government to creating a healthy network public opinion ecology.

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## Research on the Influence of Consumer Perceived Product Innovation on Brand Evangelism

Wang Pengtao, An Yamei

School of Management, Wuhan University of Technology, Wuhan, P.R. China, 430070

(E-mail: 805743824@qq.com, 784200936@qq.com)

**Abstract:** Product innovation is a hot topic in management studies, but previous studies have ignored consumers' subjective views on product innovation. In fact, the consumer perceived product innovation is not only closely related to product characteristics, but also influenced by the consumer characteristics and buying situations. And the consumer perceived product innovation will significantly affect consumers' brand attitude. Perceived product innovation is stronger, and the brand identity is higher. It is more likely to cultivate brand evangelists. Therefore, starting from the consumer perceived product innovation and based on the S-O-R model, this paper takes the brand identity as the intermediary variable, constructs the conceptual model of the perceived product innovation on brand evangelism, and explores the cultivation path of the brand evangelists. The model was supported by analyzing the data collected from 144 consumers. The results are as follows: Perceived product innovation has a positive effect on brand identity, brand identity has a significant positive effect on brand evangelism, and brand identity plays a mediating role between perceived product innovation and brand evangelism.

**Key words:** Perceived product innovation; Brand identity; Brand evangelism; S-O-R model

### 1 Introduction

Innovation has always been an important topic in management research at home and abroad. However, past innovation research mainly focused on the impact of product innovation on performance from the company perspective, while ignoring consumer perception and judgment of the product innovation. In fact, there is a significant difference between an enterprise's understanding of product innovation and consumers' actual subjective perception of product innovation. Consumers' perception of product innovation is not only closely related to product characteristics, but also influenced by many factors, such as individual characteristics and buying situations. In addition, consumer perception of product innovation will significantly influence consumers' brand attitude. When the consumer perceived product innovation is stronger, it is more likely to become brand evangelist.

In recent years, the brand has received more and more attention from companies. A good brand can not only increase the intangible assets of the company, enhance the competitiveness of the company, but also establish a good relationship between the consumer and the brand, resulting in evangelist behavior. Perceived product innovation is beneficial for consumers to have positive association with the brand and stimulate their sense of identity, which is conducive to the generation of brand evangelism. Therefore, this paper constructs "Perceived Product Innovation - Brand Identity - Brand Evangelism", selects the mobile phone brand as the reference brand, discusses the mechanism of consumer perceived product innovation affecting the brand, and provides the theory for the enterprise to innovative products and

cultivate brand evangelist

### 1.1 Literature review and research hypotheses

The S-O-R theory is stimulus-organism-response theory which was proposed by Mehranian and Russell. Based on the S-O-R theory, this paper constructs a model of “perceived product innovation-brand identity-brand evangelism”. Perceived product innovation is the source of stimuli. Consumers are inspired by the brand to bring their own innovation and stimulate their own pleasing experience with the brand.

#### 1.1.1 Perceived product innovation and brand identity

The concept of perceived product innovation was first proposed by Rogers. It is the subjective judgment of consumers on a product that is different from other similar products, and is mainly judged from the two dimensions of novelty and practicality. It mainly includes two aspects: First, it refers to the subjective evaluation of consumers' differences, novelty and uniqueness of the product; second, consumers perceive the novelty degree of a product by comparing it with other similar products (Goode, 2013). Therefore, this paper defines perceived product innovation as the subjective judgment of consumers on the novelty and practicality of mobile phones compared to other similar products in reality or ideal.

Perceived product innovation and brand identity. Product innovation perception can stimulate consumers' innovative associations with brands, thereby producing a sense of identity (Chen Shu, 2015). An empirical study shows that perceived product innovation has a positive impact on brand identity (Xue Zhe, 2018). Based on the above analysis, the following hypotheses are put forward:

**H1: consumer perceived product innovation has a positive impact on brand identity.**

**H1a: consumer perceived product innovation has a positive impact on personal brand identity.**

**H1b: consumer perceived product innovation has a positive impact on social brand identity.**

#### 1.1.2 Brand identity and brand evangelism

Lam defines brand identity as the psychological state of consumers' cognition, emotion and evaluation of a brand, emphasizing the unity between psychological level and a brand (Lam, 2010). It should be divided into two dimensions based on the differences in self-motivation defined by consumers, mainly personal brand identity and social brand identity (Rio, 2001). Therefore, this article uses the research of scholars Rio on brand identity, and measures from the two dimensions of personal brand identity and social brand identity. Brand evangelism refers to the fact that consumers freely convey the positive experience and feelings of specific brands, and frequently show strong desire to influence others' buying behavior (Doss, 2014). Brand evangelism is used to describe a group of consumers. Their enthusiasm for brand recognition and loyalty reached preaching enthusiasm. There was a higher-level consumer behavior than the brand's positive word-of-mouth communication. Not only did it continue to purchase the brand, but it also positively recommended people nearby to purchase the brand. It may even ruin other brands with competing relationships (Yuan Denghua, 2016). According to the study of the above scholars, this article adopts Yuan Denghua's viewpoint on the definition of brand evangelism.

Brand identity and brand evangelism. An empirical study shows that brand identity can significantly influence "positive brand recommendation" and "anti-competitive brand", that is, influence

the brand evangelism (Becerra, 2013). The scholar takes the industry of high definition video game as an example to find that brand loyalty, brand community identity and self-connection are the predominant factors of brand evangelism, and the brand evangelists will take "badmouth" and other injurious behavior to the competitive brand (Marticotte et al, 2016). Consumers with a higher level of brand identity is more likely to form a brand evangelism (Yuan Denghua, 2016). Based on the above analysis, the following hypotheses are put forward:

**H2: brand identity has a positive effect on brand evangelism.**

**H2a: personal brand identity has a positive effect on brand evangelism.**

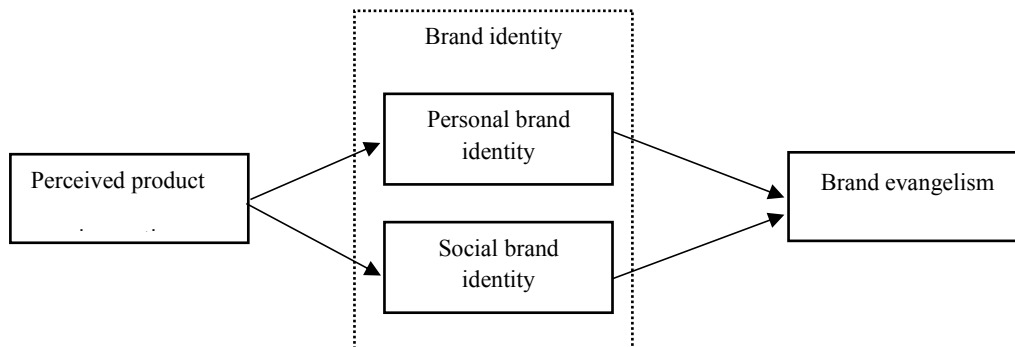
**H2b: social brand identity has a positive effect on brand evangelism.**

### 1.1.3 The intermediary role of brand identity.

Brand satisfaction indirectly affects brand evangelism through brand identity of consumers, and brand identity plays an intermediary role in this process (Doss, 2014). The scholar points out that the psychological mechanism of brand evangelism is that "brand experience" develops into "brand evangelism" through "the ultimate brand trust and identity" (Yuan Denghua, 2016). Yang Xiaoyan (2008) found that trust in brands is the main driver of consumer intentions and behavioral implementation. If consumers have concerns or distrust of the brand's attributes and values, then he will avoid the consumption behavior of the brand. Xia Xiaoping (2011) used green food as the research object to verify the positive influence of consumer brand identity on brand esteem and purchase behavior. Based on the above analysis, the following hypotheses is put forward:

**H3: brand identity plays an intermediary role between perceived product innovation and brand evangelism.**

As a result, the brand identity is finally generated and the brand's evangelism behavior is finally



driven by this state. The specific model diagram is as follows:

## 2 Questionnaire Design

### 2.1 Variable measurement

All the scales in the study were revised on the basis of the maturity scale and the purpose of the study, thus ensuring the reliability and validity of the measurement. The paper reference the maturity scale of Goode and so on to measure the product innovation perception, including 5 items. The measurement scale for brand identity draws on the scale used by Rio (Rio, 2001), individual brand identity contains 3 questions, social brand identity contains 3 questions. Matzler is used for the survey of brand promotion, and there are 6 items in this scale (Matzler, 2007).

## 2.2 Data collection and sample characteristics

The questionnaire survey was conducted in Wuhan, Hubei from April 2018 to May 2018. The survey channels were mainly combined through online surveys and offline surveys. Online surveys were conducted by WJX, QQ, WeChat, etc. to ensure the randomness of the samples and ensure the authenticity of the data sources. The next survey was mainly conducted by interview method, through the in-depth interview to obtain consumer personal experience and behavior information in order to discover the key factors affecting consumer brand promotion behavior. A total of 150 questionnaires were issued, of which 144 were valid questionnaires, with an effective rate of 96%.

## 3 Empirical Analysis

### 3.1 Reliability and validity test

After the questionnaires were issued, the questionnaires were collected, and the invalid questionnaires were rejected, 144 valid questionnaires were collected. In order to ensure the validity of data, SPSS 22 software was used to conduct quality inspection and preliminary data processing, including reliability and validity test. The results of the test are shown in Table 1.

**Table 1 Reliability Statistics Table for Observable Variables**

Observed Variable		Cronbach's Alpha Coefficient	KMO	Result
Perceived Product Innovation		0.786	0.866	Good
Brand Identity	Personal Brand Identity	0.858	0.743	Good
	Social Brand Identity	0.814	0.784	Good
Brand Evangelism		0.759	0.761	Good

The scale test results show that the Cronbach's Alpha coefficients are between 0.7-0.9, indicating that the reliability of the questionnaire is good and can be further analyzed. The KMO values used in this paper are located between 0.7-0.9, respectively, indicating that the item has good convergence validity and the scale has good construct validity.

### 3.2 Analysis of structural equation model

In this paper, we use AMOS 21 software to establish structural equation model, test the model and verify the hypothesis. The results of the structural equation test are shown in Table 2.

**Table 2 Analysis Results of Structural Equation Model**

Path	Path coefficient	Estimate	C.R.	P	Result
Perceived Product Innovation→Personal Brand Identity	0.624	0.110	0.914	***	Adopted
Perceived Product Innovation→Social Brand Identity	0.595	0.226	0.875	***	Adopted
Social Brand Identity→Brand Evangelism	0.002	0.055	0.803	0.002	Adopted
Personal Brand Identity→Brand Evangelism	0.618	0.107	0.786	***	Adopted

From table 5-2, we can see that the structural equation model is well fitted and can effectively test and explain the relevant hypotheses. That is to say, hypothesis 1-a, 1-b, 2-a, 2-b are adopted.

### 3.3 Test of the mediating effect

With the help of SPSS20.0 PROCESS plug-in, we use Bootstrap method to test the mediating effect of brand identity. The results show that the confidence interval is (0.005, 0.341) 、 (0.006,0.256) , and does not contain 0, indicating that the mediating effect of brand identity is significant. That is to say, hypothesis 3 is adopted.

**Table 3 Analysis Results of Mediation Effect Model**

	P.E.	Bias-Corrected Percentile 95%CI		
		Lower	Upper	Results
Perceived Product Innovation→Brand Evangelism	0.505	0.269	0.341	*** (P=0.001)
Perceived Product Innovation→Personal Brand Identity→Brand Evangelism	0.058	0.005	0.111	*** (P=0.009)
Perceived Product Innovation→Brand Evangelism	0.186	0.116	0.256	*** (P=0.001)
Perceived Product Innovation→Social Brand Identity→Brand Evangelism	0.059	0.006	0.112	*** (P=0.001)

## 4 Conclusion

Through literature research and data analysis, the following conclusions are obtained. (1) Perceived product innovation has a positive impact on brand identity. In particular, it has a significant impact on personal brand identity. (2) Brand identity has a positive impact on brand evangelism. The two

dimensions of brand identity (personal brand identity and social brand identity) have a positive impact on brand evangelism. Among them, personal brand identity has a significant positive impact on brand evangelism. (3) Brand identity plays an intermediary role between perceived product innovation and brand evangelism.

This conclusion has certain guiding significance for the marketing practice of enterprises. (1) Enterprises should examine product innovation from the perspective of consumers and attach importance to customer's perception of product innovation. In the process of product innovation, enterprises should focus on how to increase the consumer's perception of innovation. (2) This study is conducive for the enterprises to the formation of marketing promotion strategy based on the specific content of perceived product innovation and brand identity. It can also put forward reasonable and feasible suggestions for the brand strategy and brand management of the enterprises. (3) In this paper, the research on the formation mechanism of brand evangelism provides a feasible suggestion for the enterprise to cultivate its own brand evangelists, which is beneficial to the enterprise to advocate the maintenance and cultivation of the customers.

Due to the limitations of time and energy, there are still some deficiencies in this study. For example, the scale used in this paper is based on the mature scale abroad without considering the Chinese context and modifying some of the items. However, the cultural background of foreign countries is quite different from that of our country. The future research can be focused on the following aspects: first, by observing the actual performance of the brand evangelists under different cultural backgrounds, the measurement dimension and index of the brand evangelism are tested to improve the adaptability of the scale. Second, we can explore the actual needs of brand evangelists' consumption, and take this as the starting point of enterprise innovation, and change the way of product innovation. Third, we further study how to drive the online behavior of brand evangelists, and examine how brand evangelists affect the perception and preference of other consumers to specific brands through social media for the O2O marketing.

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# Research on Service Innovation of the Cloud Logistics Platform Based on Factor Analysis

Wu Xia, Zhang Jianming

Wuhan Huaxia University of Technology, Wuhan, P.R. China, 430223

(E-mail: sunnywu529@163.com,huozhetree@163.com)

**Abstract:** With the foundation of “cloud computing and big data”, the cloud logistics platform is a modernized network information technology platform that provides the comprehensive logistics services for customers. Service innovation of the cloud logistics platform will effectively improve logistics efficiency of the whole society. By reviewing the research status of the cloud logistics platform, user service satisfaction of the cloud logistics platform was investigated through questionnaires. SPSS software was used to do factor analysis for data to explore primary influence factors for user satisfaction of the cloud logistics platform. Based on it, the author proposed the countermeasures and advice on service innovation of the cloud logistics platform.

**Key words:** Big data; The cloud logistics platform; Factor analysis; Collaboration

## 1 Introduction

With the foundation of “cloud computing and big data”, the cloud logistics platform integrates with the internet, Internet of Things and advanced logistics management philosophy to provide the comprehensive logistics services for customers. As the interactive medium of logistics service participants, the cloud logistics platform attracts and integrates with the professional logistics service resources that re complementary with core services, offers the systematic logistics services to customers, and shows the service resource configuration and service operation management functions. With the development of information technology, the cloud logistics platform (i.e. highway logistics platform, port logistics platform and logistics information service platform) is constantly coming out like mushrooms after rain, resulting in intensifying competition in the logistics market. If the cloud logistics platform wants to maintain a dominant position in the competition of logistics market, it is necessary to continuously make a service innovation to strive for development. Studies of domestic and overseas scholars on the cloud logistics platform are mainly concentrated on the concepts and features of the logistics platform, framework of the logistics platform, and functional structure of the platform (H Ramirez, B Maschke, D Sbarbaro,2013).Cloud uses lots of mutually associated virtual machine techniques to do resource allocation with the market orientation and completes customer-driven service management based on the service level agreement(SLA), while the cloud platform is the foundation to uniformly and dynamically provide and exhibit the computer resources(Buyyar, Yeocs, Venugopal,2009).The cloud logistics platform is an important tool to do intelligent matching between resources and information and to facilitate production activity control. It is a multi-functional platform that serves for each object in the logistics process (Athanasios A. Pallis,2013). The platform services are featured with network externality, resource integrality, functionality, cooperativity and derivative (Hua Zhongsheng,2014). The goal of the logistics information platform service mode based on cloud ecology

is to build the platform ecosystem of common value, which requires the interaction, sharing and collaboration of all parties on the platform to achieve common value creation(Xing Daning,2016).The cloud logistics mode has better management effect and broad development prospects, which is manifested in integrating resources and sharing resources to improve logistics operation efficiency and service quality(Wang Zhihong,2019).Multiple scholars conducted the theoretical elaboration on the business service mode of the cloud logistics platform, but there are fewer studies on the service innovation countermeasures proposed for the influence factors of user satisfaction based on the cloud logistics platform. In this paper, customer satisfaction of cloud logistics platform is investigated through questionnaire, and factor analysis of data is carried out by SPSS software to dig out the main influencing factors of customer satisfaction of cloud logistics platform. Based on this, countermeasures and Suggestions for cloud logistics platform service innovation are proposed.

## **2 Influence Factors for User Satisfaction of the Cloud Logistics Platform**

### **2.1 Data acquisition**

Using a random sample survey,325 questionnaires were granted and 310 effective questionnaires were recycled with the effective rate as 95%. SPSS20 was used to do statistical analysis for the questionnaire data.

### **2.2 Reliability and validity**

SPSS20 was utilized to analyze the Cronbach's coefficient as  $\alpha=0.826$ . The reliability was more than 0.7, showing that the questionnaires had consistency and good questionnaire reliability.

The variable validity analysis was conducted by making a comparison between correlation coefficient KMO and Bartlett inspection. SPSS20 was used for KMO and Bartlett inspection. KMO was 0.802, which was very close to 1, showing the good convergence validity. The usefulness degree of questionnaires was higher. Sig was close to 0, showing that the questionnaires were suitable for factor analysis.

### **2.3 Composition of influencing factors**

By looking up relevant literatures and information, the indexes of affecting user satisfaction of the cloud logistics platform are analyzed: with regards to the services, technologies and functions of the cloud logistics platform, it can be observed that 18 basic indexes will affect user satisfaction, including new information push of the platform, personalized customization, convenient resource matching, real-time monitoring, reliable operation application, effective demand analysis, successful browse, intuitive and convenient operation, fast data processing, the latest laws and regulations, reliable information of freight sources, specific vehicle information, enterprise recommendation, timely satisfaction of needs, timely response of feedback, reasonable charge, convenient process and information safety protection(Wang Jie, Zhang Hongchao, Wang Yu,2019). Based on these indexes, the user questionnaires of the cloud logistics platform were designed. Also, Likert Scale was adopted to design the five-level measurement and problems. "Very dissatisfied", "dissatisfied", "general", "satisfied" and "very satisfied" should be represented from 1 to 5 scores.

SPSS was utilized to do factor analysis for the questionnaire results. Variables with high degree of overlapping and strong correlation in information were screened out. The factors that dominated the leading influence degree were selected as influence factors for analysis to obtain Table 1 and Table 2:

**Table 1 Extraction of Influence Factors**

No.	Initial eigenvalue			Extraction of quadratic sum			Rotation of quadratic sum		
	Total	Variance %	Accumulation %	Total	Variance %	Accumulation %	Total	Variance %	Accumulation %
1	7.912	43.956	43.956	7.912	43.956	43.956	7.265	40.361	40.361
2	3.227	17.926	61.882	3.227	17.926	61.882	3.166	17.590	57.951
3	1.867	10.372	72.254	1.867	10.372	72.254	2.092	11.624	69.575
4	1.377	7.650	79.903	1.377	7.650	79.903	1.859	10.328	79.903
5	.941	5.230	85.133						
6	.791	4.395	89.529						
7	.604	3.357	92.885						
8	.401	2.228	95.113						
9	.340	1.891	97.004						
10	.239	1.328	98.332						
11	.145	.803	99.135						
12	.089	.495	99.630						
13	.038	.212	99.842						
14	.016	.087	99.929						
15	.010	.057	99.987						
16	.002	.013	100.000						
17	4.684E-016	2.602E-015	100.000						
18	-3.47E-016	-1.932E-015	100.000						

Four factors were extracted from the factor analysis. The initial eigenvalue, variance and accumulated contribution rate of each factor are shown in the above-mentioned Table. The accumulated contribution rate was 79.903%, showing the good overall effect.

**Table 2 Rotary Component Matrix**

	Components			
	1	2	3	4
The latest laws and Regulations	0.932			
Specific vehicle information	0.879			
Reasonable charge	0.783			
Enterprise recommendation	0.689			
Information safety protection	0.683			
Reliable information of freight sources	0.678			
Successful browse		0.921		
Intuitive and Convenient operation		0.557		
Convenient process		0.950		
Fast data processing		0.926		
Convenient resource matching		0.637		
Effective demand analysis			0.831	
Personalized customization			0.739	
Real-time monitoring			0.938	
Reliable operation application			0.931	
Timely satisfaction of needs				0.930
Timely response of feedback				0.795
New information				0.626

push of the platform

### 3 Results Analysis

As shown in the above-mentioned table2, the first components include the latest laws and regulations, specific vehicle information, reasonable charge, enterprise recommendation, information safety protection and reliable information of freight sources, showing that the cloud logistics platform users pay attention to the service quality of comprehensive information resources, reflecting in information timeliness, reliability and safety. The second components get involved in successful browse, intuitive and convenient operation, convenient process, fast data processing and convenient resource matching, showing that the cloud logistics platform users pay attention to the convenience in the platform function design. The third components contain effective demand analysis, personalized customization, real-time monitoring and reliable operation application, indicating that the cloud logistics platform users lay emphasis on business service diversity and intelligence. The fourth components get involved in timely satisfaction of needs, timely response of feedback and new information push of the platform, implying that the cloud logistics platform users value the interactive experience service efficiency in the platform. Therefore, it can be observed that user satisfaction is mainly affected by the service quality of comprehensive information, convenient platform functions, intelligent diversity of business services, and interactive efficiency of the cloud logistics platform.

In order to analyze the influence degree of specific influence factors, the score of each factor was used to calculate the comprehensive score and rank in order. The component weight was firstly calculated and the comprehensive coefficient of each factor was calculated and shown in Table 3:

**Table 3 The Comprehensive Coefficient Table of Each Factor**

	1	2	3	4	Score	Rank
Convenient resource matching	0.079	0.137	-0.04	0.066	0.075	1
Fast data processing	0.128	0.03	0.035	-0.096	0.072	2
Effective demand analysis	0.064	0.106	-0.031	0.17	0.071	3
Reliable information of freight sources	0.052	0.087	0.033	0.183	0.07	4
Specific vehicle information	0.092	-0.006	-0.028	0.178	0.063	5
Reasonable charge	0.149	-0.027	-0.044	-0.084	0.062	6
personalized customization	0.118	0.129	-0.125	-0.207	0.058	7
Information safety protection	-0.009	0.311	-0.003	-0.077	0.057	8
Timely response of feedback	-0.013	0.301	0.025	-0.089	0.055	9

Convenient process	0.132	-0.038	-0.012	-0.12	0.051	10
New information push of the platform	0.01	0.042	-0.038	0.334	0.042	11
Reliable operation application	-0.03	-0.003	0.505	-0.15	0.034	12
Timely satisfaction of needs	0.085	0.07	0.083	-0.519	0.024	13
Successful browse	-0.054	-0.221	-0.097	0.071	0.014	14
Real-time monitoring	-0.07	-0.083	0.519	-0.029	0.007	15
Intuitive and Convenient operation	-0.081	0.125	-0.063	-0.133	-0.037	16
The latest laws and Regulations	-0.158	0.096	0.032	0.104	-0.051	17
Enterprise recommendation	-0.148	0.067	0.023	0.067	-0.057	18
Component weight	0.550	0.224	0.130	0.096		

It can be found from the above-mentioned table that top 10 ones respectively include convenient resource matching, fast data processing, effective demand analysis, reliable information of freight sources, specific vehicle information, reasonable charge, personalized customization, information safety protection, timely response of feedback, and convenient process. Therefore, it can be observed that in the big data era, the intelligent service of the cloud logistics platform is considered as the most important influence factor that affects the customer satisfaction, fully showing the features of the big data era, intelligent resource matching and demand analysis. If the service intelligence provided by the platform can greatly meet needs of users, the satisfaction will be higher. Also, the functional technical design of the platform should be concise and high-efficient. This aspect also conforms to the situation in today's society—efficiency first. The enterprise that can acquire information at the soonest can first seize the market and gain the maximum benefits to realize the self-development. Also, reasonable charge shows the attention on the cost control. The development of the platform and enterprises can't be separated from control of various costs. In order to gain the better development, it is necessary to do reasonable management on costs, set up a fair price and improve user viscosity.

## 4 Service Innovation of the Cloud Logistics Platform based on Influencing Factors

### 4.1 Perfect the service function design of the platform and improve customer satisfaction

Firstly, it is necessary to learn from the service functions of the mature cloud logistics platform to perfect and enrich the service functions of the platform. To perfect the service functions and satisfy more service needs of enterprise users (i.e. provide park planning service, information planning service and supply chain optimization service) not only can improve profits of user enterprises and the platform, but also can enhance logistics service quality and increase customer satisfaction for logistics services. Besides, big data should be fully utilized. Relevant information can be collected by analyzing

transaction data of the platform, issuing investigation on the platform, and giving a telephone interview to know about enterprise demands. Corresponding services will be provided in line with user enterprise demands. According to the service conditions of user enterprises, different attentions of users will be found out. Then, according to attentions of enterprises, it is essential to perfect and facilitate the platform construction, perfect service functions, and improve customer satisfaction(Zhang Jiping, Luo Wenping,2019).

#### **4.2 Recommend accurate business of big data and meet the personalized needs of users**

It is necessary to integrate with resources, realize resource information sharing, as well as improve logistics operation efficiency and service quality. The cloud logistics platform has multiple advanced logistics technologies, Internet of Things, big data and other emerging technologies, and develops an integration and sharing role on data resources. In terms of logistics enterprises, data information gained on the cloud logistics platform can be used to gain the logistics market information. The accurate business layout can be carried out by combining with advantages of logistics business, so as to realize the accurate business recommendation and improve logistics service quality and efficiency. Based on the personalized service recommendation for enterprises, enterprises will be able to rapidly gain information, reduce time waste on each process, reduce information costs, and bring more earnings to user enterprises. Personalized services enhance communication in both parties, so that the platform will know well with user enterprises, promote the platform construction, and greatly improve enterprise loyalty to the cloud logistics platform.

#### **4.3 Fully realize resource sharing and reduce user costs**

On the one hand, resource sharing of the cloud logistics platform will reduce an asymmetric problem of market information and decrease operation costs of logistics enterprises. On the other hand, the technical advantages of the cloud logistics platform will provide a logistics technical solution for logistics enterprises (TaoHuiping,2018). For example, on the basis of big data, cloud computing and Internet of Things, the distribution route of logistics enterprises are optimized or platform resources are redistributed through the calculation and management ability of the cloud logistics platform, thus multiple logistics enterprises collaborate with each other to complete the same logistics business. According to layout of different logistics enterprises, the logistics transfer process and empty-loading ratio of logistics transportation will be reduced, so as to reduce costs.

#### **4.4 Perfect the software and hardware facilities on the platform and improve logistics safety**

On the one hand, the cloud logistics platform embodies the strength of itself and determines the information processing capability of the platform. On the other hand, convenient process, fast data processing and convenient resource matching are important factors of customer satisfaction, thus improvement on the hardware facilities of the cloud logistics platform not only enables the platform to have the better development, but also intensifies the response speed, so as to strengthen the handling efficiency of enterprises. It is necessary to reinforce cloud computing, big data and Internet of Things, facilitate the online and offline intelligent integration of the cloud logistics platform and collaborative development, constantly enrich the cloud logistics participants, perfect and improve the cloud logistics products and service quality(especially for the logistics distribution process, service traceability process, and allocation of cargos), reinforce the supervision on each process of the cloud logistics platform, strictly control transaction on the platform, let user enterprises track each step in real time, improve enterprise reliability, let enterprises attract more customers, and expand the market. Reinforcing the logistics process supervision can promote the cloud logistics platform to manage all kinds of information and participants, own the strict control, guarantee logistics safety, and promote the normal operation and sustainable development of the platform (Wang Xiran,2017).

## 5 Conclusion

Through the analysis, it could be observed that the user satisfaction of the cloud logistics platform might be mainly affected by service quality of comprehensive information, convenient and fast platform functions, intelligent diversity of business services, and interactive platform efficiency. Based on it, by combining with the important degree ranking of specific influence factors and utilizing big data, the author came up with the service innovation countermeasures for the cloud logistics platform from service function optimization, demand analysis, cost control and safety supervision, so as to provide the reference for developing the cloud logistics platform. In the later stage, the investigation samples can be improved to conduct an in-depth study on the security risk control of cloud logistics platform.

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# Performance Evaluation of Listed Commercial Banks Based on Factor Analysis

Xiong Bin

Graduate School, Wuhan University of Technology, Wuhan, P.R.China, 430070

(Email: 173099175@qq.com)

**Abstract:** Commercial banks are an important driving force of national economic development and financial system construction, and play an important role in credit creation, financial services, economic regulation and other aspects. Due to the special asset and liability structure and business scope of commercial banks, the traditional business performance rating system is no longer applicable. This paper takes 16 commercial banks listed in a-share market as research objects, including state-owned and joint-stock commercial banks. Through the construction of business performance evaluation system and the adoption of factor analysis method, this paper puts forward countermeasures and Suggestions to improve the business performance of listed commercial banks.

**Key words:**Listed commercial banks; Business performance; Performance evaluation; Factor analysis

## 1 Introduction

Commercial banks take profit as the target and a variety of financial assets as the business objects. Their business scope involves asset business, liability business and off-balance sheet business, and they have the function of credit intermediary and value creation. Commercial banks can make full use of their capital, technology and information advantages to provide a wide range of financial services and intermediary services to meet the needs of different subjects. At the same time, commercial industry can effectively adjust the structure of social and economic development and industrial structure, and is an important driving force for national economic development, as well as an important part of the financial system. With the development of social economy and financial system reform, the banking industry has been expanding its development in our country, and presents the industry trend, the banking industry gradually reduce the barriers to entry, commercial banks increasingly fierce competitive environment, the market share of a shrinking, industry increased risk factors, main show is the non-performing loans of commercial banks to increase, the deterioration of asset quality, lack of financial innovation, etc. Meanwhile, the development of internet finance has also posed new challenges to commercial banks and brought significant negative impact on their performance (Shen Chuang and Liu Xiaotian, 2017). Therefore, commercial banks should improve their service level while paying attention to operating efficiency. By evaluating the business performance evaluation of commercial banks and putting forward corresponding countermeasures and suggestions, it is helpful to find out the problems existing in the development of commercial banks at the present stage, improve the operation efficiency and benefit of banks, and realize the value maximization.

Scholars at home and abroad have done extensive research on the business performance of commercial banks. Main influencing factors include capital adequacy ratio, business expense ratio and non-interest income (Lu Li et al., 2016). Under the new market environment, commercial banks should accelerate the transformation and upgrading in combination with their own development characteristics and improve their own development ability. Cost to income ratio was one of the main factors affecting operating performance. By improving the management level of leaders, employee performance will be affected, thereby affecting the operating performance of banks (Hawaldar et al., 2016)). There was an inverted “U” relationship between intermediary business and operating performance of commercial

banks (Chen Yuxiao and Zhou Zhaoxiong, 2017). The liquidity ratio of commercial banks, rate of return, capital adequacy ratio and management level would directly affect the operating performance of banks, while the industry growth rate has no significant impact on the operating performance (Rani D. M. and Zergaw L. N., 2017; Parka and Jangb S. C., 2013). The balanced scorecard method was adopted to evaluate the performance of commercial banks' management from finance, customer, internal operation, learn and grow four levels design corresponding evaluation index system, and thought that commercial banks should formulate strategic performance evaluation mechanism, improve internal management level, through the cooperation with the third party payment platform to provide value-added services, and then into a modern commercial bank (Yuan Yongjing, 2018).

Existing scholars' researches on commercial banks' operating efficiency mainly focus on their profitability, management level and risk management level. This paper uses factor analysis method to analyze the operation efficiency of commercial banks objectively, and puts forward effective improvement measures according to the existing problems in the development of commercial banks, so as to promote the sustainable development of commercial banks in the fierce market competition environment.

## 2 Research Design

### 2.1 Mathematical model of factor analysis

Factor analysis is a statistical analysis method proposed by k. Pearson, Charles Spearman and other scholars (Christopher H. and Scott R., 2018). It is a process of selecting several influential factors that can represent the majority of indicator factors, namely principal component factors. By using linear function, the analysis process is simplified, and the final score of each indicator is calculated for performance evaluation. Assuming that the sample size is n, each sample has p evaluation indicators, and the original data of each indicator is x, an evaluation matrix is formed, as shown in 1-1:

$$X = \begin{pmatrix} x_{11} & x_{12} & \dots & x_{1p} \\ x_{21} & x_{22} & \dots & x_{2p} \\ \dots & \dots & \dots & \dots \\ x_{n1} & x_{n2} & \dots & x_{np} \end{pmatrix}$$

Each row of vectors constitutes a random vector that can be observed, and if its mean is u, then the mathematical model of factor analysis is

$$\begin{cases} x_1 = u_1 + a_{11}f_1 + a_{12}f_2 + \dots + a_{1m}f_m + \varepsilon_1 \\ x_2 = u_2 + a_{21}f_1 + a_{22}f_2 + \dots + a_{2m}f_m + \varepsilon_2 \\ \dots \\ x_p = u_p + a_{p1}f_1 + a_{p2}f_2 + \dots + a_{pm}f_m + \varepsilon_p \end{cases}$$

Where,  $f_i$  is the common factor that cannot be observed,  $\varepsilon_i$  is the special factor (which is the unique factor of component  $x_i$ ), and each factor, common factor and special factor are mutually independent.

The matrix of the factor analysis mathematical model is

$$\vec{x} = \vec{a}\vec{f} + \varepsilon, \quad A = \begin{pmatrix} a_{11} & a_{12} & \dots & a_{1m} \\ a_{21} & a_{22} & \dots & a_{2m} \\ \dots & \dots & \dots & \dots \\ a_{p1} & a_{p2} & \dots & a_{pm} \end{pmatrix}$$

Where,  $a_{ij}$  is the factor load, and the greater its absolute value is, the stronger the correlation between  $x_i$  and  $f_i$  is, which is also the ultimate goal of the factor molecule to obtain the value of  $a_{ij}$ .

### 2.2 Design of evaluation index system

Commercial banks are an important part of the financial system. Due to their special asset and liability structure and business scope, it is required that the evaluation index system must be scientific and complete to reflect their operating efficiency from multiple perspectives. In order to ensure the reliability of the evaluation results, this paper, on the basis of the principles of comparability, quantifiability, relevance and comprehensiveness, and by referring to the research results of existing scholars, analyzes from the four levels of profitability, loan management ability, asset safety and development ability, and preliminarily selects 11 financial indicators. Among them, profit maximization is the internal driving force of the development of commercial banks, which reflects the operating ability of commercial banks to off-balance sheet business. The safety of assets can provide reasonable guarantee for the normal operation of commercial banks, which is the ability of commercial banks to cope with risks and the prerequisite for them to obtain high profits. Development ability is the future development trend of commercial banks, which reflects whether they can achieve sustainable development in market competition. Its evaluation index system is shown in table 1.

**Table 1 Business Performance Evaluation Index System f Commercial Banks**

Level indicators	The secondary indicators	Calculation method
Profitability	Rate Of Return on Total AssetsX <sub>1</sub>	(Net profit/total assets at the end of the year)*100%
	Rate Of Return on Common Stockholders' EquityX <sub>2</sub>	(Net profit/year-end net assets) *100%
	Total Asset TurnoverX <sub>3</sub>	(Total sales/average total assets) *100%
Loan management ability	Loan of Asset RatioX <sub>4</sub>	(Total liabilities/total assets) *100%
	Debt-equity RatioX <sub>5</sub>	(Total liabilities/total owner's equity) *100%
	Loan-to-deposit RatioX <sub>6</sub>	(Total loan/total deposit) *100%
Asset security	Non-performing Loan RatioX <sub>7</sub>	(Non-performing loan balance/total loan balance) *100%
	Provision CoverageX <sub>8</sub>	(Non-performing loan loss provision/non-performing loan balance) *100%
Development capacity	Increase Rate of Main Business RevenueX <sub>9</sub>	(Operating income growth at the end of this year/operating income at the end of last year) *100%
	Net Profit Growth RateX <sub>10</sub>	(Net profit growth of this year/net profit of last year) *100%
	Capital Accumulation RateX <sub>11</sub>	(Growth of owner's equity this year/at the end of last year) *100%

### 3 Empirical Analysis

#### 3.1 Data collection and processing

In this paper, 16 commercial banks with more than five years of establishment and listed in A shares are selected as research samples. These banks are large and medium-sized commercial banks in China, which are representative to a certain extent. The evaluation of its operating performance can represent the current situation and existing problems of commercial banks in China. On this basis, this paper selects the financial data of each bank on December 31, 2016 for empirical analysis, all of which are derived from Guotai'an CSMAR database. Because of the different dimensions of financial indicators, it is necessary to deal with the original data dimensionless. The formula used is as follows:

$$y_{ij} = 0.1 + \frac{x_{ij} - m_j}{M_j - m_j} \times 0.9$$

Among,  $m_j = \min(x_{ij})$ ,  $M_j = \max(x_{ij})$

#### 3.2 Factor analysis process

KMO and Bartlett tests were carried out on 11 preliminarily selected indexes by SPSS 19.0 software to test the partial correlation of each evaluation index, that is, whether it was in accordance with the normal distribution, and if the value of KMO was less than 0.5, it was not suitable for factor analysis. The actual test results are shown in Table 2, from which we can see that the KMO value is 0.509, indicating that there is a certain correlation between the selected financial indicators, which is suitable for factor analysis. In addition, Sig. The value was 0.000, which was significantly lower than the significant level of 0.05, which further showed that the data were in accordance with the normal distribution.

**Table 2 KMO and Bartlett Tests**

Kaiser-Meyer-Olkin measure of sampling adequacy		0.509
Approximate chi-square		220.207
Sphericity Test of Bartlett	df	55
	Sig.	0.000

Through the analysis of the common factor variance of each index, it is found that the extracted variance is more than 0.6, which indicates that the extracted components can effectively describe the basic information of 11 items of financial data. Then the eigenvalues and contribution rates of the coefficients are analyzed, and the results are shown in Table 3. It can be seen that there are four eigenvalues that meet the conditions, and the contribution rate of cumulative variance is 90.342%, which indicates that the four principal components cover the basic information of the original 11 financial indicators. These four comprehensive indicators can be used to reveal the operating performance of listed commercial banks. Among them, the contribution rate of the first principal component factor was the largest, which was 43.906%.

**Table 3 Total Variance Explained**

Component	Initial eigenvalue			Extract square sum load			Rotation squared load		
	Total	Variance %	Accumulate %	Total	Variance %	Accumulate %	Total	Variance %	Accumulate %

1	4.830	43.906	43.906	4.830	43.906	43.906	3.594	32.673	32.673
2	2.392	21.743	65.649	2.392	21.743	65.649	2.770	25.181	57.853
3	1.490	13.544	79.193	1.490	13.544	79.193	2.277	20.702	78.555
4	1.226	11.150	90.342	1.226	11.150	90.342	1.297	11.787	90.342
5	.586	5.325	95.667						
6	.254	2.308	97.975						
7	.114	1.040	99.015						
8	0.090	0.817	99.832						
9	0.016	0.145	99.977						
10	0.002	0.015	99.991						
11	0.001	0.009	100.00						

Extraction method: principal component analysis

The rotation component matrix is obtained by orthogonal rotation method, as shown in Table 4. The financial index with large load in principal component 1 is the profit rate of total assets, the rate of return on net assets and the turnover rate of total assets, which is defined as profitability factor F1; The ratio of asset to liability is the largest in principal component 2, followed by the ratio of debt to equity and the ratio of deposit to loan, and the correlation coefficient of the first two indexes is more than 95%, which is defined as loan management ability factor F2. The load in principal component 3 is the non-performing loan ratio, and the provision coverage is defined as the asset security factor F3. The largest load in principal component 4 is the capital accumulation ratio, followed by the net profit growth rate and the operating income growth rate, which is defined as the development ability factor F1.

**Table 4 Rotating Component Matrix**

	Component			
	1	2	3	4
X1	0.718	-0.559	0.176	0.232
X2	0.844	0.295	0.029	0.268
X3	0.636	-0.060	0.052	0.335
X4	0.213	0.972	-0.068	0.005
X5	0.272	0.957	-0.020	-0.025
X6	-0.765	0.663	-0.254	0.131
X7	-0.882	0.015	0.758	0.162

X8	0.309	0.334	0.856	-0.083
X9	-0.044	0.392	-0.306	0.684
X10	0.180	0.461	0.146	0.721
X11	0.059	0.153	-0.866	0.935

According to the variance contribution rate of each factor, it is regarded as the weight, and the comprehensive evaluation model of business performance is constructed,  
 $F = 0.32673 \times F_1 + 0.25181 \times F_2 + 0.20702 \times F_3 + 0.11787 \times F_4$ , According to the coefficient matrix of the score of each factor, the score of the factor is calculated, and the mathematical model is as follows:

$$F = \sum_{i=1}^{11} a_i X_i \quad (a_i \text{ is the Score coefficient for financial indicators, } X_i \text{ is the Value for financial indicators})$$

Through calculation and analysis, the comprehensive score and ranking of the operating performance of 16 listed commercial banks in A shares in 2016 are obtained, as shown in Table 5:

**Table 5 Comprehensive Score and Ranking of Commercial Banks**

	F1 (ranking)	F2 (ranking)	F3 (ranking)	F4 (ranking)	Comprehensive score	Comprehensive ranking
Bank of China	-0.143 (4)	0.173 (15)	0.284 (9)	0.584 (14)	0.124	14
China Construction Bank	-0.232 (6)	0.364 (14)	0.528 (4)	0.863 (6)	0.227	7
ICBC	-0.218 (5)	0.166 (16)	0.517 (5)	0.815 (7)	0.174	12
ABC	-0.446 (16)	0.742 (9)	0.545 (2)	0.598 (13)	0.224	8
Industrial Bank	-0.334 (10)	1.064 (1)	0.529 (3)	0.645 (10)	0.344	3
Bank of Communications	-0.330 (8)	0.405 (13)	-0.071 (13)	0.440 (16)	0.031	16
Shanghai Pudong Development Bank	-0.396 (14)	0.886 (4)	0.286 (8)	0.902 (4)	0.259	5
Ping'an Bank	-0.257 (7)	0.597 (12)	-0.213 (16)	1.311 (1)	0.177	11
Minsheng Bank	-0.427 (15)	0.990 (3)	0.328 (7)	0.649 (9)	0.254	6
China Merchants Bank	-0.331	0.710	0.564 (1)	1.221 (2)	0.331	4

	(9)	(10)				
China Citic Bank	-0.368 (12)	0.752 (8)	-0.145 (15)	0.620 (12)	0.112	15
Everbright Bank	-0.422 (13)	0.875 (5)	0.151 (11)	0.454 (15)	0.167	13
Huaxia Bank	-0.334 (11)	0.773 (7)	-0.099 (14)	0.996 (3)	0.182	10
Beijing Bank	-0.083 (3)	0.603 (11)	-0.018 (12)	0.625 (11)	0.195	9
Nanjing Bank	0.375 (1)	0.867 (6)	0.159 (10)	0.671 (8)	0.453	2
Ningbo Bank	0.256 (2)	0.997 (2)	0.475 (6)	0.870 (5)	0.536	1

### 3.3 Results analysis

From the perspective of profitability, urban commercial banks rank the top three, namely Nanjing Bank, Ningbo Bank and Beijing Bank. In addition to Agricultural Bank of China, the other four state-owned commercial banks also have outstanding profitability. Among joint-stock banks, Ping'an Bank, China Merchants Bank and Industrial Bank have good profitability, while Shanghai Pudong Development Bank and Minsheng Bank rank lower. The reason may be that their non-performing loan ratio is relatively high in 2016 (1.89 and 1.68 respectively), while the non-performing loan ratio of commercial banks is the lowest (0.87), which further affects the provision for bad debt, resulting in poor profitability.

In terms of loan management ability, Industrial Bank, Ningbo Bank and Minsheng Bank rank the top three respectively. Commercial banks and investment banks as its strategic development direction, by the end of 2017 and 346 commercial banks established close relations of cooperation, information management system is relatively perfect, and is not bound by loan-to-deposit ratios, resulting in the development of bank customer group, improve the quality of the loans and loans. In addition, industrial bank combines financial products with scientific and technological development, and through financial innovation provides the market with a variety of innovative products and services, such as golden eye and digital cloud, etc., to meet customer needs, while constantly improving the bank's governance structure and improving its risk management ability (Larry L. and Silvia Z., 2018). The non-performing loan balance of state-owned commercial banks is relatively large. The loan-to-deposit ratio of Bank of China, China Construction Bank, Industrial and Commercial Bank of China and Bank of Communications is above 0.7, and that of Agricultural Bank of China is 0.65.

In terms of asset safety, except for bank of communications, the other four state-owned commercial banks ranked relatively high, indicating that after the share reform and capital injection, the capital accumulation of state-owned commercial banks has been growing, the non-performing loan ratio has been greatly reduced, and the provision coverage has been improved, guaranteeing the safety of assets to some extent (Chadha S. and Sharma A. K., 2016). Among joint-stock banks, China Merchants Bank ranks first in asset safety, while Ping'an Bank, Citic Bank and Huaxia Bank rank lower, indicating that banks should also pay attention to asset liquidity and safety while pursuing profit maximization, so as to improve the comprehensive performance level.

In terms of future development capacity, Ping'an Bank, China Merchants Bank and Huaxia Bank rank the first three and are all joint-stock banks. Compared with state-owned commercial banks, although joint-stock banks are relatively small in scale, their operating income and net profit grow rapidly and their information disclosure mechanism is more perfect. Their operation and development bring certain capital accumulation to banks. Urban commercial banks rank 5th, 8th and 11th

respectively in terms of development ability, indicating that although urban commercial banks do not have a high market share, their profitability is outstanding and they rank high in terms of loan management ability and other aspects, and they are potential stocks for the development of commercial banks. China Construction Bank, Agricultural Bank of China, Bank of Communications and other state-owned commercial banks, due to their large scale of operation, weaker business expansion capacity and financial product innovation capacity than joint-stock banks, have slow growth rate of operating income, net profit and capital accumulation rate.

It can be seen from the comprehensive ranking in table 4 that the comprehensive operation performance of Ningbo Bank, Nanjing Bank and Industrial Bank is the highest. The reason may be that these commercial banks continue to expand the scale of business outlets, provide innovative products and services based on customer demand, and effectively meet the market demand. However, Bank of Communications, Citic Bank and Bank of China are relatively backward in comprehensive operation strength, mainly in terms of asset safety and loan management ability, which will affect the sustainable development of commercial banks in the future.

#### 4 Conclusion

The research shows that, compared with state-owned commercial banks, urban commercial banks have outstanding operating performance, especially Bank of Ningbo and Bank of Nanjing. The operating performance of joint-stock banks is uneven, but most of them rank above the medium level. State-owned commercial banks have certain advantages in asset security. According to the actual situation of commercial banks, it puts forward the following suggestions. (1) Commercial banks should maintain profitability persistence and loan management efficiency. This is the basic dynamic of commercial bank's survival and the foundation, such as establishing information management system, optimizing the organizational structure and credit management system, improving the work efficiency, and reducing operating costs and operating risk. Meanwhile, commercial banks should expand their business scope, find new profit growth points through financial innovation, fuse of finance and science and technology, and improve their profitability and loan management ability. (2) Commercial banks should pay attention to their non-performing loan ratio and allocation coverage, improve loan quality by optimizing loan structure and business structure, strengthen customer credit assessment, and establish risk warning mechanism. The key way for commercial banks to improve their business performance is to expand loan business on the basis of ensuring the safety of funds, provide diversified financing channels and provide guarantee for the sustainable development of banks.

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# Research on the Industrial Development Mode of “Internet plus Hunan Embroidery” : from the Perspective of Intangible Cultural Heritage Protection

Wang Aimin, Liu Wenhua

School of Management, Wuhan University of Technology, Wuhan, P.R.China, 430070

(E-mail: wangam@vip.163.com,1786584887@qq.com)

**Abstract:** At present, "Internet plus", as a new economic form, has become an inevitable field in the development of various industries. intangible cultural heritage represents the unique culture, spiritual characteristics and values of all ethnic groups, and plays a vital role in shaping China's cultural self-confidence and activating cultural soft power. In this paper, Hunan Embroidery, one of the intangible cultural heritage items of traditional technology, is taken as the main research object. On the basis of summarizing the cases of the excellent industrial development mode of "Internet plus Embroidery" from the perspective of intangible cultural heritage protection, this paper reconstructs the new industrial development mode of "Internet plus Hunan Embroidery", and expounds in detail the operation mechanism and benefit of the new mode. The purpose of this paper is to provide reference for the development of Hunan Embroidery enterprises under the background of "Internet plus".

**Key words:** Intangible cultural heritage protection; Internet plus; Hunan Embroidery; Industrial development mode

## 1 Introduction

In 2006, Hunan Embroidery was included in the first batch of national-level intangible cultural heritage projects (Zhang Zhaolin,2016). It is a Hunan folk craft with a strong Hunan culture. Since the emergence of the first embroidered village of Hunan Embroidery in 1898, the Hunan Embroidery industry has undergone more than one hundred years of change and development, forming an industrial chain integrating R&D, production and sales (Zuo Xiao,2017). However, with the advent of the Internet era, the development of science and technology and modern industry has made the traditional handicraft production methods of Hunan Embroidery outdated, the products lack innovation, the marketing mode is backward, the financing channels are reduced, and the loss of Hunan Embroidery skills, lack of talents, and inadequate implementation of protection policies are not in place(Mou Xingang and An Li,2015). This makes Hunan Embroidery into a development dilemma. At present, how to protect and inherit the skills of Hunan Embroidery in the "Internet plus" era and promote the successful transformation and upgrading of Hunan Embroidery industry is an important issue. Therefore, it is of practical significance to analyze the development mode of Internet plus Hunan Embroidery industry from the perspective of intangible cultural heritage protection.

"Internet plus" is the result of the use of Internet Thinking in practice. It is a new format formed by the Internet evolution under the environment of Innovation 2.0. It refers to the combination of traditional industries and the Internet, and the transformation of production methods and business through the use of Internet information technology and Internet platforms (Sun Shun Yao,2016). Mode reconstruction and business system renewal to promote industrial transformation and upgrading, improve the level of development, and ultimately increase the wealth of the whole society. At present, China mainly implements three methods of intangible cultural heritage protection, namely, rescue protection, productive protection and legal protection. Hunan Embroidery belongs to the intangible cultural heritage

project of traditional crafts. It has its own production attributes and commodity attributes. It should be based on productive protection, and legal protection and rescue protection will develop in harmony (Wu Xu,2017).

## 2 The Typical Cases of the "Internet plus Embroidery" Industry Development mode from the Perspective of Intangible Cultural Heritage Protection

### 2.1 Cases analysis of typical modes from the perspective of rescue protection

Rescue protection refers to a kind of protection for intangible cultural heritage projects and their inheritors, including digital protection and inheritor protection (Xin Wang and Rong Zheng,2018). The former is to record specific intangible cultural heritage projects by means of science and technology, with the help of photography, pictures, writing and so on, to integrate these information into a database for retention protection, while the latter is to train talents for specific intangible cultural heritage projects. Let the intangible cultural heritage inheritors develop in the process of inheritance and innovation.

#### 2.1.1 Digital protection perspective - Hunan Embroidery digital museum

In the current technology-oriented era, the digitalization and informatization of traditional physical museums is the collision and blending of traditional culture and Internet technology (Huanjun Cao,2014). It not only makes the management of the museum systematic, informative, and convenient, but also expands the entities in the library. The preservation and communication channels of the collection broke through the time and space restrictions of the physical museum service. The Shaping Hunan Embroidery Museum in Hunan Province has created an online digital museum that integrates the information resources of Hunan Embroidery and has the functions of storing, displaying and sharing resources related to Hunan Embroidery. It is an open and all-round network platform. The public can understand and learn the cultural resources of Hunan Embroidery and appreciate the collection of Hunan Embroidery without leaving the household. Shaping Hunan Embroidery Digital Museum is built based on the browser/server system structure. It consists of three major business modules: virtual museum, database and background management system. The virtual museum is created by FLASH technology, the 360-degree three-dimensional display of the physical museum information, including the museum guide and collection display, viewers can freely move to choose the viewing angle, The database includes the collection database, the needle library and the Hunan Embroidery character library, the background management system is mainly to digitally organize, process and release the physical museum resources and industry dynamics, providing display and retrieval services for tourists. Figure 1 is a diagram of the overall architecture of the museum.

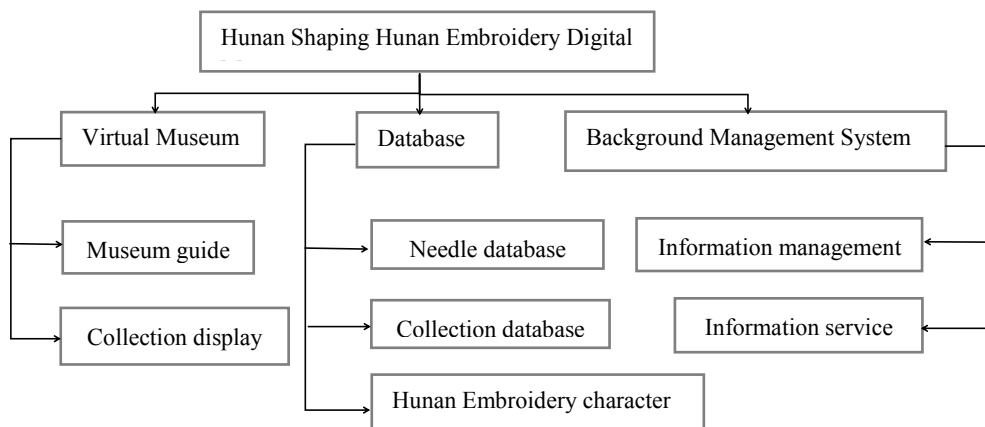


Figure 1 Shaping Hunan Embroidery Museum Overall Structure

### 2.1.2 Talent cultivation perspective - online embroidery education

According to data released by CNNIC, as of 2018, the number of online education users in China reached 144 million, of which the number of mobile online users accounted for 120 million. With the development of online education, many embroidery industries disseminate embroidery knowledge through online video, online open classes or the establishment of online schools, to meet the needs of students, and to cultivate heirs of different embroidery projects. On March 6th, 2018, Suzhou University released a large-scale online open class "Silk Culture and Products" for 9 weeks and 3-4 hours per week on the MOOC online platform. Students only need to register to login. The curriculum, the autonomy and convenience of students' learning is greatly improved. The online embroidery education reduces the learning threshold for embroidery knowledge, making students no longer limited to time and venue (Zeng Ximei et al,2013).

## 2.2 Cases analysis of typical mode from the perspective of productive protection

Productive protection refers to intangible cultural heritage projects that have production attributes and commodity attributes for traditional crafts, fine arts, etc., so that they can convert intangible cultural heritage resources into cultural products by means of production, circulation, and sales in the process of production practice (Yuan,2018). Intangible cultural heritage projects are protected and passed on in production practice. Productive protection is mainly reflected in the innovation of production technology, product design, marketing mode and financing channels.

### 2.2.1 Production process perspective - computer embroidery machine

Because embroidery has the characteristics of handicrafts, the production cycle is long, the creation cost is high, and the lack of embroidery workers often leads to a situation in which the supply in the embroidery industry is in short supply. In order to cope with this situation, computer embroidery machines came into being. At present, 80% of the domestic computer embroidery machine market is occupied by Dahao Technology, and it has a market share of more than 60% in foreign markets. The computerized embroidery machine developed by Dahao Technology has become an Internet intelligent terminal integrating process embroidery operation, order tracking management and machine diagnosis and maintenance. Dahao Technology has also developed a control software APP, and the staff can carry out the computer embroidery machine on the mobile terminal. Remote control, network management, order management, etc. After installing a chip, a computer embroidery machine can store 800 patterns and 100 million needles. Dahao Technology's operating income in 2018 reached 1.06 billion yuan, an increase of 27.99% over 2017. The development and operation of the computerized embroidery machine has greatly improved the production efficiency of the embroidery industry, reduced the pressure of traditional embroidery workers, and alleviated the shortage of embroidery products.

### 2.2.2 Product design perspective - Suzhou Embroidery plus cultural and creative industries

The cultural and creative industry is a smart-led industry with creativity as the core, the main culture as the soul, the support of science and technology, the creative development and utilization of cultural resources by individuals or teams, and the marketing of intellectual products or intellectual property (Dele Cui et al,2017). At present, most of China's embroidery industry is mainly based on the production of arts and crafts, and the price is expensive. Suzhou Embroidery is the first embroidery industry involved in the field of cultural creativity, and has developed a variety of Suzhou Embroidery products that are novel in design, practical and affordable. For example, Suzhou Embroidery wallets, card holders, bookmarks, business card holders and other products that integrate the elements of Suzhou

embroidery, and the prices of these products are around 100 yuan. The development mode of “Suzhou Embroidery plus cultural creation industry” innovates the products from product design, integrates Suzhou Embroidery elements into various practical products in life. This mode plays a big role in adding product value and expanding corporate visibility and market share.

### 2.2.3 Marketing mode perspective

#### (1) E-commerce plus Hunan Embroidery industry

The embroidered e-commerce road began in 2011 with the Hunan Jin Embroidery Research Institute to open the “Golden Caixia” store on Taobao platform. At present, there are three main development modes of e-commerce in Hunan Embroidery industry. One is to open online stores for Taobao, Tmall, Jingdong and other third-party e-commerce platforms for B2C mode sales, the second is to build online malls for sales, the third is to use WeChat From the media platform, they open a store on the mobile side and sell Hunan Embroidery products based on the user's social network. The e-commerce road of Hunan Embroidery Industry has opened up online sales and communication channels for the traditional Hunan Embroidery industry, which has reduced product transaction costs, promoted product sales and information transmission more quickly and efficiently. It provides a bright road for the transformation and upgrading of the traditional Hunan Embroidery industry.

#### (2) Self-media content shopping guide

self-media is a way to share the news, knowledge, interesting things, and mental journeys around us, after the public is integrated into the Internet knowledge and information era. At present, many Hunan Embroidery enterprises have opened Weibo and subscribed articles, and through the production of high-quality content about Hunan Embroidery, packaging Hunan Embroidery history and culture, Hunan Embroidery craft, and Hunan Embroidery products to attract fans to purchase. There are 86 public numbers about Hunan Embroidery that can be found on WeChat homepage. Dozens of companies such as “Yifei Hunan Embroidery”, “Red Hunan” and “Jin Caixia Hunan Embroidery” have been well done. Hunan Embroidery enterprises use the community effect of self-media to introduce the high-quality content, let the public understand the history and culture of Hunan Embroidery, grasp the consumer psychology, and guide consumers to place orders for shopping.

#### (3) Opinion leader

Under the guidance of government policies, the wave of traditional culture in 2017 swept through various industries such as film and television, variety, education, and the Internet. For example, the documentary "Looking for Craftsmanship", "Hundred Hearts and Craftsman" and other intangible cultural heritage and inheritors are broadcast on the video website. In December 2017, "National Treasures" is a cultural program that tells the cultural heritage of past and present. Concerned, once the program was broadcasted, the domestic search for tourism and cultural products increased by 50%. In 2017, under the efforts of the government and various industries, the cross-border integration of the Internet and the traditional cultural industry was greatly promoted, and the traditional culture became a new “network red man”. The Hunan Embroidery industry has been among them. With the help of video, variety, live broadcast, and film and television channels, the popularity of Hunan Embroidery was attracted to attract the attention of the public. which not only spread the culture of Hunan Embroidery, but also directly or indirectly drove the sales volume of Hunan Embroidery products and improved Hunan Embroidery. The overall level of development of the industry.

### 2.2.4 Perspective of financing channels - Patchwork Embroidery plus Internet crowd funding

The Patchwork Embroidery originated from the Dabujiang area of Cangzhou City, Hunan Province.

It originated in the Han Dynasty and was popular in the Ming and Qing Dynasties. It is a national-level intangible cultural heritage project. Internet crowd funding refers to the act of the fundraiser through the Internet crowd funding platform to initiate fundraising from the mass sponsors. At present, Internet companies such as Jingdong, Taobao and Tencent have launched crowd funding platforms, and some self-built special crowd funding platforms are also emerging to serve social, poverty alleviation and entrepreneurship.

Combining Patchwork Embroidery with Internet crowd funding is He Juan, a non-genetic inheritor of patchwork embroidery skills. In 2013, He Juan established a company to engage in the business of patchwork embroidery products. He Juan submitted his design products to the Taobao crowdfunding platform for review. After the approval, on November 8, 2015, Taobao crowd funding platform launched a patchwork project, including five products, namely mobile phone case, key case, and Fu. Word, Zhong Ni image and head band, raising the target of 50,000 yuan, and promoting it on the crowd funding homepage. As of December 3, 2015, the total amount of crowd funding was 37,094 yuan, and 74% of the target task was completed. The pattern of Patchwork Embroidery plus Internet crowd funding has improved the popularity of patchwork embroidery, increased the sales volume of Patchwork Embroidery products, expanded new financing and sales channels with Taobao crowd funding platform.

### **3 The Development Mode of "Internet Hunan Embroidery Industry" from the Perspective of Intangible Cultural Heritage Protection**

#### **3.1 Construction of the development mode of Hunan Embroidery industry**

##### 3.1.1 The main elements of the pattern

###### (1) Government

The government is the subject of legal protection and rescue protection. Legal protection refers to the legislative bodies to formulate laws and regulations on intangible cultural heritage protection and development, to support and restrict the healthy and orderly development of intangible cultural heritage industries, and to carry out protection work mainly from human rights law, environmental law and intellectual property law. Hunan Embroidery is one of the first batch of national-level intangible cultural heritage projects, and the government has the responsibility to protect and develop it. Therefore, in the process of constructing the development mode of the Internet plus Hunan Embroidery industry, the government is an important main element for legal protection and rescue protection of Hunan Embroidery.

###### (2) Hunan Embroidery enterprise

Hunan Embroidery enterprise refers to a legal person or other social economic organization engaged in the R&D, production and sales of Hunan Embroidery products for the purpose of profit. Whether it is in the traditional market of Hunan Embroidery or the Hunan Embroidery market under the background of the "Internet plus" era, Hunan Embroidery enterprise has been the main force to promote the development of Hunan Embroidery industry. Building the Internet plus Hunan Embroidery industry development mode, Hunan Embroidery enterprises have become an indispensable one.

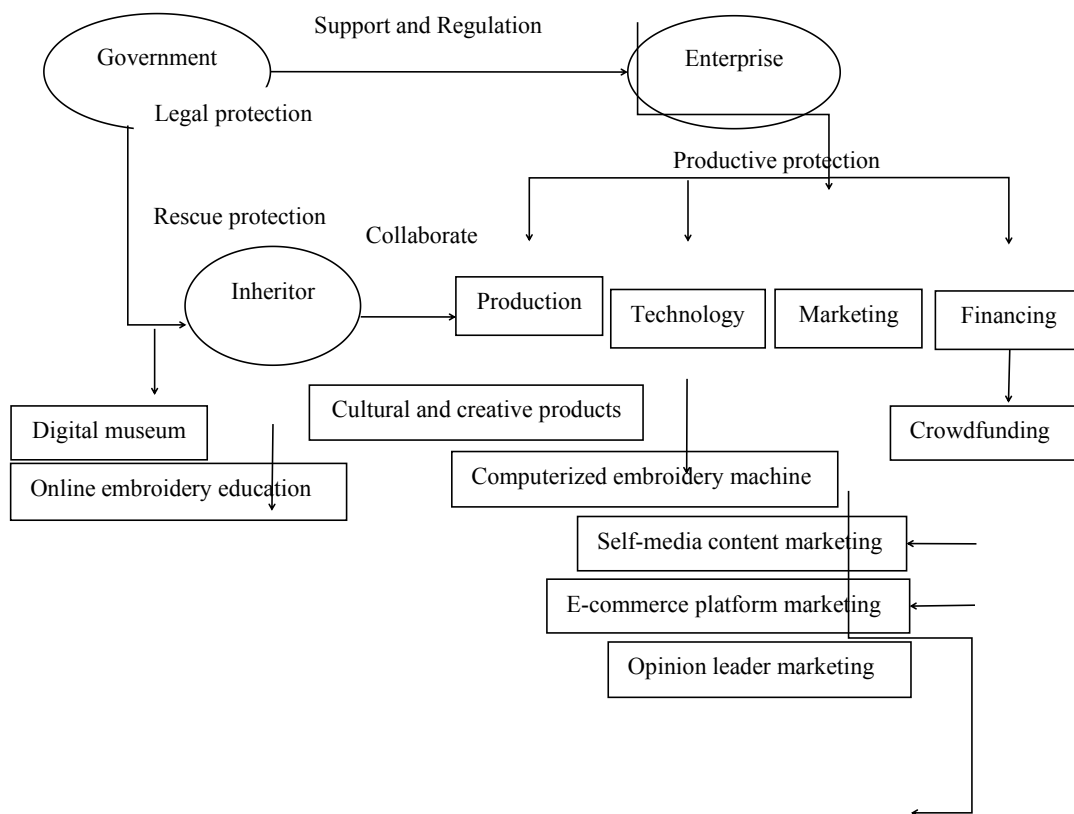
###### (3) Hunan Embroidery inheritor

The inheritor of Hunan Embroidery is a complete master of the traditional cultural knowledge of Hunan Embroidery, the skill of Hunan Embroidery, and actively carry out the inheritance activities

related to Hunan Embroidery. It is representative and authoritative in the Hunan Embroidery industry, and is approved by the state, province, city and county. The level of the accreditation authority represents the level of the inheritor of the Hunan Embroidery project. The protection of the inheritors is one of the ways in which the government carries out the rescue protection of Hunan Embroidery techniques, and it is an effective guarantee for the inheritance of the knowledge and skills of Hunan Embroidery. In the development process of the Internet plus Hunan Embroidery industry, Hunan Embroidery inheritor is an important main factor.

### 3.1.2 Constructing the development mode of "Internet plus Hunan Embroidery industry"

Based on the perspective of intangible cultural heritage protection, comprehensively develop the current "Internet plus Embroidery Industry" excellent development mode, build a government, Hunan Embroidery enterprise, and inheritors as the main elements, with productive protection as the main protection method, legal protection method and rescue protection method. A comprehensive development mode of "Internet plus Hunan Embroidery Industry" with coordinated development. The development mode is shown in Figure 2.



**Figure 2 "Internet plus Hunan Embroidery" Industry Development Mode from the Perspective of Intangible Cultural Heritage Protection**

### **3.2 The operation mechanism of the new mode**

#### 3.2.1 Hunan Embroidery enterprise business process

##### (1) R&D procession

Hunan Embroidery enterprises can follow the development mode of Suzhou Embroidery plus cultural and creative industries, and hire excellent design teams and Hunan Embroidery inheritors to develop Hunan Embroidery products. Hunan Embroidery Enterprises provide R&D funding support. Hunan Embroidery inheritor and design team are responsible for the R&D of cultural and creative products. The combination of Hunan Embroidery pattern, method, materials and design team design concept creates a practical life that belongs to Hunan Embroidery industry. Cultural and creative products are affordable, such as stationery, cups, clothing, card holders and other products.

##### (2) Producing procession

The production of traditional Hunan Embroidery products is mainly based on manual workshop-style hand-embroidering. The production cycle is long and the process is complicated, which is not suitable for mass production. The essential feature of Hunan Embroidery enterprises is profitability, and the traditional production style are already backward. The computerized embroidery machine integrates the process of embroidering operation, order tracking management, machine diagnosis and maintenance as one of the Internet intelligent terminals, as well as a special control software APP. The staff can remotely control and manage the computerized embroidery machine on the mobile terminal. Hunan Embroidery enterprises can purchase computer embroidery machines for product production, improve the production efficiency of products, and reduce production costs.

##### (3) Marketing procession

In the "Internet plus" era, the marketing methods of Hunan Embroidery enterprises mainly include e-commerce platform marketing, self-media content marketing and opinion leader effect to drive marketing. The marketing mode of e-commerce platform can be realized in three ways: one is to open an online store on the third-party e-commerce platform for B2C mode sales, the second is to build the online shopping mall to sell products. The third is to use the self-media platform to sell products based on the social network. The self-media content marketing is an indirect marketing method. It refers to the production of high-quality content about Hunan Embroidery through the self-media platform such as subscribed articles, attracting fans' attention and praise, ultimately get profit. The opinion leader marketing mode refers to the popularity through video, variety, live broadcast, film and television channels, attracting the attention of the public, making Hunan Embroidery become opinion leader, spreading the knowledge of culture and driving the sales of products.

##### (4) Financing procession

In addition to the traditional methods of bank loans, venture capital, bond issuance, and stock issuance, the "Internet plus" era of Hunan Embroidery enterprises can also learn from the example of "Patchwork Embroidery plus Crowd funding" and set up the target amount of fundraising, use social platforms to raise funds from the public.

#### 3.2.2 The government cooperates with the development of Hunan Embroidery enterprise

The government can formulate reasonable policies, increase investment promotion, and gather foreign embroidery enterprises in one region to stimulate innovation and orderly competition, resulting in the cluster effect of Hunan Embroidery industry. In the region, the government supports the



cultivation of a certain embroidery enterprise and encourages it to acquire other small and medium-sized enterprises to expand itself, making it a leading enterprise and driving the development of other Hunan Embroidery enterprises. In the industrial chain, in the vicinity of the Hunan Embroidery industrial cluster, cultivate sericulture and forestry parks, integrate the production of embroidery threads, embroidery production and sales, ultimately reduce industry costs and improve operational efficiency.

### 3.2.3 Inheritors cooperate with Hunan Embroidery enterprise to R&D production

The Hunan Embroidery inheritor has mastered the complete knowledge of culture and skill and technique. It is a living resource database of Hunan Embroidery intangible cultural heritage project. Hunan Embroidery enterprise can hire Hunan Embroidery inheritor to assist in the R&D of products. Hunan Embroidery Enterprise provides financial support. The inheritor cooperates with the design team to combine the embroidery pattern, the embroidery method, the different embroidery materials and the concept of the design team to jointly develop different kinds of cultural creative derivatives with Hunan Embroidery elements.

## 3.3 Benefits analysis of the new mode

### 3.3.1 Industrial ecological benefits

In the newly constructed "Internet plus Hunan Embroidery" industry development mode, the government, Hunan Embroidery enterprises and inheritors are three main elements. The government supports and regulates the orderly development of Hunan Embroidery enterprises through the formulation of policies and systems. At the same time, the good development of Hunan Embroidery industry is conducive to the protection and inheritance of Hunan Embroidery culture and skills. There is a duty to regularly organize the inheritance activities of Hunan Embroidery culture and cultivate follow-up talents. Hunan Embroidery inheritors cooperate with enterprises to carry out R&D of Hunan Embroidery products, and enterprises provide financial rewards to inheritors. In the new mode, it not only realized the win-win situation of the government, Hunan Embroidery enterprise, and inheritor, but also promoted the development of the entire Hunan Embroidery industry. Figure 3 shows the ecological system of the Hunan Embroidery industry under the new mode.

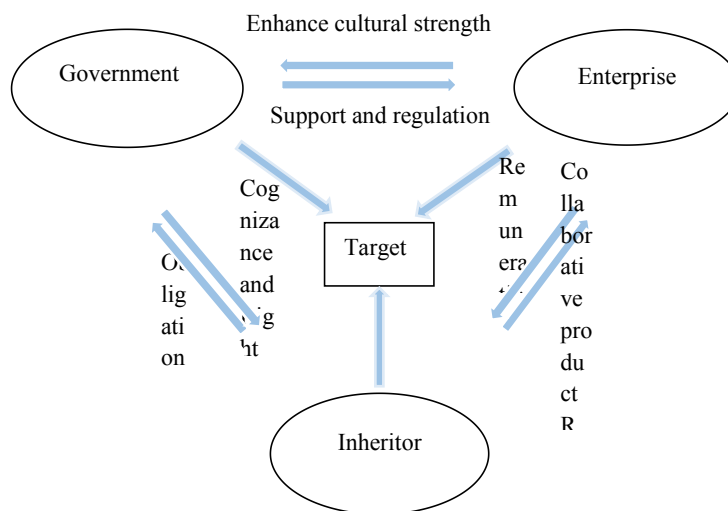


Figure 3 Ecology System of Hunan Embroidery Industry under the New mode

### 3.3.2 Economic benefits

The income under the new mode is mainly reflected in the two main bodies of enterprise and inheritor. In the "Internet plus" era. The direct purpose of Hunan Embroidery enterprises is to increase the economic profits. Hunan Embroidery enterprises have direct economic benefits under the mode of productive protection. The Hunan Embroidery inheritor, as one of the targets of the government's rescue protection, received the government's financial support. They also cooperated with Hunan Embroidery enterprise to assist them in product R&D and obtain wages.

### 3.3.3 Cultural benefits

As a national intangible cultural heritage project, Hunan Embroidery has a distinct regional and national character, and contains the spiritual connotation of Hunan culture. It is a cultural card for foreign exchanges in Hunan province. Under the new mode of "Internet plus Hunan Embroidery", the government has strengthened legislation and established a "national plus province plus city plus county" four-level intangible cultural heritage project and inheritance list protection system, giving Hunan Embroidery and inheritors legal status and society. The government builds the Hunan Embroidery digital museum, expands the channels for disseminating cultural knowledge of Hunan Embroidery. Inheritors teach students through online video, online open classes, online schools, it spreads the knowledge of Hunan Embroidery culture. Through the production and sales of Hunan Embroidery products, Hunan Embroidery enterprises have promoted the spread of cultural knowledge while gaining economic value. Under the new mode, the common goal of the government, the inheritors and enterprises are to make the Hunan Embroidery intangible cultural heritage project better protected and develop.

## 4 Conclusion

Taking the Hunan Embroidery industry under the intangible cultural heritage traditional technology as the main research object, this paper explores how to make use of the Internet Thinking and technology to innovate and "make blood" development under the background of "Internet plus". The first part of this paper describes the relevant theories of "Internet plus" and intangible cultural heritage protection. Secondly, On the basis of theory, this paper sums up the cases of excellent development mode of "Internet plus Hunan Embroidery industry" and "Internet plus other embroidery industry" from the perspective of intangible cultural heritage protection. To provide the basis for the innovation of the development mode of Hunan Embroidery industry under the background of "Internet plus", Finally, on the basis of the second part, from the perspective of intangible cultural heritage protection, this paper constructs a new development mode of "Internet plus Hunan Embroidery industry", and expounds the operation mechanism and benefits of the new mode in detail. The mode of this paper provides a reference for the development of Hunan Embroidery industry under the background of "Internet plus".

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# Application of Big Data Analysis in the Innovation of Information Resources Management

Luo Qifeng, Yang Jiaqi, Li Siqian

School of Transportation, Wuhan University of Technology, Wuhan, P.R. China, 430063

(E-mail: 443293143@qq.com, styjq@whut.edu.cn, siqian\_lee@whut.edu.cn)

**Abstract:** In the literature management, the approach of using big data theory to carry out data mining, mass data analysis and high dimension data reading embodies the advantages of big data technology. Through scientific statistics and analysis of network reading and other complex big data, it can greatly improve the scientific research and teaching work in university. Meanwhile, big data technology enables university libraries to cooperate successfully with other academic research institutions in the internet age. The application of big data technology in university libraries has become a landmark achievement of the innovative development strategy on information resources management.

**Key words:** Big data analysis; University library; Information resources; Data management

## 1 Introduction

The first explicit analysis of big data analysis on university library management is the massive reading data. From the representation of data analysis, the analysis of massive data can be understood as the classification and management of the records of the reading objects such as the literature and information of interest to the readers. The big data technology is suitable for the data management of the university library, and it also has the time and space attributes. An important function of the analysis and management of mass data is to analyze and organize the determined data targets in order to provide the value and basis of the existence of the digital book resources (Cohen et al., 2009). The reading data in massive data can not only reflect the importance of the document, but also reflect the utilization ratio of the document. Literature knowledge is the interpretation and expression of concepts, and reading data is an important material to reveal the mode and relationship of knowledge existence. A single data record cannot explain the value, reliability and cognition of knowledge (Tu, 2012). It is only to organize and relate the data of different records in order. The reading information of readers is analyzed through big data analysis, and the key clues of the common and different reading information related to the knowledge literature are compared. Through an orderly interpretation of the effective information to induce the knowledge structure and clues hidden in data, we can approve the reliability and value of the knowledge.

## 2 The Application of Big Data Analysis on Data Management, Literature and Knowledge Module in University Library

The process of using big data technology to analyze library literature knowledge is complicated. Knowledge acquisition can be divided into explicit knowledge acquisition and tacit knowledge acquisition. Data obtained by explicit knowledge acquisition is called dominant data. The mass data analysis of the dominant data is obtained by measurement and classification according to a certain rule or theory. The analysis is used to describe the total amount of reading and the acquisition of the concept of knowledge, such as the classification reading of the science department, the literature collecting,

news events reading, internet and public knowledge media platform participating, and so on. The purpose of data analysis is to objectively evaluate the degree and intensity of utilization of information resources in university libraries (Cuzzocrea, 2011). However, a lot of knowledge and information cannot be obtained directly by quantifying. This part of knowledge and information needs to be inferred through model assistance. And the data used in the unknown conceptual modeling are called recessive data. The important role of the recessive data analysis is to reveal the reliable basis of the explicit knowledge and information.

Taking the PBL (Problem-Based-Learning) teaching mode data analysis and research as an example, PBL is a learning method and a related knowledge system based on problem solving and the ability of autonomous learning for college students (Jones, 2012). The PBL teaching model can arouse the enthusiasm and initiative of college students and form the skills of solving problems and the ability of autonomous learning. By analyzing the clicks of college students accessing relevant knowledge as the dominant statistics, it is showed that colleague students can solve problems independently without teachers' guidance. This data analysis conclusion is also benefited from a group of high dimensional recessive data: taking the sum of the dominant data taken by the university students in the library and the clicking data of the knowledge related knowledge as the sum of recessive data. It's a complex experiment, and the key to the success is how to design and analyze the data of double blind. By trying the effective recessive knowledge structure of data management, the comprehensive observation data supporting the research can be obtained. The information of purchasing book, the total reading of the electronic information resources and the related recessive consumption data can provide follow-up support for the study. For example, the students with weak awareness of the PBL can pay attention to the research results of this subject, and the students with a strong sense of PBL are concerned about the information acquisition of interdisciplinary knowledge related to the field of the subject. Therefore, the PBL teaching model cannot be separated from the mass data collection and analysis of the information technology in university library. On the basis of the full acquisition of dominant data, we should also use the big data technology to analyze the recessive data to provide an objective scientific data reference for the research project.

### **3 Cloud Computing in Big Data Perspective and Data Mining of University Library**

The cloud computing academic cooperation program, jointly launched by Google, University of Washington and Tsinghua University, is actively exploring the new model of data management in university libraries in the era of big data. Cloud computing is a super computing method in virtual computing environment (Yao, Tian, 2012). It is dynamic and extensible. The cloud computing technology based on the university library includes four layers of data architecture: Infrastructure-as-a-Service (IaaS), Platform-as-a-Service (PaaS), Software-as-a-Service (SaaS) and Data-as-a-Service (DasS), which is the network computer technology and the cluster computing technology that serves the readers (Feng, 2012). The internet has brought new opportunities for the development of university library services, such as fast feedback, online reading, intelligently borrowing, reading software online upgrading, and so on.

Cloud computing has changed the research of university library information platforms from the previous study of single computer software development and evolution systems to the integration of social knowledge networks and public knowledge platforms. The information resources of university library use the computer cloud computing technology to link the social dispersed large-scale electronic literature publishing system closely with the individual terminal readers, research institutions and academic groups, and raise the demand of the university library information resources and service to a closely related model. It also expands the total amount of literature knowledge and diversity the ways of acquiring knowledge in university libraries. Such as the resources sharing in different university

libraries, the utilization and development of the software engineering of university books, the adaptive of the upgrading of the book reading software, the storage pool of precious literature, the desktop pool of reading terminal, and the security pool of the cloud computing disaster recovery system. The cloud computing and the data mining of university library are relative but different: the dynamic and scalable computing power of the cloud computing brings the possibility for the high efficiency and mass reading data management of the university library (Liu, Huang, 2011). In the cloud computing environment, the number of click times of E-books has provided the academic dynamic data and related dissemination of knowledge to the publishers, the book companies and other knowledge publishing corporations and the writers. It can guide the library collection, the knowledge consumption, the information resources and the library literature update and development. The service-oriented characteristics of cloud computing makes it possible for university libraries to provide data mining of collection literature services for university scientific research. Meanwhile, the development of cloud computing technology cannot live without the support of the data mining of university library. Taking the literature search as an example, the search based on cloud computing includes three parts: web storage, search processing and front-end interaction. With the development of broadband technology, the literature of university library also includes the literature of multimedia data (Newman, 2011). The search engine that can query images, sounds, pictures and films has been developed. And the images and videos are the supplement of the text information of the contemporary university library. The data mining of university libraries has been widely used in these parts, such as the web page removal in web storage, web sorting in search processing and query classification in library front-end interaction. Therefore, the cloud computing technology provides a technical basis for the library's massive reading and the complex electronic literature data mining. It has brought a breakthrough innovation to the public library resources service under the network environment (Devenport, 2007).

#### 4 Big Data Case Analysis on Research Cooperation of Academic Institutions

The case data in this paper is derived from the literature records of CNKI, including the author and author institutions of the literature. Network nodes are used to represent the research institutions. The edges in the network represent the jointly published literature of the corresponding two nodes (research institutions), and the weight of edges is decided by the number of co-published literature of the corresponding research institutions. An undirected graph of different scientific research institutions in cooperation network is presented with 179 nodes and 779 directed edges. Assuming that  $G = (V, E)$  is used to represent the cooperation network of research institutions. The  $V$  is the small node set and  $E$  is the set of edges.  $W_{vw}$  is the number of edges between the vertex  $V$  and  $W$ . The weight of the network edge is defined as follows:

$$W_{vw} = \sum_k \left( \delta_v^k \delta_w^k / \binom{2}{n_k} \right) \quad (1)$$

Where  $W_{vw}$  is the institution, the weight of the edge is between  $v$  and  $w$ ,  $n_k$  is the research institution and author affiliation of literature  $k$ . If the institution  $v$  appears in paper  $k$ ,  $\delta_v^k = 1$ , otherwise,  $\delta_v^k = 0$ . With the formula in case, one paper contributes only one edge weight to the whole cooperative network of scientific research institutions, which avoids the high evaluation of one paper on the whole organization cooperation network due to the joint publication of multiple research institutions. The network data analysis is shown in Table 1.

**Table 1 The Scientific Research Cooperation Weighting Statistics of Different Research Institutions**

No.	Node	Node	Weight
1	Capital University of Economic and Business	China University of Finance and Economics	3.33333

2	Capital University of Economic and Business	Renmin University of China	3
3	Beihang University	Jilin University	3
4	Beihang University	Harbin Institute of Technology	2.33333
5	Wuhan Institute of Technology	China University of Geosciences	4
6	Wuhan Institute of Technology	Tsinghua University	2
7	Huazhong Science and Technology University	Peking University	3.33333
8	Huazhong Science and Technology University	Wuhan University	5.33333

In this case the data is stored in the hard disk data “affiliations, txt” of university library. The original data of the case is named dt.TXT. As shown in Table. 1, each row represents an edge, the first and second column represents the nodes in the network, and the third column is the edge of the weights in the network. Based on the dt data, the undirected graph is constructed with the software packages “igraph”, and the basic information about the cooperation between research institutions on the internet is presented. R package in igraph software is loaded to call the data with require (igraph). FN algorithm is expressed as: (plotcg, layout=L, vertex, color=color vertex, label=NA). The results of data mining about the cooperation between research institutions on the internet in FN algorithm is shown in Table 2.

**Table 2 Results of Network Data Mining in Cooperative Universities**

Cooperation region	Name of cooperative universities and research institutes	Number of institutions
1. Beijing	Tsinghua University, Peking University, Renmin University of China, Beijing Normal University, Chinese Academy of Social Sciences...	20
2. Northeast region	Chinese Academy of Sciences, Harbin Institute of Technology, Jilin University, Dalian University of Technology, Jilin University of Finance and Economics...	26
3. Eastern China	Fudan University, Nanjing Normal University, Nanjing University of Finance and Economics, Nanjing Agricultural University, Zhejiang University...	18
4. Southern China	Sun Yat-sen University, Jinan University, South China University of Technology, South China Normal University, South China Agricultural University...	10
5. Central China	Wuhan University, Huazhong Science and Technology University, Central China Normal University, Zhongnan University of Economics and Law, Central South University...	28
6. Northwest Region	Northwest University, Xi'an Jiaotong University, Shaanxi Normal University, Xi'an University of Technology, Chongqing University...	17

According to the results of the network information data mining, the data analysis is continued. The method of nonnegative matrix decomposition, with the advantages of high operation speed and high Interpretability, is the optimization and most popular method at present, which attracts the attention of more and more university libraries. Moreover, the nonnegative matrix analysis technique is applicable to the collection of electronic image storage, the text data and literature document classification in university libraries. The function NMF that can be decomposed into nonnegative matrices is created firstly, and the data mining of cooperative universities and research institutes is carried out with the function (Badea, 2005). Then the R package Rcolor Brewer is installed and the palette under the requirement of Institution category for each node is also installed. As shown in Table 2, the first cooperation region is Beijing, which mainly included the Tsinghua University, Peking University, Renmin University of China, Beijing Normal University, Chinese Academy of Social Sciences and other 15 cooperative universities and research institutes. The remaining cooperation regions are distributed in the Northeast region, Eastern China, Southern China, Central China and Northwest Region. After the data mining and data analysis of cooperative universities and research institutes, the corresponding R package “entropy” programming is explained.

Big data technology overcomes the physical distance of scholars in different regions and various institutions. The data of academic achievements in different universities and research institutions is deeply summarized, sorted, counted and calculated with the big data technology on the internet, and the general situation on the resource sharing and in-depth academic cooperation between the universities with major research institutions is analyzed. The information resource platform of university library becomes the data hub between cooperative universities and research institutions, which provides the sufficient information technology support for the cross-regional cooperation of academic resources in China.

## 5 Conclusion

The big data technology is used to establish a comprehensive platform for literature resources and information in university library, which provides a variety of big data analysis services in data collection, creation, detection, synthesis, coding, storage, publication, retrieval, judgment, problem solving and academic researching in colleges and universities. It is not only greatly expanded the function of university library in the digital age and also greatly promote the utilization of the books intelligence and literature. Moreover, it has promoted the knowledge innovation module of the discovery of new knowledge and interdisciplinary learning from big data, and the development and innovation of the information resource management model in university library.

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# **Separate Sections and Key Points: The Application of Big Data in Agricultural Science and Technology Information Service: Based on the Two Main Bodies of Supply Side and Demand Side**

Yang Yu, Liu Jun

School of Marxism, Wuhan University of Technology, Wuhan, Hubei, China, 430000

(E-mail: 1445233678@qq.com, 76737306@qq.com)

**Abstract:** At present, the development of agricultural informatization in China is at a critical stage. The construction of agricultural science and technology information service platform with big data is of great significance to the development of agricultural modernization. Theoretically, the agricultural science and technology information service platform based on big data can effectively promote the interactive communication between agricultural researchers and producers and achieve a win-win situation. This study uses the method of empirical analysis, through visits and questionnaires, to explore the actual situation of demand docking between the two main bodies under the background of big data, and then find out the deviation between the actual situation and the theoretical conception. Based on the analysis results, it concludes that there are still some problems in the current development, such as low participation enthusiasm and poor participation. The conclusion is that the construction of agricultural science and technology database should be divided into sections and key parts.

**Key words:** Big data; Agricultural technology; Demand docking; Information service

## **1 Introduction**

Big data plays an important role in the process of agriculture becoming more and more modernized and informatized in China. The big data characterized by Volume, Velocity, Variety, Value and Veracity "5V" provide new path and new choice for agricultural science and technology information service (Wang Wensheng, 2015). Under the guidance of the Ministry of agriculture's guidance on promoting the development of big data in agriculture and rural areas (Nongshifa, 2015) and other important documents, the construction of agricultural science and technology big data has been rapidly carried out everywhere. However, for the two main subjects of agricultural science and technology service, agricultural researchers and agricultural producers, will the platform meet the needs of both of them and achieve the mutual benefit?

## **2 Mutual Benefit: The Ideal Form of Agricultural Science and Technology Information Service Mode under Big Data**

Many scholars at home and abroad attach great importance to the application of big data in agricultural science and technology information service. For its two main bodies, agricultural researchers and agricultural producers, it is the academic expectation of scholars to achieve a win-win

situation. Agricultural science and technology information resources, as the primordial and basic data generated from agricultural research activities and the source of information for analysis and research, are important supports for scientific and technological innovation, and have great scientific value, economic value and social value (Gui Shuting, 2018). Digital agricultural science and technology information platform can save time and energy for researchers to find and analyze information, and grasp the latest frontier trends, so as to improve the efficiency of agricultural research output and promote the development of scientific research. The same is true for agricultural producers. Scholar Sripad K. Devalkar points out that the Indian government pays attention to integrating agricultural data and completing agricultural science and technology information database by using big data technology, which provides convenient, detailed and professional agricultural science and technology information for farmers and greatly improves agricultural production efficiency (Sripad K. Devalkar, 2018). In the era of big data based on the Internet and the media, the relationship between simple and active information transmission in the agricultural science and technology information service is broken. Not only the supply side of scientific research achievements can get the reflection of agricultural operators on agricultural science and technology in time, understand the adjustment of planting structure of agricultural operators, grasp the transformation effect of agricultural scientific and technological achievements. The main body of agricultural management can also retrieve relevant agricultural science and technology through various channels according to their own needs, greatly expanding the information acquisition space, and effectively avoiding the "bullwhip effect" of information transmission (Liu Min, 2019). To some extent, they have affirmed the powerful data analysis and processing technology under the background of big data, providing strong protection and path selection for the communication between the two main bodies of agricultural science and technology information service.

On the whole, from the perspective of agricultural researchers, with the help of comprehensive data and information platform, it is possible to share scientific research results and practical technology with agricultural producers in a timely manner, and understand the technological needs of agricultural producers and the feedback of technology use, and promote the innovation of new technologies once again. At the same time, the transformation of scientific research paradigm brought by big data enables agricultural science and technology personnel to discover new knowledge from massive data and improve practicability and pertinence of scientific research (Wu Bingfang, 2016). From the perspective of agricultural producers, we can quickly retrieve the required scientific and technological information, and timely feedback the problems and doubts in the application of new technologies, which can better meet the production needs, make agricultural inputs and outputs in direct proportion, which is a virtuous cycle of win-win cooperation (Li Lingping, 2016). This study uses an empirical analysis method to explore whether the role of agricultural science and technology information service based on big data on the supply side and demand side of agricultural science and technology information is consistent with the above theoretical ideas.

### **3 Empirical Analysis Process**

On the basis of collecting feedback on the supply and use of agricultural scientific and technological information in the major network information service platforms, this study explores the real prospect of the docking communication between the supplier and the demander of agricultural scientific and technological information under the background of current large data by means of questionnaire and field interviews and data processing and analysis.

#### **3.1 Index system and questionnaire issuance**

Combined with previous studies on this issue, we constructed an index system in connection with the actual situation (see Table 1), and designed questionnaires for two main subjects, agricultural researchers and agricultural producers. In view of the subjects of agricultural producers, a random sample survey was conducted at Yin Zu town and Li Bu Town in Huangshi city of Hubei Province, the town of Bu river, Cen he town of Jingzhou, Tuanshan town of Xiangyang City, Wolong Town, Tunpu township of Enshi City, etc. 120 questionnaires were distributed, and 112 valid questionnaires were collected, with an effective recovery rate of 93.3%. In view of the main body of agricultural researchers, a total of 46 questionnaires were distributed in Huazhong Agricultural University, Hubei biological science and technology Career Academy and other agricultural research institutes, and a total of 45 valid questionnaires were collected, with an effective recovery rate of 97.83%.

**Table 1 Index System**

Classification	Specific Indicators	
Agricultural Scientists	(X1) Research field	(X2) Browse feedback information
	(X3) Performance appraisal	(X4) Using feedback information
	(X5) Supply information frequency	(X6) Cognition of supply importance
	(X7) Required feedback content	(X8) Satisfaction with feedback information
	(X9) Cognition of feedback importance	
Agricultural Producers	(X1) Agricultural type	(X2) Browse supply information
	(X3) Agricultural scale	(X4) Adoption of information on Supply
	(X5) Educational level	(X6) Effect of new science and technology
	(X7) Income level	(X8) Cognition of supply importance
	(X9) Feedback frequency	(X10) Cognition of feedback importance
	(X11) Required supply content	(X12) Satisfaction with supply information
	(X13) Is there Internet access?	

### 3.2 Principal component analysis

There are many indicators showing the current situation of agricultural science and technology information supply and demand docking, which may have interactive effects. Therefore, this study adopts the principal component analysis method. After data standardization, the applicability of factor analysis was tested for the two sets of data, and the results showed that the method was suitable for use (see tables 2 and 3).

**Table 2 KMO and Bartlett Test Tables for Agricultural Researchers**

Kaiser-Meyer-Olkin Metric for Sampling Sufficiency		0.816
Approximate chi square		296.995
Bartlett Sphericity Test	df	43
	Sig.	0.000

**Table 3 KMO and Bartlett Test Tables for Agricultural Workers Producers**

Kaiser-Meyer-Olkin Metric for Sampling Sufficiency		0.887
Approximate chi square		296.995
Bartlett Sphericity Test	df	43
	Sig.	0.000

Secondly, the two sets of data are extracted by principal component analysis respectively, and the variance maximization method is used to factor rotations, and the variance contribution rate and factor load and factor load value of each factor are obtained. The cumulative variance contribution rate reaches 83.685% and 86.236% respectively, indicating that the overall situation can be explained better (see Table 4, table 5).

**Table 4 Conclusion of Factors Extracted from Agricultural Researchers**

Common Factor Naming	Variance Contribution Rate after Rotation	Factor Load and Factor Load Value
Group Characteristics	20.121%	(X1) 0.668, (X7) 0.723
Participation Enthusiasm	33.273%	(X3) 0.962, (X5) 0.969, (X2) 0.973, (X6) 0.957, (X9) 0.815
Participation Effect	30.291%	(X4) 0.976, (X9) 0.981

**Table 5 Conclusion of Factors Extracted from Agricultural Producers**

Common Factor Naming	Variance Contribution Rate after Rotation	Factor Load and Factor Load Value
Group Characteristics	21.692%	(X1) 0.912, (X3) 0.925, (X5) 0.931, (X7) 0.911, (X11) 0.721
Participation Enthusiasm	33.654%	(X9) 0.985, (X2) 0.972, (X10) 0.953, (X8) 0.897, (X13) 0.887

Participation Effect	30.890%	(X4) 0.982, (X6) 0.899, (12) 0.916
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## 4 Results

According to the questionnaire data and principal component analysis, it is known that under the background of big data, agricultural science and technology information service has not achieved the desired result. As agricultural science and technology information providers and agricultural producers of information demand side, there is no good interaction and demand satisfaction. We have summarized the current problems into two main points:

(1) The enthusiasm of the two sides is low: If we want to make the two main bodies achieve mutual benefit in agricultural science and technology information exchange, we must first have the support of data information (Wu Bingbing, 2015). In reality, most agricultural producers lack initiative in expressing their aspirations and providing feedback due to their low quality of science and technology, lack of information awareness and high cost of network infrastructure (Wang Zuzhu, 2015). At the same time, the research work of agricultural researchers is influenced by many factors such as policy orientation, market changes, interest distribution and so on. In addition, the limitations of farmers and the regional characteristics of information feedback will not completely determine the direction of scientific research and information supply according to the needs of farmers.

(2) The effect of communication is not good: Although the big data platform provides a carrier for information exchange, the operation mechanism of the platform is still not perfect. The gap between the two sides of information supply and demand in space and discourse system makes information communication gap, not only cannot fully tap the value of information provided by agricultural researchers, but also the farmers' demand for science and technology and feedback information cannot be targeted to reply and solve (Zhu Fangchang, 2017). For example, a farmer feedback strawberry malformation through the platform. The advice given by experts is to control temperature and humidity, soil moisture content. However, the lack of specific methods for measuring soil water content and controlling temperature and humidity has not solved the technical difficulties faced by farmers in actual operation.

On the basis of analyzing the realistic problems and focusing on how to build a large database and promote the mutual win-win situation between the providers and the demand side of the agricultural science and technology information providers, this study gives the following two suggestions:

(1) Agricultural science and technology database should be established according to the actual needs of different links in different agricultural fields. In all fields of agriculture, it can be divided into planting, forestry, animal husbandry and fishery. From the management of production process, it can be divided into facility planting, facility farming and precision agriculture. Agricultural technology may run through every aspect of agriculture (Meng Xiangbao, 2014). In order to make mass agricultural science and technology information play a substantial role, we need to build different databases based on categories. For example, the planting industry can be specifically divided into food crops, fruit, tea, cotton and so on, each of which can be specifically divided into crop seeds, irrigation, fertilization, pest control and other contents. Based on the characteristics of crops, a specific agricultural science and technology information database is established to ensure that agricultural researchers' information supply is classified and orderly, and the feedback information of agricultural producers can be followed.

(2) The construction of agricultural science and technology database should be focused and targeted. At present, it is still difficult to build a large database containing all agricultural science and technology

content, So for the emerging agricultural technology, we need to provide detailed data information and a convenient feedback platform for agricultural production personnel to understand and select, and timely feedback doubts and problems, in order to promote the improvement of new technology once again. For example, the popularization and application of new technologies such as planting Chinese herbal medicines and fruits will require more interaction and interaction between the providers of agricultural science and technology information and the needs. For rice and corn, the more regular crops will depend on the experience gained by farmers in actual production. This type requires less agricultural technology, so the construction of related databases can also reduce the pressure.

## 5 Conclusion

Based on literature review, this paper describes the ideal form of agricultural science and technology information service to promote effective docking between agricultural researchers and agricultural producers in the context of big data. Through empirical analysis, the gap between reality and idealized state is verified. The conclusion is that agricultural science and technology database should be divided into blocks and focused on targeted construction. This study still has some shortcomings, such as how to define the classification standard of agricultural technology categories and establish a more effective agricultural science and technology information service platform, which is the direction for further research.

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## **Research on Agricultural Science and Technology Information Service Model and Its Problems Based on Big Data**

Li Yulin<sup>1</sup>, Liu Jun<sup>1</sup>, Wu Yongzhang<sup>2\*</sup>

1 School of Marxism, Wuhan University of Technology, Wuhan, P.R. China, 430000

2 Hubei Academy of Agricultural Sciences, Wuhan, P.R. China, 430064

(E-mail: 1652417587@qq.com, 76737306@qq.com, wyz@hbaas.com)

**Abstract:** With the continuous development of big data technology, its application in agricultural science and technology information service has gradually attracted attention from all walks of life. This paper analyses the theoretical model of agricultural science and technology information service based on big data and the optimization and improvement of the traditional agricultural science and technology information service mode. It also analyses the feasibility of applying big data technology in contemporary agricultural science and technology information service and the problems that easily arise in the application process, and puts forward some countermeasures and suggestions.

**Key words:** Big data; Agriculture; Scientific and technological information service; Theory construction

### **1 Introduction**

In 2015, the State Council issued the Circular of the State Council on the Issue of the Platform for Action to Promote the Development of Big Data (Guofa, 2015). Under its guidance, the Ministry of Agriculture issued the Implementation Opinion of the Ministry of Agriculture on Promoting the Development of Big Data in Agriculture and Rural Areas (Nongshifa, 2015) on 31 December of the same year, which defined the overall requirements for the development and Application. But it can also be seen that, big data is still in the stage of development, and its application in agriculture and rural areas is not mature at present. The role of big data in agricultural science and technology information service is not fully reflected. Although the agricultural science and technology information service model based on big data has been widely praised by all walks of life in recent years, can this model really be widely promoted? What problems will it face in the actual operation process?

### **2 Research Status of Agricultural Science and Technology Information Service Based on Big Data**

#### **2.1 Limitations of traditional agricultural science and technology information service**

Traditional agricultural science and technology information service mode is easy to form "information island" in the process of information transmission (Liu Min et al., 2019). Under the new situation, farmers have the need to quickly obtain information on various kinds of breeding technology,

processing technology, market dynamics, policies and regulations, life science popularization and so on. However, the traditional rural science and technology information service still stays at the level of holding training courses, technical consultation and issuing technical materials, scientific and technological discs. It is difficult to meet the increasing demand of farmers for science and technology information (He Yijun, 2016). Traditional service mode is mainly one-way service, which can not realize the interaction and exchange of information. In addition, the traditional agricultural science and technology information service institutions are unevenly distributed, and farmers have a higher cost of obtaining information. For farmers, the access to information is single, the way is backward, and the basic conditions of rural science and technology information service are still weak. (Wang Haiyan, Shao Xiwu, 2010). After the tax and fee reform, the original agricultural technology extension station was cancelled, and the agricultural science and technology information service system also appeared incompatible phenomenon.

## **2.2 Advantages of big data agricultural science and technology information service**

Through the in-depth application of the Internet and big data, we can accurately understand the needs of farmers and make scientific and technological research and development more precise to connect with farmers. Using data management supply chain, data perception marketing, data guidance services, the use of data not only affects marketing but also can guide their "production" (Zhang Xingwang etc., 2019). Big data can enhance the ability of scientific research providers and industrial demanders to acquire agricultural science and technology information, expand the space for agricultural operators to participate in the transmission of agricultural science and technology information, thus realizing the sharing of agricultural science and technology information and eliminating "information islands" (Liu Min et al., 2019). Overall, big data can help to develop modern agriculture with high efficiency, safety, economy and environmental protection (Liu Fanglin, 2018).

## **2.3 Application of big data agricultural science and technology information service**

The French government has taken effective actions in integrating agricultural data and completing agricultural science and technology information database by using big data technology. With the help of the Internet, it provides farmers with convenient, detailed and professional agricultural science and technology information, which greatly improves the efficiency of agricultural production. (Song, P, Y Chen, 2015). Promote agricultural science and technology information service through Internet search data analysis, utilization of agricultural professional database and analysis and utilization of data from self-Media platform (Chen Shengwen etc., 2014). The application of large data of agricultural science and technology information in agricultural enterprises is also studied. Taking the Climate Corporation as an example, the model of integrating weather simulation, massive plant root structure and soil quality with large data is analyzed. It is pointed out that it is helpful for them to make more accurate comprehensive judgment on the prediction of agricultural accident weather risk (Hamish Barwick, 2016).

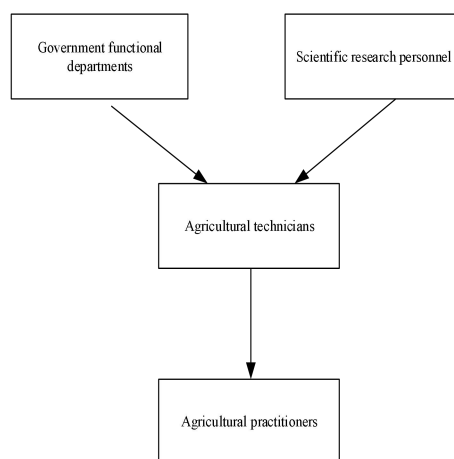
Generally speaking, scholars have made a thorough study on the advantages of big data technology compared with traditional agricultural science and technology information service mode. They have also made a comprehensive study on the application of big data and the existing problems, but they lack the theoretical construction of the application of big data technology in agricultural science and technology information service. In other words, academic circles focus more on applied research, while theoretical research is slightly inadequate.

### 3 Theoretical Construction of Agricultural Science and Technology Information Service Based on Big Data

With the continuous development of big data technology, its application field is gradually expanding. Before discussing the theoretical model of agricultural science and technology information service based on big data, we should first make clear what is big data. In *The Age of Big Data*, written by Victor Mayer-Schoenberg and Kenneth Cookie, big data refers to the analysis and processing of all data without the shortcut of random analysis (sample survey). Some scholars believe that large data is generally a large number of complex structures and different types of data aggregates, data processing based on cloud computing, relying on data sharing to form a resource body (Xu Meng, 2019). IBM proposes that big data has “5V” characteristics of volume, velocity, variety, value and veracity.

#### 3.1 Theoretical construction of traditional agricultural science and technology information service model

Traditional agricultural science and technology information service mode mainly adopts the way of "upload and download": government organs release policy information, laws and regulations related to agricultural science and technology, and scientific research institutes and agricultural colleges provide agricultural science and technology information. Through the study and dissemination of agricultural technicians, it is transferred to agricultural practitioners and radiated through "herd effect" (Fig. 1).



**Figure 1 Information Service Process of Traditional Agricultural Science and Technology**

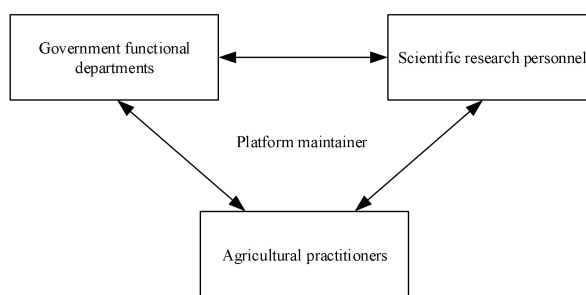
In this process, the information service of agricultural science and technology that agricultural practitioners can obtain depends on the degree of imparting by agricultural technicians. The whole process is transmitted from the first level to the lower level, that is, the agricultural science and technology information service obtained by agricultural practitioners is indirect and one-way, they can only passively accept, but can not convey their needs and wishes upward. Due to the limitation of administrative system, there are many disadvantages in the process of information transmission, such as long channels, many links and slow speed, which will lead to incomplete, asymmetric and untimely information acquisition by farmers.

In addition, the traditional agricultural science and technology information services will also use radio, television, newspapers, publicity materials and other media for information services. However, its drawbacks are also obvious. Radio and television are non-repeatable, which is not conducive to farmers

to learn a certain scientific and technological information many times; newspapers and publicity materials and other paper media can carry a limited amount of information, which is not intuitive enough only through text description and image display.

### 3.2 Optimization and improvement of traditional agricultural science and technology information service model by big data technology

Agricultural science and technology information service based on big data relies on Internet and cloud computing, and realizes information communication and sharing through unified data information collection and service platform. According to the principles of practicability, systematicness, ease of use, extensibility, comprehensive service and security, the agricultural science and technology information service platform is constructed. The network platform can replace the agricultural technicians as the link between the supplier and the demander of agricultural sci-tech information service, avoiding the inadequate information transmission and information distortion and error caused by the uneven technical and cultural levels of agricultural technicians (fig. 2).



**Figure 2 Agricultural Science and Technology Information Service Flow Based on Big Data**

There are two main sources of data. One is to carry out field measurements by manual means, that is, farmers themselves or other agricultural professionals, and input the collected data into a unified data collection platform. Second, through the modern Internet of Things technology, the environment can be monitored 24 hours in real time, and the data can be automatically transferred to the platform. These data include the application of an agricultural technology in different environments. Every farmer will transfer the data from his own production process to the platform, which can be aggregated into a huge database. After the original data is transferred to the platform, the data are classified and analyzed by technicians. Some simple data processing can be automatically completed by computer. Through the technologies of de-duplication and noise reduction, data storage, fusion and big data mining analysis tools, the classification subjects of agricultural planting and breeding are analyzed. Information processing intention, remove useless or false information, classify surplus information data, form different types of databases, and automatically generate background information such as source data, access to data and environment. The results of the analysis can guide the information suppliers to provide more targeted agricultural science and technology information services. The main body of information supply can directly provide information to the platform. For example, the staff of government departments can update the relevant policies, measures, laws and regulations of agricultural science and technology on the platform, and the researchers can send relevant scientific research information and achievements.

According to the source channel and type of information, the platform can be divided into different modules, such as integrated information service module, agricultural technology service module, online education and training module, expert online consultation module, agricultural scientific research

information module, etc. A set of systematic and structured agricultural science and technology information service database is formed through the combination of audio and video. Agricultural practitioners, such as farmers, agricultural enterprises and cooperative organizations, can directly obtain the required information from the platform. If the demand can not be met, they can also feed back the demand to the information supplier through the platform, thus realizing the effective connection between the supply and demand of information. This platform can be presented by many terminals, such as website, mobile phone APP, etc. Compared with the traditional agricultural science and technology information service mode, it is more convenient, fast, accurate and efficient.

## **4 Practical Problems and Countermeasure Suggestions on the Application of Big Data in Agricultural Science and Technology Information Service**

### **4.1 Practical problems of big data application in agricultural science and technology information service**

#### **4.1.1 Problems in data acquisition**

Big data needs to be supported by a sound and perfect network system, but the survey shows that in 2018, the scale of rural netizens in China is only 222 million, and the Internet penetration rate is only 38.4%. At present, the digital and networked environment in rural areas has not yet formed, and there is a lack of hardware facilities to provide data. In areas where the Internet has become popular, there are also problems that farmers can not provide accurate data. Taking the implementation of an improved variety as an example, it requires farmers to have a comprehensive understanding of the relevant situation of planting, but in practice, farmers often have difficulty in grasping comprehensive land parameters, such as temperature, humidity, soil acidity and alkalinity, seed development and so on. Due to the limited scientific and technological quality and cultural level of most peasants, it is difficult to guarantee the comprehensiveness, authenticity and reliability of the data.

The cost of organizing measurements for agricultural professionals is high. Moreover, the location of agricultural industry in China is mostly in undeveloped areas. It is impossible for professionals to survey all areas, to observe and monitor these areas for a long time, and to ensure real-time data. Although the accuracy and timeliness of data can be guaranteed by using Internet of Things technology, China's agriculture is dominated by small-scale production, the cost of Internet of Things will be high, and the level of agricultural automation in China is low, so the data of fine operations can not be obtained.

#### **4.1.2 Problems in data arrangement and analysis**

How to classify and organize massive data is also a big challenge. At present, there is no uniform criterion for the division of agricultural fields in academic circles. Before 1990s, agricultural information was customarily divided into four categories: agriculture, forestry, animal husbandry and fishery. However, with the development of science and technology, such as "shrimp-rice co-cultivation" technology and other types of symbiotic agricultural models have emerged, the traditional way of division has been unable to meet the needs of reality.

Big data is a huge amount of data with complex structure and diverse content. Its requirements in data analysis, processing and storage are much higher than other traditional databases (Chahaixia, 2019), which can not be separated from the support of human resources, and must be a professional with agricultural and computer technology background. However, due to the emergence of big data as a new

technology in recent years, there is still a lack of relevant professionals. The difference between the agricultural science and technology information service based on big data and the traditional agricultural science and technology information service lies in the diversification of its service objects, from a single farmer as the object to a variety of agricultural industry practitioners and scientific researchers. Obviously, there is a huge gap between farmers and scientific researchers in cultural level and scientific quality. Whether farmers can understand some professional terms, and whether the popularization of professional terms will lead to distortion of original intentions, all these need a large number of professionals to solve.

#### 4.1.3 Problems in data export and platform construction

The greatest advantage of applying big data to agricultural science and technology information service lies in the realization of information communication and sharing, which can not be separated from the perfect legal mechanism, operation mechanism, management mechanism and supervision mechanism. From the point of view of the legal system, the relevant laws and regulations for the application of big data in agricultural science and technology information service are not perfect. There is a lack of policies and regulations to promote agricultural rural informatization and data construction in line with the actual situation in rural areas, and a lack of unified standard system and operational norms. The division of powers and responsibilities of the functional departments of agricultural science and technology information service is not clear, and there is a phenomenon of multi-department management. The main body of scientific research information supply is more diverse, who will supervise them and how to supervise them, who will supervise them after the establishment of a unified data information platform, whether a special department should be set up for this, and so on. These problems still need to be solved. In other words, the agricultural science and technology information service model based on big data lacks a perfect institutional environment.

### 4.2 Countermeasure and suggestion

#### 4.2.1 Perfecting agricultural infrastructure and improving scientific and cultural quality of farmers

The state should increase financial support for agricultural science and technology information service based on big data, promote infrastructure construction in rural areas, and provide material basis for it. Promote the popularization of the Internet and broadband, and provide appropriate financial subsidies to some poor areas, so as to reduce the cost of using the network, realize that every household has access to the network, and build a perfect information network system. Publicize the advantages of big data agricultural science and technology information service to farmers, cultivate network awareness and information awareness, take villages as units, improve the ability of farmers to apply network through collective training or one-to-one counseling. At the same time, it is necessary to train farmers and related personnel in data acquisition ability so as to collect real and effective data resources.

#### 4.2.2 Attracting and training professional talents

The government can vigorously publicize the good prospects of agricultural science and technology information service model based on big data, and improve the talent introduction system through policy guidance. In the educational system, courses related to this can be offered, and talent transfer agreements signed between relevant departments and educational institutions can solve the problem of talent scarcity from the source. For those who have already taken office and have mastered Internet technology, targeted training related to agriculture can be carried out, so as to train more professionals with both agricultural and computer technology background. At the same time, by improving the salary and treatment of such talents, and improving the incentive and incentive system, talents will be absorbed into the construction of large data agricultural science and technology

information service.

#### 4.2.3 Establishment and improvement of management and supervision mechanism

In view of the agricultural science and technology information service based on big data, the government should take into account all aspects of the specific situation and issue a set of perfect rules and regulations to clarify the distribution of powers and responsibilities of various departments. Coordinating government departments, agricultural enterprises, scientific research institutes and agricultural colleges to build a standard system of large data agricultural science and technology information service, and to establish industry norms. Establish error correction system and emergency system to remedy problems in the operation of the platform in time.

## 5 Conclusion

Big data is a new technology in the Internet era. It has a wide range of applications, and it will continue to improve and innovate in the process of social development. Compared with the traditional agricultural science and technology information service model, the agricultural science and technology information service model based on big data has significant advantages. However, due to the high technical content of agricultural science and technology information service based on big data, the uneven scientific and cultural quality of the service objects, and the imperfection of related facilities, many problems will arise in the operation process. These problems can not be solved in a short time. To improve with the continuous development of big data technology, we need not only the support of the state and government, but also the practice of social enterprises and agricultural personnel. Only in this way can we seek new vitality for the development of agricultural modernization in China. Keeping up with the trend of social development, China's agricultural economy will not lag behind, and China's agricultural economy will be able to achieve substantial and sustainable development.

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# Research on University Library Self-built Resource Repositories in a Big Data Environment

Sha Zhengyu

Library, Wuhan University of Technology, Wuhan, P.R.China, 430070  
(E-mail: 4261731@qq.com)

**Abstract:** Through the literature statistics analysis, the paper describes research on self-built resource construction of university library repositories in recent years, trying to furnish theoretical basis of the transformation of university library self-built resource construction. Starting from the existing situation of the library, it discusses the influence of big data onto university library data, resource construction, service for readers, teaching, scientific research and librarians, finally, proposes innovative self-built resource repositories for university library in the era of big data. A new self-built big data management system should be established, to provide highest quality services for teachers and students.

**Key words:** Information resources construction; Self-built resource repositories; University library; Big data

## 1 Introduction

By the end of the last century, internet technology had developed rapidly and internet information had shown explosive growth. From the beginning of this century, development of the open-access movement provided free, quick and up-to-date research sources to others. On such an international scale, while purchasing digital databases, many university libraries began to build their own repositories, such as subject information portals, special repositories, etc., which collect freely available resources or open access to provide a strong supplement for academic services.

To date, according to statistics in progress, the number of self-built repositories for 985-Project sponsored university library in China was more than 190, library self-built repositories forming a certain portion (Chen Si et al., 2016). However, the existing repositories have gradually fallen behind the progress of science and technology. Library service has gone through the process of resource services, information services and knowledge services during this period. Those repositories information and services could no longer meet the rapidly changing needs of users. Now they need information immediately (Su Xinning, 2015). Taking the subject information portal as an example: many university libraries have used the subject knowledge service platform to replace those old repositories, using them to take advantage of the latest technologies. Digital resources of new platforms became more frequent and the organization of resources is more standardized, it could also adapt to new demands of users. The old subject information portal became increasingly difficult to develop, and other types of self-built repositories also faced similar dilemmas as subject information portals.

In a big data environment, great changes have taken place in data sources, database technology and database application. So, the old library self-built repositories need to find new ways to develop. The purpose of this paper is to analyze and review research of university library self-built repositories and find better ways to facilitate their improvement.

## 2 Database Analysis

### 2.1 Literature statistics analysis

We used the China Academic Journal Network Publishing Database (CAJD) as literature sources to research the statistics of self-built university library repositories based on publications between 2006 and 2018. A total of 1264 journal articles were retrieved. In core journals, with the same search conditions, the scope of Journals with the search limited to SCI source journals, EI source journals, core journals, and CSSCI, 312 papers were retrieved. The calendar year data is shown in Table 1.

**Table1 Statistics on the Publication of Library Self-built Repositories in China**

Sector	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	Totals
Papers	64	74	94	120	125	123	124	115	125	97	62	71	70	1264
Core papers	15	14	23	36	43	38	42	35	24	14	8	11	9	312

In Table 1, from 2006 to 2008, the number of research literature in self-built repositories is on the rise, and the number of core papers is also increasing. From 2009 to 2014, the number of research literature is large. At the same time, the number of core journal papers has also increased significantly. From 2015 to 2018, the number of research papers began to decrease. The trend of the number of publications in core journals is the same.

Through analysis of changing trend in number of literature, it can be concluded that the research on library self-built repositories has been on the decline. From the actual situation, the amount of papers published in the self-built repositories for university library is basically consistent with the actual situation of self-built repositories for universities. Under the new technological environment, the development of such is in on decline, but in the case of development, it continues to be sustained.

From CAJD, through statistics of research literature about library self-built repositories in big data environment for universities, 205 pieces of literature were retrieved, of which 39 papers are in the core journals (Table 2).

**Table 2 Statistics on the Publication of Resource Construction in the Context of Big Data in China**

	2013	2014	2015	2016	2017	2018	Totals
Papers	3	18	38	48	39	59	205
Core papers	1	5	9	9	6	9	39

The research literature about library self-built repositories in big data environment has been on the rise in recent years, so have been the core papers. It can be seen that the related research about library self-built resources gets involved in the context of big data, the research is still in its budding stage.

### 2.2 Research field

When we analyze the content of 303 core papers from 2006 to 2017, it reveals that nearly 200 papers are discussed around resource construction. The relevant papers mainly focus on quantity statistics, resource types, database technique, digital resources sharing, existing problems of resources

construction, network platform, library service, as well as intellectual property rights and evaluation systems of the self-built repositories. The theoretical research can be classified into three stages: the first stage: discussion of the theory about the necessity of self-built repositories; the second stage: affirmation and study self-built repositories; the third stage: theoretical regression, summary and inductive analysis (Lin Zengxing, 2018; Chen Shanmin, 2017).

In general, the content of existing self-built resources research is mainly based on experiences and review, while the number of research papers on their construction in the background of big data is limited. The research is in the initial stage of theoretical discussion and case analysis. Xiao Ximing pointed out in the "Hot Issues of Information Resources Construction in China from 2013 to 2015" through literature and data analysis that big data and information resources construction is a heated issue in the field of information resources construction in the past three years (Xiao Ximing et al., 2016).

### **3 The Impact of Big Data on Libraries**

#### **3.1 New data environment**

Most of the existing self-built library repositories are mainly concentrated on scholars' databases, academic paper databases, dissertations & amp. thesis databases, special databases, etc. These repositories use different management platforms to access and manage data. Users end up searching every repository to find the information they want, or retrieve the same data from different repositories, which is obviously unreasonable.

In a big data environment, the characteristic of the library has been generalized quantification, relevance and diversification (VANESSA J, 2017). Great changes have taken place in the content and types of library data. At present, most of these library's affairs already have quantitative data, such as library equipment and sensor information. Besides, library user behavior data, library digital resources analysis data, data of library data usage analysis, institutional repository data, and the existing library self-built repositories data compose big data collection of library.

In view of the goals of providing services for university discipline construction, teaching, and scientific research, the university's data onto teaching and research should not be ignored too. Various valuable information on the internet is also necessary for the library's self-built repositories, such as research project application information, conference information, scientific research data, social data on mobile platforms, event report data, etc.

By collecting the scattered data using acquisition technology and obtaining these structured, semi-structured and unstructured heterogeneous bits of data, self-built repositories can use this greatly to their benefit (Zhang Hong, 2016).

#### **3.2 New technology**

Big data technology development makes it possible to provide alternative solutions to replace those old self-built repositories. At present, the development of artificial intelligence has made a qualitative leap. The rapid development of computer hardware and software supports the improvement of computing power and the breakthrough of core algorithms. In such an environment, libraries should combine resources with new technologies, innovate and deepen services, and provide a good platform for personalized learning (Liu Wei et al., 2013).

Based on non-relational database technology, the new library self-built repositories could be

constructed to realize a unified data storage and management. Through cloud computing, we can create indexes and identifiers for data, which help to realize search, association, visualization, analysis and application of data. Data mining should become an effective tool to find hidden valuable information on the repositories too. Rapid development of acquisition technology can help us obtain various kinds of data, such as using a web crawler to help us get whatever sort of information we need from the web. For new library self-built repositories, the semantic web is used as the knowledge representation. We could expect effective application of other technologies to improving library service, such as artificial intelligence or machine learning techniques.

We believe that more and more new technologies could help us attain our objectives in work, as the application of new technologies in the library has become an irresistible trend.

### **3.3 Changes in user's demand**

In the face of massive data, users' needs have changed a lot user requirements for resource acquisition are time-sensitive, diverse, comprehensive, accurate, easy to obtain, personalized, etc.

The different individuals or background difference between the users leads to the diversification of the user needs. The personalized needs of users require the library to fundamentally change from the concept of resource construction and service.

Data in a big data environment is changing rapidly. If the information lacks effectiveness, it will lose its value. Users are eager to get real-time information quickly with simple and efficient means.

In the traditional mode, the library only provides readers with book lending services, electronic resources services or network resource information services. However, the user demand has changed dramatically from the big data thinking mode. They need more than just information resources, but also expertise, research hot spots, research frontiers, and research data (Sun Yongsheng et al., 2016; Gao Lin, 2015). What they need is not a piece of information, but the reorganization and analysis of the processed information. More and more users are looking for forward-looking, comprehensive and systematic knowledge services.

Under the support of mature technical conditions, users have higher requirements for the comprehensiveness and accuracy of accessing resources.

## **4 Transformation of Library Self-built Repositories in a BigData Environment**

### **4.1 New platform**

The new data environment and data technologies make it possible to build new library self-built resource platforms.

Through the new platform, we can collect library big data through data extraction technology. Library big data usually comes from sensor of library, library automation system, social network data on mobile devices, library service platform, Network data, database, System log, etc. We extract the required data from these data sources and clean inaccurate data. After filtering and rejecting incorrect data, the data is finally converted into a predefined data model according to requirements, and loaded into the data warehouse. Various types of structured, semi-structured and unstructured massive data support high-quality data services of library (Huang Chuanhui, 2018).

Through the new platform and data warehouse, we can achieve a more flexible resource clustering method. Based on data clustering, the library can analyze various data clustering and find rules to formulate strategies. Based on data clustering of thematic, libraries can provide a variety of content-riches thematic information services. Based on data clustering of user characteristics, personalized data collections can be pushed to users in time too (Du Hui et al., 2015).

Through the new platform, we can analyze user behavior by analytic visualizations, data mining algorithms or predictive analytic capabilities, researching user needs and personalized characteristics, pushing more reasonable personalized service content. Through analysis tools, library can analyze resource utilization and find potential causes that affect resource utilization, seeking a more reasonable resource allocation method and improving the quality of resource services. Through statistical analysis of data, combined with work experience, it will help us improve the efficiency of library work.

#### **4.2 New service**

Big data has not only brought changes in our lives and businesses, but also brought changes in our thinking models, which affected the development of all walks of life. In a big data thinking model, the data we need is on a full scale. Correlation between data is not necessarily a causally maintained relationship, but even the wrong data can be related data. Following this, libraries can gather the user's characteristics and requirements. Accordingly, library can provide users with new services catered for their needs (Guan Sifa, 2015).

First, the library can provide personalized services, such as online open classes, books, or documents that users are interested in. Personalize library services such as academic news services, research hot spot services, latest conference information services and personalized learning program customization services are also available.

Second, it can improve subject services of the library. Using big data technology, flexible resource clustering can be used to reveal a discipline theme. Data mining technology can help us find the potential relationship data onto some theme, which enrich the content of library subject service.

Third, it can deepen library disciplines service (Huang Weiling, 2016). By mining the self-built resource data onto the library, the library can obtain a large amount of data, such as scientific research activities, library literature coverage, utilization, scientific research output, and development trends. These kinds of data can provide more comprehensive and flexible information support for discipline building.

Lastly, we can make library's unified retrieval platform base of library self-built repositories, which can coordinate the accuracy and completeness of results better. Through the new library self-built repositories, users can gain knowledge service directly, not only information or data service.

All in all, more new models of library services based on big data technology are expanded to deepen the library service level. It provides supporting for teaching work and scientific research in universities, such as timely tracking services and scientific research data services.

#### **4.3 New ways of working**

The important point of this way of thinking is that all things can be quantified by data. Based on the collection and analysis of the library affair data onto new self-built repositories, we can have insight into the user's behavior preferences. As according to such, we can evaluate or forecast library affairs. For example, by analyzing the use of library resources, we can understand the success or failure of its construction strategy. Accordingly, the optimization scheme could be formulated for more rational

allocation of resources. By analyzing usage habits of library users, more suitable opening hours and space arrangement of libraries can be discussed. A library development trend can be predicted through big data, which can help library managers make a decision.

The research and practice of library self-built repositories can inspire the librarians to improve the professional skills and data analysis capability through learning. In our era of big data, data-driven decision has revolutionized all walks of life. If we can be good at analyzing data, we can improve personalized services through user behavior data analysis, analysis discipline research on hot spots, and predict discipline development trends through literature analysis, or make new library construction strategies by library affair data analysis. It is important that librarians should have the capacity to work with data collection, data sensitive and logical analysis. Combining work experience, human creativity, lifelong learning, communication, and innovation can make the library self-built repositories develop maximize their efficiency.

## 5 Conclusion

Driven by the “Double-first-class” construction goals, higher requirements are placed on library digital resource construction and services (Zhao Limei et al., 2019). In the big data environment, we should get rid of traditional thinking and subjective speculation. As an indispensable part of library resources construction and self-built repository construction, we need to establish a new repository management system. Based on mass of data onto new repositories, new application technology should be used towards scientific prediction, rapid decision-making and responses, such as big data analysis or big data visualization. It can help us to maximize the value of big data library resources, and new repository management systems will provide ever-changing service through application technology too. The transformation of self-built repositories will help us deepen the service libraries can provide and improve the efficiency of their utilization. Therefore, the proposition should be looked into further because it is essential to maintain any library’s longstanding healthy and sustainable development.

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# Universal Conceptual Intelligence Structure Based on Visual Intelligence for Automatic Recognition of All Objects Without the Big Data

Xu Xuetao,

School of Foreign Language, Wuhan University of Technology, Wuhan, P.R.China, 430070

(Email: xuxuetao@whut.edu.cn)

**Abstract:** Sheer fiddling with data regardless of concept, the three elements of big data, computing power promotion and good AI algorithm of traditional AI can't bring real, understandable AI. To achieve semantic intelligence with the aid of semantics is logically ridiculous, from concept to intelligence is a prospective way. Concept is not only the basis of brain intelligence, but intelligence itself because the formation process of concept is visual intelligence driving and thus make concept an intelligent structure, which further makes the conceptual neuron network emerge conceptual intelligence as logical reasoning and semantic thinking. Conceptual intelligence of system 2 is based on visual intelligence of system 1. Visual intelligence is that our brain making classification is not based on absolute difference but on the visual proportionality of relative difference. Concept intelligence is that concept and neuron are structurally isomorphic. Classification is not based on similarity, which in nature is relative difference, nor the classify-as, which in nature is classify-into. Single concept has several transverse dendrites and a longitudinal nerve axon, transversely, each connecting path in each single cognitive domain with the relative big difference relations, which found the semantic intelligence of conceptual association and logical reasoning, fuzzy operation and simultaneously result accuracy. Concept can be precisely positioned by an aggregation of several big differences relations in multi-cognitive domains. Longitudinally, axons are the information channels where the remaining information of small differences from the upper conceptual classification transmitting to the next concept of the network to continue the fine classification. Classification is based on the proportion of differences in the same cognitive domain, each time according to the principle of big differences, from big to small differences as peeling an onion.

**Keywords:** AI; Relative Difference; Visual Intelligence; Proportion; Conceptual Intelligence

## 1 Introduction

At the 2018 CCF-GAIR conference, academicians from many top colleges or universities around the world discussed the defects of the deep learning algorithm as well as the neural network structure and the limitations of "big data". Professor Ma Yi<sup>1</sup> talked of the limitations of 'big data': "taking image processing as the example, billions of data are still 'small samples,' the amount of data that can really train a good model tends to be infinite, but even with big data to train the model, there is still an essential difference from the ideal intelligent model". As to the limitations of DNN structure, he stated

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<sup>1</sup> Ma Yi, professor of the Department of Electronic Engineering and Computer at the University of California, Berkley.



that “with a small change in the imported data, there will be a great change in classification, the problem of the algorithm lacking of robust has not been solved until now. They say that Neural Network is the bigger, the better, the deeper, the more accurate, that is nonsense.” Many companies reported that even under a training of a large number of samples and that the accuracy of the trained system model is as high as 99%, the system would still make a lot of retarded mistakes and easy to be interfered with in the practical application.

Realizing the size of the data "big or small" is not decisive, Academician Zhang Ba, dean of the School of AI at Tsinghua University, pointed out that “the three elements ‘big data, computing power promotion and good AI algorithm’ of traditional AI can’t bring real intelligence. “The current AI can only follow the rules, it has no flexibility and the intelligence people want. The current basic approach to AI is flawed, so we have to work towards an real, understandable AI”.

Academician Zhang is insightful, he realized that the three elements of traditional AI can’t bring real intelligence, and most likely, he realized the problems of traditional data, so he comes to semantics, but the semantic vector space he presented as a solution is theoretically imperfect, it has insurmountable problems and technically impossible. Zhang says that lacking common sense is the reason the machine lacking reasoning. This is surely a brilliant idea! But how? He says that “The first step towards real, understandable AI is to build a common sense base for machines”. “Through embedding to turn symbols into vectors as far as possible to keep the semantics not lost.” “the second step is to raise the feature space to semantic space by unifying the perceptual and knowledge world”. “The key is to convert the obtained scalar data into vectors to use them on the machine”, but so far, he says “to combine behavior (eigenvector) with data (symbolic vector) into the semantic vector space or to project perception and cognition into the same space to establish a unified neural network to realize semantic understanding seems difficult”.

Academician Zhang’s deep insight coincides with our long-term conviction that the pure data-driven system, or sheer fiddling with data regardless of concept, no matter how brilliant the algorithms is, can never produce real intelligence. We are not surprised at the failure of the three elements. Wrapping imbecile with elegant words of “training results unstable, algorithm not robust” can’t cover the fact of results computing wrong. The current algorithms are based on probability and statistics. Complexity and clumsiness are twins. Taking the face recognition and the auto-driving as examples, to display one time of a printed striped paper in front of the camera, the whole AI system will immediately collapse. Can we call that intelligence? Therefore, analyzing the current technology problems to put forward a new scheme to realize real understandable AI become this paper’s focus.

## **2.Rational: From Semantics to Intelligence is no Better than From Concept to Intelligence**

### **2.1 Semantic vector space as the solution is impractical**

To achieve semantic intelligence with the aid of semantics is logically ridiculous, that’s to put the carriage before the horse. No intelligence, no classification, which as a higher intelligence produces concept, concept with conceptual intelligence produces language. Higher intelligence is based on lower intelligence, both classification and conceptualization have intelligence and all is the products of neuron network. That is, intelligence produces language, not on the opposite. Analyzing language to make an intelligent machine is like analyzing thunder to make a lightning machine. The method Academician Zhang offered is an amelioration to or born from the traditional methods of knowledge map or language processing. Their common ground is from semantics to intelligence. In my opinion, it is hard to reach the right meaning of words by cutting words out of sentence. Sometimes, a sentence can be a big

concept and is inseparable in semantics. For example, Chinese have a like to say “zuo dian ti”, which in English is “sit elevator”. English speakers may wonder why Chinese use “sit” instead of “stand”? Chinese explained to them that “sit” here just means “stand”! “sit” means “stand”? See what I mean? Sentence is beyond analysis. “zuo dian ti” is more like a concept than two words. Concept is the smallest complete meaning, it can as small as a word, as big as a sentence. Both words and sentence are representations, representation of meaning and both can associate with real scenes. People know that the specific meaning of a word is determined by the sentence, and the sentence as a whole by bigger context, but few knows it’s the sentence instead of the word that firstly mappings the scene. Saussure said that language segments the world. He was saying language, not words. It indicates that it’s sentence firstly mapping the scene. Lexical meaning comes from sentence decoding or scene decoding. My daughter Snow white, before learning to speak, at the 7<sup>th</sup> day of her birth, flushed her face, furiously spited out one sentence “wo da shi ni men”, in English “I beat you to death” while her mouth was forced open by a spoon and fingers that four people pressed her on bed to feed medicine. I tell this story with the risk of being treated as a liar, but even though, I decide to be brave to let the truth spread. Of course, after that, she was incapable of talk until one years old, actually she knew the lexical meaning of “ I, you and death” about two years old. How can a person use the right sentence in the right situation while fully unknowing most of the words in the sentence? But this is beyond dispute especially when we spot some trendy adults learning to speak only one whole sentence of “I love you” in French, Russia, or other unknown language while fully unknowing how many words in the sentence utterance, but this doesn’t hinder them from using the sentence rightly and being welcomed. I brave this story out not to prove how my daughter is, but to explain how great Saussure and the real language acquisition process is. I never mean to treat my daughter’s story as an experiment or a proof, but it reveals two basic facts: firstly, it is sentence that firstly mapping the scene, that sentence decoding is much later. Secondly, before sentence mapping the scene, situations or reality had been roughly classified and learned by brain, this means concept or concept system is developed before and independent of language system, that’s why animal can carry out simple think with no language. Universe starts from one sound of “Bang”, the first sound of baby’s talk “ah” or “cry” contains all the words throughout his life. As one fertilized egg splitting into a complex body, the simplest "ah" can split into human language. Undecoded sentence as a whole mapping different scenes which concept system classified, then the meaning of the classified scene is transferred to the associating sentence, then sentence gains its meaning. Different pronunciations between two sentences mapping the different scene features between two scenes, “difference mapping difference”, words with different pronunciations are decoded.

Our brain receives speech sound more like that of the tape recording: voice is continuous and there is no clear boundary between the pronunciations of words, the whole sentence including dialect features in the pronunciation in whole are copied down truthfully, the accent, tone and even para-language of a family can pass on to the next generation, everything indicates that sentence in the form of physical wave is wholly copied down by brain, and then as a whole to associate the real scene. This can explain why a word or a sentence has so many pragmatic or contextual meanings, it turns out that the polysemy is determined by the fact that it’s the sentence which firstly associates different scenes. Contextual meaning determines the meaning of a sentence, and the meaning of a sentence is decomposed into vocabulary, so the meaning of a sentence can be expressed by wrong words or even words with the opposite lexical meaning.

All in all, the way to dig words out of the sentence to extract meaning is fundamentally wrong. Chinese have an old saying “cutting paragraph to extract meaning is ridiculous”. The semantic vector or common sense base is of little value even if it was established in such a way for semantics extracted in this way with a large number of polysemy and no way to mapping specific scene. We don’t need to analyze the pragmatic meaning of vocabulary, because the pragmatic meaning of words originates from the conceptual meaning produced by conceptual classification, which is independent of language, the

pragmatic meaning can be acquired from the real scene cognition which includes visual recognition(see figure 1:one of the equation I developed), object classification and the classified backgroundlization.

$$\text{spacing between object and its background} = \frac{\text{Binocular visual aberration of the object}}{\text{Eyes spacing}} \times \text{spacing between object and the midpoint of two eyes}$$

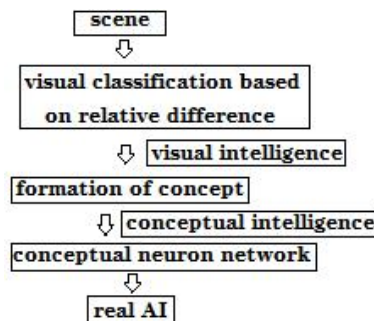
**Figure 1 Visual Intelligence: Visual Recognition and Backgroundlization**

By the way, we need to note that classification is to facilitate thinking efficiency by fading the classified things into background to meet the fuzzy dealing. In another word, background is also the category for fuzzilization or edgeinglization, or more simply, classification is backgroundlization to release brain’s calculation burden.

**2.2 From concept to intelligence is a realistic and prospective way**

Sheer fiddling with data regardless of concept can never produce real intelligence, that’s why both Probability Statistics and Pure Mathematical Fuzzy Logic Calculation can’t achieve real intelligence. Probability Statistics uses pure data calculation technology to drive the system, which makes machine can only execute instructions, lack of flexibility. Though the fuzzy logic is not considered using of Probability Statistics, but as long as it remains to be the past like of mathematical reasoning and logical programming, the conceptual logical reasoning and semantic thinking will never be realized. The current computer, it is either 0 or 1, but there are a lot of uncertainties between 0 and 1. Is there a contradiction between achieving the result accuracy of either 0 or 1 and achieving that accuracy by simultaneously using a fuzzy calculation process? The answer is “no”, provided we abandon the outdated mathematical scheme of current fuzzy logic operation and replace it by a new model we called the neural network of conceptual intelligence structure(NNCIS)( see chapter 3).

Intelligence requires accuracy, accuracy requires fuzzy, so intelligence requires an intelligent conceptual structure. Simplicity and fuzzy calculation should be the features of physical structure of neuron network instead of the features of algorithms. If we can use physical structure to replace algorithms to directly produce intelligence, we don’t need algorithms at all. We’d better believe that real intelligence is produced by the structural connecting details of neural network and the data inter-connecting relationship, and both are owing to nature’s harmoniously physical neural network design than by advanced algorithms or the data abundance. Creator’s hand to create intelligence is intelligent that in our brain there is no algorithms, so both the neural network structure and the data produced by the neural network structure are inevitably with spiritualism.



**Figure 2 the Process to AI**

So, the solution is we have to descend to the formation of concepts to study the visual principle of contrastive classification. Since concept is based on the scene, so the semantic intelligence is related to visual automatic classification intelligence. Conceptual meaning and the establish of conceptual neuron network must be based on real scenes, that is, concept intelligence is based on visual intelligence. Lexical meaning is mainly pragmatic meaning, which derives from the conceptual meaning, and conceptual meaning originates from the visual classification of things. The process to realize AI (see figure 2). The value to study the visual classification process of the conceptual meaning formation is far greater than only to study the superficial meaning of vocabulary from the level of context.

As long as the NNCIS can automatically learn from the automatically visual classification and the algorithms will immediately lose its significance. As to the distributed storage and extraction technology of information in NNCIS, iteration, recurrence manners are important, because the process to store and extract information must be accurately reversible. To the latter area, we don't pretend we know everything at the present time, but we know that the data of relative difference classification can be represented by 0, 1 which coincides with the machine code (see chapter 3), that is, to use visual intelligence to automatically establish conceptual intelligence to achieve real, understandable AI is methodologically feasible.

### **3 Conceptual Intelligence Based on Visual Intelligence as the New Direction**

According to Daniel Kahneman, there are two systems—the system 1 and system 2 in our brain. System 1 operates automatically and quickly, with little or no effort and no sense of voluntary control. System 2 allocates attention to the effortful mental activities that demand it, including complex computation. Kahneman's division is simple and useful, but we should understand that system 1 is the basis of System 2 and that his division is just functional. Structurally, regarding system 1 as the upper layer or peripheral part of system 2 is not accurate, taking visual intelligence and conceptual intelligence as the example, based on my research, they are respectively of system 1 and system 2, but both are the products of the same neuron network, so their relationship is actually “one same neural network, two reversible processes”.

Visual intelligence, which is of System 1, refers to the automatic process of visual classification by producing inner-connected visual data to form and position concept, it is a datum forward polymerization process, while conceptual intelligence, which is of System 2, refers to the process to use the inner-connected data produced by the visual classification of system 1 to activate conceptual connecting to carry out conceptual reasoning, which is a datum reverse divergence process.

To find out what happened to system 1 or what visual intelligence is the foundation to understand and achieve the function of system 2 or conceptual intelligence. Apparently, difference to classification is the foundation to make judgment and choice. The reverse is more illuminating: being able to make a judgment or choice in itself is the sign of intelligence and the ability to conceptualize based on classification. That is, classification is the basis of conceptualization and intelligence. But the question is why conceptualization or a conceptualized neural network can produce intelligence only when conceptualization is based on visual classification? The answer is that the process of visual classification and conceptual classification themselves have the intelligence: the visual proportional classification intelligence based on relative difference and the multi-cognitive domain positioning intelligence (see 3.1).

### 3.1 Principle of visual intelligence: law of visual proportional classification in single cognitive domain based on relative difference comparison

Since human operates visual classification and conceptualization automatically and quickly, so the process of visual classification to achieve intelligence, of itself and of the conceptual formation process are of intelligence. Because comparison is mainly carried out within a single cognitive domain each time, and considering visual automatic classification is the major content of system 1, so we just choose one single visual cognitive domain from all the cognitive domains as the example to illustrate the visual automatic classification principle of brain.

The comparison of two images or concepts is considered difficult to identify the differences. We know they are different, but can't tell what exactly the differences are, this is actually we don't know why they are different, or what makes these differences?

I find that vision has intelligence in its classification and further the concept formation has intelligence. Let's use three numbers of "10, 5, 2" as the example to illustrate the visual intelligence. To be more intuitive or direct, I drew three straight lines in the left Picture with respectively the accurate height of "10, 5, 2", and the transverse distance between them is equal(see figure 3). Before comparing their heights, we should understand that there are absolute differences between each them two and relative differences among them. According to the absolute difference, since  $10-5=5 < 5-2=3$ , so, straight lines of 5 and 2 should be classified into the same category, because the absolute difference 3 that between 5 and 2 is smaller than the absolute difference 5 that between 5 and 10. But visual classification experiments(see figure 3 carefully and try to make classification according to their heights based on your brain's judgments) have shown that all the people intuitively divide 10 and 5 into the same category.

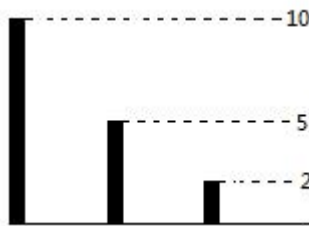


Figure 3 Visual Intelligence Based on Visual Proportional Classification

Why? This is because  $10/5=2$ ,  $5/2=2.5$ , because  $2 < 2.5$ , so 10 and 5 are divided into the same category. It proved to be that people makes classification not on the basis of absolute difference but according to relative difference on the basis of visual Proportionality. I call this phenomena of relative difference principle of visual classification the Proportionality Principle of Visual Intelligence(PPVI). Though I called it visual intelligence, the principle of visual intelligence classification is applicable to all the cognitive domains, such as height, thickness, straightness, curvature, speed, acceleration, size, amount, color, time, degree, density, consistency, even gravitation, etc, all classification in each cognitive domain is automatically, so it's actually the universal classification intelligence that brain evolved. As a lower intelligence of system 1, it's the foundation of higher intelligence, such as conceptual intelligence of system 2.

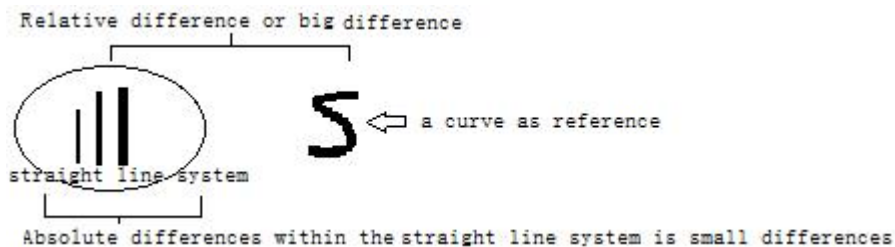
### 3.2 Conceptual Intelligence

#### 3.2.1 Absolute difference and relative difference in classification

Things are relatively existed. The relativity of image existence and conceptual existence originates from the difference comparison between or among things. There are two kinds of differences between or among things—absolute difference and relative difference. Without the absolute difference between things, there will be no differentiation, no individual discrepancies, no psychological significance of things, and above all, no relative difference and classification as well as conceptualization.

Difference is the essential reason for the recognition of things and the formation of Concepts. It's wrong to say that the recognition of things and the formation of concepts come from the similarity of things. According to the similarity theory, the similarity of dogs is "dog", of rabbits is "rabbit", of animals is "animal", of biology is "biology", of substance is substance, of the three states of solid, liquid, gas are respectively them own. That's senseless and ridiculous. If we understood that the three states are existed relatively, we would not go to similarity to take it as the reason of similarity, but shift to relative difference, anyway what making solid is solid is that it's not liquid and gas.

Absolute difference is the difference between any two things in a single cognitive domain comparison, it is the foundation of relative difference and classification but itself has little for classification. For example, two straight lines are different in length, but you have no reason to make classification based on absolute difference. After all, classifying them into one or two type(s) equals to zero or no classification. Relative difference is the difference among any three things in a single cognitive domain comparison, it's more valuable than absolute difference. Any three things can be classified into two categories, I take it as a doctrine, because there is always relative difference among any three matters. Therefore, relative difference makes classifications and concepts as well as the recognition of things. It is important to note that similarity is a pseudo-concept, it is not the basis of concept. Similarity is in nature of difference, more specifically, the relatively difference.(see figure 4)



**Figure 4 Similarity is in Nature of Relative Difference**

Brain recognizes things by establishing conceptual classification based on relative differences not on absolute differences. For instance, a person taking off his jacket, the absolute difference before and after the motion is the jacket, jacket is just one part of that person, apparently the part can not be a base to recognize the whole.

The last but not the least, people says that classification is according to the similarity of the same category. This sounds contradictory, because there is question between the similarity and the same category very like the relationship between chicken and egg, which goes first and who decides who? If similarity and the same category can't determine each other, then, we can't help but ask what on earth determines the similarity and same category? To avoid similarity itself as the answer, the answer can only be the opposite: Difference. Yes, Similarity is difference. So called similarity is in nature the

relative difference. People do not classify things according to similarity but according to relative difference. We must note, similarity is relative difference, but relative difference is not similarity. Why not? Because difference is absolute. There are only absolute difference and relative difference in the world, other than that, there's nothing else. Absolute difference is caused by absolute movement, both are the origin of the world, they are synonyms. Taking straight lines as an example, people say that the similarity within the system of straight lines is straight line, but in fact, this is said relative to an external reference, such as a curve. Therefore, so-called similarity within the straight lines system is essentially the big difference between the straight line system and the outside curve system. This is similar to the space theory. There is actually no similarity within the straight lines system except for absolute differences between them, such as the small discrepancies in other cognitive domains of length, thickness, color, smoothness, and even the degree of straightness, so, straight lines can be further classified according to newly emerged relative differences.

### 3.2.2 Neuron Network of Conceptual Intelligence Structure

Based on relative difference, visual contrast, visual recognition and visual classification, the process of concept formation is actually establishing connections between concepts in every cognitive domain, these connections can return to produce logical reasoning and brain intelligence.

As to image recognition, the current technology and all expert system are characterized by calculating small differences and comparing for similarities, but the similarity and the classifying-as are unreal, they are respectively relative difference and classifying-into. Image recognition based on the relative differences is more practical. In face recognition, the same face of the same person produces different images in our two eyes and the image is inconstant and always varying from time to time(that's of great value and significance, but we don't discuss here), hence, the same person's faces with small discrepancies consist a system, so-called similarity is the big difference with respect to another system of other people's faces. The face recognition process from Macro to micro like peeling onion, the so-called similarity of one person's faces is the big difference between human faces and animal faces, man and woman, old and young, my faces and your faces. This is our brain's real processes of image recognition.

When machine identifies a face, it needs not only to recognize a face according to the "big difference" (relative to animal face), but also to identify whose face it is based on the "small difference" between faces. To this moment, the big difference ( between man and woman, between old and young) is deepening to be smaller and smaller difference to the degree that the "small difference" between individual faces nearly fall in the same person, for example the human+man+young + facial organs category, so the difference is small. But big and small are relative, within the small difference of faces, we still can find relatively big difference in the small difference comparison. It is, among small, there are relative big. The process to identify whose face is, is according to the "relative difference" between my faces and other's faces, which people usually treat it as a process of classify-as, but because my faces are not exactly the same in all the time or situations, for example, your face has the "small difference" before and after wearing glasses, makeup, a little white and fat in winter, a little black and thin in summer, etc. Since difference is absolute and similarity is fake, and the latter is unable to work and not robust but relative difference in nature, the recognition process is forever classify-into, not classify-as, so the recognition process is always relatively like peeling an onion, getting ride of the big difference(the classified), left the small discrepancies(the unclassified), among the small ones, there are still bigger ones, therefore, classify-as is fake as well, face recognition is always a classify-into process from big difference to small difference following the principle of the relative difference and visual intelligence.

Classification based on the relativity of difference leads to an effect that each time of classification

can find only one biggest difference among all cognitive domains. For example, what's the biggest difference between human and animal? The answer is intelligence, other features like having language or different shape are relatively unimportant. When classification deepens to category of mammal, hair may be the biggest difference between human and gorilla, other features like breast-feed or straight walking are relatively unimportant. When classification deepens to category of human, as for the white and the black, color may be the biggest difference while intelligence and language may be unimportant. The peeling onion and dichotomy process cause the concept to have a hierarchical structure and every time of classification is a fuzzy calculation, so the result on the contrary is accurate. Because the secret of brain classification is to save energy, to get ride of the already classified to focus on the unclassified, so the classified is always treated by brain as the background of further classification, this can explain why we have attention and what is noticed is always in the center of eyeballs. That's so called visual attention.

All in all, difference is absolute, similarity is relative difference, there is no classify-as but classify-into in our brain. The so-called classification is to classify-into things like peeling onion according to the order of relative differences among things from big to small. Just as all elephants' "big" is relative to all other animals' "small". If there was no other animal's "small", there would be no elephant's so-called similarity of "big". Brain recognize things according to the big difference, which doesn't require accuracy, fuzziness is the advantage of the big differences to achieve result accuracy. A veiled face, a scared face, a face without eyes, all can be classified into faces by brain, but machine will be knocked down. Why? Because brain adopts "classified into" but machine adopts "classified as". Twins are the easiest to be classified into the same category, because they are more distinct from others. They are firstly classified into human, then into twins, both are based on the relatively difference. Recognition is achieved in such a way.

#### **4 Conclusion**

The formation of concept is not directly related to language but based on visual intelligence, which and conceptual intelligence produce image recognition intelligence and semantic intelligence, not on the opposite. Visual intelligence of proportional classification based on relative difference with the characteristics of high simplicity and universality, itself is intelligence. Visual intelligence is an universal automatic classification principle, it can be applied to all cognitive domains. The conceptual intelligent network has conceptual intelligence because the network is based on the proportional classification principle of visual intelligence and is isomorphic to neuron network structure. A concept can be positioned by an aggregation of several transversely relative difference connections in several main cognitive domains. There are many transversely relative difference connections among concepts in different cognitive domains. The shape of the concept has several transverse dendrites and a longitudinal nerve axon, each transverse connection path is a large difference relation which can be represented by 0 and 1, that is the basis of realizing fuzzy operation and simultaneously result accuracy. Axons are the information channels where the remaining small difference information from the upper classification is transmitted to the next concept of the network to continue the fine classification. Classification is based on the proportion of differences in the same cognitive domain, each time according to the principle of big differences, from large to small differences as peeling an onion. Big difference in Classification, which is in nature of proportionality and relativity, can also be looked as based on the relative distance among things, according to the distance from big to small, layer by layer classification.



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## Study on Rural Logistics Mode Based on "Internet Plus": Taking Some Cities in Hubei Province as an Example

Li Jue<sup>1</sup>, Zeng Xueqin<sup>2</sup>

1 School of Computer Science and Technology, Wuhan University of Technology, Wuhan, P. R. China, 430070

2 Faculty of Physics and Electronic Science, Hubei University, Wuhan, P. R. China, 430062

(E-mail: kingofjade@qq.com, 1305360873@qq.com)

**Abstract:** Nineteen major reports put forward "the strategy of revitalization of the countryside". And the key to the Rural Revitalization is to strike a good fight against poverty. Poverty alleviation by e-commerce is the landing of the "Internet Plus" in the field of poverty alleviation. It is also an important way to deepen the poverty alleviation, to implement the precise poverty alleviation strategy and to boost the Rural Revitalization Strategy. However, the complex geographical conditions, poor traffic conditions, difficulties in logistics transportation, high logistics costs and long circulation cycle are major factors which constrained rural e-commerce development (Yang Huijuan, 2019).

**Keywords:** Rural E-commerce; Rural Logistics; Internet Development; Rural Revitalization

### 1 Introduction

Kalin Hristov (2017) thinks that the Internet Plus initiative has been recently introduced as a way to reinvigorate China's slowing economy. As is known to us all, many companies are using logistics software and the Internet to run their business more efficiently and meet the needs of customers (Aldin & Stahre, 2003), now the countryside also welcome the Internet. In recent years, rural work has always been the most important target of the Party and the state. At the beginning of 2018, the Central Conference on Rural Work pointed out that the road of rural development with Chinese characteristics is not isolated rural development, but rural development linked with urban and rural development, not relying on the traditional "trinity" development of land, capital and labor, but making full use of modern science and technology, especially modern information technology, to promote the realization of the strategy of rural revitalization, that is, making full use of computing, Machine, Internet, Mobile Network, Internet of Things, Big Data, Cloud Computing, Block Chain, AI Artificial Intelligence and other technologies promote the development of modern rural areas. On February 4, 2018, the No. 1 Document of the Central Committee of 2018 was published, namely, the "Opinions of the Central Committee of the Communist Party of China and the State Council on Implementing the Rural Revitalization Strategy". The opinion pointed out that it is necessary to persist in solving the "three rural issues" as the top priority of the party's work, which will continue to increase the policy of strengthening agriculture, benefiting farmers and enriching farmers, and solidly promote agricultural modernization and new rural construction, and comprehensively deepen rural reform. As Maier (2017) points that electronic commerce is the collection information flow, business flow, cash flow, logistics is a process of trade

transactions, since have received extensive attention of society from all walks of life, certainly including the countryside life

By the end of 2017, Chinese agricultural population has reached 41.48%, which means that nearly half of Chinese people live in rural areas. By the end of 2017, the number of broadband access in rural areas has reached 93.77 million, which shows that the rural e-commerce market is huge (Wu Lixia & Zhang Yuejin, 2019). Under the trend of "Internet Plus" and rural revitalization, "rural electric business" will become one of the main force of rural industry. The advantages of price and more alternative categories have brought about the impact on the typical characteristics of rural traditional shopping. In addition, we find that those migrant workers, who have gained more insights in big cities and experience in online shopping, are also driving the consumption of online shopping in rural areas when they return to the countryside. More than 10% of the income of the new generation of migrant workers comes from the purchase of clothing, and mainly from the purchase of online shopping. These young migrant workers are the main participants of rural e-commerce at this stage.

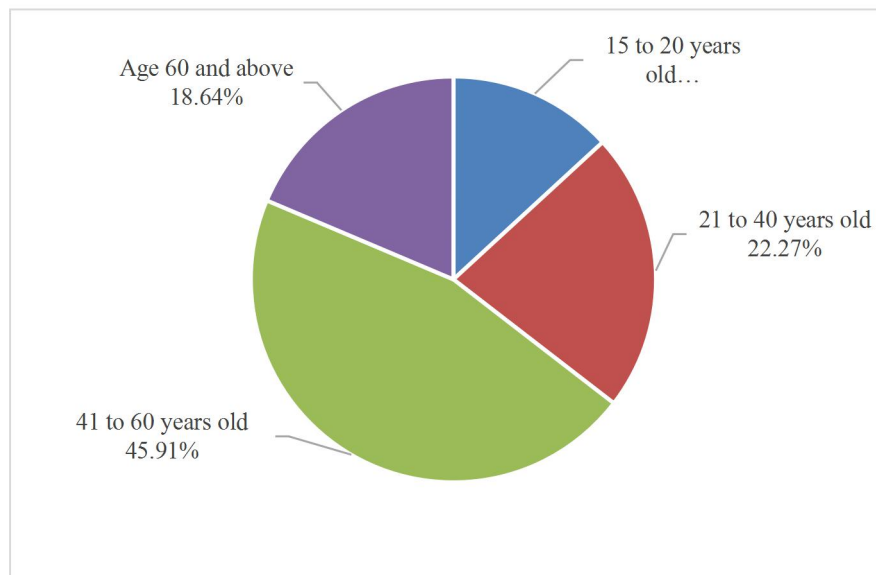
However, due to geographical location, infrastructure and many other factors, rural logistics has begun to restrict the development of rural e-commerce, and become the bottleneck of rural economic development. Looking at the national conditions, China is a big agricultural country, and the output of agricultural products ranks the top in the world. However, there are always problems in the supply and demand of domestic agricultural products, and a large number of unsalable agricultural products are serious. In this context, in order to promote the development of rural e-commerce industry, China must build a unique e-commerce distribution logistics network system covering prefecture-level cities, especially some agricultural products can enjoy the green channel policy in the transport process. According to this regulation, the relevant departments must reasonably plan the transportation route from the rural production base to the wholesale market, and form the distribution network and distribution line covering prefecture-level city, county-level city, Township and rural areas (Zhang Yan, 2019).

Guidelines issued by the Central Committee of the CPC and the State Council on the three-year campaign to win the battle against poverty put forward: speeding up the "express delivery to the countryside" project, improving the rural logistics distribution system in poverty-stricken areas, and strengthening the construction of cold-chain facilities in agricultural production bases with distinctive advantages. Generally speaking, the definition of logistics refers to the use of various modes of transportation, such as transportation, storage, distribution, loading and unloading, to achieve the transfer of goods from one place to another in space. Therefore, effective logistics channels play an important role in realizing the circulation of urban and rural commerce and trade, and further promoting the integration of urban and rural commerce and trade. From the perspective of industrial composition, logistics as an important part of economic development, its development level will affect the overall quality of economic development. At present, the rural logistics industry is still in the stage of development, even in some economically underdeveloped areas, which is still in its infancy. The logistics network is few, the coverage rate is generally low, the warehousing facilities are simple and the technical equipment is not perfect, the unified logistics information platform has not been established, the large logistics data has not been formed, and the information can not be exchanged and transmitted in time, which leads to the inability to collect, analyze and share logistics information resources. And industry development lacks scientific and rational mechanisms and models and related policies (Yuan Shujuan, 2018). The author visits and investigates the development of logistics economy in villages and towns under the jurisdiction of Xiangyang, Yichang and other cities in Hubei Province. Through the construction of models, data comparison and literature analysis, to a certain extent, the author draws the experience of rural logistics economic development that can be popularized, and finds the problems that need to be solved urgently in the process of development.

In the early stage, the author sent out 225 questionnaires to residents in Zaoyang City, Hubei Province, and 220 valid questionnaires were recovered. The Respondents involved in all age levels, including urban areas, townships, community villages and other places, including e-commerce, growers, courier company leaders, students, ordinary residents and other professionals.

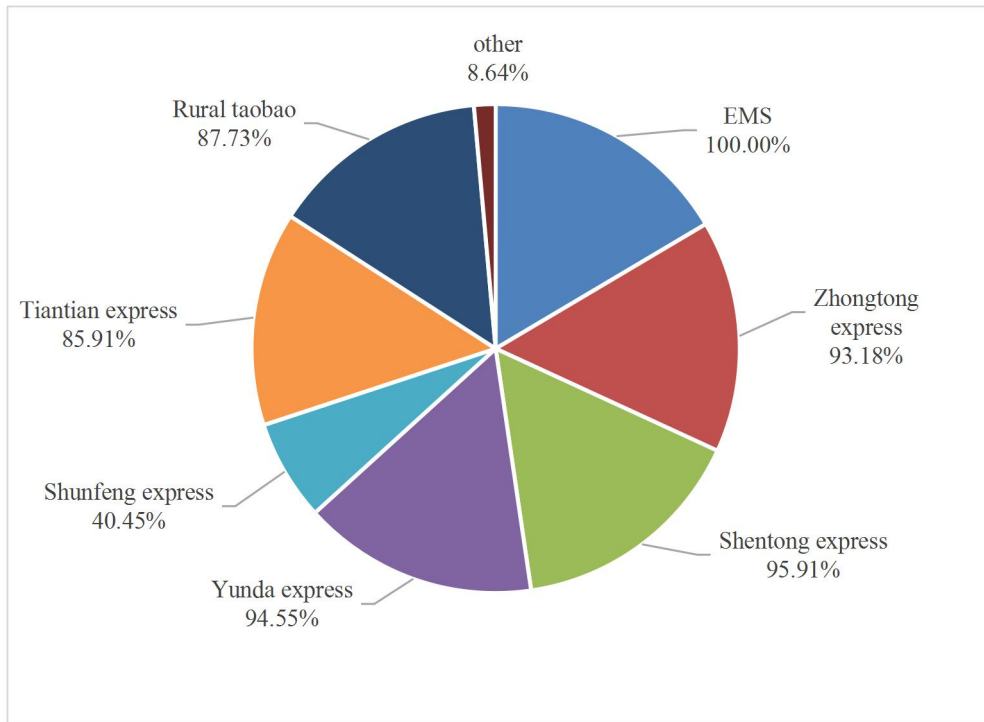
## 2 Reflections on the Current Situation of Rural Logistics in Zaoyang, Hubei Province

### 2.1 Investigation on the current situation of rural logistics in Zaoyang city



**Figure 1 Age Distribution of Respondents**

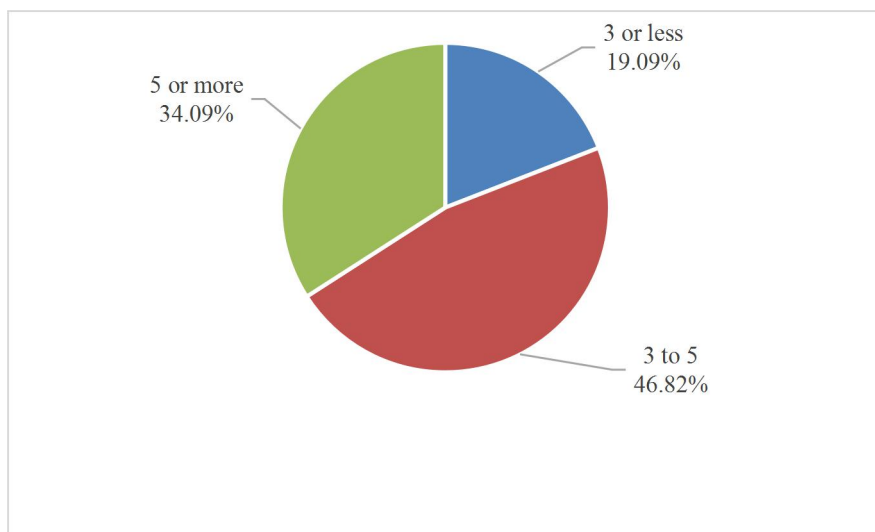
The survey involves all age groups. According to the staff who cooperated with the survey, most of the residents who stayed in the towns of Zaoyang City were middle-aged and above, and most of them took advantage of the geographical advantages of Zaoyang City to engage in planting industry. In recent years, the rapid development of rural e-commerce in Zaoyang City has attracted many young people from abroad to return home and start businesses.



**Figure 2 The Distribution Chart of Common Express**

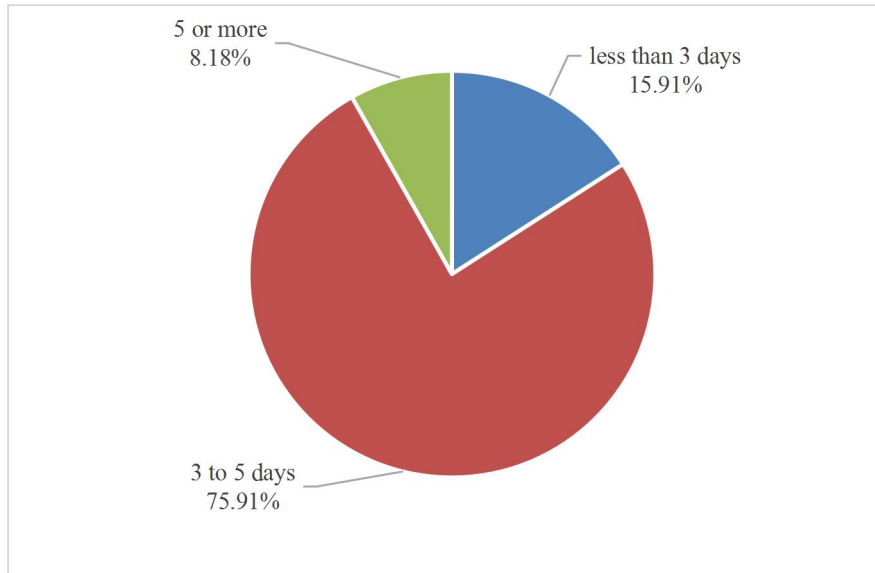
**Delivery Companies in the Villages and Towns Where the Respondents are Located**

The survey results show that Chinese Post (EMS) is basically universal in all villages and towns of Zaoyang City, and the "four links and one access" express delivery network is quite popular, second only to postal express delivery, while the more expensive Shunfeng express in urban areas, the fewer village and town-level network outlets. In addition, there are a few Xiangyang city-level logistics companies also exist in some townships.



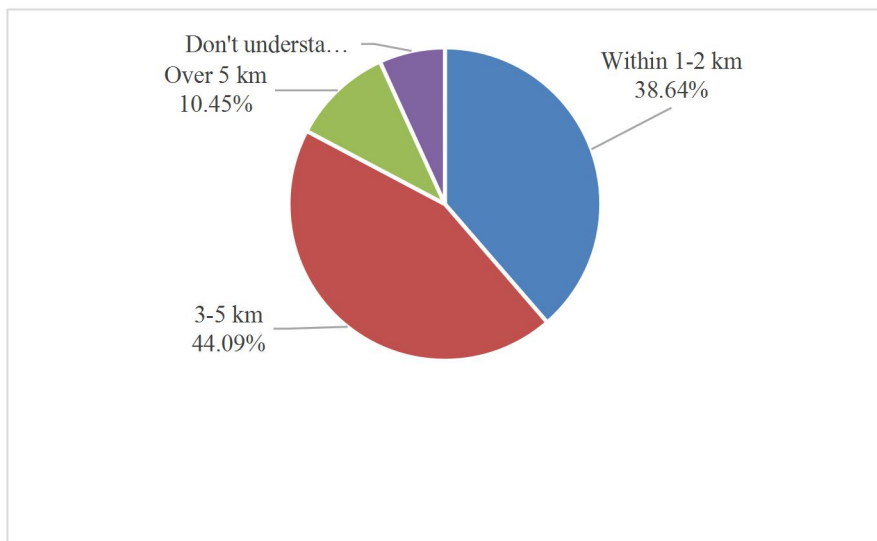
**Figure 3 The Distribution Map of the Number of Express Outlets Near the Villages and Tomns Where the Respondents are Located**

The above survey results show that there are only 3 or less express network points near a few villages and towns serving the residents' lives. In villages and towns with slightly developed traffic, the number of express network points reaches 3 to 5, while in a few villages and towns with important traffic positions, the number of express network points can reach 5 or more.



**Figure 4 Distribution of Delivery Time**

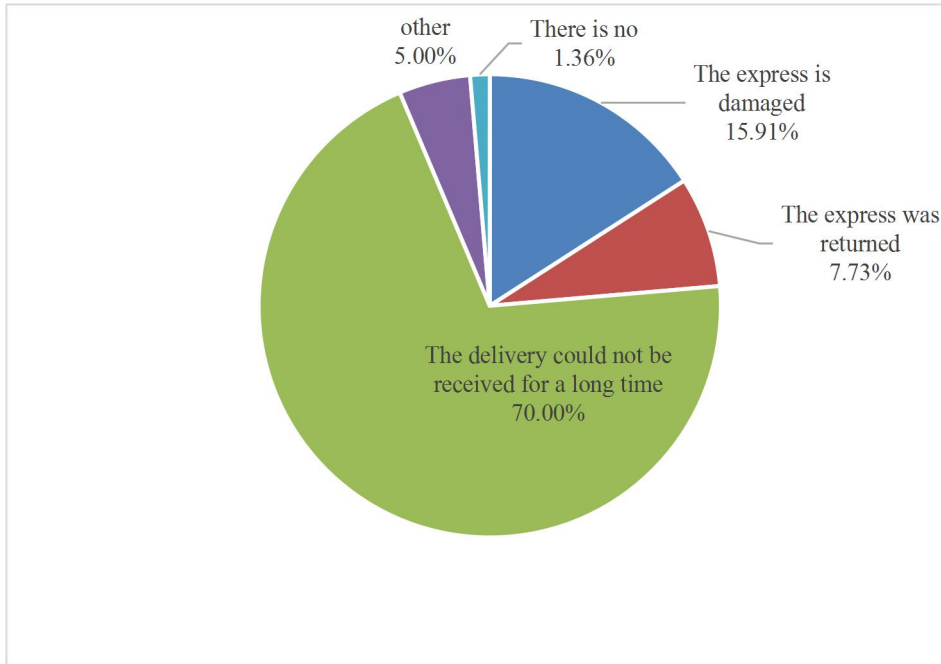
Surveys show that most residents need 3 to 5 days to receive or deliver express delivery, and the time to receive or deliver express delivery is usually less than 3 days from the village and town residents of the city-level express sorting center, while in southern mountain area of Zaoyang, the time to receive or send express delivery may be 5 days or longer.



**Figure 5 The Distribution Map of the Distance Between the Villages and Towns Where the Respondents are**

**Located and the Express Outlets**

The above distribution map shows that most of the residents live in 3-5 kilometers of the local distribution of express delivery network, living in villages and towns, urban residents, only 1-2 kilometers away from the express delivery network, in villages and towns with inconvenient traffic, still need to be 5 kilometers away from the express delivery network.

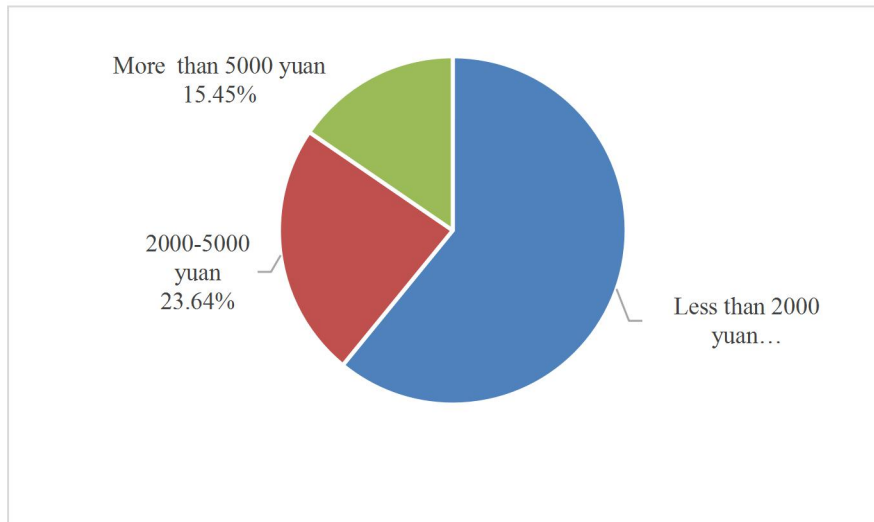


**Figure 6 Distribution Map of Service Problems Encountered by Respondents**

The survey shows that the main problem that residents encounter is that the delivery time is too long. In addition, in the process of delivery, the damage of express delivery also occurs. A few residents said that they had experienced the return of express delivery.

**2.2 Survey on online sales of residents of Zaoyang city**

As the survey shows, over half of the people have the experience of selling agricultural products online,. And according to the interview with team members, the other part of people, who have no such experience, are not able to conduct online sales.



**Figure 7 Online Sales of Agricultural Products Income Distribution Map**

Most of the residents regard online sales of agricultural products as a sideline industry. Among them, 60.91% of the residents earn more than 2000 yuan from online sales of agricultural products, 23.64% of the residents earn 2000-5000 yuan from online sales. In addition, a small number of large farmers and e-commerce have long-term online sales channels with income of more than 5000 yuan.

### **2.3 A survey of suggestions on logistics development**

Among the 220 people who participated in the questionnaire. 134 of them thought that improving the current situation of rural logistics should improve the traffic conditions, strive for village-to-village communication and household-to-household communication; 20 of them said that improving the current situation of rural logistics should relax policies, encourage everyone to develop rural e-commerce industry and stimulate the development of rural logistics industry with demand; in addition; 66 of them thought that training should be organized to train relevant industries' Talents.

## **3 Analysis of the Field Survey Result in Zaoyang**

### **3.1 Visiting Sanjie group of Zaoyang city -- storage and logistics system for rural e-commerce services**

The head of Zaoyang Sanjie Group and chairman of Zaoyang Electronic Commerce Association introduced to the team members the standardized warehousing of electronic commerce and the logistics system responsible for distribution of Sanjie Group.

#### **3.1.1 Standardized warehousing that integrates storage, testing and sub-packaging.**

In order to promote the rapid development of electronic commerce in Zaoyang City scientifically and effectively, Sanjie Group, the industry leader, first built a standardized warehouse. Sanjie Group's standardized warehouse is equipped with automated sorting equipment and improved on the basis of ordinary sorting equipment, which adapts to the characteristics of peaches that can not withstand bumps. At the same time, there is a relatively complete evaluation system in the warehouse. For each batch of



products sold online, besides the necessary safety assessment of pesticide residues, a series of scientific analysis has been made on the sugar content of fruits and the shelf life of fruits.

### 3.1.2 Logistics system for delivering agricultural products

Agricultural products sales have a great impact on harvest weather. In a few days of maturity, it is necessary to race against the clock to pick, sort, pack and ship them out. For this reason, Sanjie Group cooperates with many logistics companies to deliver goods to customers in the shortest possible time. According to statistics, Zaoyang peaches are usually sold to Guangzhou. In peak season, peaches picked in the morning are transported to the sorting center by express train in the afternoon for direct distribution. In addition, the precise poverty alleviation channel developed by Jingdong Logistics Company is not only cheaper than other logistics companies, but also meets the requirements of distribution speed.

## **3.2 Visiting the head of "four connections and one access" in Xinglong town -- about the development of several frequent express companies**

### 3.2.1 Express business model of "four connections and one access"

In Xinglong Town, Zaoyang City, members of the practice team visited the head of "four links and one access" express company. After the introduction of five leaders, team members learned that "four links and one access" generally adopts the franchise system. After application and headquarters evaluation, express outlets can be set up in areas of scale, requiring separate facades and regular business and service assessment. Unlike direct operation, franchise system requires the person in charge to bear all risks, transportation costs and transit costs are also borne by the person in charge.

### 3.2.2 Efficiency of "four links and one access"

Because of the scale requirement of setting up express delivery network, the network often only exists in the areas with Township level. For the demand of picking up and sending mail in administrative villages, it often needs to go to the towns where it can meet. In the administrative villages with relatively developed traffic, the head of the town-level network often invests in setting up a temporary express delivery receiving and discharging point to provide convenience for villagers. Therefore, breaking the "last kilometer" of distribution, logistics development path is blocked and long.

## **3.3 Visit the business transportation of Xiangyang Branch of Chinese Post -- the leader of cracking the "last kilometer" of rural distribution.**

The postal company combines with the village e-commerce network to realize the delivery of express delivery by the village. 102 new postal routes have been developed. The total mileage of the postal routes is 4309 kilometers. And specially equipped with 12 minivans, 3 pickup trucks, 1 medium-sized van, 62 delivery personnel, according to the city to town once a day, the town to the administrative village five times a week of distribution frequencies for express logistics distribution. At the same time, the postal company has signed cooperation agreements with 11 express delivery companies, such as Yousu, Xinyu, Zeda, Xiangyang Guoda and Zhisheng, to establish an open platform to realize the sharing of logistics distribution resources. Postal companies issue courier bills in village-level online stores, and all 11 courier companies cooperating with them send courier bills, which are brought back by postal couriers and distributed to city-level warehouses. The last and first kilometers of express delivery are made by postal companies.

## **4 Problems Existing in current Rural E-commerce and Logistics**

### **4.1 Express company "sweep the snow in front of each door".**

Except for Xiangyang Branch of Chinese Post, to a certain extent, to realize the sharing of logistics distribution resources, in other aspects, express companies "sweep the snow before the door". In transportation, express companies generally take ordinary express delivery items as the main part, only when the network express is not loaded with cars, can they store and transport agricultural products to major e-commerce warehouses. Therefore, in the peak season when agricultural products are concentrated, there is still a phenomenon of "cannot be transported out", which often leads to the phenomenon of unsalable products. This is also the reason at the beginning of this summer, which is similar to "Peach Township Peach can't sell, throwing pond to feed fish".

### **4.2 Express association exists in name only**

The express association which manages the major express companies has not played a great role. In the peak season of logistics and transportation demand, several express companies have jointly raised their prices, which has not provided the necessary convenience for the suppliers.

### **4.3 Logistics infrastructure still needs to be strengthened.**

Agricultural products are natural products, with strong seasonality, affected by weather and other factors. In the survey, members of the practical team found that, in addition to large-scale e-commerce companies own warehouses, logistics companies do not have basic safeguard facilities for storage, transportation, packaging, loading and unloading, low standardization of equipment, poor mechanization and automation level, imperfect infrastructure of rural logistics, logistics equipment is relatively backward.

### **4.4 Traffic conditions can not keep up with the needs of the logistics industry.**

One of the important reasons why express companies "mainly focus on big cities and take small places" is that the transportation development in rural areas is backward and the transportation cost is high. In the process of investigation, members of the practice team also learned that the common network of several major express companies often stopped with towns. For administrative villages, one is inconvenient traffic, the other is not up to the scale of opening network. Compared with the development of logistics express industry in southern and northern areas of Zaoyang City, we can see that the number of network outlets in northern plain area is obviously more than that in southern mountain area.

### **4.5 Lack of technical support.**

When interviewing villagers in Xinglong Town, when members of the practice team asked why their peaches were not sold online, the aunt said that she would not do a series of online operations. It is understood that Zaoyang City has joined several vocational schools to carry out training, but the scale still can not meet the needs of the public, so that many farmers who want to develop e-commerce stop at the technical link.

## **5 Conclusion**

Gimnez and Ventura (2003) pointed out that information and communication technology

are very important on the development of supply chain. Combined with the data of field research and literature analysis, the current development of rural logistics in China can be said to usher in a new opportunity. In particular, the intake of "Internet Plus" and other elements adds vitality to the development of rural logistics, so as to glimpse the future trend of new rural construction, that is, refinement, technicalization and datamation. Of course, in this process, it is inevitable to face many problems and solve the corresponding constraints, such as the concept of farmers, technical assistance, policy implementation, etc. Therefore, the author also has the following suggestions and prospects.

### **5.1 Cultivate the main body of rural logistics market.**

Actively promote the integration of rural logistics resources and realize the diversification of market subjects. Accelerate the pace of assets reorganization and transformation of the original agricultural products circulation enterprises; Change the current situation of small scale, monotonous and closed operation; And in accordance with the development direction of agricultural products circulation industrialization; Focus on increasing support for the wholesale market of agricultural products, agricultural products transport enterprises, import and export enterprises, logistics distribution enterprises and large food chain supermarkets; Relying on the market, organize the Agricultural Product Transportation Association and encourage the development and cultivation of modes such as "production land + farmers", "processing enterprises + farmers", "production and marketing enterprises + farmers, distribution centers + farmers"; so as to improve the degree of market organization.

### **5.2 Improving the technical level of rural logistics**

With the development of modern science and technology, logistics equipment and technology are constantly improving, which can maximize the loss of agricultural products in the process of transportation and storage, reduce logistics costs and improve product added value. The government should encourage rural logistics enterprises or individuals to purchase advanced logistics transportation equipment and refrigeration and fresh-keeping equipment by means of financial discounts and financial support; they also should constantly strengthen the standardization of rural logistics, actively adopt international or domestic logistics standards in the logistics links of transportation, packaging, processing and warehousing, and actively develop the transportation of containers and large refrigerated vehicles in accordance with market requirements. Continuous improvement of rural logistics technology.

### **5.3 Logistics pattern of "Freight Line + Passenger Transport Alliance".**

At present, the experience of "Freight Line + Passenger Transport Alliance" in Zigui County of Yichang City has been popularized throughout the province. Drawing lessons from this experience, the logistics pattern of "freight liner + passenger transport alliance" was formed by the trunk line of large logistics companies in Zaoyang City, truck delivery in city and town, and passenger cars in villages. The seamless docking of "station-to-station, station-to-point and point-to-door" was realized to solve the embarrassing situation that the administrative villages could not reach the construction of express delivery network, express delivery could not go out and could not be delivered. Break the "last kilometer" of logistics distribution (Zhang Xiliu, 2019).

### **5.4 Accelerate the implementation of "land allocation".**

The e-commerce of Zaoyang city has a certain scale. In the peak season of fruit market, there is a great demand for logistics. Logistics companies sign up to implement "land allocation". After sorting and packaging from the origin, they are directly transported to the sorting center of the destination city for distribution. The next day goods ordered online can be delivered to the hands of customers, which not only greatly improves the effectiveness, but also increases the satisfaction process of customers. The

greatest advantage is to solve the problem that the logistics demand can not be satisfied, and successfully solve the problem of slow sales.

### **5.5 Improve the level of commonality in logistics and distribution.**

The realization of joint distribution is the best mode of resource integration among distribution modes. In particular, multiple enterprises jointly implement the distribution mode of distribution. According to the actual situation of local development, each logistics company can cooperate, divide the region, and realize that a specific company is responsible for a certain region. As Tan Xinming & Tong Guangzhan (2018) point that it can improve the utilization of resources and greatly reduce the cost of distribution.

## **Acknowledgement**

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# Research on Operation Performance Evaluation System Construction for National Digital Publishing Bases

Liu Yuhan<sup>1</sup>, Liu Yongjian<sup>2</sup>

1 School of Architecture and Urban Planning, Huazhong University of Science and Technology, Wuhan, P.R.China, 430074

2 College of Computer Science and Technology, Wuhan University of Technology, Wuhan, P.R.China, 430070

(E-mail: ilovemcgrady001@126.com, liuyj626@163.com)

**Abstract:** National Publishing Bases are high-tech industrial clusters which possess characteristics of cultural and creative industry dominated by the government. They have already become power producers and incubators of Chinese digital publishing industry. However, the existing research rarely involves the operation performance evaluation construction, thus hardly measures the practical operation situation. This thesis combines the practical operation situation of National Publishing Bases, adopts Delphi method and analytic hierarchy process to construct the operation performance evaluation system and get the corresponding weight of each index based on relevant industrial clusters theories. Initially build a 4-dimensional operation performance evaluation system including technological innovative ability, media convergence ability, market profitability and base scale. This system provides important decision-making reference and practical guidance for measuring the operation performances of National Publishing Bases.

**Keywords:** Digital Publishing Bases; Operation Performance; Evaluation System; Industrial Clusters

## 1 Introduction

The operation performance of National Publishing Bases refers to level and consequence operated by all bases bodies together under the certain resources, circumstances and conditions. Operation performance can estimate the working progress and effect through different dimensions. It is a relatively comprehensive and scientific evaluation method. The operation performance evaluation of National Publishing Bases needs to combine relative methods of industrial clusters and development characteristics of bases to conduct comprehensive judgement of possession, using, management and economic resources allocation. Therefore it can get relative objective and scientific judgement of development of every single base (Wang Can, 2013).

It needs to refer to operation performance evaluation system of cultural and high-tech industrial clusters. Wang Xin (2012) utilizes Fuzzy Comprehensive Evaluation (FCE) to construct operation evaluation system of electronic information industry. The system divides into aggregation ability, competitive ability, innovation ability, intensity of cooperation, economic capability and input-output capacity. Guo Wei (2013), Wang Huan (2012), Tian Xuefeng (2016), Li Wen (2009) and other scholars evaluate such industrial clusters for Sichuan, Hubei, Hebei, Jiangsu and other provinces. The result show that innovation is the crucial element to promote the operation performance for such industrial

clusters.

## **2 The Significance and Functions of Operation Performance Evaluation System Construction of National Publishing Bases**

### **2.1 The significance operation performance evaluation system construction**

Constructing the operation performance evaluation system of National Publishing Bases can simplify and quantify the complex relationships of all fields in the comprehensive performance system of bases. The construction of operation performance system has positive effects for reducing bases running cost, enhancing productivity, optimizing the industrial structure, expanding competitive advantage, removing obstacles to development and other aspects. Therefore the bases and the government can estimate the operation situation through the evaluation system.

### **2.2 The functions of operation performance evaluation system construction**

The functions of constructing operation performance evaluation system mainly reflect three aspects: measurement, comparison and prediction. The function of measurement means the system can estimate the operation effect specifically so that every base will know their advantages and disadvantages distinctly. The function of comparison can help bases to confirm the status in the same industry. Therefore the bases and the government can know operation status from different aspects, periods, variations and trends. The function of prediction focuses on future development trend of bases.

## **3 Construction of Operation Performance Evaluation System**

### **3.1 Preliminary election of evaluation index**

According to the researches based on performance evaluation of industry clusters by numerous scholars, the indexes primarily includes economic benefit, social benefit, Effects of competition, technological innovative ability, production capacity, input-output capacity, cluster concentration, government forces and other aspects (Yang Xin, 2008; Jiang Yuxia, 2009; Du Lei, 2016). Different types of industry clusters have different deviations to choose indexes. Combined the theories of industry clusters and practical characteristics of National Digital Publishing Bases, the research adopts the Delphi method to collect the suggestions of industry experts from State Administration of Press and Publications, Chinese Academy of Press and Publication, Hubei Changjiang Publishing and Media Group, Time Publishing and Media Group, Huazhong National Digital Publishing Base and Hangzhou National Digital Publishing Base. Through making a synthetic judgment on the availability and importance of indexes, the evaluation system can be preliminarily divided into three hierarchies: target level, module level and index level. The target level refers to the evaluation object: the operation performance of National Digital Publishing Bases. Module level includes four dimensions: technological innovative ability, media convergence ability, market profitability and base scale.

#### **3.1.1 Technological innovative ability**

As an industry cluster combined with cultural and high-tech industry, the technological innovative ability National Digital Publishing Bases reflects in technology R&D capability, cultural expression, digital content creativity and many other aspects(Sun Ling, 2015). High-quality digital publishing

productions not only rely on superior digital content, but also need advance high-technology to support. Therefore, the technological innovative ability will be reflected through following key indicators: numbers of technology enterprises, numbers of digital publishing enterprises, speed of producing new products and technology diffusion rate.

### 3.1.2 Media convergence ability

Even though the technology level in the bases largely decides the usage experiences and convenience like terminals, softwares and platforms of digital content, circulation channels and other aspects, but it is only the bridge which connect with users and digital content products. The development essence of digital publishing bases is offering services for dissemination of knowledge content. The quality of digital content is the core in the publishing industry. Therefore cultural industry strength will be reflected through following three indicators: the number of traditional publishing enterprises, cultural brand awareness and media convergence ability.

### 3.1.3 Market profitability

The market profitability directly reflects the market share of every base in the digital publishing industry, it is composed by four indicators: operation revenue, net profit, revenue growth rate and revenue as a percentage of the digital publishing market.

### 3.1.4 Base scale

Base scale embodies the current overall scale and horizontal volume of every base. It is composed of following four indicators: total number of employees, total number of enterprises, growth rate of the number of enterprises settled in and general assets.

## 3.2 Confirmation of the index system weight

To confirm the weight of the index system needs following specific steps based on Analytic Hierarchy Process: construct judgement matrix, calculate maximum eigenroots and eigenvectors of judgement matrix, consistency check, calculate combination weight vector and consistency check and determinate the weight of indexes.

### 3.2.1 Judgement matrix construction

According to the Analytic Hierarchy Process proposed by Professor Tomas L.Saaty in 1970s. This method can divide elements which are relevant to decisions into different levels. It includes both the rating and comparison methods. Rationality requires developing a reliable hierarchic structure or feedback network that includes criteria of various types of influence, stakeholders, and decision alternatives to determine the best choice (Thomas L.Saaty, 1990).

This investigation altogether provides 30 questionnaires and 24 were recovered. 23 questionnaires were valid. The effective questionnaire returns-ratio is 77%.

The experts are from State Administration of Press and Publications, Chinese Academy of Press and Publication, Hubei Changjiang Publishing and Media Group, Time Publishing and Media Group, SinoMaps Press, Phoenix Publishing and Media Group, Publishing House of Electronics Industry and other well-known publishing houses. The judgement matrix of target level is shown in the Table 1.

**Table 1 The Judgement Matrix of Target Level**

	A <sub>1</sub>	A <sub>2</sub>	A <sub>3</sub>	A <sub>4</sub>
A <sub>1</sub>	1	1	2	3
A <sub>2</sub>	1	1	1	2
A <sub>3</sub>	1/2	1	1	2
A <sub>4</sub>	1/3	1/2	1/2	1

Similarly, four judgement matrixes of module level can also be constructed as A<sub>1</sub>, A<sub>2</sub>, A<sub>3</sub> and A<sub>4</sub>. The judgement matrix A<sub>1</sub> of technological innovative ability is shown in the Table 2.

**Table 2 The Judgement Matrix A<sub>1</sub> of Technological Innovative Ability**

	B <sub>1</sub>	B <sub>2</sub>	B <sub>3</sub>	B <sub>4</sub>
B <sub>1</sub>	1	1/2	1/4	1/5
B <sub>2</sub>	2	1	1/3	1/4
B <sub>3</sub>	4	3	1	1/2
B <sub>4</sub>	5	4	2	1

The judgement matrix A<sub>2</sub> of media convergence ability is shown in the Table 3

**Table 3 The Judgement Matrix A<sub>2</sub> of Media Convergence Ability**

	B <sub>5</sub>	B <sub>6</sub>	B <sub>7</sub>
B <sub>5</sub>	1	1/2	1/3
B <sub>6</sub>	2	1	1
B <sub>7</sub>	3	1	1

The judgement matrix A<sub>3</sub> of market profitability is shown in the Table 4

**Table 4 The Judgement Matrix A<sub>3</sub> of Market Profitability**

	B <sub>8</sub>	B <sub>9</sub>	B <sub>10</sub>	B <sub>11</sub>
B <sub>8</sub>	1	2	1/4	1/3
B <sub>9</sub>	1/2	1	1/2	1/2
B <sub>10</sub>	4	2	1	1
B <sub>11</sub>	3	2	1	1



The judgement matrix  $A_4$  of base scale is shown in the Table 5

**Table 5 The Judgement Matrix  $A_4$  of Base Scale**

	B <sub>12</sub>	B <sub>13</sub>	B <sub>14</sub>	B <sub>15</sub>
B <sub>12</sub>	1	1/2	1/3	1/5
B <sub>13</sub>	2	1	1/4	1/2
B <sub>14</sub>	3	4	1	1/2
B <sub>15</sub>	5	2	2	1

### 3.2.2 Calculate maximum eigenroots and eigenvectors of judgement matrix

In general, it can adopt summation or root-finding method to calculate approximately the approximate value of eigenvalue when we calculate maximum eigenroots and eigenvectors of judgement matrix based on AHP. In this article, we adopt summation method to solve.

(1) To normalize each line of vectors of A, the results shows that

$$\tilde{w}_{ij} = a_{ij} / \sum_{i=1}^n a_{ij} \quad (\text{Formula 1})$$

(2) To sum  $\tilde{w}_{ij}$  on the basis of rows, the results shows that

$$\tilde{w}_i = \sum_{j=1}^n \tilde{w}_{ij} \quad (\text{Formula 2})$$

(3) To normalize

$$\tilde{w}_{ij}, w_i = \tilde{w}_i / \sum_{i=1}^n \tilde{w}_i, w = (w_1, w_2, \dots, w_n)^T \quad (\text{Formula 3})$$

### 3.2.3 Final determination of index weight

(1) The index weight of module level

First, it is necessary to normalize the judgement matrix A to get:

$$\tilde{w}_0 = \begin{pmatrix} 0.3529 & 0.2857 & 0.4445 & 0.3750 \\ 0.3529 & 0.2857 & 0.2222 & 0.2500 \\ 0.1765 & 0.2857 & 0.2222 & 0.2500 \\ 0.1177 & 0.1429 & 0.1111 & 0.1250 \end{pmatrix}$$

To sum  $\tilde{w}_0$  on the basis of rows, the results shows that:

$$\tilde{w}'_0 = (1.4581 \quad 1.1108 \quad 0.9344 \quad 0.4967)^T$$

To normalize  $\tilde{w}'_0$ , the results shows that:

$$\tilde{w}_0'' = (0.3645 \quad 0.2777 \quad 0.2336 \quad 0.1242)^T$$

$\tilde{w}_0$  refers to the eigenvector which corresponds to the weight of every index.

Then calculate the maximum eigenvalue of judgement matrix A:

$$\lambda = \frac{1}{n} \sum_{i=1}^n \frac{(A\tilde{w}_0'')_i}{\tilde{w}_0''_i} = \frac{1}{4} \times (4.0658 + 4.0483 + 4.0323 + 4.0366) = 4.0458$$

According to the consistency check formula proposed by Saaty,

$$CI = \frac{\lambda - n}{n - 1} \quad \text{(Formula 4)}$$

If the calculated result is smaller than 1, it means the result has passed the consistency check.

To conduct consistency check:

$$CI = \frac{\lambda - n}{n - 1} = \frac{4.0458 - 4}{4 - 1} = 0.0153$$

Saaty also proposed the table of random consistency index by 100~500 random samples. The numerical comparison table is shown in Table 6.

**Table 6 The Random Consistency Index of RI**

<i>n</i>	1	2	3	4	5	6	7	8	9	10	11
<i>RI</i>	0	0	0.58	0.90	1.12	1.24	1.32	1.41	1.45	1.49	1.51

According to the random consistency index, the results shows that:  $RI = 0.9$

Therefore:

$$CR = \frac{CI}{RI} = \frac{0.0153}{0.9} = 0.017 < 0.1$$

The results shows that judgement matrix A has passed the consistency check.

(2) The index weight of index level

Similarly, the weight of every index in index level can also be calculated. The judgement matrix  $A_1$  of technological innovative ability can be normalized as:

$$\tilde{w}_1 = \begin{pmatrix} 0.0833 & 0.0588 & 0.0698 & 0.1026 \\ 0.1667 & 0.1177 & 0.093 & 0.1282 \\ 0.3333 & 0.3529 & 0.2791 & 0.2564 \\ 0.4167 & 0.4706 & 0.5581 & 0.5128 \end{pmatrix}$$

To sum  $\tilde{w}_1$  on the basis of rows, the results shows that:

$$\tilde{w}'_1 = (0.3145 \quad 0.5056 \quad 1.2217 \quad 1.9582)^T$$

To normalize  $\tilde{w}'_1$ , the results shows that:

$$\tilde{w}''_1 = (0.0786 \quad 0.1264 \quad 0.3054 \quad 0.4896)^T$$

$\tilde{w}''_1$  refers to the eigenvector which corresponds to the weight of every index of technological innovative ability.

Then calculate the maximum eigenvalue of judgement matrix  $A_1$ :

$$\lambda = \frac{1}{n} \sum_{i=1}^n \frac{(A_1 \tilde{w}''_1)_i}{\tilde{w}''_1_i} = \frac{1}{4} \times (4.0212 + 4.0174 + 4.0727 + 4.0829) = 4.0486$$

To conduct consistency check:

$$CI = \frac{\lambda - n}{n - 1} = \frac{4.0486 - 4}{4 - 1} = 0.0162$$

According to the random consistency index, the results shows that:  $RI = 0.9$

Therefore:

$$CR = \frac{CI}{RI} = \frac{0.0162}{0.9} = 0.018 < 0.1$$

The results shows that judgement matrix  $A_1$  has passed the consistency check.

The weight of judgement matrix  $A_2$ ,  $A_3$ , and  $A_4$  can be calculated and checked through the same way. The calculated results of judgement matrix  $A_2$  is:  $\tilde{w}''_2 = (0.1699 \quad 0.3873 \quad 0.4428)^T$ . The calculated results of judgement matrix  $A_3$  is:  $\tilde{w}''_3 = (0.1530 \quad 0.1400 \quad 0.3682 \quad 0.3388)^T$ . The calculated results of judgement matrix  $A_4$  is:  $\tilde{w}''_4 = (0.0854 \quad 0.1531 \quad 0.3281 \quad 0.4334)^T$ . All the calculated results have passed the consistency check.

### 3.2.6 Consistency check of combination

The overall index level also should be conducted to consistency check based on AHP. Saaty proposed the formula of consistency check of combination so that we can calculate the result:

$$CR^* = \frac{CI^*}{RI^*} = \frac{\sum_{i=1}^n w_i CI_i}{\sum_{i=1}^n w_i RI_i} = \frac{0.3645 \times 0.0162 + 0.2777 \times 0.00915 + 0.2336 \times 0.071 + 0.1242 \times 0.06437}{0.3645 \times 0.9 + 0.2777 \times 0.58 + 0.2336 \times 0.9 + 0.1242 \times 0.9} = 0.0407 < 0.1$$

The results calculated above shows that the overall judgement matrix has passed consistency check. It means the combination weight vector can be the final weight value.

### 3.3 Confirmation of index weight of the operation performance system

Trough the research steps above based on Delphi method and AHP, the overall operation performance evaluation system can be confirmed, the weight of every level can be calculated as shown in Table 7.

**Table 7 The Index Weight of Operation Performance Evaluation System of National Publishing Bases**

Target level	Module level	weight	Index level	weight
Operation Performance Evaluation System of National Digital Bases	Technological innovative ability	0.3645	The number of technology enterprises	0.0786
			The number of digital publishing enterprises	0.1264
			Speed of producing new products	0.3054
			Technology diffusion rate	0.4896
	Media convergence ability	0.2777	The number of traditional publishing enterprises	0.1699
			Cultural brand awareness	0.3873
			Concurrence ability	0.4428
	Market profitability	0.2336	Operation revenue	0.1530
			Net profit	0.1400
			Revenue growth rate	0.3682
			Revenue as a percentage of the digital publishing market	0.3388
	Base scale	0.1242	Total number of employees	0.0854
			Total number of enterprises	0.1531
			Growth rate of the number of enterprises settled in	0.3281
			General assets	0.4334

#### 4 Conclusion

The article constructs the operation performance evaluation system of National Digital Publishing Bases based on Delphi and AHP method. The system is composed by 4 module dimensions and 16 specific indexes. The calculated results shows that the weight of technological innovative ability is the highest among these 4 modules. It reacts the core effects in operation performance of National Digital Publishing Bases. The index weight of technology diffusion rate has reached 0.4896. It means the application and diffusion speed of high-technology largely decides the level of technology in the bases as industrial clusters. Media convergence ability takes the secondary position compares to market profitability. The weight shows that the quality of digital content production still relies on digital content

enterprises but not high-tech enterprises. The weight of base scale is 0.1242. It means digital publishing industry is obviously different from traditional heavy industries. The size of base scale can not influence the development crucially.

This system provides important decision-making reference and practical guidance for measuring the operation performances of National Publishing Bases. Therefore we can directly analyze the practical operation situation of every aspect.

### Acknowledgement

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# Research on Enterprise Management System Innovation in the Era of “Internet +”

Wang Jianguo

School of Law, Humanities and Sociology, Wuhan University of Technology, Wuhan, P.R.China,  
430063

(E-mail: 27073636@qq.com)

**Abstract:** The rapid popularization of the Internet has gradually broken the traditional management thinking of enterprises, especially in the “Internet +” era. More and more Chinese enterprises widely participate in the global international major business transaction, such as economic globalization, regional economic integration. Can Chinese enterprises figure out an effective internal governance mechanism in the management system? This paper will analyze the concept of "Internet +", compare the internal management system of Chinese and foreign enterprises, find out the problems existing in the management system of Chinese enterprises, and try to find targeted solutions.

**Key words:** Internet; Management; Institutional innovation; Change

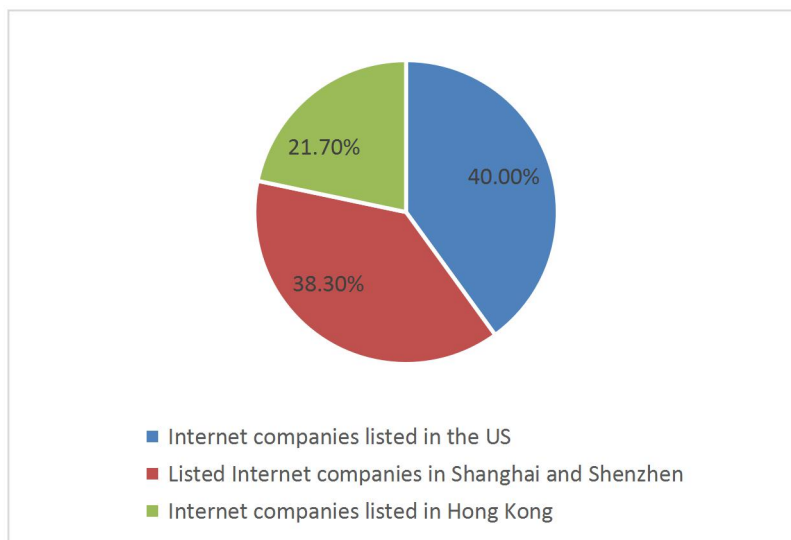
## 1 Introduction

In 1972, the United Nations put forward the concept of "Internet+" at the seminar on human environment. At the third session of the 12th National People's Congress, Premier Li Keqiang put forward the concept of "Internet +" in his government work report. In 1994, the Chinese government formulated the white paper on China's population environment and development in the 21<sup>st</sup> century, which for the first time incorporated the strategy of sustainable development into the long-term plan of China's economic and social development. The outline of the 13th five-year plan sets out the direction and goals for the implementation of "Internet +"(Chen Xiaoping,2002). The plan is clear: we need to implement the "Internet +" action plan, develop Internet of things technologies and applications, develop the sharing economy, and promote the integration of the Internet with economic and social development. We will implement the national big data strategy and promote open sharing of data resources. We will improve the mechanism for universal telecommunications services by speeding up the network and cutting costs, to advance the development of next-generation Internet. We will promote innovation in industrial organizations, business models, supply chains and logistics chains, and support innovations based on internet +.

At present, the academic community pays more attention to the issue of enterprise management innovation in the Internet era. Some scholars believe that since China introduced the "Internet +" strategy in 2012, "Internet +" has been integrated into all walks of life and various fields, making China step into The Internet age. Due to the strong openness and integration of the Internet, this also provides a once-in-a-lifetime historic opportunity for corporate management. Under the "Internet +" strategy, higher requirements are put forward for enterprise management work, and the optimization and improvement of enterprise management mode should be vigorously promoted. In particular, enterprises

must deeply understand the important value of enterprise management innovation in the Internet era, and analyze and restrict in depth. All aspects of enterprise management innovation in the Internet era, using system thinking and innovative ideas, vigorously promote enterprise management reform, innovation and development (Li Xiaocheng, 2019). Some scholars pointed out that enterprises in the Internet era should continue to innovate their management concepts, management models, organizational structures, and human resources management methods, strengthen their links with the market, and establish a good information feedback mechanism to improve the management efficiency of enterprises and promote The further development of the company provides technical support for the sustainable operation of the company (Lin Minjun, 2019). Some scholars believe that under the background of the Internet, enterprise management should adopt an innovative model and explore new development paths. On the basis of mastering the development requirements of the times, we should appropriately innovate management models, seize development opportunities, guide enterprises to develop in the direction of modernization, and fully demonstrate the application advantages of Internet technologies (Tan Ying, 2018). In addition, some scholars believe that in the context of the "Internet +" era, the survival and development lines of enterprises have undergone qualitative changes. The buyer's market has become the lever for enterprises to obtain survival points. "Smart service" has become the market characteristic of the economy and society. This is the "marginal effect" brought by the "Internet +" era. Therefore, enterprise management must embed information technology such as big data and cloud computing in time, and exert its value and functions in production management, business process reengineering, and collaborative supply chain management. Through technological innovation, user demand tapping potential and cost management are reduced. The development needs of enterprises such as production management and business process reengineering, and the deep integration of "Internet +" enterprise management innovation (Guo Ya, 2018). Other scholars believe that in the innovation of enterprise management, it should reflect the characteristics of the era of "Internet +" era of convenience and high speed. In management and management, enterprises must not only arrange production, management, and management according to their own scale, capital, and system. They also need to reflect the needs of users in business management and put user needs first. At the same time, users can absorb user experience and user feedback on products through the Internet, deepen the communication between enterprises and users, and let users get a good experience (Cui Yijia, Wu Zhiwei, 2018).

With the continuous popularization of the Internet, China's Internet industry has ushered in an opportunity for rapid development. As of December 2018, the total number of Internet listed companies in China and abroad was 120, an increase of 17.6% compared with the end of 2017; the overall market value of domestic and overseas Internet listed companies was 7.89 trillion yuan. Among them, the number of Internet companies listed in Shanghai and Shenzhen is 46, which is the same as that at the end of 2017; the number of Internet companies listed in the US is 48, an increase of 7 from the end of 2017; the number of Internet companies listed in Hong Kong is 26, compared with 2017. At the end of the year, 11 were added, as shown in Figure 1.



**Figure 1 Distribution of Internet listed Companies in China**

After 30 years of reform and opening up, Chinese enterprises have been absorbing the essence of developed countries (regions) such as Europe, America and Japan in terms of enterprise management system, forming a set of enterprise management system suitable for China's national conditions. The rapid popularization of the Internet has gradually broken the traditional management thinking of enterprises, especially in the "Internet +" era. More and more Chinese enterprises widely participate in the global international major business transaction, such as economic globalization, regional economic integration(Demsetz.H,2006). Can Chinese enterprises figure out an effective internal governance mechanism in the management system? This will be the focus of this article. This paper will analyze the concept of "Internet +", compare the internal management system of Chinese and foreign enterprises, find out the problems existing in the management system of Chinese enterprises, and try to find targeted solutions.

## 2 Overview of Enterprise Management System

Enterprise management system refers to the internal and external system that the enterprises will involve when they are engaged in commercial activities(Fan Jingli, Zheng Boxun,2013).The external system environment of enterprise includes: *Constitution, Securities Law, Contract Law, Enterprise Law, Corporation Law*, rights awareness, professional ethics and so on. And the government issued the related laws and regulations, such as *Food Safety Law, Labor Law, Environmental Protection Law* and so on for all walks of life, which provides an external organization system environment for the enterprise. Inner-enterprise also has a set of system supporting its operation. Taking the company's articles of association as the core, the enterprise generally sets up performance management, attendance management, marketing management, human resources management, incentive mechanism, responsibility according to their own actual conditions(Fan Jingli, Zhong Chenbo,2015).These rules guide enterprises to be engaged in business activities. In business activities, enterprises constantly improve and formulate new rules and regulations according to external market, internal structure and other factors. Its purpose is to better carry out management work and promote the sustainable development of enterprises.



### **3 Comparisons of Chinese and Foreign Enterprise Management Systems**

#### **3.1 Traditional Chinese enterprise management system**

Under the influence of Chinese social development, dynasty change, foreign trade, war and other factors, Chinese traditional enterprise management system has gradually formed a unique "mainland culture" type enterprise management system (Hart.O, Moore.J, 2008). For instance, *Sun Tzu's Art of War* is the existing comparatively completed system of military operations and internal organization and management. *The Patriarch System* was mainly based on the regional control, and this system was formed due to the needs of war, business and trade. *Leading by teachers* is an effective way for enterprises to retain their important skills (Ju Fanghui, Xie Ziyuan, Bao Gongmin, 2008). *The Craft Inheritance System* is a kind of mysterious inheritance system in which some skills are passed down only to female or male. *The Patriarchal Management System* is the "one person alone has the say" management pursued by most enterprises, in which the "Leader" is the spiritual leader of the enterprise.

#### **3.2 Modern Chinese enterprise management system**

China's modern enterprise management system not only inherits the traditional Chinese enterprise management system, but also absorbs the management systems of developed countries such as Hong Kong, Macao, Taiwan, Europe, America and Japan since the reform and opening up. Such management systems as *the Patriarchal Management System* and *Leading by teachers* are still the management methods chosen by most enterprises (Stephen F. King, Thomas F, 2005). With China's reform and opening up, enterprises from Hong Kong, Macao and Taiwan have flooded into the mainland, and more foreign investment has taken part in China's commercial activities. In order to develop the enterprise, it also introduces such systems as manager system, quality management, 5S management, 7S+1 management, performance appraisal management, corporate culture construction, setting more awards and so on.

#### **3.3 Japanese enterprise management system**

It was once touted as the four magic weapons of Japanese economic management: lifetime employment system, seniority-wage system, enterprise union and decision-making mechanism (Zhang Weiyong, 2005). It has become an important experience of domestic and foreign enterprises in Japan's rapid economic development in 1980s. However, with the great recession in Japan in 1990s, the Japanese government took various measures to stimulate the economy, including reforming the management system and rigid national regulation, but still failed to reverse the trend of Japanese economic recession.

From the above comparison of enterprise management system, there are several characteristics: First, some good applicable management systems are retained and gradually optimized; second, enterprises must actively or passively absorb advanced management system concepts to develop; third, a good management system must be open, inclusive and keep pace with the times (Ning Xiangdong, 2006). On the contrary, today's Chinese enterprise management system can be said to be an effective system accumulated by enterprises in the collision of commercial and trade circulation. Fourth, only in the suitable external environment, can the enterprise management system play its role. If just applied mechanically, the result is often the opposite to what one wishes.

## 4 Problems Existing in Chinese Enterprise Management System in the Internet + Era

The era of Internet + has completely changed people's life, study and work habits. As of December 2018, the number of netizens in China reached 829 million, and a total of 56.53 million new netizens were added throughout the year. The Internet penetration rate was 59.6%, an increase of 2.9 percentage points from the end of 2015, as shown in Figure 4-1. Rise of the individual, disruptive innovation, and fan economy have demonstrated the value of the individual, and infinitely amplified it. The world is also becoming a flat world because of the Internet (Barbara van Mierlo, Cees Leeuwis, Ruud Smits, Rosalinde Klein Woolthuis, 2009). As a single point, each individual can suddenly arise anytime and anywhere. The era of Internet + is an era of publicizing individuality and exerting the role of the individual. In the future, human beings and the Internet will also become more symbiotic and integrated. Technology and human beings will gradually become one and realize the ultimate human intelligence. The development of the Internet and technology connects the individual with the world, making individual autonomy stronger and human beings more social. Meanwhile, traditional jobs are disappearing and new ones are popping up. In the face of the fast pace of the Internet, Chinese enterprise obviously cannot adapt to or keep up with the pace. There are mainly the following problems.

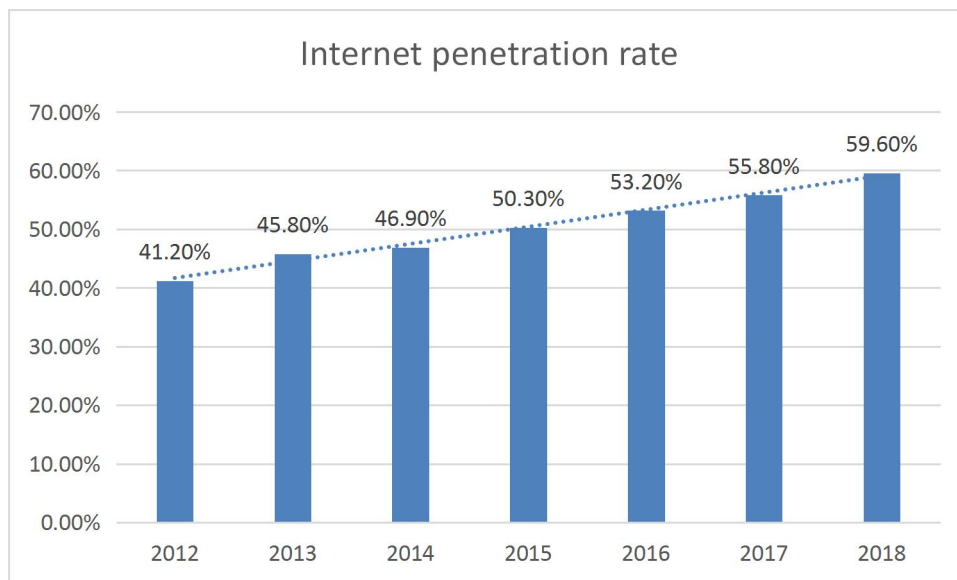


Figure 2 China's Internet Penetration Rate from 2012 to 2018

### 4.1 Lagging internal management system

First of all, some enterprises' internal management system has confused related information and serious overlapping phenomenon. For example, Chinese enterprises have the problem of authenticity and accuracy of financial information in financial management. Secondly, although the enterprise has established relevant internal management system, it lacks rationality and scientificity, and cannot be integrated with the enterprise's development goal and business environment, thus leading the enterprise cannot maximize its own value in the business process.

#### **4.2 Governance structure to be improved**

On the one hand, some enterprises have not set up internal governance mechanism in line with the development of the era of Internet +, leading that the advantages of internal management system cannot reflect the value of enterprise operation and development(Peter Joore,2007). On the other hand, due to the lack of internal supervision departments in enterprises, the management system isn't implemented, and thus the internal management cannot achieve the desired effect.

#### **4.3 Lack of containment in institutional setting**

Firstly, there is no effective containment between posts, which leads to confusion or overlapping of rights in some posts. Secondly, some employees of relevant positions have low professional skills and lack of solid theoretical knowledge, which leads to the failure of effective development of management system in enterprise operation(Yao Yao, Zeng Xianfeng,2015).Third, some personnel have professional knowledge and skills, but after the change of the management system, they cannot conduct in-depth research on the new system. So there are frequent operational errors and misjudgments of information in the process of work.

#### **4.4 Lack of public relations emergency response measures**

In the Internet age, all kinds of information transmission channels and ways are diversified and real-time. In the process of operation, some enterprises will inevitably deal with some topics which are interesting to the competitor and the news media because of personnel changes, labor disputes, reasonable tax avoidance, etc. Once exposed, the enterprise has to struggle to deal with it. This not only has an impact on the marketing of enterprises, but also sets up obstacles in strategic development and other aspects. At the same time, due to these unplanned events, the established plans such as department collaboration and internal management will be disrupted.

### **5 Solutions**

The development of the Internet is beyond people's imagination and prediction, and it is an uncontrollable development state. Just as the "Effect of Sand" shows, enterprises cannot predict when they will run their own business and when the events that are not conducive to the enterprise will occur. As an enterprise, what it can do is to practice its skills, instead of replacing traditional management with the best management. The enterprise should transform the organizational structure, update the management system and optimize department functions with the ideas and methods of the Internet. In view of the above problems existing in the current enterprise management system, this paper proposes the following solutions.

#### **5.1 Improving the efficiency of system implementation**

When formulating the relevant enterprise management system, the rationality and operability of the system should be fully verified, so as to improve the cognition of the whole staff to the system, strengthen the staff's understanding and publicity of the system, and improve the staff's recognition of the system. The implementation of the system cannot focus on the form, but constantly improve the system in the development of enterprises, and make the system more in line with the development of enterprises and the needs of the times.

### **5.2 Improving the quality of management personnel**

The low quality of enterprise management personnel is an important factor which leading to the enterprise management system that cannot be effectively implemented. It's necessary to strengthen professional ethics education and job responsibility education for the management, and improve the awareness of dedication of the management staff. It can teach staff to highly understand the corporate culture and implement the system. In this way, the effect of the low quality of the management on the overall atmosphere of the enterprise can be avoided.

### **5.3 Establishing and improving incentive mechanism**

In the process of enterprise system setting, first of all, it is necessary to establish an incentive mechanism and set up a publicity group to publicize the incentive mechanism to every department, group and individual, so as to stimulate the enthusiasm of employees, improve their recognition of the mechanism and promote the effective implementation of the system. For the first time, enterprises should establish a corresponding incentive feedback mechanism according to the specific situation of the implementation of the incentive mechanism, so as to ensure that the system can be put into practice and achieve real results. Secondly, in the setting of incentive mechanism, multiple awards, such as safety award, full attendance award, performance award, innovation award, communication award, stability award and loyalty award, should be set according to the situation of each position and work, so that most employees can participate in the competition and activities.

### **5.4 Establishing and improving the supervision mechanism**

The supervision mechanism includes several functions: the first is to supervise the implementation of the system; the second is to collect market information; the third is to provide information data support for enterprise decision-making; the fourth is to control enterprise operating costs; the fifth is to supervise enterprise management violation (self-correction and repair function). In short, corporate supervisory departments should have even more comprehensive functions than the national development and reform commission, and should act as the "brain" of business operations.

### **5.5 Grasping the core of enterprise operation**

In the era of Internet +, to obtain opportunities for sustainable development, enterprises should not only integrate multiple development relationships, but also focus on refinement. At the same time, the enterprise should establish a unique corporate culture, so that employees can understand the long-term direction of the enterprise, understand its own tasks and goals, work hard on the stability and adaptability of the enterprise, and cultivate the self-innovation of the enterprise.

### **5.6 Improving internet operation capacity**

The Internet is personalized and subversive. Enterprises cannot participate in business activities without the Internet. In the era of Internet +, the Internet is no longer a platform, but an important tool for enterprise operation. The enterprise must have a professional maintenance and management of the Internet team, the team should coordinate the relations of various departments within the enterprise, play a good linkage role, and integrate the resources of the enterprise.

### **5.7 Improving the ability of public relations response**

Internet information transmission has the characteristics of fast speed and high participation. It seems that there is no place to hide for the enterprise internal information in the era of Internet +. Enterprises should not only establish and improve a set of internal information strategic confidentiality

and supervision and management system, but also set up an independent public relations department to deal with the negative information of enterprises, and strengthen the social publicity of enterprises. In an emergency, they can quickly and effectively make timely and effective response.

### **5.8 Respecting and recognizing the value of the individual**

Enterprise development must follow the "people-oriented" concept, respect and attach importance to personal value. For example, Steven Jobs is the spiritual leader of Apple, and whether Cook can become the next Jobs is yet to be proven. Especially in the era of Internet +, we must fully stimulate individual potential, respect and recognize individual value, and break the traditional management thinking mode. If an enterprise has a core, a department has a core, and a group has a core, the enterprise's core competitiveness of talents can be formed by the multi-point linkage.

## **6 Conclusion**

The era of Internet + is strange to every business operator, and there is not much successful experience to be copied for reference. In this era of rich imagination, enterprises are faced with more opportunities and challenges than ever before. What they can do is to practice basic skills and adapt to changes with times. The system is the support of the normal operation of an enterprise. A good system can boost the development of the enterprise, while an unreasonable system may lead the enterprise into failures. Business owners must break the traditional mode of thinking, using the Internet to integrate internal and external resources from a new view. Based on the principle of respect for personal value, business owners must use a strategic holistic view to grasp the opportunities derived from the Internet. We need to have the determination to make self-revolution, and interpret the enterprise value through innovation, creativity, integration, inclusiveness, symbiosis, co-prosperity and sharing.

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## Research on Operation Management of Video Websites in China

Lv Rui<sup>1</sup>, Ping Yue<sup>2</sup>

1 University Office, Wuhan University of Technology, Wuhan, P.R.China, 430070

2 School of Humanities, ZhiXing College of Hubei University, Wuhan, P.R.China, 430070

(E-mail: lvruui0401@126.com, pzy720@163.com)

**Abstract:** This paper takes operation management of Chinese video websites as the research object, using the literature review method, case analysis method and other research methods to analyze the operation and management mode and the dilemma of China's video website. It is believed that with the rapid development of the Internet, challenges and opportunities coexist in the video website development in China. From the aspects of diversified development strategy, strengthening media integration, and laying emphasis on re-investing in user market segmentation, the future development direction of Chinese video websites has been constructed, and the conclusion has been drawn that the development prospects of Chinese video websites are bound to be promising.

**Key words:** China; Video website; Operation; Management

### 1 Introduction

According to the "China Internet Network Development Status Report" released by China Internet Network Information Center (CNNIC) in August 2018, as of June 30, 2018, the number of Chinese netizens reached 802 million, with a penetration rate of 57.7%. With the popularity of the Internet, the Chinese Internet industry has developed rapidly and maintained a good momentum. Video websites have emerged with the rapid development of the Internet. Based on the learning, entertainment and sharing needs of people on the Internet, video content is produced, distributed, shared and disseminated, and profitable through advertising, user payment and branding strategies (Shi Shuli, Meng Zhe, 2016). Different from the increasingly mature video websites of Europe and the United States represented by the US video website YouTube, Chinese video website encounters both great opportunities for development and the impact of social networking platforms, new media convergence technologies, and copyright protection after the five stages of germination, exploration, stability, growth and transformation which the Chinese video website has undergone since the establishment of LeTV, the first video website in China in 2004. This paper starts with analyzing the current operation and management mode of Chinese video websites, and points out that China's video websites have the dilemma of single profit model, serious content homogenization and high operating cost. The focus of this paper is to make some explorations on how Chinese video websites face future development trends and how to develop emerging strategies. On literature review, research in China, retrieval of "video website" in China How Net, the search results show that there are more than 6500 relevant Chinese literatures, among them, more than 80 articles were analyzed from the perspective of video website operation. From the perspective of video website operation, the article mainly includes four aspects: research on content of video website, research on operating mode of video website, research on operational dilemma and countermeasure of video website, research on the development strategy of

video website from the perspective of new media integration. For example, in "the content characteristics and ways to survival of self-made programs on video website", Li Xiang summarized the reasons for the rise of self-made programs on video website and their performance, propose differentiated strategies for homemade programs on video website. In "the struggle and puzzlement of iQiyi: an analysis of the operating mode of Chinese video website", Wei Liu divides the operating mode of video websites into two kinds: UGC mode represented by You Tube and official mode represented by Hulu. In "The future development trend of video website in China", Lu Jianfeng forward that the future development of video websites is mainly driven by two aspects, one is to constantly innovate the profit model, the other is to continuously enhance brand influence. On research abroad in China, video websites abroad have been established earlier and developed faster, relevant literature mainly focuses on the origin, development process and development status of You Tube and HuLu two benchmarking websites, most of them focus on case studies, few studies have been done on the overall operation management of video websites.

## **2 Mode of Chinese Video Website Operation Management**

The video website operation management mode is mainly analyzed from the aspects of the source of the video content as the key carrier and the profit mode of the video website. The video content source determines the overall operation direction and development mode of the video website, and the profit model determines the influence and long-term strategy of the video website.

### **2.1 Main source of video content**

#### **2.1.1 User generated content (UGC)**

UGC, that is, user sharing content, means that the video content created by the user can be published and shared at any time in the video website, and other users can view, share, comment and collect on the platform. User sharing content is based on the needs of people's social interaction. It is also the most important source of content at the beginning of the video website. It is characterized by personalization, so that users can become the masters of the Internet. For example, the US video website You Tube is a typical representative of users sharing content (Qin Zongcai, Liu Li, 2016). The website slogan is "Broadcast Yourself", which fully demonstrates that the website provides people with an open self-display space, which can fully exert their self-creation. The Chinese video websites Youku and Tudou are also typical representatives of sharing content. Their slogan is "Everyone is the director of life". The website emphasizes the important position of original video content sharing, highlighting its originality and grassroots characteristics.

#### **2.1.2 Copyright purchase**

In the early days of the creation of Chinese video websites, a large amount of unauthorized video contents were uploaded to the video website, causing many disputes and lawsuits. With China's deepening of the rule of law, copyright protection has been raised to an important position. The State Administration of Press, Publication, Radio, Film and Television have issued a series of rules and regulations on copyright protection. Chinese video websites have begun to pay attention to copyright purchases, through the purchase of high-definition genuine TV dramas and movies and TV shows, a complete viewing experience was provided to users, and sticky audiences were gained by the video website. For example, the Hulu video website jointly invested by the three major broadcasters in the United States, namely, National Broadcasting Global, Fox, and ABC, has won the favor of users by purchasing a large number of high-quality genuine professional video content (Inc L.P, 2018). The



Chinese video website iQiyi takes "Yue enjoy quality" as its concept, and through the continuous capital investment, it will purchase high-definition genuine video content as an operation strategy, so that users could get a good viewing experience.

### 2.1.3 Homemade content

As the competition of video websites continues to intensify, users sharing content and copyright purchases have become the main way of video content sources of major video websites. In order to highlight the differences between video websites, professional technical teams have been hired to combine the characteristics of the websites with the needs of the audience to make homemade micro-video, TV series, movies, TV programs and other content. In recent years, the self-made content of Chinese video websites has presented the characteristics of continuous improvement of content quality even close to or exceeding professional standards. For example, Sohu Video has always used self-made boutique video content as a development strategy, and has invested a lot of money and resources for self-made content and Sohu produced channels are also set on the website. In recent years, self-made dramas such as "Dear, Princess Disease" and "swordsman Ritian" have been popular among users, and even the phenomenon of self-made dramas being sold back to traditional TV media has appeared.

**Table 1 User Size of China's Homemade Variety Show in 2017**

number	Variety Name	platform	Maximum monthly equipment coverage (ten thousand)
1	China has hip hop	iQiyi	10768.7
2	My sister is hungry	iQiyi	6110.7
3	Son of Tomorrow	Tencent Video	5578.4
4	Let's Talk	iQiyi	5533.1
5	Where is Dad going	Mango TV	5099

## 2.2 Profit model of video website

### 2.2.1 Advertisement income

Advertising revenue is the initial and most important source of profit for all video websites. As the application of video websites on the PC side and mobile clients continues to grow, the demand of users continues to increase, and advertisers' focus on advertising is transferred from traditional media to emerging media such as video websites. Video advertisements can be roughly divided into three types: patch ads, overlay ads, and implant ads. A patch advertisement is also called an in-video advertisement, which means that the advertisement content is mandatorily played in the front, middle or back when the user uses the video content, and the advertisement effect is directly related to the click rate of the video content. Coverage ads are the most basic form of advertising for video sites. They appear statically or dynamically at any location on the video site page. Coverage ads are not mandatory ads and usually do not affect the playback of the video and the clicks of the site content. Some ads can be manually closed. Implanted advertising is a new form of advertising, which has also been widely used in video websites. Advertisers indirectly incorporate the representative symbols and features of advertising products into

video content through title and implantation in video to make users to subtly accept advertisements for achieving marketing purposes.

### 2.2.2 User payment

In order to obtain a large number of audience and a high user click-through rate, Chinese video websites generally provide users with free video content, but with the development of market economy and fierce competition, Chinese video websites have gradually begun to charge users for providing high quality video content. In China, the shopping website has formed a relatively complete payment mode for member users. Member users can enjoy discounts and high-quality services after the payment. In the process of paying for video website, with the increasing awareness of copyright protection, users have changed the concept of free access to video resources, and gradually accept the form of watching video content by paying members fees (Bi Qiumin, Zeng Zhiyong, 2012). In 2010, Chinese video websites LeTV and Youku took the lead in providing member-paid services. Later, mainstream websites such as iQiyi and Sohu also launched membership payment services of which the initial results were not satisfactory, but with the change of users' concept, income from members' paying continues to grow.

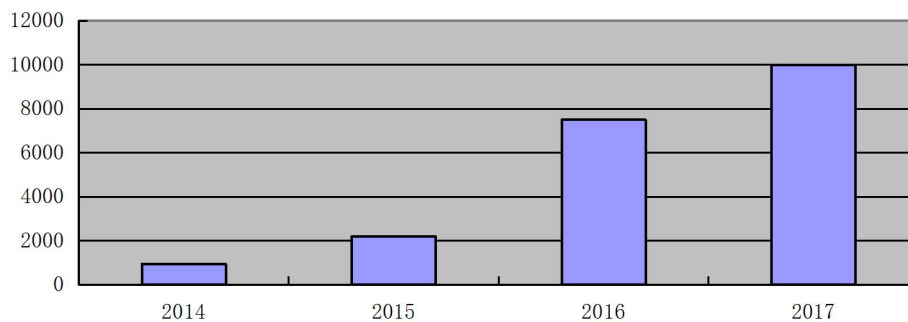


Figure 1 Scale of Video Payers in China from 2014 to 2017(ten thousand)

### 2.2.3 Branding strategy

The branding strategy is the highest value-added profit model for video websites, and it is also a sign that video websites are gradually maturing. Branding strategy means that video websites rely on the influence of their own brands to achieve profitability by building network platforms, copyright operations and operations, and capital operations for enterprise users. Strategies of conformity and alliance have been applied by China's video websites in succession for a better implement of the branding. Youku video and potato video have been merged into Youku Tudou in a way of 100% share swap. The three mainstream websites Iqiyi video, Tencent Video and Sohu Video have formed a strategic alliance and established "video content cooperation organization" to achieve resource interoperability and platform cooperation.

## 3 Operation Management Dilemma of Video Website in China

### 3.1 Single profit model

Although the video website has multiple profit models, the user payment and branding strategy is still in the exploratory stage. At this stage, the profit model of Chinese video websites is mainly based

on advertising revenue. Due to the single profit model, video websites rely too much on advertising revenue, which requires video content to win more users' click-through rate, attract users' attention and sell their attention to advertisers (Gou Shixiang, Wang Ling, 2010). In order to maximize profits, video websites take risks to use a lot of erotic videos that spoof click-through rates, and post video links for the purpose of spreading viruses, and low-key whispers, which is not conducive to the normal competition of video sites and social civilization.

### **3.2 High content homogenization**

Although each video website has different development strategies and focuses, under the China's video website environment and limited innovation, content homogenization is still very high, almost every video content resource can be found in multiple other videos. This also reduces the brand loyalty of the users'. Although video websites are constantly seeking differentiated competition under the strategy of self-made content and proprietary rights and the content homogenization has been improved, but working capital and investment are limited. All the video websites have adopted multiple forms of comprehensive development strategies so that the phenomenon of quality is inevitable.

### **3.3 High operating costs**

During the process of development of China's video websites, unremitting exploration of development strategies and approaches to be in line with the development of the industry and the development of its own needs has reversed the condition of being unable to make ends meet and start to achieve profitability, however, the more and more fierce market competition makes various video websites to seek differentiated development, and to put an constantly increasing investment in self-made content and copyright purchases, and to spend a lot of money to purchase a popular online drama which have made a rapid price expansion of the copyright. So that the increase proportion of copyright costs has led to an increase in operating costs. In addition, in order to ensure users to have high-definition, smooth and high-quality experience, video sites will continue to invest in technology updates.

### **3.4 The dysfunctional copyright protection system**

The Chinese video website has been facing the dilemma of copyright protection since its inception. A lot of manpower and material resources are required to deal with copyright disputes because of the problem of disputes and litigation cases which are caused by the copyright problem, so that the pace of development is stunted. The deep-seated reason for the copyright problem of video websites is the temptation of profit. Video website mainly relies on users to share content. In order to gain greater benefits, some video websites which are not disciplined enough have relaxed the review and check of the video content, which ultimately caused infringing behavior. With the continuous strengthening of China's efforts to crack down on piracy and the increasing legal awareness of the majority of Internet users, the copyright protection system of Chinese video websites has been gradually established, but the road is still very long, and it requires the participation of multiple subjects including legislation, justice, administration, and rights holders to gradually complete the copyright protection system.

## **4 Operation Management Development Direction of China's Video Website**

### **4.1 Expand the industrial chain and implement a diversified development strategy**

With the rapid development of the Internet, video websites solely rely on the video content resources of the website itself to make profits that are not in line with the needs of the times (Wang Ling, 2009). It is necessary to improve the market competitiveness by improving the industry chain. Through

cooperation with mobile terminal manufacturers, the hardware market is occupied to facilitate penetration into the home. By arranging the TV client and hardware facilities to occupy the user's living room, which is helpful to improvement of the user's viewing service and improvement of the advertising bargaining power and profitability. China's video websites must adhere to the road of sustainable development, implement a diversified development strategy. Through the wide-ranging use of applications such as 4G and even 5G networks and the popularization of APP software or many other various forms to expand market in various domain such as mobile phones, tablets, mobile internet technologies, mobile social platforms, etc. The special advantages of three-dimensional integrated marketing shall be given to full play, and the influence and potential advantages of high-quality content resources shall be constantly magnified, so that unexpected surprises would be created.

#### **4.2 Enhance media convergence and promote user experience**

Media convergence is the general trend of the development of new media, and the era of the continuous development of Internet technology. In the macro background of media convergence in the information age, Chinese video websites should make full use of digital technology to share big data technology among different media to realize video content resource sharing, optimize service content and improve product quality (Hao Weida, 2013). Through media integration, we could gradually explore the unique competitive advantage of our own brand. By relying on this high-quality user experience, we may finally get the promotion of brand's goodwill and user stickiness.

#### **4.3 Precise content delivery, focusing on user segmentation**

As Internet users are increasingly demanding service quality, Chinese video websites must take a differentiated path in order to differentiate themselves in the future market competition. Through the analyses of the market distribution pattern, customer needs and their own positioning, Chinese video website could make a precise localization, and highlight user's personalized needs. Each video website needs to focus on the user market segmentation. With the help of big data technology, video websites could collect and share user-related data in various ways, grasp the individual needs of different users, and tailor the video content according to the user's needs to improve user dependence.

### **5 Conclusion**

The last 15 years have witness Chinese video website's appearance in 2004, and it's transformation from weak to strong, from exploration to maturity. The future development of the Internet is changing and the future development of Chinese video websites would absolute not be a smooth sailing, especially under the impact of current social networking platform represented by the short video of the vibrato, and the live broadcast of Betta. But the video website is going to base on the unique video content resources, and take strong capital operations and social operations as shields to hold huge development opportunities against all the challenges. This paper starts with the operation management mode of Chinese video website, analyzes the video content source and profit model, and puts forward the dilemma of monopoly, homogenization and high operating cost which China's video website operation management has encountered. After the analysis of the dilemma, this paper focuses on pointing the future development direction of China's video website operation management, namely, expanding the industrial chain and implementing diversified development strategies; strengthening media integration and enhancing user experience; accurate content delivery, focusing on user market segmentation. The proposal of these viewpoints has certain reference significance for the future

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## Foreign Experience and Reference in Operation Supervision of Sharing Bike

Yang Jiaqing

School of Law, Humanities and Sociology, Wuhan University of Technology, Wuhan, P.R. China,  
430063(E-mail: 258601839@qq.com)

**Abstract:** The earliest bicycle in history appeared in France. The origin of bike-sharing is still in Europe. The "white bike project" in the Netherlands was the earliest form of bike-sharing. Nowadays, some foreign countries also attach great importance to the development of sharing bike, and regard sharing bike as an important way to optimize the public transport structure. This paper will make an analysis of the foreign experience of the operation and supervision of sharing bike, in order to provide some experience reference for improving the operation and supervision of sharing bike in China.

**Key words:** Sharing bike; Operation supervision; Experience; Reference

### 1 Introduction

The earliest bicycle in history appeared in France. In 1790, the French invented the wooden bicycle, which was the first bicycle in history (Wafic El-Assil, Mohamed Salah Mahmud, Khandker Nurul Habibi, 2017). After continuous improvement, a bicycle with modern transportation significance was gradually formed. The origin of bike-sharing is still in Europe. In 1960s, there was a "white bike project" in the Netherlands, where a group of young people put white-painted bicycles in public places for free use, which was the earliest form of bike-sharing. Up to now, some foreign countries also attach great importance to the development of sharing bike, and regard sharing bike as an important way to optimize the public transport structure (Philipp Aeschbach, Xiaojing Zhang, 2015). We can make an analysis of the foreign experience of the operation and supervision of sharing bike for providing some experience reference for improving the operation and supervision of sharing bike in China.

At present, the social problems caused by sharing bicycles have aroused the attention of the academic circles. Some scholars have proposed countermeasures and suggestions for standardizing the sharing of bicycle operations. Li Yanqing (Li Yanqing, 2018) believes that the standard shared bicycle operation needs to start from the following aspects: First, formulate clear administrative regulations to guide the scientific development of the shared bicycle economy; Second, enhance the legal operation awareness of shared bicycle operating enterprises; Third, enhance the public The legal literacy, the standard use of shared bicycles. Deng Daming and Li Zijian (Deng Daming and Li Zijian, 2017) put forward their own views on the supervision strategy of sharing bicycle deposits. They believe that to strengthen the supervision of shared bicycle deposits, first of all, it is necessary to clearly understand the legal nature of sharing bicycle deposits, and prevent the sharing of bicycle deposits from illegal fundraising or malicious circle. Second, to further clarify the supervision of the shared bicycle deposit, the clear department is responsible for the supervision of sharing the bicycle deposit; again, the introduction of third-party credit supervision agencies to prevent the risk of capital run; Finally, build a unified supervision platform to achieve shared bicycles The immediacy of financial data regulation. Wang

Guangrong (Wang Guangrong, 2017) believes that the key to solving the problem of shared bicycle operation lies in constructing a legal mechanism for cooperation between government and enterprises, strengthening the legal responsibilities of the government and enterprises in the process of sharing bicycle operations, and avoiding the mismanagement of shared bicycle operation supervision. Huang Yibo and Nie Ning (Huang Yibo and Nie Ning, 2017) believe that the biggest risk facing shared bicycle operation is capital risk, and the effective strategy for mitigating the risk of funds is to deposit the deposit of shared bicycles to a third party, and this third party should be a bank. Hong Ping, Zhang Xiaya, and Yu Shuaidong (Hong Ping, Zhang Xiaya, and Yu Shuaidong, 2018) believe that the strategy of strengthening the supervision of shared bicycle deposits can be started from the following aspects: first, the regulators and departments that clearly share the deposit of bicycles; second, the introduction of the deposit custody system; Determine the deposit of the interest rate; Fourth, the risk reserve is prorated. Fu Rui (Fu Rui, 2017) believes that the operation of standard shared bicycles needs to focus on solving the following two problems: first, to clearly share the responsibility of the bicycle during the cycling process; second, to clarify the legal responsibility of private possession of shared bicycles.

It can be seen from the previous literature review that the current academic circles have already carried out a richer discussion on the issues related to shared bicycles. The legal issues of sharing bicycle operations and the legal regulation measures have formed certain research results. These research results provide ideas, methods and theoretical guidance for the research of this paper. However, in these research results, there is a lack of comparative horizons, and there is no comparative analysis of the experience of developing bicycles abroad. Based on this, this paper intends to study the supervision experience of foreign shared bicycle operation, in order to seek breakthroughs and innovations in theoretical research.

## **2 Experience in Operation Supervision of Sharing Bike in Foreign Countries**

### **2.1 Experience in operation supervision of sharing bike in the Netherlands**

As early as 1890, the Netherlands began to build the world's first bicycle lane, which to some extent promoted the development of Dutch bike-sharing. Specifically, the experience of operating and supervising bike-sharing in the Netherlands mainly focuses on the following aspects.

The first is to set up special bicycle roads and penalize users who do not ride on special roads. The right of way of sharing bike is a major issue related to the operation of sharing bike. Without the right of way, the operation of Shared bikes can hardly be guaranteed. In order to ensure the operation of bike-sharing in the Netherlands, bicycle lanes are specially planned. Currently, the total length of bicycle roads has exceeded 35,000 kilometers, accounting for about 30% of the total length of roads in the Netherlands. Not only that, in the bicycle special road, the bicycle signpost is also specially painted and set up for each place between the interval distance, direction and other information. Thanks to this, users of sharing bike can enjoy certain convenient conditions during their riding (Pucher J, Buehler R E, 2012). At the same time, some warnings or fines will be given to cyclists who cross the bike lane, which actually regulate the cycling behavior of cyclists.

The second is to stipulate in the law that sharing bike has the relative preferential right to use the special roads for bicycles. In order to encourage residents to travel in a green way, the Netherlands clearly stipulates that sharing bike has the relative priority of the right to use special bicycle roads. When motor vehicles want to use or occupy bicycle roads for special reasons, they must try to avoid sharing bike and give priority to the travel of sharing bike.

The third is to give some tax breaks to users of sharing bike. Cyclists who often use sharing bike can get certain tax breaks or exemptions in the process of tax payment, as well as deposit reduction.

The fourth is to improve the construction of parking lots for sharing bike and set up a reward system for reporting illegal parking. Currently the number of sharing bike in the Netherlands is more than 17 million while the population of the Netherlands is only about 17 million. The number of sharing bike puts forward certain requirements on the parking lots, otherwise it will affect the public order. Therefore, the government actively supports the construction of bicycle parking lots. Dozens of large bicycle parking lots have been built all over the country. On this basis, a reward mechanism for illegal parking has been set up. Anyone who finds disorderly parking behavior can report it, and the informant can get corresponding rewards, which objectively avoids the problem of disorderly parking of sharing bike.

## **2.2 Experience in operation supervision of sharing bike in Japan**

Japan's land area is small and land resources are very scarce, so the development of public transport has become a key breakthrough to solve the problem of resource shortage. Therefore, sharing bike is also developing rapidly in Japan. In 2012, there were only 20,000 people using sharing bike in Japan, while in 2016, the number was nearly 2 million people. In order to regulate the operation of sharing bike, the Japanese government has also taken a series of measures.

The first is to introduce special bicycle management laws. As early as 1980, Japan promulgated the law on promoting the safe use of bicycles and the construction of bicycle parking lots, aiming at the social problems caused by improper bicycle parking (Greg Rybarczyk, Changshan Wu, 2010). In 1994, on the basis of revising this law, Japan promulgated the law on measures to promote the safe use of bicycles and comprehensively promote bicycle parking, focusing on solving the parking problems caused by bicycles. In 2012, Tokyo's Seitama City issued the first local bicycle management act in Japan -- "bicycle use charter", which mainly refines the regulations on traffic management of bicycle use, so as to minimize traffic accidents in the process of bicycle use. In 2017, Japan introduced a law to promote the use of bicycles, which clearly stipulates that bicycles are environmentally friendly means of transport. This has improved the legal status of bicycle traffic in Japan's traffic law, in which explicit provisions have been made on the parking, leasing, sharing and management of bicycles, which is the most important legal basis for the operation supervision and management of sharing bike.

The second is to define the regulatory bodies of sharing bike. In the law on promoting the use of bicycles in Japan, it is clearly stipulated that a bicycle promotion headquarters shall be set up under the Ministry of Land Infrastructure and Transport, which shall be responsible for the formulation and implementation of bicycle promotion plans to promote the development of bicycle sharing business. In addition, the bicycle promotion headquarters is also responsible for supervising the implementation of bicycle plans in various places, especially supervising the number of sharing bike and the development scale of sharing bike enterprises in various places, so as to avoid excessive growth of sharing bike. It can be seen from this that there are clear regulatory bodies for Japanese bike-sharing operations.

The third is to strengthen the supervision of parking behavior. Japan clearly stipulates that pedestrians have the absolute priority of the road, bicycles have the relative priority of the right to travel, and motor vehicles must avoid pedestrians and bicycles. However, while emphasizing the relative priority of bicycles, Japan's road traffic law strictly limits the abuse of the priority of bicycles, requiring bicycle users to abide by traffic rules and park their bicycles in designated parking lots. This actually creates good conditions for the operation of sharing bike, which not only encourages residents to use sharing bike, but also strictly requires residents to abide by traffic rules. Moreover, Japan also encourages bicycle companies to offer deposit reduction or break to users who comply with their parking obligations, which helps to cultivate good parking habits.



The fourth is to specify the obligation in the allocation of bicycle parking lot. Japan has made clear provisions on the obligations of local governments in the allocation and construction of bicycle parking lots (Elliot Fishman, Simon Washington, Narelle Haworth, 2014). Therefore, the Ministry of Land Infrastructure and Transport of Japan has issued the regulations on the obligation of allocation and construction of standard bicycle parking lots. It clearly stipulates the obligation of each building to provide bicycle parking lots and requires local governments to cooperate. Table 1 shows the regulations for the allocation of bicycle parking lots in Osaka. It can be seen from this that Japan clearly stipulated the main body of bicycle parking, which to some extent helped to solve the problem of disorderly parking of bicycles.

**Table 1 Standards for Construction of Bicycle Parking Lots in Osaka, Japan**

Facility	Facility size	Scale of bicycle parking lots
Amusement facilities, retail stores, convenience stores, catering stores, karaoke shops, etc.	over 300 square meters	One bike per 15 square meters
Sports facilities, government departments, etc.	over 400 square meters	One bike per 20 square meters
Banks, post offices, etc.	over 500 square meters	One bike per 25 square meters
Learning facilities, cinemas, theaters, hospitals, etc.	over 600 square meters	One bike per 30 square meters

### 2.3 Experience in operation supervision of sharing bike in France

Bicycle operation also started early in France. In 1974, the French city --- La Rochelle launched the "Yellow Bike" project, in which the government provided yellow bikes to citizens for free, so that citizens could use bicycles to travel. In 2007, Paris established the public bicycle rental system Velib, which has become a relatively successful operation case of bike-sharing project since its operation. Among the cyclists in Paris, one out of three rides a bicycle in the Velib system. The experience of bike-sharing operation in France mainly focuses on the following aspects:

The first is to strengthen the regulation of sharing bike. France attaches great importance to the planning and construction of exclusive bicycle roads. In Paris, bicycle lanes of more than 370 kilometers have been built, which cover most streets in downtown Paris. Like the Netherlands, France also attaches great importance to the regulation of bicycle traffic. For users who do not follow the transportation rules, France requires bicycle enterprises to cancel their bike rental qualification.

The second is to reasonably plan bike rental sites. France attaches great importance to the planning of bike rental sites as a breakthrough to promote the orderly operation of bike-sharing. Take Paris as an example, at present, there are more than 1400 bike rental sites in Paris. These bike rental sites are equipped with the Internet query system, so that Parisians can check the usage of bicycles at any rental site, which greatly improves the efficiency of bicycle operation.

The third is to strengthen the investigation of bicycle safety risks. French sharing bike also faces the problem of damage when operating, in order to solve this problem, the government cooperates with bicycle enterprise, paying funding dedicated to repair the damaged bike and irregularly checking on the security situation of traffic. Once finding that bike is not in conformity with the operating conditions,

enterprises will be punished, which can supervise bicycle enterprises to actively fulfill obligations to protect the safety of the bicycle.

#### **2.4 Experience in operation supervision of sharing bike in the UK**

With bike-sharing enterprises all over the country, the bike-sharing business in Britain is also relatively developed. The experience of UK bike-sharing operation mainly includes the following aspects:

The first is to play the role of tax in promoting the development of sharing bike. In order to promote the development of sharing bike, UK allows local finance to support the development of sharing bike. For example, after the Barclays bicycle plan was launched in London, London provided certain financial relief policies to the enterprises developing the public bicycle business, which to some extent stimulated the development of Britain's sharing bike. Relying on government tax breaks, some bike companies offer users a deposit reduction, which reduces the risk of deposit to some extent.

The second is to establish a perfect sharing bike rental system. In order to ensure the sustainable operation of sharing bike, Britain also attaches great importance to the construction of sharing bike rental system. For example, London established 24 hours car rental network system, and user can search the number of sharing bike and parking lot by touching the screen of the sharing bike rental points. Generally there will be the next rental point far from no more than 300 meters, and users can click the option on the touch screen for 15 minutes to find parking lot, which is convenient for users to find sharing bike and return the bike in time.

The third is to strictly limit the qualification of users. In the UK, bike-sharing fees are mainly charged by credit cards and debit cards, so users have to be at least 18 years old to be eligible to buy and rent the bikes, which avoids teenagers from using them at a younger age and reduces safety risks.

The fourth is to strengthen the safety supervision of sharing bike. Britain has a very strict management on the safety configuration of sharing bike, requiring bicycle enterprises to configure safety equipment as much as possible. For example, the London government requires sharing bike to be equipped with blaze lamp to ensure the safety of sharing bike at night.

#### **2.5 Experience in operation supervision of sharing bike in Australia**

In 2010, the first sharing bike operating system MBS appeared in Melbourne, Australia, which started the operation of sharing bike. The experience in the operation and supervision of sharing bike in Australia mainly focuses on the following aspects:

The first is the mandatory wearing of helmets for cyclists. Australia introduced mandatory helmet laws in the 1990s. Cyclists who do not wear helmets will be penalized. In November, 2010, the Victorian government began offering helmet rental services at some sites in an attempt to increase helmet usage. In 2013, the Victorian government further experimented with free helmet sharing, putting helmets on the handlebars of some sharing bikes. The mandatory wearing of helmets strengthens the safety awareness of cyclists on sharing bike, which is conducive to the personal safety of cyclists.

The second is to strengthen the management of sharing bike. The Australian government attaches great importance to the regulation of the operation of sharing bike. For example, the Australian government will issue a notice to the bicycle enterprises and require them to pay a certain amount of fines to get back the sharing bike if they park sharing bikes in the streets, parks and beaches at will. Sharing bikes that are not collected by operators in time will be destroyed or recycled. Through this measure, it urges bicycle enterprises to strengthen the management of sharing bike, so as to avoid the

adverse impact of sharing bike on social and public order.

The third is to strengthen the supervision of sharing bicycle deposit. The Victorian government requires bicycle companies to keep deposits in the exclusive accounts of financial institutions when collecting deposits from users. For users with good credit, bicycle enterprises are encouraged to exempt from deposit.

### **3 Reference of Operation and Supervision of Sharing Bike in Foreign Countries**

From the experience of the development of sharing bike in foreign countries, it can be seen that in order to promote the orderly supervision of sharing bike, some foreign countries have put forward corresponding laws and regulations, which provide a guarantee for the development and operation of sharing bike. From the experience of operation and supervision of sharing bike abroad, we can learn from it according to its national conditions to strengthen the supervision of sharing bike in China.

#### **3.1 Coordinating the interests of all parties and paying attention to the protection of users' security rights and interests**

From the above experience of bike-sharing operation, it can be seen that all countries pay more attention to the protection of the right of way for bicycles, which should be realized mainly in three ways: one is to pay attention to the construction of bicycle lanes in road planning. The Netherlands, France and the UK have all built their own roads for bicycles to ensure their passage. Not only that, but there are special signs on these exclusive roads to guide cyclists. The second one is to clarify the right of way for bicycles in the law. The Netherlands, Japan and other countries have clearly put forward the relative priority of bicycle traffic, which has been written into traffic laws and regulations. The priority of bicycle traffic is second only to pedestrians, which provides legal protection for the operation of sharing bike. The third one is to strengthen supervision over the safety of sharing bike. In Australia, bike-sharing riders must wear helmets, while in the UK, there is a strict age limit on users and a blaze light must be installed on bike-sharing services to ensure personal safety. The direct consequence of the above measures is to protect the safety rights and interests of users, which is a good coordination of the interests of users of sharing bike, bicycle enterprises and motor vehicle drivers.

#### **3.2 Defining regulatory bodies and implementing regulatory functions**

Government supervision is an important condition to ensure the orderly operation of sharing bike. Some foreign countries have introduced corresponding laws to strengthen the supervision of sharing bike, which also brings useful enlightenment to China's sharing bike. Australia and Japan attach great importance to the supervision of sharing bike. In particular, Japan has issued laws to make clear provisions on the supervision of sharing bike and set up bicycle promotion headquarters to endow them with the supervision function of sharing bike. At present, China's regulations on the regulatory bodies of sharing bike are not clear. For example, the description of "transportation and finance authorities" seems that both financial and transportation authorities have regulatory powers, but in fact, there is no regulatory authority that is actually implemented, let alone the sub-work and cooperation between regulatory bodies. Especially for the deposit supervision of sharing bike, the principle of "law without authorization is prohibited" is followed. The current sharing bike legal attribute is not clear, so the financial departments will not put the deposit into its regulation scope before obtaining legal authority. It leads sharing bike deposit in the current situation without supervision. The operation of sharing bike in foreign countries shows that it is necessary to further clarify the supervision department and implement its specific responsibilities, so as to construct an effective supervision system of sharing bike.

### 3.3 Paying attention to deposit risk prevention

Deposit risk is an inevitable problem in the operation process of sharing bike. Britain and Australia pay more attention to the prevention of deposit risk of sharing bike. For example, the British government encourages bike companies to reduce or break user's deposit through tax exemption policies to avoid disputes between users and bike companies due to deposit. Australia requires bicycle companies to bring the deposit of users into the supervision of financial institutions, and for users with good credit, the deposit can be exempted. These measures show that some foreign countries are aware of the risks brought by the security deposit of sharing bike, and must take effective measures to prevent the security deposit risk. Foreign experience shows us that as a product of the development of sharing economy, sharing bike must be attached importance for guarding against the risk of deposit in the operation process. On the one hand, we must strengthen the supervision of deposits, such as the supervision of user deposits by specialized financial institutions. On the other hand, by means of incentive, deposit reduction for users with good credit and replacement mechanism for deposit can also effectively prevent deposit risk.

## 4 Conclusion

As a new way of travel, sharing bike plays an important role in optimizing traffic structure, easing urban congestion, reducing travel costs and protecting urban environment. However, while bike-sharing is growing, it is also faced with a series of problems. One of the important reasons for these problems is the weak supervision on the operation of bike-sharing in China. Therefore, to solve the problems existing in the operation and supervision of sharing bike, we must start from multiple levels. While learning from the effective experience of foreign countries, according to China's national conditions, we can formulate corresponding regulatory measures to provide strong support for the benign development of this new business model.

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# Research on Optimal Path of Sports Variety Program Content Production Based on 4V Marketing Theory

Sun Jinrong, Hu Xuehui

Physical Education Department, Wuhan University of Technology, Wuhan, P.R.China, 430070

(E-mail: jinrongsun40@126.com, 741792443@qq.com)

**Abstract:** The sports variety program is an emerging products combination of sports industry and cultural entertainment industry. It can stand out from the competition of similar products and attract the attention of the public only by optimizing of content production in the context of content competition. Combined with the advantages and disadvantages of the current sports variety program in the production of content, this paper adopts the qualitative research method to construct the 4V marketing mix model of sports variety program based on the 4V marketing theory. In the meantime, the paper explores the optimal path of sports variety program in content production which is divided into four dimensions: the production of variation, the production of versatility, additional value production and the production of vibration.

**Keywords:** 4V Marketing theory; Sports variety program; Content production; Optimal path

## 1 Introduction

The appearance of sports variety program is not only a bold extension of sports competition performance industry's definition, but also a response to the audience's increasingly personalized and diversified viewing needs. In response to this development status, Li Qiumeng (2016) believes that the entry of sports elements into variety shows is an inevitable development trend from the perspective of mutual benefit and symbiosis between variety shows and sports industry. According to the development of sports variety in China, Yao Jing (2017) concluded that the imbalance of various elements is the main problem that causes discomfort to the audience. Research on content production has been launched, and Zhang Luyuan (2017) has made the following recommendations: 1. The establishment of the target theme should achieve the balance between mass groups and minority projects. 2. The design of concept should realize the balance of entertainment and sports elements. 3. Participants should achieve a balance between professionals and amateurs. Under the background of "content is king" market competition, the research of the specific path of content production optimization has a self-evident significance for the development of future sports variety program and even to the development of sports competition performance industry.

## 2 Sports Variety Program 4V Marketing Combination Mode

4V marketing theory is a new marketing mix proposed by professor Wu Jinming in 2001. It makes a comprehensive and thorough analysis of the advantages and disadvantages of the early 4P, 4C, 4R marketing mix and the historical limitations of its economic background. The 4P marketing mix is

obsessed with supply-side issues such as products, prices and channels, but lacks judgment and analysis of the demand side. The marketing mix of 4C and 4R focuses on the needs of customers starts from the demand side, but ignores the creation of product characteristics and core competitiveness. The 4V theory takes the maximization of the value of both supply and demand as the marketing concept and proposes a new marketing mix of variation, versatility, value, and vibration combined with the current era of economic form. It improves the deficiencies of the early marketing theory in the marketing combination mode from both sides of the demand side and the supply side, and provides a feasible new direction for the future development of sports variety.

In order to improve the effect of sports variety information dissemination, combined with 4V marketing theory, this study constructs a sports variety 4V marketing combination model, as shown in Figure 1.

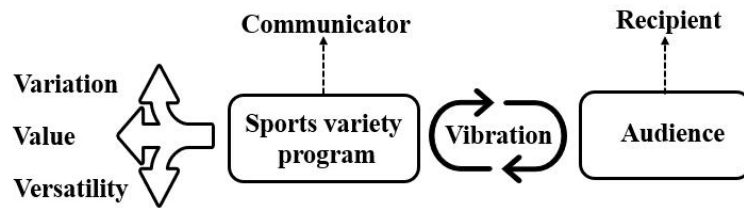


Figure 1 Sports Variety Program 4V Marketing Combination Mode

On the one hand, this model should improve the value of sports variety program content products through the production of variation, the production of versatility, additional value production from the supply side point of view. On the other hand, the audience can accept the value information of the product without error through the production of vibration.

### 3 Optimal Path of Sports Variety Program Content Production

According to the constructed 4V marketing mix model of sports variety program, the specific optimal path will be discussed from four dimensions taking content production as the starting point: variation, versatility, value, and vibration respectively.

#### 3.1 Enhance the product identification and build the core competitiveness of sports variety program

Variation production aims to cultivate the core competitiveness of sports variety in content and endues the audience with preference intention to watch sports variety through the way of "no one has the same as me, while others have the same as me". It is mainly completed from three aspects: market segmentation variation, content production variation and image production variation.

##### 3.1.1 Market segmentation variation

With the rapid development of information technology and the arrival of the all-media era, information dissemination has become a decentralized development trend. Previous content production which focuses on "big and complete" is hard to get reverberation. The seed of sports variety program is more suitable for burying the "market land" of "small and specialized" content production. The audiences of sports variety program are different from NBA, super league and other traditional head

sports IP, they are usually consisted of college students and young users who are used to using the network new media platform. From this point of view, targeting this niche market should use online media as the main channel, to establish the market positioning of sports variety program with the student and middle-income group as the main user groups.

### 3.1.2 Content production variation

There will be no shortage of product supply but only high-quality product supply will be lacked in the overcapacity market. The high-quality sports variety program products will have the following two points in the content production variation.

First of all, it is necessary to differentiate content production from non-sports variety shows. Conflict and suspense are two effective indicators to enhance storytelling and attract audiences. Through ingenious setting, it can effectively enhance the cohesiveness between programs and audiences and optimize communication effects. Therefore, the sports variety program must take advantage of its conflicting design and suspense setting to achieve the effect of the combination of real and variety through natural ways relying on its own conflicts to confront (conflict) and the unpredictability of the results (suspense). In general, the control of the setting of the big suspense is divided into a numbers of suspense composed of natural conflicts, which constitutes a chain structure of suspense-conflict-suspense.

Secondly, comparing with sports variety program of the same type, homogeneity should be avoided. Ahead of the Beijing Olympic Games, the provincial satellite TV launched a series of sports variety program which almost the same that shows no sincerity to the audiences. In contrast, "This Is Slam Dunk!" subverts the production modes of previous sports variety shows in content and form. It not only records a game with a long lens in complanation, but also shapes an emotional three-dimensional individual athlete and creates a three-dimensional passionate basketball culture scene, thus achieving differentiated production of content.

### 3.1.3 Image production variation

Eunjoo Cho et al. believe that image building for a product is an anthropomorphizing process. To achieve the goal of personalization, the products should be endowed with human emotions. Meanwhile, consumption behaviors of consumers also reflect their own images. That is, audiences prefer to watch programs that are conformed to their own images, or build their expected images in order to obtain social currency by watching programs with specific images. As mentioned above, the user portraits of sports variety program audiences is accustomed to used the network of new media. To build the image of sports variety program, we can make it by labeling the content production through analysis their diversified needs and the psychological characteristics of the pursuit of fashion culture combine with the characteristics of the sports program.

## **3.2 Provide flexible function supply to meet the needs of multi-user groups**

According to the use and gratification approach, different audiences can meet their different needs through the same media information. The essence of functional production is to provide different series production for users with different requirements.

### 3.2.1 Strengthen the core functions of sports variety program

With audience-based thinking, the audiences who watch sports variety program are roughly divided into two categories: sports enthusiasts and the potential sports fans on the Internet. To meet the needs of such a huge user groups, we should pay more attention on the core functions of sports variety program



by making sure every frame revealing sports symbols and presenting the expected sports programs to audiences with the most professional language and pictures. The core function of sports variety program lies in its professional content. It is worth emphasizing that the professionalism of sports should be put in the first place while sports and entertainment can not be separated. And only by strengthening the professional sports content production can we avoid the situation of putting the cart before the horse.

### 3.2.2 Expand the extension function of sports variety program

The core function of sports variety program is supported by the production of professional content, and the extended function will be made by the entertaining production. The partition wall will be set up between the programs and the audiences if we pursue professionalism and sportiness blindly. To put it strong, the sports variety program should expand the extended function through two channels based on not losing the features of sports competition, such as the opening of rules and the liberalization of competition system.

### 3.2.3 Explore the additional functions of sports variety program

The aesthetic paradigm of the masses has been distorted by the most traditional variety program which pursues to produce excessive entertainment content. The entertainment gradually becomes "fool" under the environment of the pursuit of entertainment production. And the additional functions of sports variety program are a correction of social aesthetics. As Terry Agleton said, "aesthetics is born as the language of the body". The audience will abandon their cognition of ugliness and flatter, reconstruct the healthy aesthetic paradigm by the production of sports variety program which shows the beauty of physical, sports and posture. It will also construct the aesthetic value of the organic combination of art and entertainment when audiences savour this ancient beauty comes from within the body.

## **3.3 Develop the additional value of products and create the best experience atmosphere for audiences**

The additional value production is to enhance the total value of sports variety program through technology addition, service addition and cultural brand addition.

### 3.3.1 Additional technology

The additional value of sports variety program can be enhanced by technical addition. It means to integrate high and new technologies organically into the content production through technical innovation. In the program, the high-speed movement and dynamic movements, the photographic capture of the bodies, the upload speed of information data, the clarity and synchronicity of the presented pictures will directly affect the experience value of audiences. The upcoming 5G era will provide a new network framework. The peak transmission speed will reach 10 Gbps. And the delay of milliseconds will mostly solve the pain points that VR, AR and other current technologies cannot be popularized in production. This will bring more development space for sports variety production in the future.

### 3.3.2 Additional services

According to the relational experience value model, service addition refers to the passive feelings of consumers on the external value of products. And the passive feelings of consumers cannot be known without external interference of products. Therefore, sports variety program needs to improve the content production in the following two aspects.

First of all, audiences can directly feel the external value of the program through exquisite program production, just like immersive scene setting. For example, the scene production of "Street Dance" chose a complete different approach from traditional recording scenes, such as a down-to-earth Shikumen Street in Shanghai, a metal arcade street in Guangzhou, a cyberpunk future street, and a Chinese-style Beijing street with red bricks, rubble and lanterns. With four streets of different styles, the exquisite scenes not only make the dancers show themselves more naturally and harmoniously, but also capture the audiences' vision instantly and immerses them in the cultural world of hip-hop.

Secondly, it is necessary to build a sensory feedback mechanism. Schramm believes that, it is necessary to bring in a "feedback mechanism" to change the "one-way uniqueness" into "two-way interaction" of the propagation path-in mass communication. The application of real-time comment technology satisfies the audiences' demand for deep interaction. It completes the transformation from the viewer to the experiencer and even to the participant. With getting this important feedback mechanism appropriately, the two-way interaction mechanism can be effectively established and the services will be more humanized by adjusting the next content production timely according to the real feeling from the feedback of audiences.

### 3.3.3 Additional culture and branding

The addition of culture and brand is to build recessive superstructure on the basis of a good economic product. It means to enhance the symbolic value of products by the symbolization of content production. The symbolic meaning of symbols will continuously convey certain information to the public, which will persist in consumers' mind and influence their consumption preferences. For example, in "Street Dance", the towel has transformed to be a promotion symbol in both personal and team dance competitions. It constructs the symbolic connection between street dance and the towel. Follow this rule, producers have to find out innovation and memory points, then repeat them through camera language. And it is necessary to strengthen the audiences' memory points, by taking the initiative to set discussion topics in mass communication and giving play to the important role of network opinion leaders like famous bloggers, so that it can successfully add cultural brand value to the program.

## 3.4 Establish deep emotional identity and cultivate audiences loyalty

From the perspective of the correlation between consumers and the consumption environment, resonance refers to the intrinsic value actively generated by audiences when they watch sports variety program. The audiences' intrinsic value can be maximized while the loyalty to the program can be cultivated through benefit resonance, demand resonance and emotional resonance.

### 3.4.1 Resonance of benefits

From the perspective of benefits, it is generally divided into two aspects: economic benefits and social benefits. Economic benefit can be seen as the return on investment ratio of audiences, that is, the ratio between the time consumed by watching sports variety program and the value obtained. In the early stage of program broadcast, the acquisition of experience value can be enhanced from variation, versatility, and value production. But, in the middle and later stages of program broadcast, the audiences' experience value will be continuously influenced by the program's reputation due to the existence of the long tail effect. And the excessive consumption of a single symbol will greatly affect the resonance of economic benefits. For example, the literary IP of "Tomb Notes" has been repeatedly used by different teams in a short period of time, and the audiences' experience value is neglected in pursuit of short-term benefits. Therefore, to achieve an organic unity of economic benefits, producers have to find a balance between short-term benefits and long-term word-of-mouth. This is called resonance of benefits.

In the terms of social benefits, sports variety program is a new way to export culture to the new generation of Internet users. It has to assume the responsibility of strengthening the culture power of motherland and send positive messages to the masses by the superior content production of sports variety program. As a sports culture brand of the new generation, although it cannot achieve the massive cultural output of NBA. But in some way, it can also shoulder the responsibility of sports culture output and build up the cultural self-confidence of the new era with its flexible content production.

#### 3.4.2 Resonance of demand

Consumers are utility maximizers, and demand resonance is actually a kind of expected value and satisfaction of consumers in pursuit of "demand satisfaction". To satisfy the resonance of demand, it is necessary to consider the content production of sports variety based on audiences. In order to achieve the popularization of sports culture from the content production, producers have to consider the audience's understanding of sports culture. From the perspective of narratology, the sports variety program should make a omnipotent narrative of the event from the perspective of God by adopting a method named zero-focus. For example, in order to make sure audiences can watch the program smoothly without barriers, "Street Dance" shows audiences the technical names of every dance movement by posting production with subtitles. This not only propagandises the sports culture, but also achieves the resonance of demands between the sports variety program and audiences.

#### 3.4.3 Resonance of emotion

Although the sports variety program takes the route of "small and specialized" content production, but it should strive to start from "wide and complete" in terms of emotional resonance. Arnold Van Gennep, a famous German anthropologist, believes that television media should construct a collective memory ceremony by the advantages of centralized communication. Because ritual sense can reflect people's inner needs and reflect the image of cultural precipitation. As an indispensable component of human civilization since its birth, sports are common memories of hundreds of millions of people. In terms of the potential volume of emotional resonance, sports are even bigger than Chinese literature. Therefore, sports variety program should transform from elitism to grass-roots and become secularization in terms of content production in order to effectively achieve the public emotional resonance.

## 4 Conclusion

This paper puts forward suggestions for the content production of sports variety program guided by 4V marketing theory. In the terms of variation production, firstly, to meet the personalized needs of the sports variety program audiences through the small and specialized market segmentation differentiation production. Secondly, to build the core competitiveness of sports variety program through the advantages of natural conflicts and suspense setting. At last, to establish a positive energy image of sports culture with higher recognition through the production of image differentiation. In terms of versatility production, the first is to provide elastic function supply for different user groups through professional core and entertainment extension function production. And the second is to correct the distorted aesthetic paradigm of the public to some extent through excavation and cultivation of additional functions. In the terms of value-added production, it is necessary to enhance the invisible added value of the sports variety program through the addition of high-tech such as AR and VR, the addition of hardware services like the refinement of the scene and the addition of software services like two-way interactive mechanism. And to provide sports variety products with higher value of symbols by producing symbolized content for establishing brand effect. In the production of vibration, the first thing is to achieve the resonance of the benefits through getting the balance between short-term benefits and

long-term word-of-mouth. Secondly, to achieve the demand resonance by spreading minority sports culture in a popular way. At last, to arouse the public's "wide and complete" emotional resonance by setting the memory of the ceremony, so that it can achieve the maximization of the utility of sports variety program and audiences.

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# Research on the Driving Factors of Customer Loyalty: Regarding iPhone as An Example

Deng Gang

School of E-Commerce, Wuhan Technology and Business University, Wuhan, P. R. China, 430065

(E-mail: 363070212@qq.com)

**Abstract:** Research indicates that loyal customers not only reject the marketing information of competitors, but also develop new customers for the enterprises. Many enterprises have realized the important role of customer loyalty, but most of them have a partial understanding about it, and fail to know how to maintain and improve customer loyalty. Through the research of relevant literature, the driving factors of customer loyalty are sorted out in this paper. Then, it regards the marketing practice of iPhone as an example to make analysis, so as to put forward the effective ways to cultivate customer loyalty in the marketing process of enterprises, and helps the enterprises to establish competitive advantages.

**Key words:** Customer loyalty; Driving factors; Cultivating method; iPhone

## 1 Introduction

In the current internet economy environment, it is increasingly difficult to retain customers for it is more convenient for them to make a wide choice. Enterprises should not only to strive for new customers, explore new market, but also retain existing customers, ensure their loyalty and stabilize market share. As to the concept of customer loyalty, it has been spotted widely since it has been proposed. A large number of studies have proved that the customer loyalty is closely related with enterprise performance, and it is undoubtedly an intangible asset of an enterprise. However, people still do not make an agreement on the its driving factors and mechanism.

Apple is a high-tech enterprise whose core business is making electronic products. CEO Steve Jobs announced the launch of iPhone at Macworld on January 9, 2007. Despite its high price, the iPhone has been embraced by millions of apple fans since its launch. According to the latest data released by authoritative research institution Counterpoint, in 2018, the top 3 share of high-end phones in the world are iPhone, which accounts for 51%; Samsung, which accounts for 22% and Huawei, which accounts for 10%. According to the results of the survey of smart phone customer loyalty commissioned by the Wall Street Journal, iPhone's customer loyalty is as high as 78%, and Samsung's customer loyalty is 58%, which ranks in the second place. There is no doubt that Apple has been successful in fostering customer loyalty.

Currently, it is widely recognized that customer loyalty refers to a repeated purchase behavior accompanied by a higher attitude tendency (Dick & Basu, 1994). As one of the earliest recognized drivers, customer satisfaction has not achieved good results with extensive practice in the industry. An integrated study shows that satisfaction mainly affect attitude loyalty while its influence on behavior loyalty is not stable (Fan Xiucheng et al., 2009). Some people propose that compared with customer satisfaction, it is easier for customer happiness to drive customer loyalty. There are three points of view created in the follow-up researches: customer happiness has a significant impact on customer satisfaction; customer happiness does not have a significant impact on customer loyalty; the relationship

between customer loyalty and happiness is influenced by moderating variables (Zhang Yuexian et al., 2013). Perceived value is considered crucial for customer repurchase intention (Blackwell, 1999). Research proves that customer engagement in value creation could considerably promote perceived value (Wang Jiuhe & Liu Lin, 2017). The influence of experience, based on customer perception, on customer loyalty is also verified (Li Huaming & Li Rong, 2013). A higher switching cost can lock customers. However, it can also bring a negative effect (Thomas O Jones, 1995). Trust is considered as an influential factor, which can lead to positive relationships, including forming the customer loyalty (Morgan & Hunt, 1994). Enterprise image determines consumer behavior, especially customer loyalty (Andreassen & Lindestad, 1998). In addition, researchers also proposed that customer loyalty is affected by contextual factors such as oriental culture (Hennig Thureau et al., 2000), similarity of value (Morgan & Hunt, 1994), competition degree (Ma Baolong et al., 2007). To sum up, there are many drivers of customer loyalty and some of them are overlapped. Based on the factors we have discussed above, scholars have made a combination and put forward many models, but still there is no agreement has been made on the mechanism of customer loyalty.

Based on the literature reviews and case studies at home and abroad, this paper tries to make a further discussion on the driving factors and its function so that it can provide available references to enterprise that they can take effective measurement to cultivate customer loyalty.

## **2 Construction of Driving Factors**

The behavioral reflection of customer loyalty is repeated purchases. Studying previous researches, the driving factors of customer loyalty should consist of customer satisfaction, customer value and conversion cost, etc. Therefore, it is important to clarify the driving factors of customer loyalty for it is the premise to explore an effective way to retain customers and maintain their repeated purchase.

### **2.1 Customer satisfaction**

Customer satisfaction is the first to be considered as the driving factor of customer loyalty. It refers to a state of pleasure or disappointment that occurs when compared the perceived value of a product or service with its expectation. Researches indicate that customer satisfaction is a demanding factor of customer purchase, word-of-mouth effect and customer loyalty (Reichheld & Sasser, 1990). With customer satisfaction, renewed purchasing behaviors will occur. Repeated purchases and satisfaction, then, generate loyalty. Therefore, it is the premise to ensure that its products and services can satisfy or even exceed customers' expectation.

### **2.2 Customer value**

Most scholars agree that customer value is customer perceived value, whose core is the weigh between perceived gain and loss. Perceived value plays a decisive role in customers' repurchase intention. And the situational factors can affect customer loyalty directly and indirectly. It could act on the composition of perceived value (Blackwell, 1999).

Customer satisfaction is to enable customers to enter the selection of products, but it cannot guarantee that the customers will continue to purchase. The relationship between customers and enterprises is the exchange of benefits and values on earth, and what the customers are loyal to be the excellent value provided by the enterprise not a particular enterprise. And what customers want is also the product value that can meet their own needs, so excellent value is the key to customer loyalty. It is the most important driver of customer loyalty. However, this does not mean that customer value can

affect customer loyalty alone.

### **2.3 Customer trust**

Customer trust refers to the identification and trust of consumers on the products or services of a certain enterprise or brand, which is the result of continuous strengthening of customer satisfaction.

Studies indicate that trust is the basis of loyalty, and there exists a certain correlation between customer trust and customer loyalty. It is believed that trust should work in a mutual way (customers and enterprises). Loyalty originates from trust, which in turn strengthens customer loyalty. It is manifested in a more positive word-of-mouth publicity, a more consumption behavior, and a stronger dependence, etc. (Dick & Basu, 1994). The empirical study conducted by Han Xiaoyun and Wang Chunxiao on the service industry has found that customer trust plays a significant impact on customer loyalty in all dimensions directly or indirectly (Han Xiaoyun & Wang Chunxiao, 2003). Only through continuously providing stable quality products and services can enterprises develop a sense of trust.

It can be seen that customer trust is the result of the continuous strengthening of customer satisfaction, and the sublimation of customer trust produces customer loyalty, trust is the foundation of customer loyalty.

### **2.4 Conversion cost**

When consumers are faced with the purchase decision, the cost of switching from one product or service provider to another is called conversion cost. Such cost includes currency cost, psychological cost and time cost incurred by switching providers. Generally speaking, the conversion cost of service is higher than that of product in general. It is believed that conversion cost is conducive to maintain the relationship between enterprises and customers for it could prevent customers from leaving the enterprise service (Anderson & Ponnarolu, 2002).

In order to avoid the psychological and emotional pressure caused by transferring new service providers and the risks and uncertainties brought by this foundation, consumers try to maintain the existing relationship, even if they are not very satisfied with the existing relationship. It can be concluded from the above that there exists a negative correlation between conversion cost and customer value and customer satisfaction; while conversion cost and customer loyalty exist positive correlation.

### **2.5 Other factors**

In addition to the above factors, social norms also influence customer loyalty. Social norms limit people's value orientation and impose an opinion on the judgments of the products, which directly influence people's choices. Researches show that enterprise image has a great influence on customer behaviors, customer loyalty in particular (Andreassen & Lindestad, 1998). And advertisements make a great contribution to build, keep and strengthen brand loyalty. In addition, customer loyalty is also influenced by lifestyle and situational factors.

## **3 Case Study of iPhone**

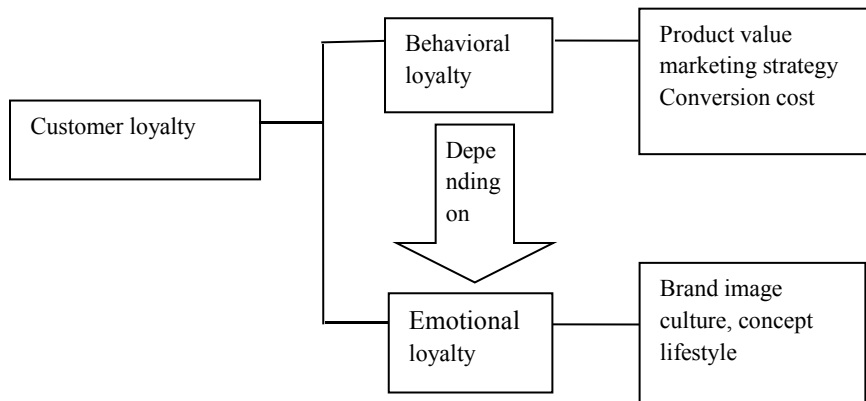
### **3.1 Customer loyalty model of iPhone**

A true customer loyalty is an internal unity of behavioral loyalty and emotional loyalty. The emotional loyalty is the fundamental factor, while the behavioral loyalty is the result of customer loyalty.

From the analysis of driving factors, behavioral loyalty comes from customer value, namely product strategy, marketing strategy and product conversion cost, etc. emotional loyalty comes from the image of an enterprise or brand, culture, values and lifestyle, etc.

From the way of cultivating customer loyalty, customer value is the premise and basis to promote the purchase and retention when the value provided by products or services meets or exceeds the expectation of customers, customer satisfaction will be generated. Repeated customer satisfaction will develop customer trust to the enterprise or brand, and then the customer trust will produce customer loyalty. Conversion cost does not bring true loyalty, it can drive behavioral loyalty. Social culture, norms, ads and lifestyle could have a moderating effect on customer value, satisfaction and trust.

iPhone creates the maximum customer value for consumers through continuous innovation, and effectively delivers customer value through advertising, experience store and other marketing means, so as to generate high satisfaction and trust and stimulate customer loyalty. While applications based on closed iOS and various technology patents may cost a lot, its unique apple culture can help customers form their value, lead a new lifestyle, and shape their attitude loyalty. Therefore, through the inductive analysis, we build the customer loyalty model of iPhone (Figure 1).



**Figure 1 Customer Loyalty Model of iPhone**

Based on this, this paper elaborates on the driving factors and cultivating methods of iPhone customer loyalty.

### 3.2 An analysis on the way of cultivating customer loyalty

#### 3.2.1 Creating excellent value to win customer trust

Customer value is the basis and premise of customer loyalty, and the functions and benefits of products are the core elements of customer value. It possesses three characteristics, the first is that software runs fast and web browsing is very easy. The second is the closed iOS operating system, which is stable. Because of the closed environment, all apps have to be strictly reviewed by apple before they can be downloaded into apple store, which ensures the unified user experiences and the product quality of apple mobile phones. The third is that it could enables apple's entertainment function to be quite powerful. All these allow the iPhone to meet customers' needs while far exceeding their expectations. Meanwhile, apple together with downstream channel operators, has set up apple experience stores to greatly deliver customer value. The experience store helps customers to fully understand the product functions and benefits before purchase, so as to reduce the risk. In the process of experience, customers



can also put forward suggestions and opinions to the staff. It cannot only win the customers' trust, but also can collect valuable ideas for product innovation in this way.

iPhone is unique in product function, appearance design and packaging, aiming to create value for customers in all aspects. Many consumers are impressed by the powerful functions and pleasant use experience of iPhone after using it, so they build a high level of trust in it and continue to make repeated purchases.

### 3.2.2 Establishing brand culture, shaping attitude loyalty

Based on its spirit of "bold innovation and dare to take risks", iPhone has created a unique brand image of apple, which makes the consumers produce a strong sense of attachment to it. Firstly, iPhone creates the skeleton of apple brand by virtue of its powerful function, outstanding performance, fashionable appearance and packaging, which is fashionable, high-end and superior. Secondly, the legendary life experience and unique personal charm of Jobs has given the apple brand spiritual connotation. Finally, the marketing skills and user experience of Apple Inc have left a deep impression on customers and cultivated more and more "apple fans". In the 2018 Brand Z 100 global brand value ranking released in London, UK, apple ranked the second with a brand value of more than 300 billion dollars.

### 3.2.3 Improving conversion costs, capturing behavioral loyalty

Apple has developed a closed iOS operating system and various innovative applications for the iPhone, which makes it powerful, stable and smooth. When the consumers become proficient in applications and get accustomed to them after experiencing learning and exploration, it will produce conversion cost compared with the using of android phones. Consumers need to spend time and energy to overcome their old habits to adapt to new systems and functions, but they cannot get better user experiences at the same time. Many customers have returned to iPhone after trying to switch to android phones.

In addition, iPhone attaches great importance to customer privacy protection, it provides customers with security protection that is far beyond android phones, which significantly reduces the risk of customers from being attacked by hackers and subjected to fraud. A classic example happened in 2016, Apple refused to help the Federal Bureau of Investigation (FBI) open the iPhone of a terror suspect to obtain the information it needs in order to protect customer privacy. The closed mobile phone system and strict privacy and security protection system increase the conversion cost of customers, and capture their behavioral loyalty.

## **4 Research Inspiration**

High customer loyalty is a magic weapon for enterprises to win the competition. Based on the summary of previous studies and the analysis of customer loyalty of apple mobile phone, the following ways of cultivating customer loyalty can be obtained in this paper:

### **4.1 Constantly creating customer value to win customer loyalty**

Customer value is the basis and premise for consumers to purchase products or services. In the information age, through powerful e-commerce system, enterprises can build customer database, implement scientific customer relationship management, timely update customer related information, discover customer demand changes, and constantly increase product added value. The composition of

customer value is diversified. Enterprises can enhance customer value through improving product value, service value, personnel value and image value. Only through understanding and striving to exceed customer expectations, improving customer satisfaction and consolidating customer trust can ultimately win the customer loyalty.

#### **4.2 Increasing conversion cost, retaining customer loyalty**

As the research and practice results have indicated, increasing the conversion cost is an effective way to retain customers and improve customer loyalty. The enterprises should try to increase the difficulties and costs of customer conversion through some ways and means so as to retain customers. Firstly, the enterprises can create irreplaceable products through patent threshold, non-standardized products and services or closed setting and so on. Secondly, the enterprises can increase the customers' dependence on enterprises through cultivating their consumption habits of products, so as to improve customer loyalty. Finally, the enterprises can implement customized marketing strategies to bind consumers with emotional bonds through one-to-one service, so as to increase conversion costs and improve customer loyalty.

#### **4.3 Establishing brand image, enhancing customer loyalty**

Simply speaking, store impression and brand image refers to the customers' overall perception and evaluation of the brand and enterprise. Only when customers have a good impression of the brand will they continue to buy repeatedly. Enterprises can leave positive attitudes and preferences to customers through store layout, advertising, a series of marketing strategies, user experience and participation in public utility activities, and enhance customer loyalty through direct or indirect methods.

#### **4.4 Improving customer engagement to improve customer loyalty**

User experience is the most direct way for customers to understand product attributes, and also the fastest way to gain favorable impression on enterprise products or services. Therefore, in order to obtain customer satisfaction, it is necessary to strengthen user experiences, enable customers to participate in the process of experience, collect customers' suggestions in the process of experience, and gradually improve the quality of enterprise products and services. In addition, through customer participation, integrating the emotion of enterprise and customer, enhancing emotional investment, strengthening customer dependence on the enterprise, so that, the customer loyalty can be improved.

## **5 Conclusion**

From the perspective of the driving factors of customer loyalty, customer value is the premise and basis to promote the purchase and retention of consumers. When the value provided by products or services meets or exceeds the expectation of customers, customer satisfaction will be generated. Continuously Repeated customer satisfaction will establish customer trust to the enterprise or brand, and customer trust drives the generation of customer loyalty. Conversion cost cannot bring true loyalty, but it can drive behavioral loyalty of customers. Social culture and norms, advertising and demographic characteristics possess moderating effects on customer value, customer satisfaction and customer trust.

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## Campus Skill Exchange APP in Smart Campus Environment

Nie Zutian

School of Computer Science, University of Melbourne, Melbourne, Australia, VIC 3000

(E-mail: 360283838@qq.com)

**Abstract:** Social APPs is now the most popular trend in APP market. In 2017, two social APPs, WeChat and QQ, have ranked the top 2 APPs in China. However, developing new types of social APPs is imperative, as the social APP market has become saturated. The literature used in this paper mainly focus on the key functions of this social APP, the typical steps to realize the key technologies of this social APP and the user analysis of their requirements. The method to build a complete mobile APP with efficiency and extensibility by constructing back-end platform and front-end application. This APP creates a brand-new way for college students of making friends and learning skills. The final goal is to use method above to propose an "online learning, offline learning" companion learning platform, which is used to teach a certain skill to others or help oneself learn a new skill. This paper will describe the system structure and structure of the campus skill exchange APP, the steps of system design are described and the key design technology of the system in detail.

**key words:** Smart campus; University; Hobby; Skill exchange APP

### 1 Introduction

According to a report conducted by Quest Mobile, in 2017, the user scale of mobile social industry was close to that of mobile netizens, with a penetration rate of 92.9% in China. Mobile netizens mainly focus on building mobile social network, among which the 'stranger social pattern' has been playing a very important role over the world since 5 years ago, especially in U.S. The fierce competition of social apps in the United States has never stopped. No matter Facebook, Instagram or Twitter, they are always in a competitive state. Now there are numerous niche and vertical social apps emerging. Compared with China, American social platforms are more decentralized and tend to be more decentralized. As Facebook's relationship chain ages, American users are turning to a new platform. In the past two years, DAU of Instagram and WhatsApp has been growing rapidly and penetrating deeper into the market. These differentiated social products are gradually spreading the social traffic of the market. With focusing on the stranger social pattern that are similar to Instagram, this campus skill exchange APP develops an "online understanding, offline learning" buddy learning platform. Smart campus environment facilitates students to improve one skill or learn a new skill. This software takes Android phone as the carrier, takes Python as the development language, uses MySQL database and Retrofit network development framework, and the integration development tool is currently very popular Android Studio (Zhang Zhihua, 2016). The target audience is mainly college students with a large number of potential users. Simple interface, clear function. The user through the phone software online know their own needs to learn the skills of the students, and exchange skills: you can install handheld have android application of this system software includes mobile phones, through login into their own user interface, can undertake the corresponding with other users access to information to send, such as register their own interests and hobbies, browse other user operations such as the rise of the hobby. This

paper discusses the user demand, the system design and key technologies of the campus skill exchange system.

## **2 User Demand and UI Design of Campus Skill Exchange System V1.0**

In terms of the design of APP user requirements, it is mainly divided into two parts: skill exchange and traveling together:

First, skill exchange: exchange skills and get what you need. It's good for trading your skills for someone else's.

Second, go hand in hand with the same goal. Suitable for learning new skills (Wu Minrui, 2019).

APP function modules are mainly divided into three modules: home page, personal information card and list.

### **2.1 Homepage design of campus skill exchange system V1.0**

According to users' search skills to find matching person to push, push the user required skills related BBS and posts (Huo Liya, 2018), the client use the layout of the card clearly intuitive display of information, at the same time call GestureDector API to implement the left slide switch, right slide like the function of the collection, right like collections are added to the same favorites eventually convenient access. At the same time, you can modify your personal information and store it in the database. When the user swipes a finger to the left on the phone screen, GectureDector's API is executed in the background, and the card creates an animation that is skipped by a left swipe. At this point the background does not execute any instructions and jumps to the next card. The user swipes his or her finger to the left on the screen of the phone. GectureDector's API is executed in the background, and the card is animated to his or her liking. At this point, the background stores the data of this card into the "list" associated with the user and jumps to the next card (Pan Chengfeng ,2017).

### **2.2 Campus skill exchange system V1.0 -- personal information card**

According to the investigation, the core information needed is: name, school, skill exchange time and specialty. Later, real name authentication will be carried out when filling in "name" and "school", so as to connect with the educational administration system of the school and ensure the authenticity of the user group. The "ideal time for skill exchange" was set up to fully consider the possibility of coordination among college students in their spare time. In addition, it also provides multiple "specialties" for filling in, so that more talented people can show themselves, enriching user experience. Then, the form is determined and the database is built to ensure the interaction between the data.

### **2.3 List of campus skill exchange system V1.0**

Including their own collection of lists as well as their matching list



**Figure 1 List**

The list is presented in a form similar to "long picture", showing all other users that the user right-slides through. The user swipes up and down to view the list (Zhu Chunhua, Zhang Yizhi, 2017).

We set up our background on the server to provide client data and facilitate real-time monitoring of client data and timely update of data to ensure the availability of users. For example, the client is interested in a message, and likes to collect, the client will send like to request to the server, the server after the receipt of a request will be like in the database to find whether also sent like requests, if the two love each other, each other displayed a pair, both the client or know each other like collection.

### **3 System Design Steps of Campus Skill Exchange System V1.0**

#### **3.1 Data collection of campus skill exchange system V1.0**

Mainly through questionnaire survey, the information required by the App is preliminarily determined as name, age, school, grade, skill calling ideal time, specialty and intention skill. Finally, based on the situation and development of the whole project, the core information of the App is determined as follows: 1. Name; 2. School; 3.

#### **3.2 Database building of campus skill exchange system V1.0**

After the core information is determined, the corresponding form is established, and the SQL syntax is deeply studied. I am proficient in using DML instructions such as select, insert, delete, update, as well as important DDL statements such as create, alter, drop and so on to perform relevant operations on database data. Meanwhile, transplant the built environment to the client platform and background, and learn to use SQLite (Lu ping, Hu Yang, 2019).

SQLite: is an in-process library that implements a self-contained, serverless, zero-configuration, transactional SQL database engine. It is a zero-configuration database, which means that, like any other database, you do not need to configure it in the system. Like other databases, the SQLite engine is not a standalone process and can be connected either statically or dynamically as required by the application. SQLite accesses its storage file directly. Advantages: learning Java and python systematically in the background setup process. Because it supports both process-oriented functional programming and object-oriented abstract programming, and has extensibility and embeddability, it finally chooses python to set up the background service. Also learn about network transport protocols, Http and Https, and RESTful architectures, and write apis that are more usable.

### **3.3 Client development of campus skill exchange system V1.0**

Learn how to use Android Studio to develop applications and SQLite to interact with data. Use XML to write UI interface, and use Java to achieve interface visualization. After the background was successfully built and the main interface UX was confirmed, we learned to use Retrofit network framework and background to complete network communication, and GestureDetector API to complete left sliding switch and right sliding core functions of favorite favorites. When you're almost done, use gradle to sign the entire application.

### **3.4 Post-optimization of campus skill exchange system V1.0**

#### **3.4.1 background optimization**

Improve data, improve data security at the same time, change the protocol from HTTP to HTTPS. Monitor client data and timely improve the frozen update data to ensure user experience.

#### **3.4.2 client optimization**

Enrich and beautify the UI interface, so that the application has better aesthetics and interaction. Solve a few bugs to further reduce the application crash rate. Performance optimization, through the refactoring of the code, so that the application response faster, less memory footprint. Network optimization, using thread pool to manage multithreading, improve the efficiency of multi-task execution and experience. Power optimization, through the assistance of Google related tools, and cannot use the permanent background, to achieve the effect of minimum power consumption.

## **4 Key Technologies of Campus Skill Exchange System V1.0**

### **4.1 Background building of campus skill exchange system V1.0**

Language: Python. Methods: Get and POST methods are combined. Get requests: when using the get method, request data is placed directly in the URL. Post request: when using the post method, the data is placed in the data or body, not in the URL, which will be ignored. Jsonify: convert dict types directly to json strings through the jsonify method. You can also convert a dict to a json string using json.dumps (jsonStr). jsonify is a json processing class that comes with flask, and the returned one is the flask result.

### **4.2 Client development of campus skill exchange system V1.0**

Modify personal information: Insert operation. Detect the API of the GestureDetector method.

```

1 public void insertCourse(Info info){
2 db.execSQL("INSERT INTO " + DataBase.TABLE_Info + " VALUES (null,?,?,?,?) ",
3         new String[]{
4             info.name,
5             info.school,
6             info.time,
7             info.resume
8         });
9 }

```

Network request: Retrofit open source network framework (Yan Yuhua, 2019).

**Figure 2 Client Development -- Personal Information Part of the Code**

NAME, SCHOOL TIME, ideal TIME, RESUME

INFOLIST: personal information. DIRECTION: change DIRECTION. Mivlike: like list (associated with a list item).

When SWIPE operation is carried out, the corresponding code of SWIPE direction is judged, and the interface shows the corresponding effects of left and right strokes respectively. After SWIPE is completed, if the SWIPE is to the right, the four items of the card are put into the "list".

GestureDetector:

GestureDetector. OnGestureListener: when a particular sports event occurs, the callback will notify the user. This class can only be used with Motion Events that are reported via touch actions (not trackball events). Use this class:

First, create a gesture detector instance for your view.

Second, onTouchEvent (MotionEvent). The methods defined in the callback execute when the event occurs.

Third, if you listen for onContextClick(MotionEvent), you must call onGenericMotionEvent(MotionEvent) in the onGenericMotionEvent(MotionEvent).



```

87
88     Observable.concat(getCache, RetrofitWork.getApi().getInfo())
89         .subscribeOn(Schedulers.io())
90         .observeOn(AndroidSchedulers.mainThread())
91         .subscribe((Consumer) (product) -> {
92             if (isLoading) {
93                 mProduct = product;
94                 Gson gson = new Gson();
95                 mProductJson = gson.toJson(mProduct);
96                 sp.saveString(PreferenceUtil.PRODUCT_INFO, mProductJson);
97                 Log.d(TAG, "accept : success : load data");
98             } else {
99                 tv.setText(mProduct._product.get(0).getName());
100                Log.d(TAG, "accept : success : get cache");
101            }
102        }, new Consumer<Throwable>() {
103            @Override
104            public void accept(Throwable throwable) throws Exception {
105                Log.d(TAG, "onError : " + throwable.getMessage());
106            }
107        });
108    }
109 }
110 }
111 }
112 }

```

Figure 3 Client Development -- Part of the Network Request Code

Retrofit:

There's A line in the retrofit documentation: A type-safe HTTP client for Android and Java. A type-safe HTTP client library. Type-safe code for accessing memory locations that are authorized to access. For example, type-safe code cannot read values from private fields on other objects. It can only be read from a well-defined permissible access type. Type-safe code has well-defined data types.

### 4.3 Database building of campus skill exchange system V1.0

MySQL is used here for related operations. MySQL is written in C and C ++, its SQL parser is written in yacc, but MySQL's lexical analyzer is homemade. MySQL is suitable for many system platforms, including AIX, BSDi, FreeBSD, hp-ux, eComStation, i5 / OS, IRIX, Linux, macOS, Microsoft Windows, NetBSD, Novell NetWare, OpenBSD, OpenSolaris, OS / 2Warp, QNX, Oracle Solaris, Symbian, SunOS, SCO OpenServer, SCO UnixWare, Sanos and Tru64. There is also a MySQL port to OpenVMS.

#### 4.3.1 Users fill in their personal information

After filling, the APP will save the data in the local database and upload the data to the server when the network is available. INSERT INTO tb\_stu1(name, school, time, resume) VALUES (' nie zutian,' 'central China normal university ',' after 3pm on May 21, 2018 ', 'basketball '); Add data

#### 4.3.2 Users like other users

Send instructions to the server, the server will other users' personal information into the "list" of this user. The MySQL database optimization based on Autopilot will be implemented later. Autopilot USES Snapshot, the Snapshot technology. In fact, a snapshot is a reference mark or pointer to the data stored in the storage device. That is to say, it is the status of the data at a certain moment. The core of its working principle is to establish a list of Pointers to indicate the address to read the data, provide an image of the instantaneous data, and then copy it when the data changes (Dang Xiangying, 2019).

At the later stage, it tries to borrow Snapshot technology in this system, which can be used to quickly obtain the user's personal information and make data copy after the diversification of user data becomes more complex.

## **5 System Deployment**

### **5.1 Through the following steps, we finally completed the campus skill exchange APP in the smart campus environment**

#### 5.1.1 Data and information collection

Mainly through questionnaire survey, the information required by the App is preliminarily determined as name, age, school, grade, skill calling ideal time, specialty and intention skill. Finally, based on the situation and development of the whole project, the core information of the App is determined as follows: 1. Name; 2. School; 3. Ideal time of meeting 4. Specialty

#### 5.1.2 Database construction

After the core information is determined, the corresponding form is established, and the SQL syntax is deeply studied. I am proficient in using DML instructions such as select, insert, delete, update, as well as important DDL statements such as create, alter, drop and so on to perform relevant operations on database data. Meanwhile, transplant the built environment to the client platform and background, and learn to use SQLite (Sun Yueling, 2018).

#### 5.1.3 Background construction

In the background setup process, I systematically learned Java and python. Because it supports both process-oriented functional programming and object-oriented abstract programming, and has extensibility and embeddability, it finally chooses python to set up the background service. Also learn about network transport protocols, Http and Https, and RESTful architectures, and write apis that are more usable.

#### 5.1.4 Client development

Learn how to use Android Studio to develop applications and SQLite to interact with data. Use XML to write UI interface, and use Java to achieve interface visualization. After the background was successfully built and the main interface UX was confirmed, we learned to use Retrofit network framework and background to complete network communication, and GestureDetector API to complete left sliding switch and right sliding core functions of favorite favorites. When basically done, use gradle signature to package the entire application (Zhang Chengyu, 2018).

### **5.2 Stage results have been achieved**

#### 5.2.1 Data collection and database construction

#### 5.2.2 Set up the background to complete core functions like collecting

Client interested in a message like collection, the client will enjoy it to the server sends the request, the background after get the request will be like in the database to find whether also sent like requests, if two showed a collection of each other, then the client show match, otherwise until both sides each other like to collect.

#### 5.2.3 Completion of core functions of the client

Realize the information in the way of card display left slide switch right slide like collection, and in the collection plate in the way of waterfall flow display like collection, at the same time can edit and maintain the function of personal data.

### **5.3 Late update**

#### **5.3.1 Background optimization**

Improve data, improve data security at the same time, change the protocol from HTTP to HTTPS. Monitor client data and timely improve the frozen update data to ensure user experience.

#### **5.3.2 Client optimization**

Rich and beautify the UI interface, so that the application has better aesthetics and interaction. Solved a few bugs, further reducing the application crash rate. Performance optimization, through the refactoring of the code, so that the application response faster, less memory footprint. Network optimization, using thread pool to manage multithreading, improve the efficiency of multi-task execution and experience. Power optimization, through the assistance of Google related tools, and cannot use the permanent background, to achieve the effect of minimum power consumption.

### **5.4 Expected research results**

Through further optimization in the later stage, the App will achieve a high-quality campus skill exchange application that integrates aesthetics, ease of use and simplicity.

## **6 Conclusion**

This paper discusses the availability of a campus skill exchange APP that allows users to discover their possible hobbies and determine the ideal time to meet with another user to learn this skill, or share a mastered skill with others. Mainly, it introduces the user demand, design steps, key technologies and system deployment of this APP. With this APP, the spare time of college students can be fully enriched.

Furthermore, this APP can be improved into a multi-function system that contains users more than just students (e.g.: kids, employees, olds).

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# **A Study on the Corelation between the Technological Sophistication Index of imports in Producer Service Industry and Technological Innovation Ability of Manufacturing Industry**

Huang Huiping, Zhong Ruojun, ZhaoYulin

School of Economics, Wuhan University of Technology, Wuhan, P.R. China, 430070

(E-mail: 997118372@qq.com, 727580274@qq.com, ylzhaow@whut.edu.cn)

**Abstract:** Faced with the current situation that China's manufacturing industry is on large scale but with a poor competitiveness, the imports of producer services can provide the solutions to the dilemma by improving the technological innovation capacity through its technology spillover effects. This paper mainly focuses on the quality of the imports in producer service industry--Technological Sophistication Index (TSI), and empirically analyzes the impacts of the overall TSI of import in productive services industry and the TSI in different industries on manufacturing innovation capacity of different countries through fixed effect model and quantile regression. The results show that the overall TSI of producer services imports have significant effects on manufacturing innovation capacity, and the impacts of different industrial TSI on developed and developing countries are not on the same level. What is more, the research conclusion has important policy enlightenment for China to develop producer service trade and improve the innovation ability in manufacturing industry.

**Key words:** Imports in producer service industry; Technological sophistication index; Manufacturing industry; Technological innovation ability

## **1 Introduction**

Manufacturing is the foundation of a country which determines a country's comprehensive strength and international competitiveness. The manufacturing industry has made great contributions to China's economic development since the reform. However, the manufacturing industry has been locked in the low-end in technology and low-value-added production links characterized by processing trade, OEM, etc., getting in the dilemma of trade. There is a big gap between China's manufacturing industry and developed countries in terms of technical quality and efficiency, the added value rate of China's manufacturing industry is about 20%, far lower than that of 35% in industrial developed countries in recent years.

This situation is mainly caused by the imbalance of industrial structure, low-leveled investment in R&D, inadequate infrastructure and so on, among which the less support from producer services industry, is one of the main factors. In 2016, the added value of producer services accounted for 25.57% of China's GDP, while that of the US accounted for 46.8% of GDP in the same period.

As supporting sector, producer service is directly related to manufacturing of forming a complete set of services, which can introduce the increasingly specialized human capital and technology capital of manufacturing, with a strong technological spillover effect (Luo and Zeng, 2017). Importing producer service plays an important role to promote the technology ability of manufacturing. Scholars define the

quality of producer services imports or the technology factors that can be used in the import as the technological sophistication index(TSI) of producer services imports (Dong,2016).In recent years, the level of TSI of producer services imports and innovation ability in China have been steadily rising, which shows a certain connection. So, what is the relationship between the quality level of different producer services imports and manufacturing innovation ability?

The technology spillover effects brought by the imports of producer services can significantly improve the level of manufacturing technology innovation, domestic and foreign scholars have conducted a series of studies on this topic. Amiti finds that the imports of producer services have a significant positive effect on the productivity and innovation capacity of the American manufacturing industry (Amiti and Wei,2006). Maouses dynamic panel GMM method then finds that imports a significant to the promotion of China's capacity for independent innovation (Mao,2010).Some researchers find that the imports in producer service industry role for the efficiency of manufacturing industry independent innovation in developed countries than in developing countries (Cai and Li, 2017), However these literatures only study the one-way effects of the quantity of producer service imports on manufacturing innovation ability.

With the concept of TSI of producer services arising, some scholars gradually pay attention to the impact of quality of imports in producer service industry on manufacturing industry. Mo finds that the imports complexity of different types of producer service trade has different influences on the manufacturing competitiveness of countries (Mo,2015). Xuan focuses on the high-tech manufacturing industry and confirms that the increasing TSI of the imports of financial services, computers and information services plays a strong role in promoting the innovation ability of the manufacturing industry (Xuan and Chen, 2017).

These studies have provided us with valuable ideas and fundamental work. Based on these researches, the paper tries to explore the correlation between the TSI of imports in producer service industry and manufacturing technology innovation ability. It attempts to improve the existing research from the aspects of data volume, industry classification and measurement methods, and finally presents conclusions and recommendations for improving the structure of imports trade and promoting the national manufacturing technology innovation capacity.

## **2 Theoretical Analysis and Hypothesis of the Study**

Producer service industry is a supporting service industry directly related to manufacturing industry. It is an emerging industry independently developed from the internal production and service industry of manufacturing industry and does not provide direct and independent service utility to consumers, which attached to manufacturing enterprises and exists in the links of enterprise production. Therefore, the imports of producer services have an impact on the level of technological innovation ability of the manufacturing industry through a certain mechanism (Dong,2016).Because the transforming capacities of imported technology spillovers of producer service ability are not the same, for different types have different role in the country's manufacturing technology innovation ability. In the following part, the relationship between the imports in producer services industry and the innovation ability of manufacturing industry from the perspective of theoretical mechanism are expounded.

### **2.1 Mechanism of imports in producer service industry promoting innovation**

Generally speaking, the imports of producer services can promote manufacturing technological innovation through the following mechanisms:

(1) Technology spillover effects

Technology spillover effects can be summarized as "learning" in the imports (Amiti and Konings, 2007), with imports of service which contains the technological secrets, technical know-how and knowledge innovation. Local companies can learn and absorb these by spillover effects (Mo, 2015), especially the service with higher TSI which contains a large number of additional values be materialized. The importing countries can absorb and digest the technical knowledge in service imports through imitation or even independent innovation, so the spillover effects of imports in producer services industry will promote the improvement of innovation ability.

(2) Innovation agglomeration effects

The producer service condenses a large collection of capital and human resources, for some manufacturing industries which are only with a comparative advantage in the specific production process. These enterprises can make up for the corresponding shortcomings and improve the production decision by importing relatively lack of producer services of core technology or process. (Luo and Zeng, 2017). They can reduce the innovation input to improve their own deficiencies, save the corresponding innovation cost, and increase the R&D projects with their own comparative advantages, so as to enhance the core competitiveness of enterprises.

(3) Competition effects

Increased imports in producer services industry will inevitably squeeze domestic producer services industry. To get from being eliminated by the market in the competition, they should not only strive to improve their R & D level, increase R & D investment and strengthen the construction of R & D talent team. It is also necessary to learn to effectively absorb the advanced technological level contained in import services, and on this basis to carry out secondary innovation and improve their own innovation ability. (Liu, 2014). Otherwise, the squeeze and competition caused by imports of services with high TSI will rapidly replace domestic services and hinder technological development. So we give:

Hypothesis 1: The TSI of producer services has a positive incentive effect on manufacturing innovation ability.

## **2.2 The restriction of the basic development of manufacturing industry**

There is a prerequisite for the positive incentive of producer service imports on manufacturing innovation, that is, the TSI of imports in producer service can adapt to the local manufacturing basis and coordinate with other production factors. This is because the improvement of innovation ability depends not only on the "amount" of input, but also on its allocation, integration and adaptation to other factors. There is not necessarily a positive relationship between factor quality and a country's realization of technology catch-up, however the correlation between them is restricted by factors such as the quality of innovation elements and the matching of innovation environment and other innovation elements. If the elements with higher quality cannot match with other elements effectively, there would be side effects on technology development (Yang and Xu, 2015). That's to say, when a country's manufacturing industry development basis is poor, and the country's imports in producer service industry with high TSI cannot fit well with the country's manufacturing industry mutual confluence, or with other elements to form the optimal allocation in the process of manufacturing production, thereby reducing the country's manufacturing industry innovation ability. So we furtherly give:

Hypothesis 2: Restricted by the development level of manufacturing industry, the TSI of disparate types of producer services has different or even negative influences on the level of manufacturing

technology innovation.

Basing on the assumptions above, this paper mainly studies the impact of the TSI of imports in producer service industry on the technological innovation ability of the manufacturing industry. The samples will be divided into developing countries parts and developed countries parts in order to test the hypothesis.

### 3 Index Selection and Model Setting

#### 3.1 Imports classification of producer service trade and calculation of corresponding TSI

The producer service data in this paper mainly comes from the United Nations Trade Development Database (UNCTAD), the paper combines UNCTAD classification standards and the national bureau of statistics classification criteria, to divide producer service units into 6 categories: financial services, intellectual property services, insurance services, transportation services, communication services and other business services. Specific categories can be seen in table1.

**Table 1 Imports Classification of Producer Services**

category	imports of producer services
Financial service (FIN)	Financial mesomeric and ancillary services
Intellectual property service (IP)	Intellectual property rights, proprietary rights and other patents and royalties
Insurance service (INS)	Insurance and pension services
Transportation service (TRS)	Transportation and its supporting and supporting services
Communication service (COM)	Communications, computer and information services
Other business services (OTH)	Professional and management consulting, technology, trade related and other business services

After classifying the imports in producer service industry, the calculation of the TSI of the imports which is as the core variables is involved. Hausmann et al. proposed a method to measure the technical content of export of finished products and applied it to producer services (Hausmann and Rodrik, 2007). This method will be used as calculating the TSI index of each producer service trade, and the specific formula is as follows:

$$TSI_k = \sum_j \frac{(x_{jk} / X_j)}{\sum_j (x_{jk} / X_j)} Y_j \quad (1)$$

Where,  $TSI_k$  is the technological sophistication index of sub-item  $k$  of producer services industry trade,  $x_{jk}$  is the export value of sub-item  $k$  of producer services industry trade of country  $j$ ,  $X_j$  is the total



export value of producer services trade of country  $j$ , and  $Y_j$  is the per capital GDP level of country  $j$ .

After calculating the TSI of each producer services industry trade, we further measure the imports TSI of each country. The specific formula is as follows:

$$IS = \sum_k \frac{m_k}{M} TSI_k \quad (2)$$

Where,  $IS$  is the imports TSI of a country's service trade,  $m_k$  is the imports amount of sub-item  $k$  of a country's service trade imports, and  $M$  is the total amount of imports in producer service industry that year. Therefore, the TSI of different producer service industries can be calculated by the formula.

According to the classification and formula (1) and (2), the sample data of 30 countries from 2000 to 2016 are calculated and drawn in figure1, which can effectively compare the changes of TSI between different years and different departments.

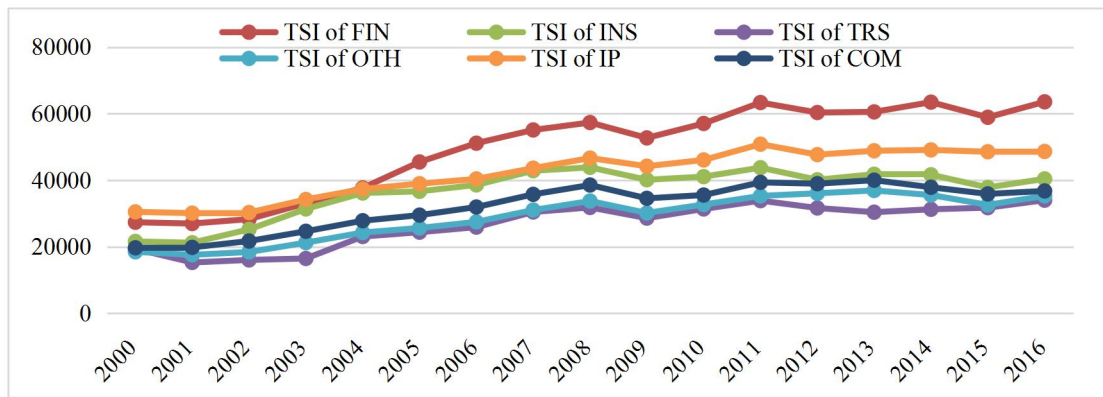


Figure 1 TSI of Different Categories of Producer Service Industry from 2000 to 2016

It can be seen that TSI of the six categories of producer service industry fluctuated and increased from 2000 to 2008, among which TSI of the financial service industry increased the most. In 2008 and 2011, due to the outbreak of the financial crisis, the TSI of the six industries decreased at the same time. According to Yang, TSI fluctuation during the crisis was mainly caused by its impact on the volume of export trade and the price of exported goods, while the actual technical connotation of each sub-industry was still relatively stable (Yang,2015). The six types of producer services trade are basically stable, forming high TSI services represented by financial services and intellectual property services, medium TSI services represented by communication services and insurance services, and low TSI services represented by other business services and logistics services.

### 3.2 Index selection

This paper mainly studies the TSI of imports in producer service industry and the quantitative correlation between manufacturing industry innovation ability. We introduce the calculation method of TSI as the core of the variables, the next step is to select a reasonable measure of manufacturing technology innovation ability, and add some controlled variables to enhance the accuracy of the measurement results.

(1) Dependent variable

There are some scholars used the method of new product output ratio (NP) to measure the innovation capacity of manufacturing industry, and the specific calculation method was the ratio of new product output value of manufacturing industry of each country to total industrial output value of that year. We will draw on this approach in the article. This index emphasizes the quality exploration of whether innovation can be translated into achievements, and has obvious improvement compared with the number of commonly used patent applications.

(2) Controlled variables

In order to more accurately and comprehensively study the relationship between TSI of imports in producer service industry and the innovation ability of manufacturing industry, this paper selects several other factors that may significantly improve the innovation ability of manufacturing industry as the controlled variables of the model, as follows:

① Trade openness(trade). It's expressed by the ratio of a country's total imports and exports to GDP. Melitz found that export trade helps enterprises to gain technological progress and increase productivity through "export learning" effects and competition effects (Grossman and Helpman,1991a).

② R&D expenditure (R&D). The ratio of R&D expenditure to GDP of a country is used in this paper.

③ Human capital level (hc). Generally speaking, a country's human capital level represents the skill level of the labor force

④ Foreign direct investment (fdi). A large number of studies have shown that FDI can promote the improvement of manufacturing technology innovation ability through technology transfer and spillover effects.

⑤ Infrastructure construction (inft). This paper uses the number of secure Internet per million people to calculate this index.

### 3.3 Data source and description

In order to enhance the accuracy of the conclusion as much as possible and obtain the most continuous data of the span as much as possible, this paper selects the transnational panel data of 30 countries from 2000 to 2016, including 20 developed countries and 10 developing countries. In this paper, the imports and export volume of producer services and trade volume of various countries involved in the calculation of TSI are derived from UN comtrade database, and the data of other controlled variables are derived from world development indicators (WDI) database. The data of the amount involved are all denominated in current us dollars. Due to the different statistical annual cycles in different countries, there are some data gaps, then the exponential smoothing method is impressed to solve it.

**Table 2 Variable Overview**

Variable Type	Variable Name	Calculation Method	Data Source
<b>Dependent variable</b>	New product output ratio (NP)	The output value of new products/the total output value	
<b>Core independent variable</b>	TSI of imports in producer Service industry (IS)	$IS = \sum_k \frac{m_k}{M} TSI_k$	
	Trade openness (trade)	Total value of imports and exports / GDP	WDI database
	R&D expenditure (rd)	R&D expenditure /GDP	UN comtrade database
<b>Controlled variables</b>	Human capital level (hc)	Number of R&D personnel per million people	
	Foreign direct investment (fdi)	Net inflow of foreign direct investment	
	Infrastructure construction (inf t)	Number of secure Internet servers per million people	

### 3.4 Model design

In order to verify the hypothesis 1, the metering design idea of the article is to use GLS method to measure the correlation between overall TSI of producer services and the manufacturing technology innovation ability of the overall sample countries and developed countries and developing countries firstly, then do a quantile regression on this basis to improve measurement results. In order to overcome heteroscedasticity, the logarithmic processing of data is performed. Based on this, the following equation is designed:

$$Ln(NP)_{i,t} = \alpha_0 + \alpha_1 \ln(IS)_{i,t} + \alpha_2 \ln(fdi)_{i,t} + \alpha_3 \ln(hc)_{i,t} + \alpha_4 \ln(rd)_{i,t} + \alpha_5 \ln(trade)_{i,t} + \alpha_6 \ln(\inf t)_{i,t} + \varepsilon_{i,t} \quad (3)$$

Where, IS represents the overall TSI of imports of producer services, i represents different sample countries, t represents time,  $\alpha_0$  to  $\alpha_6$  represents the estimated coefficient, and  $\varepsilon$  represents the error term varying with time and individual changes. Other variables are described in detail in table2 and will not be repeated here.

After completing the integrity test, in order to verify the point of view of hypothesis 2, it is necessary to incorporate the imports of producer services from different industry into the measurement system, and to distinguish between the samples from developed countries and developing countries, for analyzing the correlation between TSI of the imports of technical services for different industry and industry's ability to innovate, from which equations (4) to (9) are designed.

$$Ln(NP)_{i,t} = \alpha_0 + \alpha_1 \ln(FIN)_{i,t} + \alpha_7 \ln(fdi)_{i,t} + \alpha_8 \ln(hc)_{i,t} + \alpha_9 \ln(rd)_{i,t} + \alpha_{10} \ln(trade)_{i,t} + \alpha_{11} \ln(\inf t)_{i,t} + \varepsilon_{i,t} \quad (4)$$

$$Ln(NP)_{i,t} = \alpha_0 + \alpha_2 \ln(INS)_{i,t} + \alpha_7 \ln(fdi)_{i,t} + \alpha_8 \ln(hc)_{i,t} + \alpha_9 \ln(rd)_{i,t} + \alpha_{10} \ln(trade)_{i,t} + \alpha_{11} \ln(\inf t)_{i,t} + \varepsilon_{i,t} \quad (5)$$

$$Ln(NP)_{i,t} = \alpha_0 + \alpha_3 \ln(TRS)_{i,t} + \alpha_7 \ln(fdi)_{i,t} + \alpha_8 \ln(hc)_{i,t} + \alpha_9 \ln(rd)_{i,t} + \alpha_{10} \ln(trade)_{i,t} + \alpha_{11} \ln(\inf t)_{i,t} + \varepsilon_{i,t} \quad (6)$$

$$\ln(NP)_{i,t} = \alpha_0 + \alpha_4 \ln(OTH)_{i,t} + \alpha_7 \ln(fdi)_{i,t} + \alpha_8 \ln(hc)_{i,t} + \alpha_9 \ln(rd)_{i,t} + \alpha_{10} \ln(trade)_{i,t} + \alpha_{11} \ln(\inf t)_{i,t} + \varepsilon_{i,t} \quad (7)$$

$$\ln(NP)_{i,t} = \alpha_0 + \alpha_5 \ln(IP)_{i,t} + \alpha_7 \ln(fdi)_{i,t} + \alpha_8 \ln(hc)_{i,t} + \alpha_9 \ln(rd)_{i,t} + \alpha_{10} \ln(trade)_{i,t} + \alpha_{11} \ln(\inf t)_{i,t} + \varepsilon_{i,t} \quad (8)$$

$$\ln(NP)_{i,t} = \alpha_0 + \alpha_6 \ln(COM)_{i,t} + \alpha_7 \ln(fdi)_{i,t} + \alpha_8 \ln(hc)_{i,t} + \alpha_9 \ln(rd)_{i,t} + \alpha_{10} \ln(trade)_{i,t} + \alpha_{11} \ln(\inf t)_{i,t} + \varepsilon_{i,t} \quad (9)$$

The core variables of the above formula are the TSI of imported financial, insurance, transportation, other business, intellectual property and communication services. The specific classification details and abbreviations can be seen in table 3.1. The remaining controlled variables are the same as equation (3).

## 4 Empirical Test and Analysis

Based on the design of the above theories and models, the following part will start with the TSI of producer services from the perspective of the whole and the sub-industry, and discuss their impact on the manufacturing innovation capacity of different types of countries. To test hypothesis 1, we will explore whether the TSI of producer services has a positive incentive effects on innovation, and what different influences it has on developed and developing countries. In the model construction, the Hausmann test was firstly carried out to select fixed effect or random effect matching, followed by general regression analysis and quantile regression to enrich the conclusion. After the holistic inspection, the production service will be subdivided into industries, and the whole country and different types of countries will be compared and tested, trying to select the industries that can promote the improvement of innovation ability most and provide targeted advice for developing countries to find an import structure suitable for their own development path.

### 4.1 Inspection of overall TSI of imports in producer service industry

Firstly, the influence of the TSI of the total imports of producer services on innovation will be analyzed. According to the results from the Hausmann test, we select the fixed effect model to analyze the variables. The results are shown in Table 3

**Table 3 Impact of the Overall TSI of Producer Service Trade on Manufacturing Innovation Capability**

VARIABLES	(1)all countries	(2)developed countries	(3)developing countries
	Fixed effect	Fixed effect	Fixed effect
lnIS	0.473*** (0.0675)	0.398*** (0.0608)	0.344** (0.170)
Intrade	0.470*** (0.120)	0.0281 (0.108)	1.214*** (0.244)
lninf t	0.132*** (0.0255)	0.00809 (0.0249)	0.259*** (0.0464)
lnrd	0.860***	0.0274	1.073***

	(0.117)	(0.142)	(0.196)
lnfdi	0.0603***	0.0290**	0.0950*
	(0.0165)	(0.0123)	(0.0489)
lnhc	-0.295***	0.297**	-0.422***
	(0.0919)	(0.131)	(0.135)
Constant	16.54***	16.51***	14.27***
	(0.805)	(0.898)	(1.380)
Observations	483	314	169
R-squared	0.517	0.418	0.662
Number of country	30	20	10

Standard errors in parentheses \*\*\* p<0.01, \*\* p<0.05, \* p<0.1

The regression results show that:

(1) The overall TSI ln(IS) of producer services trade has a significant positive effects on the technical innovation capacity of all the samples, as well as the samples of developed and developing countries. This indicates that the higher the TSI of imports in producer service industry, the greater the effects on technological innovation. This is mainly due to the technology spillover brought by producer services, and this significant positive relationship proves the point of hypothesis 1.

(2) The TSI of producer services imports has a slightly greater impact on the innovation capacity of developed countries than that of developing countries. The TSI of a country or region's imports in producer service industry must adapt to the local manufacturing level and be coordinated with other production factors to give full play to the positive incentive effects brought by its imports (Mo,2015) . Developed countries owe absolute advantage to make full use of high TSI of the producer service imports. AS for developing countries which obviously lack the advantages, they cannot get as much as them from the exports to promote technology innovation ability.

(3) In the controlled variables, except the negative effects of human capital level, all the others can promote innovation ability. This is because the human capital level represents the capital in the form of a country's advanced elements, R&D spending more on innovation of incentive effects are stronger doesn't make sense. Only if good environment basis and human capital investment fit properly, can TSI of imports produce positive effects. However most of the sample countries does not meet the conditions, in that case increasing R&D staff blindly will increase the research and development costs, inhibit innovation.

(4) Because the trade and technical level of each country are at different stages of development, which makes the correlation between imports in producer service industry and innovation in manufacturing different. GLS cannot effectively reflect the characteristics, however the quantile regression defects of each error term given the same weight, can more fully reflect the relationship between the variables, the results are shown in table 4.

**Table 4 Quantile Regression Results**

	(1)	(2)	(3)	(4)	(5)
Quantile point	0.05	0.25	0.5	0.75	0.95
lnIS	0.400**	0.429***	0.465***	0.517***	0.573***
	(0.130)	(0.0941)	(0.0775)	(0.125)	(0.210)
Observations	483	483	483	483	483

Standard errors in parentheses\*\*\* p<0.01, \*\* p<0.05, \* p<0.1

The quantile regression results show that:

(1) TSI promotes the improvement of manufacturing innovation capability at all sub-points.

(2) Along with the transition from the low point to the high point, the TSI of the imports in producer service industry has a trend of increasing marginal utility in promoting the utility of innovation activities. That is to say, the TSI of producer services imports will play a stronger role in promoting manufacturing innovation capacity in countries or regions with strong manufacturing innovation capacity. It can be explained that imports utilization efficiency of producer services with different TSI depends on its matching degree and integration degree with the manufacturing production module of the importing country, which is largely determined by the technical level and innovation ability of the importing country.

#### 4.2 Inspection of TSI of imports in subdivided producer service industry

Due to the large differences in the nature of the producer service industry, distinguishing the impact of the TSI of the in producer service imports in different industries on the innovation capability of the manufacturing industry makes means. Table 5 gives results:

**Table 5 Impact of TSI of Imports in Subdivided Producer Service Industry  
on Manufacturing Innovation Capacity**

VARIABLES	(1)all countries	(2)developed countries	(3)developing countries
lnFIN	0.0332	0.0718**	0.0784
	(0.0303)	(0.0293)	(0.0647)
lnINS	0.0576*	0.0436	-0.0445
	(0.0336)	(0.0271)	(0.0792)
lnTRS	0.462***	0.331***	0.344**
	(0.0600)	(0.0564)	(0.138)
lnOTH	0.169***	0.296***	-0.131*

	(0.0410)	(0.0391)	(0.0755)
lnIP	0.243***	0.127***	0.335***
	(0.0465)	(0.0464)	(0.0868)
lnCOM	0.163***	0.198***	0.129
	(0.0430)	(0.0374)	(0.0852)
Observations	483	314	169
Number of countries	30	20	10
Country FE	YES	YES	YES

Standard errors in parentheses\*\*\* p<0.01, \*\* p<0.05, \* p<0.1

Table 5 shows that:

(1) Excluding the financial services with the highest TSI, the TSI of other producer services imports have a significant effects on the manufacturing innovation capacity of all the sample countries, among which the TSI of transportation service industry is the most powerful.

(2) Developed countries benefit more from the TSI of imports in producer service industry. All services except insurance services have a significant impact on their manufacturing innovation capacity.

(3) Only the TSI of transportation services and intellectual property services bring significant positive incentives to the manufacturing innovation capacity of developing countries, while insurance services and other business services hinder their manufacturing innovation level.

(4) The TSI of imports in financial services have a significant positive effects only on samples of developed countries.

(5) The TSI of other services industry hinders the improvement of manufacturing technological innovation capacity in developing countries, while it has the opposite effects in developed countries.

Restricted by the economic development and manufacturing level of some countries, the overall country sample can better integrate and absorb imported medium and low TSI services, such as transportation services. But the financial services with high TSI are different from them. We can easily find that the financial operation system of developed countries is highly efficient, and the imports of financial services is an important supplement to the domestic financial system, which can introduce external competition and stimulate a country's financial system to operate more efficiently due to the inadequacy of its own system (Grossman and Helpman, 1991b). Other services with low TSI need to invest more labor and material resources. Developed countries can make up for their disadvantages by importing such producer services with medium and low TSI and provide conditions for their own manufacturing technological innovation. By contrast, developing countries' imports such commercial producer services may crowd out their well-developed peers, creating bad competition and hampering their ability to innovate in manufacturing.

## 5 Conclusions

This paper uses the multinational panel data of 30 countries, from 2000 to 2016 for empirically-analyzing the impact of the overall TSI of the imports in producer service industry trade and the TSI of different industries on the manufacturing innovation capacity of different countries through the GLS method and quantile regression under fixed effect. It can be concluded that:

(1) The overall TSI of the imports in producer service industry significantly promotes the manufacturing innovation capacity of all countries, but it promotes the manufacturing innovation of developed countries slightly more than that of developing countries.

(2) The higher the sub-points are, in other words the higher the innovation level is, the greater the incentive effects of the TSI of the imports in producer service industry on innovation.

(3) Imports of producer service industry with low TSI, such as the transportation service industry, have the strongest ability to promote the manufacturing industry innovation ability of the overall national sample, followed by the intellectual property service industry which is easier to transform and absorb. The financial services industry with the highest technical complexity has only a weaker promotion effects for developed countries.

(4) Distinguishing between developed and developing country samples, the TSI of different industries has different impacts on developed countries and developing countries' manufacturing industry innovation ability. The former mainly benefits from transportation services, communication services and other industries, while the latter is affected by transportation and the impact of intellectual property services is relatively large.

Through the research conclusions of this paper, some policy recommendations can also be put forward to improve China's manufacturing innovation ability and revise the dilemma of "large scale but poor competence" in manufacturing:

Firstly, it is necessary to reduce the trade barriers for the imports of producer services and increase the degree of openness of the service market. Make full use of the comparative advantages of the world, especially developed countries, and improve the innovation capability of domestic manufacturing industries by importing medium-technical and complex production services;

The second is to promote the advantages of the country in transportation services and other industries, strengthen technical exchanges and cooperation. Matching and continuously optimizing the imports structure of producer services trade by rationally introducing according to the development level and demand of the domestic manufacturing industry to ensure the optimal quality of production factors;

Last but not least, only when the domestic human capital and knowledge capital accumulate to a certain extent can the embedded knowledge and technology spillover of intermediate products be obtained. We must pay attention to the construction of innovation infrastructure and the cultivation of local high-quality labor force for advanced R&D abilities.

## Acknowledgement

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# The Application of Big Data Technology in College Academic Achievement Management

Xie Kai, Guo Fangming<sup>12</sup>

Deans Office, Wuhan University of Technology, Wuhan, P.R.China, 430070

(E-mail: shakekai@whut.edu.cn, songfm@whut.edu.cn)

**Abstract:** Students in the process of learning in colleges and universities will accumulate a lot of data, and the scale and speed of growth faster. How to make effective use of these abundant data resources to make decisions is an urgent problem to be solved, and big data technology provides new solutions for academic achievement management. This paper first analyzes the source and characteristics of current academic achievement data, then introduces the working idea of using big data technology to discover and predict academic achievement problems, proposes a new process of academic achievement management, constructs the main structure of the big data academic warning system, and draws the conclusion that big data technology can effectively help academic achievement management.

**Keywords:** Big data technology; Cloud computing; School management; Academic early warning system

## 1 Introduction

With the continuous development of higher education, the academic achievement management of colleges and universities is relatively complex, and the number of students and academic operations are numerous. Big data technology is needed to meet the growing management needs. As a product of the deep development of modern computer information technology, big data technology is not only the value of the ideological level, but also the methodology of the practical level. In the process of learning, college students will produce a large amount of data such as student status data, academic degree data, course data, examination data, academic achievements, award honors, disciplinary action, various assessments, teaching evaluations, etc. These are university education big data, the composition of these contents is subordinate to the research field of higher education big data. Some scholars (Liu Dan, 2015) believe that big data technology has become an extension of the body of teachers and students, gradually changing the way of existence and cognitive habits of teachers and students in teaching activities, reorganizing the activities of teachers and students and understanding the way of learning. Under this background, the traditional empirical study will be reshuffle of teaching data, the past can't collect and analysis of students' classroom performance, learning behavior data information is endowed with new capabilities and value, is the great opportunities of teaching to scientific evidence.

At present, the existing researches mainly focus on the strategy or application of big data

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<sup>12</sup> Corresponding author: Guo Fangming

technology to promote teaching management and student management in colleges and universities. Most of these researchers come from the administrative management departments of colleges and universities. They all see the importance of big data technology to the management of colleges and universities. They believe that big data technology helps the country understand the running state of colleges and universities, the changes of teachers' teaching methods, the ability of teachers to process data, the promotion of digital education resources and services, the updating of the theory and methods of administrative staff management in colleges and universities, and the individualized training of students from a macro level, but relatively little research on related technologies. How to effectively using big data technology university academic achievement management currently is an urgent need to solve the problem. In this paper, the technology of data management in school has explored the application of the article expounds how to boost academic management of big data technology and analyses the related technology, this paper puts forward the ideas of the construction of academic achievement management cloud platform.

## **2 Big Data Technology Helps College Academic Achievement Management**

University academic achievement big data is in the education teaching activities of colleges and universities, that can be collected, through the data integration can create new value(Xie Jian, 2018), from the content, concrete can be divided into student status data, education degree, course class data, test data, the academic achievement record, awards honor data, disciplinary data, all kinds of assessment data, teaching evaluation data, etc.

The academic achievement management of colleges and universities runs through the links of student status maintenance, curriculum setting, classroom teaching, taking examinations, obtaining grades, obtaining academic degrees and so on. In the actual academic achievement inspection, there are some problems:

First, the way of thinking and working methods of managers are relatively conservative, and they pay more attention to routine work and less attention to big data technology, resulting in that managers need to spend a lot of time to integrate and process data.

Second, the previous teaching management platform cannot meet the current dynamic, detailed evaluation data requirements.

Thirdly, due to the limitation of the objective conditions of running a university and the increasingly individualized and diversified learning needs of students, the degree of student satisfaction is not high.

The use of big data technology to assist academic achievement management can improve the work efficiency of managers, optimize personnel allocation, upgrade the teaching management platform, increase the data source channels, realize the requirements of evaluation data, and build a network platform to alleviate the diversified learning needs of students(Ye Huanhuan, 2018, Meng Na, 2018, Diao Zhigang, 2018, Li Zhen, DiaoGang, Zhao Huifeng, 2008).

## **3 Study Inspection System Based on Big Data Technology**

Academic achievement management has gradually become the main work of university student status management, and its importance is self-evident(Huang Rengang, 2008). Accurate prediction and

timely discovery of academic achievement problems are of great importance to the growth of students. Traditional academic warning is usually a post-analysis, which leads to a lagging work model. At present, big data technology has been mature, so it is of great significance to use big data technology for data analysis and prediction research.

Academic achievement management integrates all kinds of data, and the abundant information resources are enough to make reasonable discovery and prediction of academic achievement problems. Based on the learning rules of learners and referring to the existing big data technology system, this study proposes the following structure chart of student academic warning system based on educational big data (as shown in figure 1).The system consists of five sub-modules: data acquisition, information processing, data analysis, visual feedback and early warning.

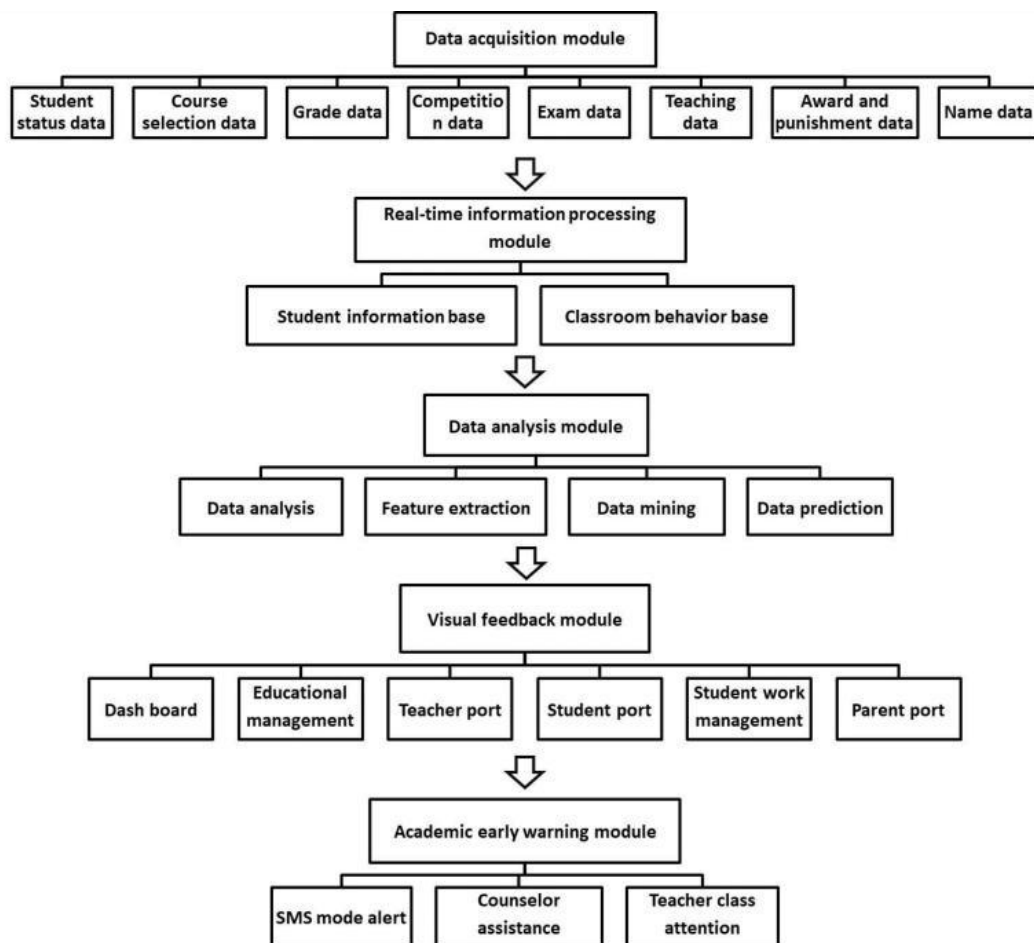


Figure 1 Structure Chart of Academic Early Warning System

### 3.1 Data acquisition module

The data acquisition module collects students' learning data through the educational administration management system. The data of students are mainly collected from the aspects of student status information, learning process (classroom behavior), academic achievement information, evaluation and teaching information, reward and punishment information, etc. For example, student status information is mainly collected from the four dimensions of students' personal basic information, personal hobbies,

graduation and middle school, and family economic status.

### **3.2 Real-time information processing module**

The real-time information-processing module USES the unified data standard to preliminarily clean, classify and count the data, and at the same time ensures the data interflow with the subsequent modules. For some real-time incremental data, such as classroom behavior data updated every day, in addition to the need to adopt this kind of data real-time storage of large capacity storage devices, also need to make real-time comparison and analysis of the results of the analysis will be stored in the student information database, to explore different personality differentiation of academic achievement problem possible.

The real-time information-processing module requires the recording of each student's academic achievement data and panoramic state detection data. The storage and transmission of these massive data bring great challenges to servers and networks. Based on the current development of technology, the appropriate storage and computing cloud platform can be selected according to the actual situation.

### **3.3 Data analysis submodule**

Data analysis submodule can be divided into classification, association rule discovery, dependency discovery, and anomaly and trend discovery. It is necessary to comprehensively use machine learning, statistical learning, neural network and other methods to extract potentially valuable information from massive teaching data and provide data support for the intervention or assistance of learners, teachers, management departments and other relevant parties.

In addition to determining whether students are at academic achievement risk, the learning analysis module is more important to use the analysis results to provide decision data for human intervention in the next step. In order to provide students with personalized teaching guidance to facilitate students to complete their studies.

### **3.4 Visual feedback subsystem**

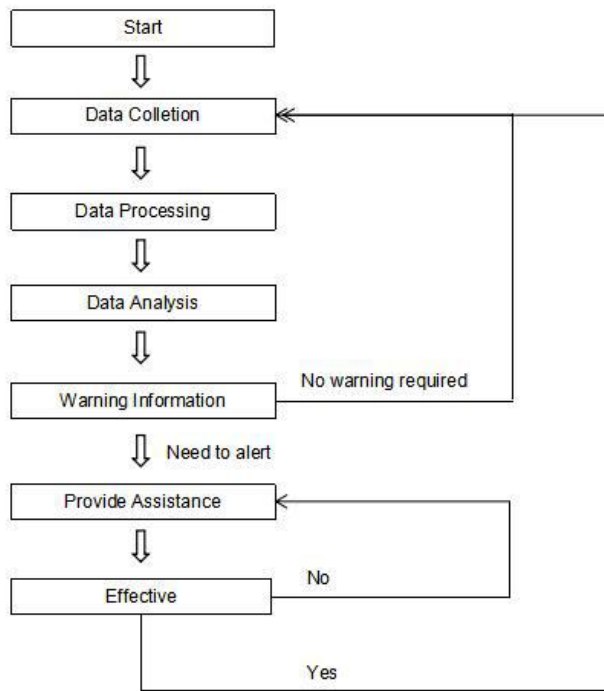
The visual feedback submodule is divided into five different user terminals: student terminal, teacher terminal, teaching management terminal, student management terminal and parent terminal. The main function of the visual instrument panel is to present the system analysis information to system participants in a timely manner. According to the needs of different participants, different terminals provide differentiated functional interfaces in terms of the received information content and information presentation mode. For example, for teaching management personnel, the dashboard displays the overall performance changes of all grades in the school in the form of charts, etc., which is data-oriented and provides decision-making data reference for credit clearing, teaching resource allocation, course selection and setting, etc.

### **3.5 Warning submodule**

With the massive accumulation of students' learning data, the warning engine will become increasingly intelligent, and more warning prompts will be completed automatically by the academic achievement management system. At the same time, considering the complexity of the academic achievement situation, the system also provides artificial warning function. The educational administration and student management personnel can help the problem students face to face and provide learning advice, psychological counseling or learning partner recommendation and other support measures. Teachers can give more attention and help to problem students by adjusting teaching methods. Parents can give their children early encouragement and psychological counseling. Thus from many aspects to promote students successfully complete their studies.

#### 4 New Process of Academic Achievement Management

Based on the structural design of the academic achievement inspection system and the existing business logic of the school's academic achievement warning, the following new process of academic achievement management is constituted (as shown in figure 2).



**Figure 2 New Process of Academic Achievement Management**

Academic achievement management students' various learning data collected through academic achievement management system, data processing module for data cleaning and proofreading after preprocessing operations, set up different real-time database, data analysis module through data mining and analysis techniques for personalized analysis and comprehensive evaluation, the results of the analysis through the visual feedback module presents different participants.

When there is an academic achievement warning, the academic achievement management system will choose different ways to deal with the warning information of different levels and push it to the students and the administrators who want to close the system. According to the warning information received, management personnel will take appropriate intervention and assistance measures in combination with their own work scope, so as to effectively improve the rate of students completing their studies.

Artificial participation makes academic achievement management more scientific and reasonable, so that students can not only feel the efficiency and convenience brought by technology, but also feel the humanistic care of schoolteachers(Zhao Xuemei, Zhao Keyun, 2018).

## 5 Conclusion

Big data technology brings new solutions to the academic achievement management of colleges and universities(Wang Chunfeng, 2018).The application of relevant technologies can facilitate the detection and prediction of academic work and fully optimize the allocation of management personnel. With the help of big data technology, daily academic achievement data report and risk, assessment can also be generated, and intelligent push can be realized(Yin Maozhu, 2018).

Big data technology will become the basis of decisions related to teaching management, and promote the transformation of undergraduate teaching management towards intensive and professional management. The established academic achievement cloud platform will become the inevitable choice to solve many academic achievement problems in the near future.

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# Research on the Influence of Airport Staff Safety Risk Perception on Violation Behavior

Zhang Qian, Luo Fan\*

School of Management, Wuhan University of Technology, Wuhan, P.R. China, 430070

(E-mail: 1010329592@qq.com, sailluof@126.com)

**Abstract:** Based on literature review and questionnaire survey, the study verifies and put forward the hypothesis model of airport staff safety risk perception, safety attitude and violation behavior. The results show that airport staff safety risk perception, safety attitude all have significant negative impact on the violation behavior, the safety attitude plays an intermediary role in the effect of safety risk perception on the violation behavior. According to the analysis results, the study provides interventions to airport staff violation behavior. Managers can proceed from the organization's security management and the staff management, and intervene in violation behavior by improving airport staff risk perception and safety strengthening safety attitude. The authors explore the impact of safety risk perception of airport staff on violation behavior, so as to provide decision support for reducing the violation behavior of staff and improve the efficiency of airport safety management.

**Keywords:** Airport staff; Safety risk perception; Violation behavior; Risk management

## 1 Introduction

The existing research shows that human error is an important factor affecting airport security accidents, and the complexity of the human determines that individual emotions, cognition and other aspects may have an impact on safety behavior. The deviation in the risk perception of airport staff is likely to lead to violations of regulations, which will lead to security accidents.

At present, domestic and foreign scholars' research on safety risk perception mainly focuses on the fields of driving, coal mine and hotel. Scholars generally believe that the level of individual safety risk perception and safety attitude will affect the violation behavior. However, scholars have no unified conclusions about whether the individual safety risk perception level has a positive or negative impact on the violation behavior, and the mediator variables selected are different. On the one hand, some studies have discussed the positive impact of security perception on security behavior (Shen Y., Tuuli M M., et al, 2015). Some scholars believe that individual safety risk perception has a significant negative effect on safety behavior, and they propose that reducing staff safety risk perception is an important way to reduce injury rate(Dong Xiaogang, Wang Shunhong, 2014). On the other hand, many behavioral studies have shown that drivers with high-risk perception levels have lower probability of traffic accidents (Rolison M. R., Scherman A., 2002). In addition, the research shows that staff safety attitude is related to safety incidents and has a significant impact on safety behavior (Wetmore M, Lu CT, 2006).

At present, most researches on the safety risk perception of airport staff mainly focus on the influencing factors and status quo of the risk perception, and lack of empirical research on the impact of the safety risk perception of airport staff on violation behaviors. So is the violation behavior of airport staff also affected by safety risk perception? If so, is the effect positive or negative?



Based on the above discussion, this study explores the impact mechanism of airport staff safety risk perception on violation behavior from the perspective of safety risk perception, and extends the research perspective of airport staff violation behavior. In addition, this study provides decision support for reducing staff violation behaviors, and promotes airport safety management.

## 2 Theoretical Analysis and Research Hypotheses

### 2.1 Research framework

Safety risk perception refers to the intuitive judgment and subjective attitude towards the possibility and severity of the consequences of risk events in production work (Xia N, Wang X, et al, 2017). In this study, the violation behavior of airport staff is defined as the production behavior that leads to safety accidents due to staff violation of safety regulations, including risk violation behavior consciously controlled by individuals and habitual violation behavior unconsciously controlled (Wang Xia, 2017; Slovic P., 1987). This study explores the impact mechanism of airport staff safety risk perception on violation behavior from the perspective of cognitive psychology and organizational behavior, and recognizes the mediating role of safety attitude by the relevant literature analysis. Therefore, this paper attempts to construct a mechanism model for airport staff safety risk perception to influence violation behavior through safety attitude. The research framework is shown as Figure 1.

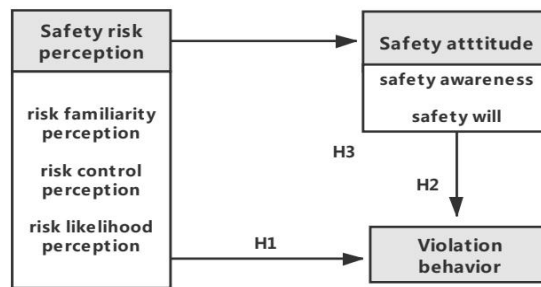


Figure 1 Research Framework

### 2.2 The effect of safety risk perception on violation behavior

Airport staff is faced with serious risk consequences when violations occur, which will affect their perception of violations. Many studies have shown that safety perception is an important antecedent variable of safe behavior (Smith T. D., Eldridge F., et al, 2016). The level of staff risk perception is affected by the following aspects: the low level of security atmosphere in the airport will reduce staff safety awareness; the stable and monotonous staff work content will cause staff to experience emotional exhaustion and job burnout; the safe working environment may cause staff to misunderstand safety behavior. Currently, the measurement method for risk perception is usually psychological measurement paradigm. Scholars gradually realize that risk perception is composed of different dimensions. Slovic divides the content of risk perception into different dimensions, such as risk control, possibility, and familiarity (Slovic P., 1987). The internal factors that interfere with violations mainly include individual mental health and safety values (Paul P. S., Maiti J, 2007; Morrow S. L., Mcgonagle A. K., et al, 2010). Based on this, the following assumptions are made:

H1: Airport staff safety risk perception has a negative impact on violations.

H1 can be divided into the following three sub-hypotheses:

H1a: Airport staff risk familiarity perception has a significant negative impact on violations;

H1b: Airport staff risk control perception has a significant negative impact on violations;

H1c: Airport staff risk likelihood perception has a significant negative impact on violations.

### **2.3 The mediating role of safety attitude**

Safety attitude is the value judgment and psychological tendency of employees when they are in safe production (Alistair Cheyne, Sue Cox, et al, 1998). This study concludes that the safety attitude of airport staff has a significant effect on violations. In general, safety attitude mainly include safety cognition and safety will dimension (Lu Bo, Chen Pei, et al, 2010; Xu Menghong, 2012). Safety cognition refers to the individual's cognition of safety characteristics and safety, mainly through individual feelings, perceptions, memories and thoughts. Safe will refers to a psychological process in which individuals strive to regulate their own behaviors in order to achieve safety goals. In recent years, many scholars have combined safety risk perception with safety attitudes and dangerous attitudes to explain risk behaviors in the fields of aviation, driving, and coal mining. Based on this, this paper proposes the following two assumptions:

H2: The safety attitude of airport staff has a negative impact on violation behavior.

H3: The safety attitude of airport staff plays a mediating role in the impact of security risk perception on violation behavior.

Among them, H2 consists of two sub-hypotheses:

H2a: Airport staff safety awareness has a negative impact on violation behavior;

H2b: The safety will of airport staff has a negative impact on violation behavior.

## **3 Study Design**

### **3.1 Research sample and data collection**

In this study, 151 staffs of T airport and S airport were surveyed online by questionnaire method, 129 valid questionnaires were received, and the recovery rate was 85.43%.

### **3.2 Measurement scale**

This study draws on the maturity scales in related fields. It includes three scales of airport staff safety risk perception, safety attitude and violation behavior, and requires the participants to answer according to the actual feelings in the work. All scales use the Likert5 graded score method, which is based on very non-conformity, non-conformity, general compliance, comparative compliance, and very consistent, representing 1 to 5 points respectively.

The security risk awareness scale refers to the relevant results of Simon's risk perception (Simon M, Houghton S M, et al, 2000), there are 12 items( $\alpha=0.852$ ). The safety attitude scale mainly have 8 items( $\alpha=0.716$ ), including 'safety regulations cognition', 'production process cognition', 'safety concept cognition', 'safe production mood', 'safe production will' and other topics (Xu Menghong,

2012). The violation behavior scale draws on the research results of Fogarty and Shaw on unsafe behavior, there are 5 items ( $\alpha=0.907$ ), including ‘safety regulations violations’, ‘labor discipline violations’, ‘operational requirements violations’ (Fogarty G J, Shaw A, 2010).

## 4 Data Analysis and Results

### 4.1 Factor analysis

Factor analysis was performed on the safety risk perception scale data. Factor 1 reflects the familiarity of airport staff with risk events (i.e. violation behavior), so it was named as ‘risk familiarity perception’. Factor 2 is about the perception of the possibility of airport staff risk arising from violations, so it is named as ‘risk possibility perception’. Factor 3 refers to the control ability of airport staff in violation of regulations and the controllable perception of consequences caused by violation decisions, so it is named as ‘risk control perception’.

Similarly, the safety attitude scale is divided into two factors. Factor 1 describes the cognition of airport staff on safety regulations and safety systems, so it is named as ‘safety cognition’. Factor 2 reflects the subjective understanding of airport staff to overcome difficulties and implement safety regulations when faced with special circumstances, which is named as ‘safety will’. The data of the violation behavior scale have passed the one-dimensional test, so there is no dimensional distinction.

### 4.2 Correlation analysis

Firstly, the overall relationship between the three scales of airport staff safety risk perception, safety attitude and violation behavior is analyzed. As shown in Table 1, overall, airport staff safety risk perception was significantly negatively correlated with violation behavior ( $r=-0.499, p<0.01$ ), and safety attitude was significantly negatively correlated with violation behavior ( $r=-0.730, p<0.01$ ).

**Table 1 Safety Risk Perception, Safety Attitude and Violation Behavior Correlation Coefficient Matrix**

Variable	Safety risk perception	Safety attitude	Violation behavior
Safety risk perception	1		
Safety attitude	.703**	1	
Violation behavior	-.499**	-.730**	1

Note: \* means significant at 0.05 level, \*\* means significant at 0.01 level (two-sided test)

Then, the correlation between the factors of safety risk perception, safety attitude and violation behavior is analyzed, the results are shown in Table 2. Risk familiarity perception is negatively correlated with violation behavior ( $r=-0.356, p < 0.01$ ), risk possibility perception is negatively correlated with violation behavior ( $r=-0.506, p < 0.01$ ), and risk control perception is not significantly correlated with violation behavior. The reason why risk control perception is not related to violation behavior may be that in a risk environment, when staff perceive that they can control violation behavior, they will think that they are less likely to take risks and thus more likely to carry out violation behavior. Safety cognition has significant negative correlation with violation behavior ( $r=-0.215, p < 0.05$ ), and safety will has significant negative correlation with violation behavior ( $r=-0.820, p < 0.01$ ). The above

analysis results preliminarily support the theoretical model and hypothesis.

**Table 2 Safety Risk Perception, Safety Attitude Factors and Violation Behavior Coefficient Matrix**

Variable	Risk familiarity perception	Risk possibility perception	Risk control perception	Safety cognition	Safety will	Violation behavior
Risk familiarity perception	1					
Risk possibility perception	/	1				
Risk control perception	/	/	1			
Safety cognition	.562**	.242**	.131	1		
Safety will	.176*	.271**	.103	/	1	
Violation Behavior	-.356**	-.506**	.085	-.215*	-.820**	1

Note: \* means significant at 0.05 level, \*\* means significant at 0.01 level (two-sided test)

### 4.3Hypothesis test results

In this study, SPSS20.0 was used for stepwise regression analysis, and the results are shown in table 3. After testing, VIF in this paper is close to 1, indicating that collinearity is not obvious.

Firstly, the regression analysis of the safety risk perception scale and the violation behavior shows that the safety risk perception has a significant negative impact on the violation behavior ( $\beta=-0.347, p<0.01$ ), hypothesis H1 is verified. The regression analysis of various factors of safety risk perception and violation behavior shows that risk familiarity knowledge ( $\beta=-0.506, p<0.01$ ) and risk possibility perception ( $\beta=-0.354, p<0.01$ ) have significant negative influence on violation behavior, which verifies hypothesis H1a and H1b. However, risk control perception factors didn't enter the regression model, indicating that hypothesis H1c couldn't be verified.

Then, the regression analysis of safety attitude and violation behavior shows that safety attitude has a significant negative impact on violation behavior ( $\beta=-0.749, p<0.01$ ), and the hypothesis H2 is verified. Similarly, we can calculate that safety cognition ( $\beta=-0.821, p<0.01$ ) and safety will ( $\beta=-0.2131, p<0.01$ ) all had significant negative effects on violation behaviors, and hypothesis H2a and H2b were verified.

**Table 3 Regression Analysis and Hypothesis Testing**

Control variable	Non-standardized coefficient		Standardization coefficient	t	Sig	ADJ.R <sup>2</sup>	F
	B	standard error	Beta				
(1)safety risk perception	-.347	.053	-.499	-6.492	.000	.243	42.152**
(2)risk familiarity perception	-2.577	.357	-.506	-7.225	.000	.372	38.834**

(3) risk possibility perception	-1.800	.357	-.354	-5.047	.000		
(4) safety attitude	-.803	.092	-.749	-8.749	.000	.490	128.803**
(5) safety attitude	-4.181	.240	-.821	-17.419	.000		
(6) safety will	-1.086	.240	-.213	-4.524	.000	.715	161.946**

Note: \* means significant at 0.05 level, \*\* means significant at 0.01 level (two-sided test)

The mediating utility test results of safety attitude are shown in Table 4. In model 2, the regression coefficient of safety attitude is significant, indicating that "safety attitude" produces mediating utility. The regression coefficient of "safety risk perception" in model 1 is significant, while it is not significant in model 2, indicating that "safety attitude" plays a full mediating role between "safety risk perception" and "violation behavior", and hypothesis H3 is verified.

**Table 4 Safety Attitude Intermediary Utility Analysis**

Independent variable	Model 1			Model 2		
	Standardized Beta	t	Sig	Standardized Beta	t	Sig
safety risk perception	-.499	-6.492	.000	.027	.312	.755
ADJ.R <sup>2</sup>	.243			.526		
F	42.152**			71.882**		

Note: \* means significant at 0.05 level, \*\* means significant at 0.01 level (two-sided test)

## 5 Conclusion

This study takes airport staff as the research object, discusses the influence of airport staff safety risk perception and safety attitude on the violation behavior from the perspective of safety risk perception, and proposes the intervention countermeasures of airport staff violation behavior. It is found that airport staff safety risk perception has a significant negative impact on violation behaviors. It means that staff with higher safety risk perception ability are more inclined to abide by safety rules and regulations and are less likely to have violation behaviors. The safety attitude of airport staff has a significant negative impact on the violation behavior. Safety attitude plays a completely mediating role in the influence of airport staff safety risk perception on violation behavior.

Managers can improve staff risk perception from the perspective of organizational safety and staff management, such as establishing risk management culture, strengthening staff safety attitudes, and conducting behavioral education.

Future studies should expand the sample size to increase the representativeness of the sample data and use objective data to avoid subjective effects of the self-measurement table.

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# Media Reporting Strategies for Public Opinion Risk Management Based on Emergency

## ---A Case of the Sinking Incident of Oriental Star Ship

Zhang Wuqiao

School of Humanities and Law, Guizhou University of Finance and Economics, Guiyang, P.R.China,  
550025

(E-mail: 892260268@qq.com)

**Abstract:** Due to the particularity of serious emergencies, China attaches great importance to the construction of emergency management system in the face of serious emergencies, especially to improve the ability of the network to public opinion and the responsibility of the news media in the process of emergent events. Taking the sinking incident of "Oriental Star" as an example, the study finds that under the background of media convergence, this sinking incident brings together the communication characteristics of various media, due to the features of content orientation, expression and narrative strategy of traditional media and emerging media. Furthermore, it realizes channel integration and cross-border communication and achieve the maximum, widest and most effective communication effect to ensure the healthy formation, development and dissemination of social public opinion by making full use of the advantages of integrated media communication. Therefore, it is a successful case of integrating media to guide the development of public opinion in a serious emergency.

**Key words:** Emergency events; Public opinion risk; Media reporting; The sinking incident

### 1 Introduction

At present, we are stepping into the era of all media. Emergencies are accompanied by high-intensity public opinion confrontation, which not only adds new variables to the emergencies, but also has an important impact on their process. The game of various media forces has become the norm (Liu Ting & Chen He, 2015). Due to the particularity of major emergencies and the severity of the results, every serious emergency in history inevitably had produced some negative comments to affect the image of the Chinese government, and even brought about adverse social consequences. However, great changes have taken place in the social environment of crisis communication in China today, such as the rapid development of communication technology, fierce competition among media, and the general enhancement of the audience's awareness of rights and psychological endurance (Sun Yuanming, 2008). Therefore, after the occurrence of major emergencies, China attaches great importance to the construction of emergency management system in the face of major emergencies, while news media plays an important role and is the key factor in the process of public opinion response. Therefore, we take the sinking incident of "Oriental Star" as an example to analyze the

media's reporting characteristics and public opinion response strategies in the face of major emergencies, so as to provide decision-making reference for formulating public opinion response policies in the face of emergencies in the future.

Many scholars at home and abroad investigate the study of media coverage from various aspect, such as the effect of trade credit on stock price (Liu Huan & Hou 2019); the content and framing of opioid-related media coverage (Russell, Spence & Thames 2019); the role of media in supervising relevant agencies and meeting the public need for related information (Chen Xueli & Valdmanis 2019); the media coverage from the major online newspapers in Mexico (Curiel, Arnau & Pinedo, et al. 2019); the application of media report strategy to study the workplace violence (Jonathan, Lu Fang, Zhang Xinqing 2019). These studies explore the feature and strategies of media coverage, with few illustrations of the media reporting strategies for public opinion risk management. So this paper takes the sinking incident of "Oriental Star" as an example to explore the strategies of media reporting for public opinion risk management.

## **2 Sample Selection**

At about 21:00 pm on June 1, 2015, the "Oriental Star" passenger liner capsized in Jianli Section of Yangtze River in Hubei Province. There were 454 people on board, including 403 tourists, 46 crew members and 5 travel agency staff, and 12 people were rescued. After this sudden major emergency, General Secretary Xi Jinping gave important instructions and Premier Li Keqiang even personally went to the scene to conduct the search and rescue work. More importantly, from the perspective of the public opinion dissemination, the investigation and study of the domestic mainstream network media, such as paper media, television, websites and WeChat and microblog, etc, showed that there has been no large-scale network rumors and negative information impact so far after this event, showing a healthy and upward social atmosphere. So, it reflects a sound emergency management system and the full role of the media in public opinion response of major emergencies in China.

### **2.1 Selection of research period**

In terms of time selection, we started at 21:00 pm on June 1, 2015, when the "Oriental Star" began to sink. Then various media carried out a full range of follow-up reports under the background of media convergence. By 11 a.m. on August 8, 432 bodies had been found. Later, after two hours of thorough and careful inspection, the Joint Acceptance Group confirmed that the body clearance had been completed, and the representatives of all parties signed the checklist, marking the completion of the site investigation and clearance of the "Oriental Star" sinking incident. Therefore, we selected a 10-day period from June 1 to June 10, 2015 to investigate the number and content of media reports by considering the particularity, continuity and lag of media reports, especially paper media and television stations.

### **2.2 Selection of target media**

Major emergencies report is a special type of report in a special period with wide public attention, high quality requirement for journalists and great instantaneous influence (Yan Liang 2015). The "Oriental Star" incident attracted wide attention and spread of reports from domestic and foreign media, which fully embodied the important characteristics of the whole media era. In the choice of target media, we focus on the domestic mainstream media: Xinhua Daily Telegraph; CCTV, Phoenix



Network, Sina Weibo, WeChat. Meanwhile, we also selected Hubei Daily and Hubei Network Radio and Television Station to better understand the coverage of the incident, because the location is within the territory of Hubei Province.

### 3 Reporting Performance of Different Media

#### 3.1 Television communication

As an important part of the daily life in today's society, television is accompanied by us every day in such crowded public areas as stations, airports, restaurants, or in private families. So watching TV especially in the public sphere is no longer the privatization of the past due to TV's publicity and recommendation characteristics. When you pass through some public spheres, the live picture of TV will inadvertently come into our eyes, or even let us stop to watch from time to time. Thus, with the wide spread of television, TV has become a kind of the most popular propaganda media as well as the main source of information for middle-aged and elderly people and network blind areas. And it has permeated all aspects of people's daily life, such as clothing, food, housing, transportation, entertainment, education, etc., and affects people's behavior.

##### 3.1.1 CCTV performance

After the "Oriental Star" incident, CCTV took a series of powerful measures immediately according to the basic rules and principles of response to public opinion, and achieved remarkable results, as shown in the table below.

**Table 1 Response Schedule of CCTV at First Time**

Time	Corresponding Measures
after the sinking incident	CCTV immediately started Level II Emergency Response Plan overnight
2: 52 a.m. on June 2	The exclusive news of "Overthrow of more than 400 Yangtze River passenger liners in the Hubei Section of Yangtze River and" was launched around the world through the "CCTV microblog".
3: 00 a.m. on June 2	CCTV News Channel is ahead of all traditional media and news agencies to send authoritative news through TV.
6: 02 a.m. on June 2	The first live phone call with the foreword reporter was broadcast.
7: 00 a.m. on June 2	CCTV broadcast important instructions from General Secretary Xi Jinping and Premier Li Keqiang
8: 00 a.m. on June 2	A reporter from CCTV's Hubei station send out the first global live broadcast on the rescue site.

CCTV has effectively curbed all kinds of rumors that once circulated in society, effectively guided the orientation of media and sound development of social public opinion by means of high-density, professional live broadcasts, bold and innovative TV expressions and authoritative information.

According to the relevant statistics, CCTV sent more than 70 reporters to the scene and the relevant provinces along the Yangtze River to carry out all-round follow-up reports during the 10-day-rescue process. And more than 110 live connections were made and more than 1100 related news items were broadcast with a total duration of more than 46 hours. CCTV News Channel ranked first in the ratings for three consecutive days from 3 to 5, June, garnering over 790 million views on the related news reported by the new media of CCTV News. During this period, 129 pieces of relevant news were released by "International Television" of CCTV to overseas media, 94 of which were used 243666 times by 833 overseas TV channels such as CNN, BBC, Al Jazeera, Brazil's Universal TV, etc. and the total talk time was about 89 hours. Therefore, CCTV distributed the largest number of publications to the single incident in the past two years no matter from the number of foreign media or the number of broadcasts. (Shen Yong & Zhang Yujun, 2015).

### 3.2.2 Performance of Hubei network radio and television station

After the sinking incident, Hubei Radio and Television Station started the emergency response mechanism quickly. According to the principle of timeliness, accuracy, openness and transparency, it actively released authoritative information, did a good job in news reporting and public opinion response to social concerns. The logo of Hubei Satellite Television Station turned black and white from 2 to 7, June to mourn the sinking incident of the Oriental Star. Moreover, live coverage of the incident was carried out during three important periods of morning, afternoon and evening. In addition to the fixed 130-minute news section in the evening, there were more than 70-100 minutes of live coverage in the daytime. The total time of live coverage on June 4 was 391 minutes, which led to the full-day broadcasting of the channel. According to statistics, after the "Oriental Star" sinking incident, Hubei Satellite TV and Hubei Public News Channel have achieved nearly 200 live broadcasting, with more than 400 minutes of live press conference and 2800 minutes of live television broadcasting. The special program of "Oriental Star" sinking incident broadcast by Hubei Satellite TV at 21:25 p.m. has received good ratings, with an average viewing rate of 0.42% and a viewing share of 1.71%, which was 27% higher than last week's program at the same time, and ranked second in the country in the evening of 2 to 4, June (Hu Sha & Shi Yongjun, 2015). It has effectively improved the viewing rate of Hubei Satellite TV and the benign dissemination effect of social public opinion.

According to the database statistics of Xinhua News Agency multimedia, Hubei Satellite TV alone broadcast 113 special news programs since the rescue of the sinking incident. Television with the characteristics of the integration of audio and video, greatly facilitates the reception effect of the audience group, makes the audience group get rid of the restriction of cultural level to fully understand the occurrence and development of events, and produces strong visual impact and emotional resonance. And the TV media, which can also demonstrate with the three-dimensional dynamic model, improves the audience's experience perception, so that the rescue work has received strong support from all walks of life.

### 3.3 Website dissemination

In today's Internet era, the two-way interactive communication and cross-communication of network media have greatly enhanced the group awareness and diffusion effect of events. User groups can effectively extend and distribute through hypertext and hyperlink on the network to make multiple users obtain information in the first time. After the incident, many websites at home and abroad have held this hot information tightly and carried out all-round online broadcast. Many websites have set up special web pages on this event. Therefore, the participation enthusiasm of the public has been greatly

improved through network media communication. For example, in the article “Expert Interpretation: Six Questions about the Sinking Incident of ‘Oriental Star’”, 6580 netizens participated in and 249 commented on this incident. Therefore, the effective participation and comments of social netizen also broadens the group awareness of events to a certain extent, and plays a positive role in eliminating bad guesses and rumors.

### 3.4 “Two Micro” dissemination

As the “two micros” represented by social networking media Weibo and WeChat have come in succession, multidimensional network channels have changed the single linear communication mode. Moreover, they have great expansion effect and provide a wide space and convenient conditions for the rapid release of information with the characteristics of one-to-one, one-to-many, or multi-to-many or multi-to-one communication.

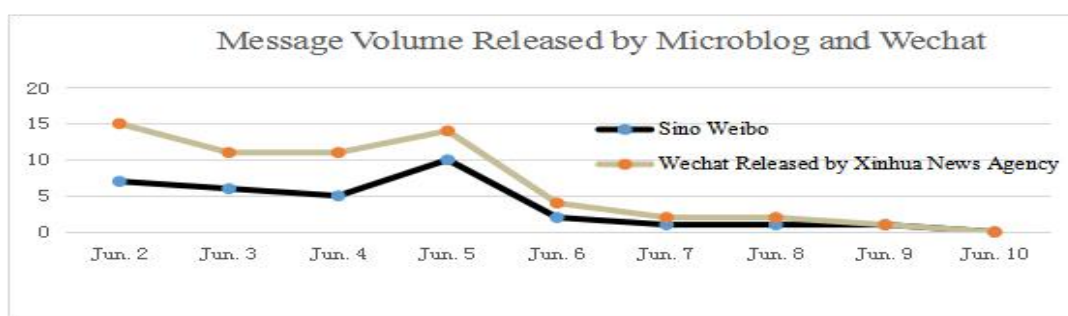


Figure 1 Message Volume Released by Microblog and WeChat

#### 3.4.1 Performance of Sina Weibo

Sina Weibo is one of the most influential social network media in China. According to statistics, Sina Weibo timely released the development of the incident with a total of 187 related Weibo messages from June 2 to June 10, 2015, after the shipwreck incident. But compared with other network media, there are still some lags. For example, the first micro-blog content released by Sina Weibo was forwarded at 7:04 a.m. on June 2 after other media reports were disseminated.

The hot topic “the Sinking Incident of ‘Oriental Star’” was launched by Sina Weibo. As of June 10, 876 million people had read the topic and 907,000 people had actively participated in the discussion, reflecting the netizen’ great concern about the progress of the incident. A total of 33 Weibo news were released on the second day of the incident, June 2, when intensive publication of information was launched on Sina Weibo. In the process of rescue for all officers and soldiers, especially on June 5, Sina Weibo also kept pace with the development of the incident, timely release of rescue progress with 10 Weibo news to the public. With the announcement of the rescue work, the number of Sina Weibo reports on the incident continued to decrease from June 8.

#### 3.4.2 Performance of WeChat Released by Xinhua News Agency

As WeChat relies on the network of acquaintances and the mass communication, it greatly improves the effectiveness of communication. Especially as people can brush micro-messages anytime and anywhere, and receive the information pushed by WeChat public number at any time in the

popularization and application of smart phones, WeChat achieve one-to-many dissemination effect and improve the rate of information attainment. According to statistics, from June 2 to June 10, 27 pieces of news related to the incident were pushed by Xinhua News Agency, of which 9 articles read more than 80,000. At 6:59 a.m. on June 2, the first news of "Oriental Star" sinking incident was pushed. The three days from June 2 to 4 were the intensive period of news announcement with 8, 5 and 6 items respectively. Then the number was gradually decreased from June 5 to 8, with 4, 2, 1 and 1 items respectively, and was not be sent after June 9. But from the concern of the circle of friends, the title "Full Understanding of the Sinking of Oriental Star within 24 Hours from a Picture", which was pushed on June 2, has attracted a great deal of forwarding and attention from netizens.

## **4. Analysis of Reporting Characteristics of Different Media**

### **4.1 Different content orientation**

New media, such as websites, TV stations, Sina Weibo and Xinhua News Agency, focus on dynamic updates of the occurrence and development of events, and timely release of real-time dynamic information of events to the public. Furthermore, they adopt two-way interaction with the audience to meet their information needs. In content, they mainly focus on the progress of events, especially the real-time updating of rescued personnel information and the number of victims. The TV stations also provides live online broadcasting to restore the event process in 3D pictures so that the audience can more intuitively understand the information of the event and the media make effective respond to the concerns and questioning of the public, such as the articles "Twelve People Were Rescued, Not 14 in the Sinking Incident of Oriental Star---- Official Explanation of the Reasons for Change in the Number of Rescued Persons" by Xinhua , and "Media: Why the Shipwreck Was Corrected after 72 Hours" by Phoenix Net.

### **4.2 Different expressions**

With the rapid development of social media, as an important social phenomenon in today's society, social language has become popular worldwide as well as profoundly affect our daily life. According to statistics, a series of popular social network phrases, such as "now my heart is almost collapsed", "the world is so big, I want to see", etc., have a very high dissemination influence and has changed the language ecological environment of the whole social media. Therefore, compared with traditional paper media, new media such as Weibo, WeChat and website are more lively, emotional and colloquial in their discourse expression to make people feel the close relationship between the audience and the media.

### **4.3 Different narrative strategies**

The honeycomb news narrative mode is the main mode of communication of the new media at present, especially the live online communication carries out bit by bit broadcasting according to the sequence of events' development. For example, in the process of hull righting and salvage, all new media have adopted real-time live broadcasting, enhancing the timeliness by means of interpolation and explanation the background of the incident and the rescue process in detail. Therefore the audience can feel the atmosphere of the scene, and better understand the occurrence and development of events, dispelling many misunderstandings and ignorance of the incident facts.

## 5 Conclusion

Under the background of all-media convergence, the “Oriental Star” sinking event has brought together the characteristics of various media, made full use of the advantages of all-media communication. And it has made full use of the communication functions of “up-to down” and “down-to-up” transmission of media to realize media integration and achieve maximum and most effective communication effect. So it is a successful case of integrating and disseminating major emergencies to ensure and guide the healthy formation, development and dissemination of public opinion. Of course, many important aspects make great contribution to the healthy influence of public opinion dissemination in this incident, such as fully cooperation among the Party and the state, the functional departments and the mainstream media, timely, high-intensity and high-frequency exposure of all kinds of information, and the continuous improvement of the media, and quality and literacy of Internet users, etc.

It is a complex systematic project to correctly guide the dissemination and development of social public opinion in a healthy and healthy direction. Especially in the era of “Internet plus” that social media is advancing rapidly, it is particularly important to establish and improve the key system, which requires such institutional arrangements, as the optimization and perfection of the system, network news release, and the strengthening of network media supervision and self-discipline. It is a serious issue for public administrators and the mainstream value how to adapt to the changes of the times, construct a new pattern of guiding work, constantly enhance the response of social public opinion, and promote the modernization of national governance system and governance capacity.

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## A Stock Price Movement Prediction Model Based on Artificial Neural Networks

Uzapi Hange<sup>1</sup>, Siyanda Andrew Xaba<sup>2</sup>

1 School of Management, Wuhan University of Technology, Wuhan, P.R.China, 430070

2 School of Art and Design, Wuhan University of Technology, Wuhan, P.R.China, 430070

(E-mail: u.hange@yahoo.com, master.xaba@gmail.com)

**Abstract:** The stock market is influenced by a number of factors and therefore it is challenging to predict. Prior researchers have proposed predicting the stock price movement using historical price data and company related factors. This paper builds a MultiLayer Perceptron neural network model that predicts whether the stock price will rise or fall based on historical stock price data. It also uses open innovation announcement data to examine whether an open innovation model that permits companies to utilize both the internal and external resources can affect the fluctuation of the stock price. The results demonstrate that the MultiLayer Perceptron ANN is able to correctly predict stock price as either rise or fall, with an accuracy of 76.2%. Furthermore, the feature selection experimentation reveals that the opening price, closing price, open innovation announcements, and highest price are the most determinant factors of stock price.

**Key words:** Stock price movement; Artificial neural networks; Multilayer perceptron; Open innovation

### 1 Introduction

The stock market is regarded highly risky with high yield; hence investors are concerned with the analysis of the stock market. Investors and researchers have been attempting to predict stock price movement using various techniques such as fundamental analysis (Hedayati, Hedayati and Esfandyari, 2016). This technique assumes that the stock price is determined by its intrinsic value. The analysis is achieved through assessing a company's operations and the market it operates in. Prior research posits that fundamental analysis is well suited for long-term prediction. (Al-radaideh and Alnagi, 2015). Technical analysis has also been employed for stock price prediction based on historical stock prices and volume data. It is rooted on the notion that history repeats itself and that future stock price trajectory can be predicted through scrutinizing past price data. Technical analysis is well suited for short term prediction (Rosati et al., 2019; Angulo-ruiz et al., 2018).

With the advent of online trading platforms, an explosive growth of data has been observed; motivating the application of artificial intelligence (AI). AI reveals hidden but useful trends from large datasets using sophisticated algorithms such as decision trees, deep learning and Artificial Neural Networks (ANNs) (Setty, Rangaswamy and Subramanya, 2010). For instance a study developed a decision tree model using past stock prices to generate decision rules that recommend whether to buy or sell stock (Al-radaideh and Alnagi, 2015). Another research proposed a deep convolutional neural network for event-based stock market forecast (Pinheiro and Dras, 2017). These studies neglect other factors such as open innovation which might impact stock price movement.

Open innovation encourages companies to tap on both the internal and external knowledge and resources to accomplish their innovation tasks (Chesbrough, 2003). A noteworthy benefit of open innovation is reduction of risk of failure due resource pooling and risk sharing amongst collaborating companies (Napiera, 2019). This can increase investor confidence in the future earnings of a firm. Even though the financial implications of open innovation are substantial, little research exists as to how it can create value for companies and consequently affect the stock price movement.

Therefore this paper contributes an artificial neural network (ANN) model that predicts whether the stock price will rise or fall, based on open innovation data and historical stock price data. The model makes use of a Multilayer perceptron (MLP) ANN. The rationale for applying ANNs in this paper is due to their capability to detect nonlinear relationships in the input data set. This makes them suitable for stock price prediction which is complex and nonlinear in nature (Victor Devadoss and Antony Alphonse Ligor, 2016). The model is tested on a company from a developing country (Alibaba). Most studies are based on companies from developed countries, however the results from

developed countries cannot be directly applied to companies in developing countries.

## **2 Stock Market and Open Innovation**

Today, a considerable number of markets are characterized by high competition. Firms are subsequently striving to differentiate their products and services to stay ahead of competition (Bergschöld and Källgren, 2014). Innovation is increasingly becoming the greatest source of gaining competitive edge and enhancing firm value. Innovation investment is inherently risky, thus it can heighten investor uncertainty, which could result in significant stock price drops (Napiera, 2019). This has heightened the demand for less risky approaches of innovation (Brunswick and Chesbrough, 2018).

Conventionally, companies relied solely on internal research and development (R&D) capabilities, facilities, knowledge and resources, to turn inventions into innovation. This is designated as, a closed innovation model (Chesbrough, 2003). Closed innovation is fraught with staggering costs and increased risks across industries (Brunswick and Chesbrough, 2018). Thus, companies are shifting from closed innovation to open innovation.

The paradigm was coined by Chesbrough to encourage companies to search for innovation opportunities beyond their confines (Chesbrough, 2003). Open innovation allows companies to leverage its partners' resources. Partners may include research centers, universities, suppliers, customers and governmental research institutes. As a result, this may reduce the innovation time by dividing labor among partners (Chesbrough, 2003). Furthermore, when external partners are involved in the innovation, the process becomes open to external scrutiny, thus timely and quality feedback can be attained. Thus, more investors would have a positive sentiment toward the company about their future profit and invest, hence affecting the stock price. Therefore this study posits that open innovation is an important factor to consider when predicting stock price movement.

## **3 Proposed Method**

The aim of the proposed model is to predict whether the stock price is falling or rising, using open innovation data and historical stock price data. The open innovation announcements deduced from company press release headlines are used as an open innovation indicator and they are nominal (Yes or No). If there is a particular announcement regarding open innovation activities such as sourcing external knowledge or partnerships or collaboration, then the value for that record is "Yes." If there is no open innovation activity then the value is "No."

The historical stock price data which are opening, high, low and closing prices for the current day, are downloaded from Yahoo finance. The model architecture is exhibited in figure 1 below;



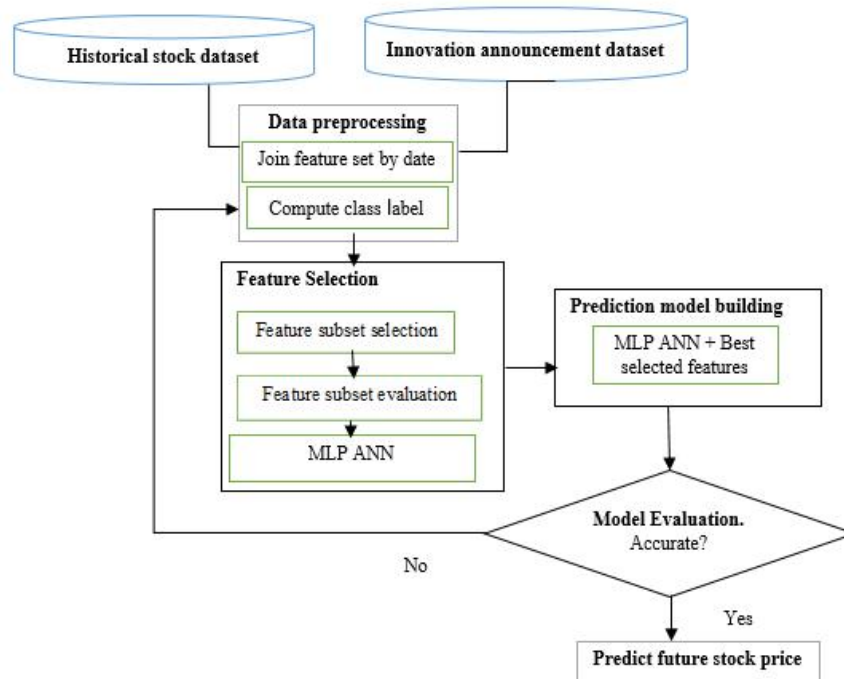


Figure 1 Proposed Model Architecture

### 3.1 Data preparation

All the data preparation is performed in Microsoft excel. The first step, is to join historical stock price and innovation announcement datasets by date. If there is a press release announcing any open innovation activity on a particular day, then the label for that day is “Yes” or otherwise “No.” The next section is to label each data instance as either rise or fall. This is computed based on the variance between the closing price of the current day and the previous day. If the closing price for the current day is higher than the closing price for the previous day, then the price label is rise, otherwise it is labeled as fall. The resulting output is used as input to the feature selection phase.

### 3.2 Feature selection

By eliminating variables that do not add any value to the accuracy of the model, the efficiency of the algorithm is enhanced (Kumar and Minz, 2014). Also feature selection chooses the most determinant variables for a particular class. This section will test whether open innovation is important for predicting stock price risk. The study applies a wrapper approach and best fit search method that use MLP ANN for subset evaluation. The advantage of the wrapper approach is that it selects an optimal subset that is most appropriate to the learning algorithm, therefore, the accuracy of the wrapper methods are normally better (Kumar and Minz, 2014). The accuracy of the wrapper method in this paper is evaluated using cross-validation.

### 3.3 Prediction model building

This section builds a model that predicts the stock price risk class based on the collected feature set. The combined dataset is split into training and testing sets, and MLP ANN is used to learn patterns from the dataset. An MLP is a feed forward ANN model that maps a set of input data in to suitable output. It comprises several layers of nodes in a directed graph, with each layer fully connected to the next one (Thota and Chandalasetty, 2013). Apart from the input nodes, every node is a processing component (neuron) with a nonlinear activation function. This ANN applies a supervised learning technique known as back propagation for building the model. Its strength lies in the ability to solve complex problems like fitness approximation. The MLP architecture is depicted in figure 2 below;

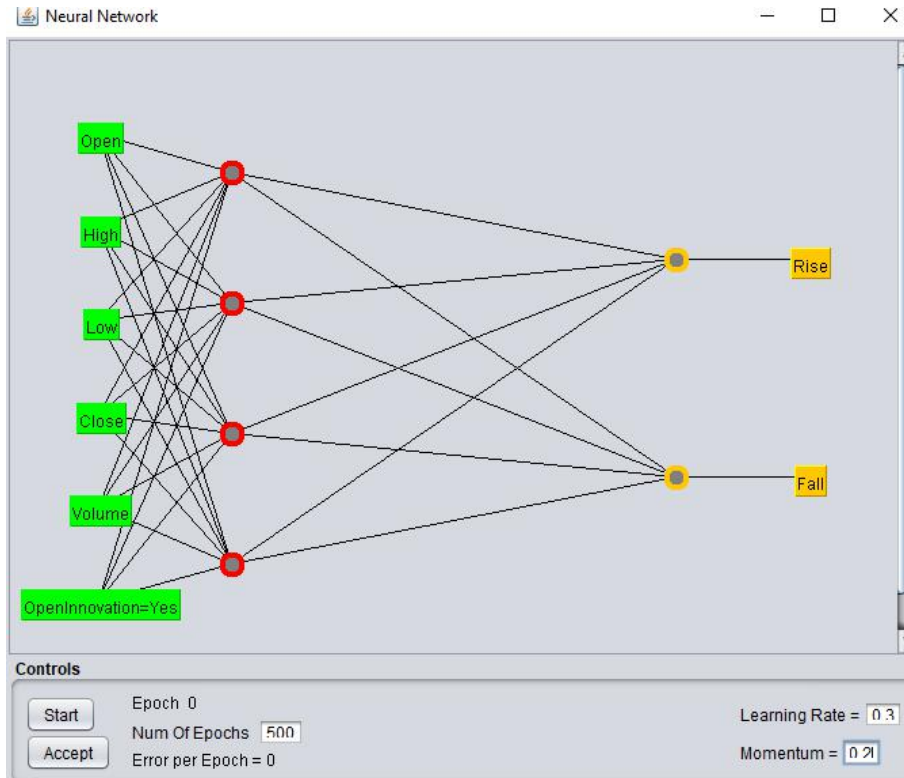


Figure 2 MLP ANN Architecture in WEKA

### 3.4 Model evaluation

An experiment is carried out for MLP ANN and percentage split validation is used to estimate performance. Out of all the instances, 80% are utilized for training and the remaining 20% make up the test set. Overall classification accuracy, is employed as an evaluation metric. It measures the overall effectiveness of the model by computing the percentage of correctly classified instances out of all the instances as shown below;

$$Accuracy = \frac{TP + TN}{TP + TN + FP + FN} * 100$$

Where TP (true positive) is the number of positive instances that were indeed correctly predicted as positive.

TN (true negative) is the number of negative instances that were correctly predicted as negative instances. FP (false positive) is the number of negative instances that were incorrectly predicted as positive and FN (false negative) is the number of positive instances that were incorrectly predicted as negative.

### 4 Experimental Results

This section describes the experimental results performed to predict the stock price movement using AI and open innovation data. The Alibaba group's stock price data from 19 September 2014 to 22 May 2019 obtained from Yahoo finance is used. The historical stock price dataset contains 1175 instances and the open innovation announcements are 86 in total. After joining the datasets, the final dataset contains 1175 instances and 7 features. A total of 940 instances are used for training the MLP ANN. Performance evaluation is done on the remaining 235 instances. The experiments is performed in the Waikato Environment for Knowledge Analysis (WEKA). The WEKA data mining workbench is an open source and free software that offers researchers a platform to conduct experiments by applying various to datasets of their choice (Hall et al., 2009). Prior to experimentation, attribute selection is performed. The rankings of the most predictive features are summarized in figure 3.

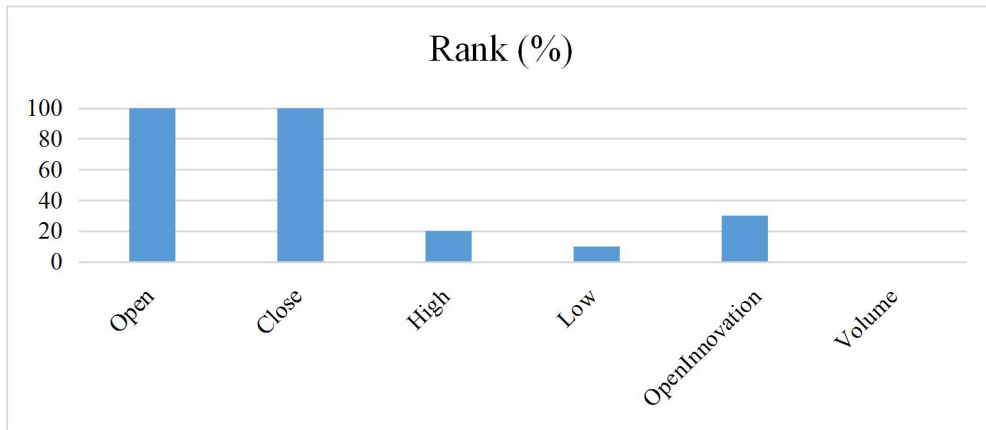


Figure 3 Feature Selection Ranking

As indicated by figure 3, the volume is least correlated to the stock price risk with a ranking of 0% and thus it is manually eliminated. After the deletion of volume feature, the accuracy of the MLP ANN remains the constant, meaning that the volume does not add any value to the effectiveness of stock price risk prediction. Similarly, the lowest price is less correlated to stock price risk prediction with a ranking of 10% and it is also deleted. However, the accuracy of the MLP ANN increases to 76.2%. This means lowest price degrades the accuracy of the stock price risk prediction. The highest price had a ranking of 20% and when it is eliminated, the model performance declines to 75.7%. Therefore highest price feature is retained. Open innovation is correlated to stock price risk with a ranking of 30%. The accuracy is the lowest (75.3%) when this feature is removed. Thus, open innovation announcements are a stock price risk factor and the feature is retained.

To this end, the final selected features for predicting stock price movement are opening price, closing price, open innovation announcements, and highest price. The results of the MLP ANN built with the selected features are shown below;

Table 1 MLP and Best Selected Features Results

Correctly classified instances	Incorrectly classified instances	Total	Accuracy (%)
179	56	235	76.1702

As illustrated in Table 1 the MLP ANN model, correctly classifies 179 out of 235 instances as either rise or fall. Thus, the overall classification accuracy of MLP ANN is 76.2%. The results demonstrate the model has a potential for practical usage in predicting stock price risk as either rise or fall. However, further improvements to the accuracy are necessary.

## 5 Conclusion

This paper presented a model based on MLP ANN, historical stock price data and open innovation announcements for predicting stock price movement. The model is developed to assist investors in their decision making process. The results indicated that the MLP ANN was able to correctly stock price as either rise or fall, with an accuracy of 76.2%. Furthermore, the feature selection experimentation also revealed that opening price, closing price, open innovation announcements, and highest price are the most determinant factors of stock price. Essentially, the results indicate the proposed approach as a promising avenue of research. However, the study is subject to some limitations. It considers Alibaba group dataset only, additional datasets need to be considered to assess the applicability of open innovation in stock price movement prediction and enhance its accuracy. The work can also be extended by examining the utility of deep learning, sentiment analysis techniques coupled with other stock price predictor variables such as corporate social responsibility.

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## **Study on Shutdown Time of Enterprises under Flood Disaster Scenario: A Case of Yuyao Companies after Typhoon Fitow**

Yang Lijiao, Ding Xiaonan, Jiang Xinyu

School of Management, Wuhan University of Technology, Wuhan, P.R.China, 430070

(E-mail: yanglj976@163.com, dxn0929@foxmail.com, jxy119@whut.edu.cn)

**Abstract:** With the acceleration of climate change and urbanization, flood disasters are becoming more and more frequent. The assessment of flood disaster loss has become the core content of disaster risk management research. However, the research methods of regional loss assessment, at present, mainly focus on using I-O and CGE models basing on macro input-output table. There are few methods to evaluate economic losses from bottom to top on the basis of micro-enterprises' loss data. In this paper, based on the data of production stagnation and reduction time of enterprises suffering Typhoon Fitow in 2013, using survival analysis model and considering the relationship between disaster risk and vulnerability of disaster-bearing bodies, we proposed a method for evaluating the shutdown time of effected enterprises. The results shows that: For all types of enterprises, inundation is an important risk factor leading to shutdown. Furthermore, when the inundation exceeds 0.5 meters, the average shutdown time of enterprises is extended by one week compared with those of enterprises whose inundation is less than 0.5 meters. If the inundation exceeds 1 meters, the average shutdown time of enterprises is 2 weeks longer than that of enterprises whose inundation is less than 0.5 meters. Meanwhile, we found that for different types of enterprises, there are significant differences in other factors leading to the extension of shutdown time except for the inundation. Therefore, combined with different influencing factors, this paper accurately estimates the average shutdown time of traditional manufacturing enterprises under 9 inundation scenarios and those of commercial enterprises under 3 inundation scenarios. The results of this study can provide input parameters for further establishing micro-enterprise loss model and connecting macro-regional loss model, and provide scientific basis for regional disaster prevention and mitigation management.

**Key words:** Flood disasters; Survival analysis model; Shutdown time of enterprises; Yuyao

### **1 Introduction**

Flood disasters are one of the most serious natural disasters causing economic losses worldwide. Hurricane Florence hit the East Coast of the United States in 2018, and the heavy rainfall caused severe flooding and property losses about 20 billion US dollars. According to China Eco-environment Bulletin 2017 published by Ministry of Ecological Environment of China, the direct loss of flood disasters in China amounted to 214.3 billion yuan. With the increase of extreme rainfall frequency caused by global climate change and the agglomeration of population and enterprises to cities, the risk of flood disaster increases(IPCC, 2014). As the core content of disaster risk management, disaster loss assessment is becoming more and more important.

At present, the researches of flood disaster loss assessment is mostly based on macro-perspective, which regards the loss of industrial sectors in the whole region. Among them, I-O and CGE loss

assessment models are taken as examples, scholars have carried out a lot of related researches (Hallegatte S, 2008; Xie wei, 2012; Zhang Peng, 2012; Wang G., 2015; Jiang Ling, 2016). These two models can be used to assess the loss for the impact of multi-region and multi-stakeholders (including government, enterprises and residents). However, they also have some shortcomings: The classical I-O model is considered to be over-estimated or pessimistic because of the linear substitution of capital and labor and the instantaneity of industrial loss rate setting (Hallegatte S, 2014; Okuyama Y, 2013). CGE model compensates for the weakness of linear substitution through non-linear function, but recent empirical studies have found that CGE model also has some weaknesses. CGE is also considered as underestimation or optimism model, because, in the short term after the disaster, the fluctuation of product price is difficult to grasp and the price of long-term products is relatively stable (Mackenzie C A, 2012). Therefore, the accuracy of the current macro-perspective model for assessing the economic losses needs to be further studied.

Aiming at the lack of loss estimation model at micro level and the problem that the accuracy of loss ripple effect evaluation model at macro level needs to be improved, this paper evaluates the actual shutdown time of micro-enterprises by investigating different types of enterprises. Meanwhile, this paper sorts out the current literature of disaster-stricken enterprises' loss. In earlier studies, Yu Qingdong (Yu Qingdong, 1998) simplifies assessment model of enterprise shutdown losses, and Mao Chunmei (Mao Chunmei, 1998) estimates the loss of shutdown through various expenses and additional expenditures incurred after the disaster. In latest research, Huang Min (Huang Min, 2015), to establish a production cut-off loss model for industrial enterprises, combines with the earthquake damage situation and production cycle theory, considering the disaster loss coefficient and production cut-off time synthetically. However, these previous studies do not examine the relationship between disaster risk and vulnerability, and were difficult to use for rapid assessment of post-disaster losses. Although the latest research involves the issue of shutdown time, the localization process of the model has not been completed due to the lack of local enterprise loss data in flood disaster scenarios.

Therefore, taking Yuyao disaster-stricken enterprises in Zhejiang Province as an example, which was attacked by typhoon "Fitow" in 2013, using survival analysis model and considering the relationship between disaster risk and vulnerability, this paper explores the key factors leading to the extension of enterprise shutdown, and estimates the shutdown time, which can provide input parameters for further establishing micro-enterprise loss model and connecting macro-regional loss model. Meanwhile, this paper can provide policy recommendations to guide the rapid recovery of enterprises after disasters, and comprehensively enhance the ability of disaster prevention and mitigation in the region, which has strong practical significance.

## 2 Methodology

Survival analysis, also known as risk model, is a statistical analysis method to study the relationship between survival phenomena and response time data. This method has been applied in biology, medicine, insurance, sociology and economics (Guan Chentao, 2017; Wu Bing, 2007; Chen Jinghao, 2016).

In this paper, the shutdown process of disaster-stricken enterprises can be understood as a survival event in essence. Stoppage time can be regarded as survival time, and the end event is the end of "stop state". In previous studies, Yang L J (Yang L J, 2016) and others initially used this method to estimate the stagnation of various disaster-stricken enterprises during the 2000 Nagoya rainstorm disaster in Japan. However, there is still a lack of research on disaster recovery factors and disaster time estimation of small and medium-sized enterprises in China under flood disaster scenarios.

## 2.1 Basic principles of survival analysis

Survival analysis includes the following four key functions: cumulative probability density function, probability density function, survival function and risk function.  $T$  represents the stochastic variables of shutdown time of disaster-stricken enterprises, the functions are defined as formula (David G. Kleinbaum, 2011):

$$F(t) = P(T \leq t) = \int_0^t f(x) dx \quad (1)$$

$$f(t) = \frac{dF(t)}{dt} = F'(t) \quad (2)$$

$$S(t) = P(T > t) = 1 - F(t) = \int_t^{\infty} f(x) dx \quad (3)$$

## 2.2 Construction of survival analysis model

Based on the above four key functions, the survival time model can be established by descriptive method, non-parametric method (K-M), semi-parametric method (Cox) and parametric method. At present, Cox model is the main method to study the influencing factors of survival duration. However, the basic assumption of this model is that different individuals have a constant proportion of mortality risk at any time. This hypothesis has some limitations for the study of different types of enterprises' shutdown time. Therefore, in order to accurately reflect the actual situation of shutdown time of various disaster-stricken enterprises, and make the research results more practical, this paper chooses the parameter method.

In order to facilitate readers to understand the whole process of building the model, this paper takes Weibull model as an example:

Weibull probability density function is as follows:

$$f(t) = k\lambda^{-k} t^{k-1} \exp(-\lambda^{-k} t^k) \quad (4)$$

The scale parameters  $\lambda$  and shape parameters  $k$  are all constants greater than 0. The survival function  $S(t)$  is as follows:

$$S(t) = P(T > t) = 1 - F(t) = \exp(-\lambda^{-k} t^k) \quad (5)$$

Introducing statistically important influencing factors,  $\ln(\lambda^{-k}) = x^T \beta$ , a Weibull model with multi-factors is constructed as follows:

$$S(t, x) = \exp[-t^k \exp(x^T \beta)] \quad (6)$$

The parameters  $k, \beta$  can be estimated by maximum likelihood estimation.

$$L = \prod_{i=1}^n [S(t_i)]^{1-\delta_i} [f(t_i)]^{\delta_i} \quad (7)$$

Where  $i$  and  $n$  respectively represent the number of the first sample and the total number of individual samples,  $\delta_i = 0$  indicates the sample lifetime is censored data, otherwise,  $\delta_i = 1$  indicates the

sample lifetime is non-censored data. The formula is further transformed into logarithmic likelihood function:

$$\begin{aligned} \text{Log}(L) &= \sum_{i=1}^n [\delta_i \log h(t_i, x_i) + \log S(t_i, x_i)] \\ &= \sum_{i=1}^n [\delta_i \{x^T \beta + \log k + (1-k) \log(t_i)\} - t_i^k \exp(x^T \beta)] \end{aligned} \quad (8)$$

### 3 Data

#### 3.1 Survey of research areas

On 7 October 2013, typhoon Fitow (201323) landed at Shacheng Town at the junction of Zhejiang and Fujian at 1:15 a.m. Affected by the heavy rainstorm caused by Typhoon Fitow, Yuyao suffered a once-in-a-century flood, with a maximum rainfall of 499.9 mm. More than 70% of the urban area was flooded, with water depth of more than 1.5 meters in many places. Water generally accumulated for more than 3 days, and in some areas for more than 10 days. According to the statistics of Government Work Report 2014 of Yuyao City, there are more than 20,000 enterprises that have been affected or shut down, and the direct economic loss of Yuyao City is 22.77 billion yuan.

#### 3.2 Research data

According to the national economic industry classification standards, the study divides the sample data of 211 disaster-stricken enterprises into 13 categories of manufacturing and 3 categories of commercial industries. Considering the analyzability of the sample, the sample of Yuyao research enterprises is further divided into two categories: 159 traditional manufacturing enterprises and 62 commercial enterprises. The traditional manufacturing industries include textile and apparel industry, culture and education industry, rubber and plastic products industry, non-metallic mineral manufacturing industry, metal products industry, general equipment manufacturing industry, special equipment manufacturing industry, automobile manufacturing industry, electrical machinery and equipment manufacturing industry, instrument manufacturing industry, paper and paper products industry, other manufacturing industries, printing and recording media reproduction industry; Commercial enterprises include resident services, accommodation and catering, and wholesale and retail businesses ( Figure 1).



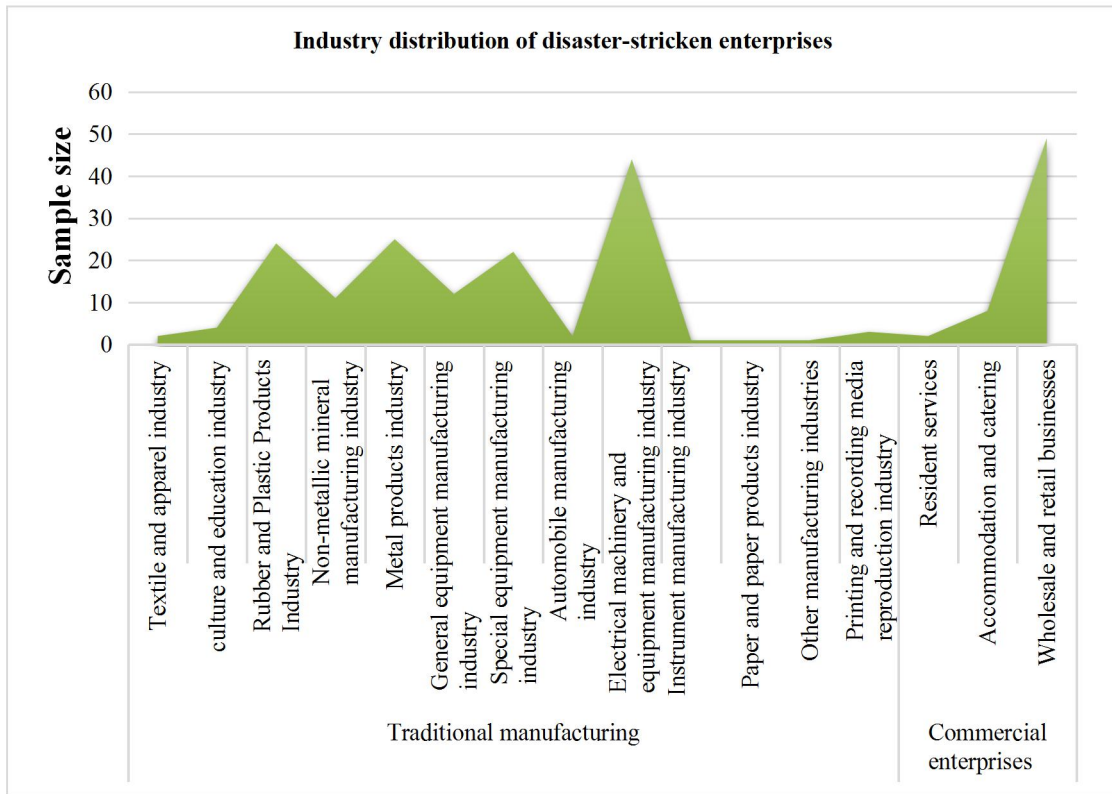


Figure 1 The Industry Distribution of Questionnaire Samples

## 4 Results and Analysis

### 4.1 Model selection

The lifetime distribution functions involved in the parametric method include Weibull distribution, exponential distribution, lognormal distribution, normal distribution. Based on the data distribution characteristics of shutdown time of different types of disaster-stricken enterprises in Yuyao City, this paper calculates the goodness-of-fit value (Table 1).

Table 1 Goodness of Fit for Each Distribution

Distribution	AIC		BIC		D	
	TE	CE	TE	CE	TE	CE
Weibull	1037.02	384.70	1043.04	388.86	0.1189	0.1508
exponential	1056.66	393.79	1059.67	395.86	0.1229	0.1264
lognormal	1195.42	376.97	1195.42	381.12	0.2109	0.1012
normal	1097.17	425.89	1103.19	430.05	0.1935	0.2303

Compared with other distribution functions, Weibull function fits well the distribution of shutdown

time for traditional manufacturing enterprises. Specifically, the AIC and BIC values of the data fitted by Weibull function are the smallest, that is, the complexity of the function model is the smallest, and the D value is the smallest, that is, the maximum vertical difference between the observed values and the fitted values of all sample points is the smallest. For commercial enterprises, lognormal function can better fit the shutdown time of enterprises.

#### 4.2 Explanatory variable selection

In this paper, shutdown time are taken as dependent variables. By screening explanatory variables, an estimation model is built to predict the shutdown time of disaster-stricken enterprises. Different from the traditional non-probabilistic regression model, this paper adopts survival analysis regression model, which can not only explore the main factors affecting the shutdown and recovery of enterprises, but also show the characteristics of shutdown time of different types of enterprises. Based on the existing researches at home and abroad, this paper finds that many scholars regard submergence depth, number of workers, loss rate of fixed assets, loss rate of inventory and decline rate of production capacity as important factors affecting the shutdown time of enterprises (Shi Yong, 2015; Zhang Y, 2009; Koks E E, 2015; Kajitani Y, 2014).

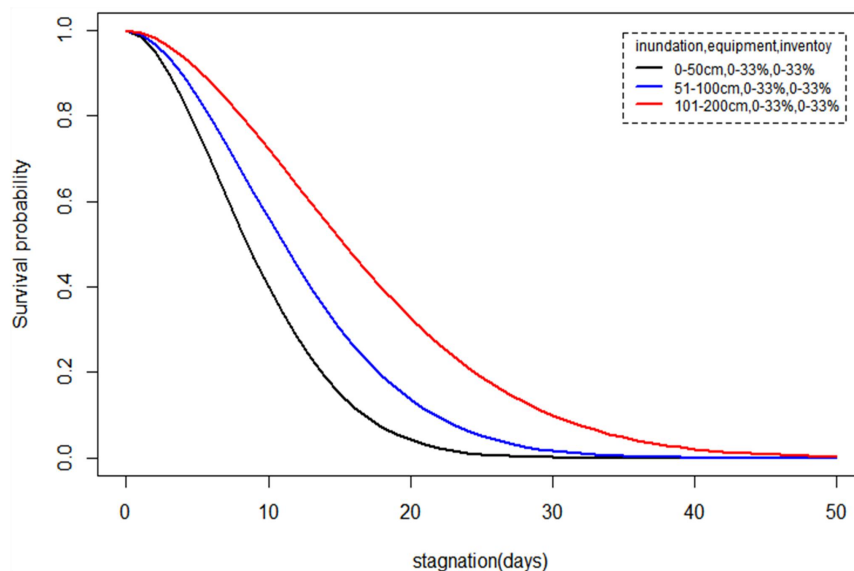
#### 4.3 Parameter estimation of the model

Based on the selection of model and explanatory variables, Weibull parameter model of traditional manufacturing enterprises affected by disasters and lognormal parameter model of commercial enterprises affected by disasters are used for shutdown time model, and the estimated parameters are as follows (Table 2):

**Table 2 Estimation Results of Parameters of Enterprise Shutdown Time Model**

(a) Traditional Manufacturing (Weibull)				
Variables	Parameters	Standard error	Z	p
(Intercept)	2.06527	0.08975	23.01	<2e-16
inundation	0.00431	0.00163	2.64	0.0083
equipment	0.00932	0.00310	3.01	0.0026
inventory	0.00461	0.00261	1.76	0.0777
Log(1/k)	-0.57725	0.06840	-8.44	<2e-16
Chisq	47.36 ( DF=3, P=2.9e-10 )			
(b) Commercial Enterprises (lognormal)				
Variables	Parameters	Standard error	Z	p
(Intercept)	1.83743	0.11372	16.16	<2e-16
inundation	0.00687	0.00214	3.21	0.0013
Log(scale)	-0.41476	0.09206	-4.51	6.6e-06
Chisq	9.49 ( DF=1, P=0.0021 )			

According to the estimated parameters, the probability distribution maps of shutdown time of disaster-stricken enterprises under different disaster levels are drawn, and the shutdown time is predicted. Take the shutdown time of traditional manufacturing industry as an example: Fig.2 shows the probability distribution of shutdown time of traditional manufacturing enterprises in Yuyao City under three different disaster levels. The black curve shows the probability distribution of shutdown time when inundation depth is 0-0.5 meters and fixed assets and inventory are slightly lost; the blue curve shows the distribution of shutdown time when inundation depth is 0.51-1 meters and fixed assets and inventory are slightly lost; the red curve shows the shutdown time when inundation depth is 1.1-2 meters and fixed assets and inventory are slightly lost. It also can be concluded that the average shutdown time of manufacturing enterprises under three disaster levels is 11, 17 and 23 days respectively. Similarly, it can be predicted that the shutdown time of Yuyao commercial enterprises under different flooding depths is 7, 13 and 16 days respectively. Therefore, when the enterprise is aware of its disaster situation (such as inundation depth), it can estimate the possible shutdown time of the enterprise, so as to rationally arrange the business strategy during the shutdown period.



**Figure 2 Distribution of Shutdown Time for Traditional Manufacturing**

Finally, a multi-variable shutdown time model are established to predict the possible shutdown time of traditional manufacturing enterprises and commercial enterprises under various submergence scenarios (as shown in Tables 3 and 4). The average shutdown time of traditional manufacturing enterprises under 9 different scenarios are predicted with different submergence depths and different composite scenarios of fixed assets and inventory losses. The average recovery time under the compound scenarios of shutdown time, different productivity decline rate and inventory loss; the average shutdown time under three different submergence scenarios and the recovery time under three different inventory loss scenarios for commercial enterprises.

**Table 3 Prediction Results of Traditional Manufacturing under Various Submergence Scenarios**

equipment & inventory	Shutdown Time(days)								
	L&L	L&M	M&L	M&M	L&S	S&L	M&S	S&M	S&S
inundation									
0-50cm	11	12	14	15	14	16	17	21	24
51-100cm	17	15	17	21	16	20	22	26	29
101-200cm	23	24	21	28	25	26	29	31	36

**Table 4 Prediction Results of Commercial Enterprises under Various Submergence Scenarios**

inundation	Shutdown Time(days)
0-50cm	7
51-100cm	13
101-200cm	16

## 5 Conclusion

Based on the survival analysis parameter model and the historical disaster data of local enterprises, this paper studies the shutdown time of disaster-stricken enterprises under flood disaster scenarios. The paper provides the basis for enterprises to formulate emergency response for flood disasters. At the same time, using this model to estimate the shutdown time of different types of enterprises under different submergence scenarios will help to accurately assess the indirect economic losses of affected enterprises. Meanwhile, the research methods and results can provide reference for studying the losses of disaster-stricken enterprises in other flood-affected areas. This study finds that:

For all enterprises in Yuyao City, the inundation depth is an important risk factor leading to the shutdown of the disaster-stricken enterprises. As far as traditional manufacturing industry is concerned, when the inundation exceeds 0.5 meters, the average shutdown time of enterprises is prolonged by one week compared with that of enterprises with inundation less than 0.5 meters; when the inundation exceeds 1 meter, the average shutdown time of enterprises is prolonged by two weeks compared with enterprises with inundation less than 0.5 meters, the same is true for commercial enterprises. Therefore, enterprises should choose higher location. Meanwhile, enterprises and governments need to strengthen the infrastructure construction of surrounding drainage systems, and formulate detailed flood control engineering measures plan.

For different types of enterprises, there are great differences in other influencing factors except inundation, which lead to prolonged shutdown time. Compared with commercial enterprises, the shutdown time of traditional manufacturing enterprises is mainly affected by the loss of fixed assets and inventory. For example, when the inundation depth of enterprises is not more than 0.5 meters, the

shutdown time of enterprises with moderate loss of fixed assets and inventory is prolonged by 1 week, while that of enterprises with severe loss is prolonged by 2-3 weeks on average.

The shutdown time of different types of enterprises can be accurately exported under various inundation scenarios, including the average shutdown time of traditional manufacturing enterprises in Yuyao City in 9 inundation scenarios and commercial enterprises in 3 inundation scenarios. The final shutdown time calculation results can provide input parameters for further establishing micro-enterprise loss model and connecting macro-regional loss model, and improve the accuracy of loss assessment.

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## Study on the Credit Customer Default of Local Commercial Bank in Southern Jiangsu Province Based on Logistic Model

Zhang Haoru, Fang Ming

School of Management, Wuhan University of Technology, Wuhan, P. R. China, 430070

(E-mail: vk110e5.7@gmail.com, fxlasting@aliyun.com)

**Abstract:** With the deepening of financial innovation and sharp changes in the external market environment, the increasing international banking risk shows a complex and diversified characteristics. In this study, a Logistic Model is used to calculate the current probability of non-retail credit customer default of local commercial banks in southern Jiangsu Province. In addition, an analysis and a suggestion of a more timely, dynamic, accurate credit rating system are given according to the default probability results. This study also has significant reference for other local commercial banks to build strategic alliance for building their internal credit rating system.

**Key words:** Commercial bank; Credit customer; Probability of default; Logistic model

### 1 Introduction

With the deepening of financial innovation and the rapid changes in the external market environment, the risks faced by the international banking industry are complicated and diversified. However, the World Bank has studied the global banking crisis and found that one of the important reasons for the liquidity crisis caused by the decline of asset quality of banks is credit risk. Credit risk has become an important cause of bank failures and even regional and global financial crises.

After the financial crisis came up in 2008, the Basel III was introduced in 2010. With several twists and turns, it finally released its latest regulations on January 2013. The new agreement calls for commercial Banks to use the internal rating method to evaluate customers' credit status (Arun C. et al., 2017). In order to distinguish different types of credit risk, the Basel committee classified the risk into sovereign risk, bank risk, corporate risk, retail risk, project financing risk and equity risk according to different risk exposures. The internal rating method (IRB) includes the primary method and the advanced method. It refers to the method to determine the risk-weighted assets of an asset business based on risk parameters such as default probability (PD), default loss rate (LGD), default risk exposure (EAD) and maturity (M). The new capital agreements also points out that commercial banks must carry out comprehensive reform in order to meet the basic conditions of internal rating system.

In terms of research on credit rating, a scholar summarized that credit rating and loan to small customer appear to be inefficiency, thus more attention should be paid to small and medium-sized financial industry (Leonard et al., 2018). However, the credit rating process could even be related to irrational decision (Gibson et al., 2014).

However, as far as the domestic situation is concerned, large state-owned commercial banks like ICBC and joint-stock commercial banks like CMB have successively carried out the construction of internal rating system and achieved a certain degree, but the implementation of new capital agreement

of local commercial bank is just at the initial stage. Without the huge resource owed by the large state-owned commercial bank and the joint-stock commercial bank, local commercial banks tend to build a smaller and easier internal rating system, or outsource that to an agency. And it is not rarely to find that local commercial bank share their ratings information with their peer. While a more rating industry competition leads to stronger corporate misreporting incentives, it is important to strengthen the internal rating system (Lee K. et al., 2019). In addition, some empirical evidences show regional bias in credit rating agencies (Talha A.Y. et al., 2018).

In terms of research on credit rating index system, the main point of credit rating index system is to clarify the credit elements, which methods are mainly 3C, 5C, 3F, 5P in the world (Xiang Lishuang et al., 2019).

Afterwards, Logistic Regression, Neural Network and Factor Analysis Models were introduced into the credit rating, which made up for the shortcomings of traditional methods like lack of objectivity and comprehensive analysis. Traditional Logistic Model and Probit Model are widely used due to their strong ability of identification, prediction, promotion and good comprehensibility (He Guanghui et al., 2017). For the first time, dynamic information was integrated into the rating model to make up for the deficiency of existing studies that pay less attention to the change trend of evaluation value, which is more consistent with the variability characteristics of enterprises (Zhang F. et al., 2016). Thus, the comprehensiveness and reliability of evaluation conclusions are improved.

## 2 Sample

The internal credit rating method of bank credit customers is a process of gradual evolution and continuous improvement, especially since the 1950s. With the development of credit risk analysis technology, more and more quantitative techniques have been gradually applied to the internal credit rating of commercial bank. After several the financial crises outbreak, with the modern computer technology development, the banking industry pays more and more attention to the quantitative analysis of risk.

The credit rating system is an important role for commercial banks to evaluate credit and reflect the solvency and willingness of bank loan customers. The relative measurement of these factors in credit management system is mainly the market competitiveness of customers, the solvency of assets and the organizational management level of customers. China's commercial banks are divided their own credit customers into different credit grades with their evaluation system, which includes Five Grades System, Nine Grades System and Seven Grade System.

Although there are some differences in the setting of credit rating index system of China's commercial banks, the content of their evaluation indexes is almost the same. The customer sample used in this study is generally composed of four categories of indicators, including the organization's financial performance, capital operation, solvency and development prospect. Basic, revision and evaluation are the three levels of rating indicators. These three levels of rating indicators are mutually calibrated to form credit rating results. The final customer score is divided into the following credit ratings: 80 or higher to AAA; 80-70 to AA; 70-60 to A; 50-60 to BBB; 40-50 to BB; 30-40 to B; all scores below 30 are in level C.

The data source of this study is the data of credit customers of several commercial banks in southern Jiangsu Province. All these commercial banks have explored ways to implement new capital agreements for their developments. It is also the precedent that China's local commercial banks start to



implement the Basel III. In order to scientifically and reasonably construct the credit customer default probability model of commercial financial banks, the data selection scope is the total number of corporate loan customers occurred and recorded in these commercial banks in southern Jiangsu Province, namely the sample population selected by the model. The sample is divided into 9 categories according to the main industry which the customer operates, which includes steel trade, construction, Class C production, Class B non-textile production, Class B textile industry, Class A non-textile production, Class A textile industry, non-steel wholesale and retail and service industry. This paper analyzes the rating distribution of 69632 automatic ratings and effective ratings of non-retail credit customers as of June 30, 2015, as shown in the following figure.

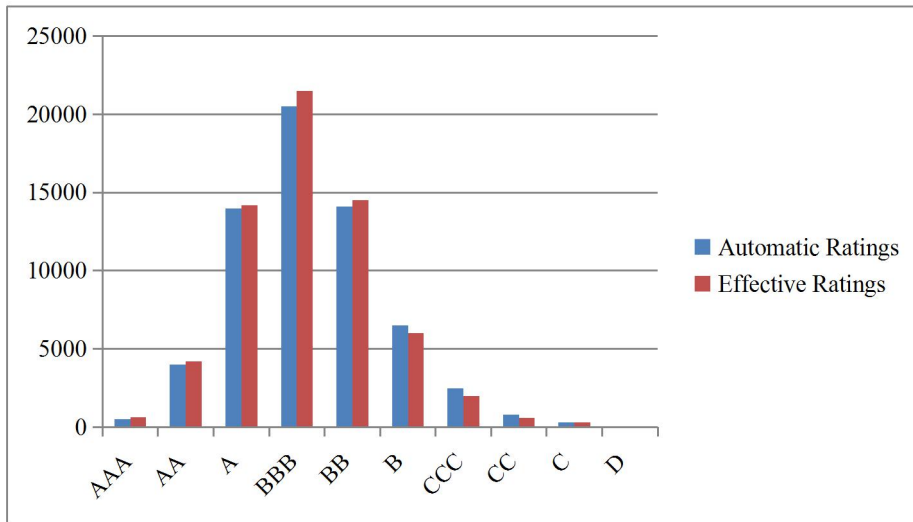


Figure 1 Customer Credit Rating Sample Distribution

### 3 Model

The core of the modeling method is to establish a model to measure risk factors. The most critical indicators of risk factors are default probability (PD) and default loss rate (LGD). The default probability refers to the possibility that the borrower cannot repay the loan principal and interest or fulfill the obligation in a certain period in the future. The default loss rate refers to the percentage of the amount of losses caused to the creditor by the borrower in the risk exposure (creditor's rights) once the borrower defaults, namely the severity of the losses. The current calculation model for PD mainly is Logistic Model, which suits to the cases where the dependent variable is a classification variable (Yue Linlin, 2015).

The default probability model used in this paper is Logistic model. This is because the Logistic function is simpler and clearer than the cumulative normal distribution and has abundant economic implications, as the formula shown below:

$$P(y_i = 1 | x_i) = P[\varepsilon_i \leq (\alpha + \beta x_i)] = \frac{1}{1 + \exp(-\varepsilon_i)}$$

The advantage of Logistic Model is that it can give us a probability between 0 and 1 and there is an inflection point in the curve, which means the value of the function increases slowly at first, then accelerates, and then decelerates and increases. This phenomenon is very consistent with the economic

meaning and business intuition, such as the impact of income on purchasing behavior. The Logistic Model is also logarithmically linear in nature, with many linear properties and it can introduce multiple factors in regression form.

After referring to reference and analyzed the complicated index rating system, nine indicators with high coefficients are selected to cover the three aspects of debt paying ability, profitability and operation ability, which include leverage, ROA, operating profit, ratio of total liabilities to deposit-income, EBITDA, sales revenue, capital accumulation, total asset turnover, long-term asset suitability(Gibson H.D. et al., 2014)(Antonella M., 2019). Due to the space and confidentiality factor, it is not possible to elaborate.

The final Logistic Model form is shown below:

$$P(y = 1|\chi) = \rho = \frac{\exp(\alpha + \beta_1\chi_1 + \beta_2\chi_2 + \beta_3\chi_3 + \dots)}{1 + \exp(\alpha + \beta_1\chi_1 + \beta_2\chi_2 + \beta_3\chi_3 + \dots)}$$

#### 4 Empirical Results

In this paper, the Logistic default probability model was used to analyze the default probability of all sample as of June 30, 2015, and the descriptive figure of PD of effective rating are presented in the form of graph as shown below.

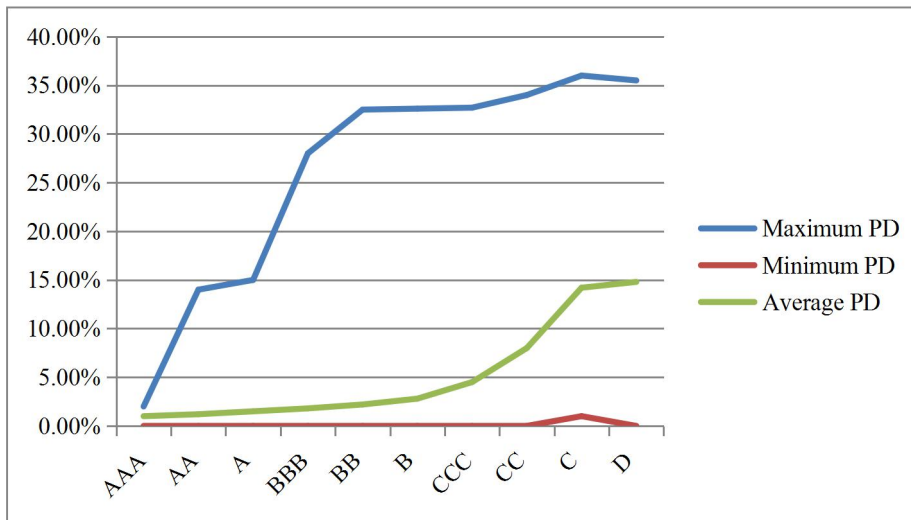


Figure 2 Effective Ratings PD Descriptive Figure

It is not difficult to figure out from the figure above that the average default rate of non-retail credit customers of several commercial banks in southern Jiangsu Province is about 1.7%. At the same time, with the gradual decrease of credit rating of non-retail credit customers, the default rate also shows a trend of gradual increase in turn, and the standard deviation of default rate is also increasingly large. That means a greater fluctuation range of default probability, which basically conforms to the basic law of default of non-retail credit customers in China.

From the above nine sectors, it is also not hard to find that the average default rate of non-retail

credit customers of several commercial banks in southern Jiangsu Province is different, which is determined by the development prospect of different industries and the quality of customer base. In general, the lower the average default rate, the higher the quality of non-retail credit customers in the industry. The detailed empirical results are shown below:

**Table 1 Nine Industry Average PD(%) Calculated Based on Logistic Model**

Class	Class A Textile Industry	Class B Textile Industry	Class A			Steel Trade	Non-steel Wholesale & Retail	Service	Constru ction
			Non- textile Product ion	Class B Non-textile Production	Class C Product ion				
AAA	0.454	0.421	0.366	0.332	0.432	0.891	0.966	0.199	0.991
AA	0.779	0.679	0.568	0.634	0.424	1.482	0.873	0.700	1.472
A	1.012	1.214	0.904	0.998	1.238	1.594	1.369	0.812	1.494
BBB	1.338	1.421	1.177	1.477	1.437	2.093	1.332	1.069	2.193
BB	2.181	2.365	1.864	1.732	1.923	2.852	2.045	1.524	2.832
B	3.472	3.876	2.743	2.984	3.014	3.904	2.328	2.326	3.814
CCC	5.032	5.132	5.040	5.132	5.234	4.966	2.449	3.331	4.466
CC	4.821	4.774	11.080	11.113	11.314	6.351	16.228	9.804	6.321
C	8.446	8.338	19.218	19.423	19.569	1.114	-----	15.530	1.101
D	12.645	13.987	14.835	14.423	15.019	-----	0.223	35.599	-----
Avg.	1.683	1.745	1.742	1.792	1.893	2.164	1.620	1.537	2.054

## 5 Conclusion

Credit rating is the basis of risk measurement. Without credit rating, there is no real risk management. Therefore, the research on the theory and method of credit risk rating is of great practical significance to the development of China's commercial banks, especially the development of risk management system. Based on the new requirements of the new capital agreement on the internal credit rating system, this study conducts an empirical study on the internal credit rating of the credit customers of several commercial banks in southern Jiangsu Province.

In line with the requirements of the new capital agreement, this paper analyzes and redesigns the internal credit customers rating system, and puts forward the idea of constructing default probability model by using Logistic Model. The Logistic Model involved in this paper is mainly aimed at calculating non-retail credit customers' default probability, and analyze the calculation results. The results show that the number of customers in 9 industries is close to the normal distribution, and the average default rate of steel trade industry is the highest, 2.164%. The service sector had the lowest average default rate, 1.537%.

A more timely, dynamic and accurate credit rating system is necessary for the current mechanism, therefore some suggestions are given according to the study. First of all, commercial bank should pay attention to the training, discovery and reserve of rating personnel, constantly optimize the structure of professional personnel, improve the business skills of relevant staff, and use a variety of measures to ensure its stability. Secondly, strengthening the professional training of credit staff, especially credit and

credit approval personnel, and improving their professional ability are conducive to improving the overall risk control ability of commercial banks and effectively identifying and resolving risks in core businesses. Finally, appropriate incentives and collaboration with professional institutions are also necessary to local commercial banks' rating system.

With the improvement of China's financial market, local commercial banks need to further design LGD models in the future, so as to better enter the stage of advanced internal rating law. In addition, only general corporate exposures are selected for the division of risk exposure in this paper, but other corporate exposures such as public institutions, professional loans and other financial institution exposure models are not analyzed, which needs to be further improved in future studies.

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## Research on Innovation Performance of High-Tech Enterprises from the Perspective of Venture Capital

Ye Xiaofen, Cheng Liang

School of Economics and Management, Wuchang Shouyi University, Wuhan, China, 430064

(E-mail: yexf1983@163.com, 1932773177@qq.com)

**Abstract:** High-tech enterprises are the main force of technological innovation. Introducing venture capital is the key measure to improve its innovation ability. Starting from the relationship between venture capital and high-tech enterprises, this paper analyses the influence of venture capital participation, venture capital share ratio, venture capital with state background on innovation performance of high-tech enterprises, then selects the high-tech enterprise data listed on GEM, and uses the regression analysis method for empirical research. The research results show that improving the innovation performance of high-tech enterprises is related to the participation of venture capital. Then, through further testing of the data, it is concluded that the characteristics of venture capital are also the key factors to improve the innovation performance of high-tech enterprises. Finally, according to the results of empirical analysis, this paper puts forward corresponding suggestions from three perspectives: government, venture capital institutions and enterprises.

**Key words:** Venture capital; High-Tech enterprises; Innovation performance; Regression analysis

### 1 Introduction

China has always advocated that science and technology is the first productive force. On October 18, 2017, the 19th National Congress of the Communist Party put forward that innovation is the first driving force to lead the development of science and technology. As an important force of technological innovation, high-tech enterprises have created 65% of invention patents and 80% of new products in China. However, high-tech enterprises have always been facing difficulties in financing because of their uncertain market prospects, high risks and large demand for financing. Because of their natural conservatism, the traditional financing channels and methods can't meet the demand for finance of high-tech enterprises. The emergence of venture capital has become a catalyst for promoting technological innovation in high-tech enterprises. In recent years, theorists have also paid much attention to the research of high-tech enterprises and venture capital. Some research results show that venture capital can help the growth of high-tech enterprises (Hassan, 2007; Pender, 2010; Gou Yannan, 2014), especially the increase of R&D investment (Zhang Pengkai, 2015; Hou Sihui, 2016; Ning Yuxin, 2017). Although the practice and the theory agree that venture capital has a positive effect on the technological innovation of high-tech enterprises, the effect is still lacking demonstration. This paper will select profitability index and technological innovation ability index to conduct exploratory research on venture capital and high-tech enterprises from the perspective of innovation performance.

## **2 Research Model Construction**

### **2.1 Research hypothesis**

Firstly, this paper studies the impact of venture capital participation on innovation performance of high-tech enterprises, and then on the basis of venture capital, further studies the impact of the Share-holding ratio and the state-owned background of venture capital on innovation performance of high-tech enterprises.

In the early stage of high-tech enterprises, it is difficult to obtain capital investment from traditional channels. The participation of venture capital exactly solves the financing difficulties of high-tech enterprises, and makes a significant positive impact on enterprise innovation performance (Hua Yong, 2018; Zou Shuang, 2017). At the same time, venture capital also brings advanced management experience to high-tech enterprises and helps them transform innovative achievements into market products. Thus, the first hypothesis of this paper is put forward.

H1: Venture capital participation has a positive and significant impact on the innovation performance of high-tech enterprises.

The control right of venture capital to high-tech enterprises is mainly determined by the proportion of equity held by venture capital, which is positively correlated. That is to say, the technological innovation ability of enterprises changes with the change of Share-holding ratio of venture capital. Another research shows that venture capital with large share-holding ratio is more conducive to technological innovation input and output of enterprises (Li Jiujin, 2018). Thus, the second hypothesis of this paper is put forward.

H2: The shareholding ratio of venture capital has a positive and significant impact on the innovation performance of high-tech enterprises.

Venture capital institutions with state-owned background have rich experience in investment management. They have a mature service system, which can not only provide more perfect services, but also help enterprises improve their innovation level (Wu Tao, 2017). Thus, the third hypothesis of this paper is put forward.

H3: State-owned venture capital has a positive and significant impact on the innovation performance of high-tech enterprises.

### **2.2 Sample selection and data source**

As part of the capital market, the GEM market is dedicated to promoting technological innovation in small and medium-sized high-tech enterprises. The accuracy, transparency and asset structure of its data are relatively good. Therefore, this paper selected 210 high-tech enterprises listed on GEM from 2015 to 2017 as research samples, of which 86 listed companies have venture capital background, accounting for 42.38%. The venture capital data comes from the company's prospectus, and the patent data is obtained from the website of the national patent search and analysis. The other data are from the Guotai'an database and the Shenzhen Stock Exchange.

## 2.3 Variables designing

### 2.3.1 Dependent variables

This paper measures the innovation performance of high-tech enterprises through profitability and technological innovation ability. The profitability is measured by the return on net assets; the technological innovation capability is measured by the investment in R&D and the number of patents. So, the return on net assets, R&D investment and the number of patents are taken as the dependent variables of this empirical study.

### 2.3.2 Independent variables

In order to measure the impact of venture capital on innovation performance of high-tech enterprises, this paper chooses venture capital, shareholding ratio of venture capital, state-owned venture capital as independent variables to investigate.

### 2.3.3 Control variables

Innovation performance of high-tech enterprises will be affected and constrained by other factors, such as enterprise size, establishment years, industries, regions, government subsidies and so on. These factors constitute the control variables of this study.

The design of dependent variables, independent variables and control variables is shown in Table 1.

**Table 1 Variables Description Table**

Variable Type	Variable Name	Variable Symbol	Variable Description
Dependent Variables	profitability	ROE	return on net assets
	technological innovation output	P	number of patents
	technological innovation investment	R&D	R&D investment amount, logarithmic
Independent Variables	venture capital	VC	venture capital, remember 1, not 0
	shareholding ratio of VC	VC share	the proportion of venture capital
	state-owned venture capital	VC background	state-owned, remember 1, not 0
Control Variables	years of establishment	Age	between the date of establishment and listing
	enterprise size	Size	total assets, logarithmic
	area	Area	eastern, central and western regions
	government grants	Gov	total amount, logarithmic
	industry	Industry	industry 1, information technology 2, others 0.

## 2.4 Modeling

In order to test the impact of venture capital participation on innovation performance of high-tech enterprises, this paper constructs the following models:

$$H1-1: ROE = \beta_0 + \beta_1 \times VC + \beta_2 \times Industry + \beta_3 \times Area + \beta_4 \times Age + \beta_5 \times Size + \beta_6 \times Gov \quad (1)$$

$$H1-2: R\&D = \beta_0 + \beta_1 \times VC + \beta_2 \times Industry + \beta_3 \times Area + \beta_4 \times Age + \beta_5 \times Size + \beta_6 \times Gov \quad (2)$$

$$H1-3: P = \beta_0 + \beta_1 \times VC + \beta_2 \times Industry + \beta_3 \times Area + \beta_4 \times Age + \beta_5 \times Size + \beta_6 \times Gov \quad (3)$$

In order to test the impact of different shareholding ratios of venture capital on the innovation performance of high-tech enterprises, the following regression models are constructed:

$$H2-1: ROE = \beta_0 + \beta_1 \times VCshare + \beta_2 \times Industry + \beta_3 \times Area + \beta_4 \times Age + \beta_5 \times Size + \beta_6 \times Gov \quad (4)$$

$$H2-2: R\&D = \beta_0 + \beta_1 \times VCshare + \beta_2 \times Industry + \beta_3 \times Area + \beta_4 \times Age + \beta_5 \times Size + \beta_6 \times Gov \quad (5)$$

H2-3:

$$P = \beta_0 + \beta_1 \times VCshare + \beta_2 \times Industry + \beta_3 \times Area + \beta_4 \times Age + \beta_5 \times Size + \beta_6 \times Gov \quad (6)$$

In order to test the impact of different backgrounds of venture capital on innovation performance of high-tech enterprises, this paper constructs the following regression models:

$$H3-1: ROE = \beta_0 + \beta_1 \times VCbackground + \beta_2 \times Industry + \beta_3 \times Area + \beta_4 \times Age + \beta_5 \times Size + \beta_6 \times Gov \quad (7)$$

$$H3-2: R\&D = \beta_0 + \beta_1 \times VCbackground + \beta_2 \times Industry + \beta_3 \times Area + \beta_4 \times Age + \beta_5 \times Size + \beta_6 \times Gov \quad (8)$$

$$H3-3: P = \beta_0 + \beta_1 \times VCbackground + \beta_2 \times Industry + \beta_3 \times Area + \beta_4 \times Age + \beta_5 \times Size + \beta_6 \times Gov \quad (9)$$

## 3 Empirical Analysis

### 3.1 The impact of venture capital on the profitability of high-tech enterprises

The regression analysis results of the impact of venture capital on the profitability of high-tech enterprises are shown in Table 2. From Table 2, we knew that the significance of venture capital participation for corporate profitability is 0.445, and there is a high degree of independence among the variables, because the VIF value is 1.571. Therefore, the participation of venture capital has a positive and significant impact on the profitability of enterprises. The significant difference of venture capital with different shareholding ratios is 0.896, while the VIF value of variance expansion factor is 1.38, which shows that the shareholding ratio of venture capital has a significant impact on the profitability of enterprises. The significance of venture capital in different backgrounds to the profitability of enterprises is 0.218, and the VIF value is 1.153. Therefore, it shows that the improvement of



profitability of enterprises is also positively related to venture capital with state-owned background.

**Table 2 Analysis of the Impact of Venture Capital on Profitability**

Model	Un-standardized	Standardized	T	Sig.	Collinear Statistics	
	Coefficients	Coefficients			Tolerance	VIF
	Std. Error	Beta				
(constant)	.173		-2.031	.044		
VC	.012	-.065	-.765	.445	.637	1.571
VC share	.001	-.013	-.165	.869	.725	1.380
VC background	.019	-.090	-1.235	.218	.867	1.153
Industry	.010	-.012	-.169	.866	.927	1.079
Area	.011	.082	1.178	.240	.953	1.049
Age	.001	-.082	-1.169	.244	.925	1.081
Size	.021	.159	2.075	.039	.781	1.280
Gov	.012	.131	1.687	.093	.762	1.313

a. Dependent variable: ROE

### 3.2 The impact of venture capital on R&D investment of high-tech enterprises

The regression analysis results of the impact of venture capital on R&D Investment of high-tech enterprises are shown in Table 3. The significance of venture capital participation in R&D investment for technological innovation is 0.905, which shows that the participation of venture capital has a positive and significant impact on R&D investment of technological innovation. The significant effect of venture capital with different share-holding ratio on R&D investment of technological innovation is 0.822. This shows that the higher the proportion of equity held by venture capital, the more financial support it will get in R&D. Enterprises will be more focused on technological innovation, and they will invest more in R&D. The significant effect of state-owned venture capital on R&D investment of technological innovation is 0.473, which shows that improving the level of technological innovation investment of enterprises is related to state-owned venture capital.

**Table 3 Analysis of the Impact of Venture Capital on R&D Investment**

Model	Un-standardized Coefficients		Standardized Coefficients	T	Sig.	Collinear Statistics	
	B	Std. Error	Beta			Tolerance	VIF
(constant)	-.977	.595		-1.641	.102		
VC	-.005	.041	-.007	-.120	.905	.637	1.571
VC share	-.001	.004	-.012	-.225	.822	.725	1.380
VC background	-.048	.067	-.036	-.719	.473	.867	1.153
Industry	.293	.034	.416	8.523	.000	.927	1.079
Area	.054	.038	.068	1.412	.159	.953	1.049
Age	-.002	.004	-.031	-.637	.525	.925	1.081
Size	.784	.072	.577	10.848	.000	.781	1.280
Gov	.151	.042	.196	3.643	.000	.762	1.313

a. Dependent variable: R&D

### 3.3 The impact of venture capital on patents of high-tech enterprises

The regression analysis results of the impact of venture capital on patents of high-tech enterprises are shown in Table 4. According to Table 4, the significance of venture capital participation to the patents is 0.042. The participation of venture capital has a positive impact on the technological innovation output, that is, venture capital is conducive to the improvement of the output level of technological innovation. The significance of venture capital with different shareholding ratios to the patents is 0.337. The venture capital with large shareholding ratio will increase the enterprise innovation achievements output. The significance of venture capital in different backgrounds to the patents is 0.408. State-owned venture capital is more conducive to improving the technological innovation output of enterprises.

**Table 4 Analysis of the Impact of Venture Capital on Patents**

Model	Un-standardized Coefficients		Standardized Coefficients	T	Sig.	Collinear Statistics	
	B	Std. Error	Beta			Tolerance	VIF
(constant)	-455.753	88.231		-5.165	.000		
VC	12.411	6.075	.163	2.043	.042	.637	1.571
VC share	-.618	.642	-.072	-.963	.337	.725	1.380

VC background	-8.245	9.938	-.057	-.830	.408	.867	1.153
Industry	.263	5.088	.003	.052	.959	.927	1.079
Area	-3.014	5.693	-.035	-.529	.597	.953	1.049
Age	.155	.536	.019	.290	.772	.925	1.081
Size	41.181	10.712	.277	3.844	.000	.781	1.280
Gov	15.874	6.158	.188	2.578	.011	.762	1.313

a. Dependent variable: P

## 4 Conclusion

Starting from the relationship between venture capital and high-tech enterprises, this paper analyses the influence of venture capital participation, venture capital share ratio, venture capital with state background on innovation performance of high-tech enterprises, then selects the high-tech enterprise data listed on GEM, and uses the regression analysis method for empirical research. The results show that venture capital has a significant role in promoting the profitability and R&D investment of high-tech enterprises, and a general role in promoting the number of patents of high-tech enterprises.

Therefore, in order to make better use of venture capital to improve the patent production of high-tech enterprises, we should make more efforts. First, in the face of technological innovation achievements of enterprises, the government should establish an effective intellectual property system, protect achievements and guide enterprises to carry out technological innovation. Second, after venture capital enters the enterprise, venture capital institutions take advantage of their rich management experience or technical advantages to strengthen the operation and management of venture capital, and ensure that venture capital is used for its original purpose. Third, high-tech enterprises can divide enterprise research and development projects into four stages: establishment, implementation, conclusion, transformation, and implement comprehensive management by designing monitoring measures of key points in each stage.

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## **Study on Employee Relationship Risk on the Effectiveness of Enterprise Structure Change in Cote d'Ivoire**

Monhéséa Obrey Patrick Bah<sup>1</sup>, Akadje Jean Roland Edjoukou<sup>2</sup>

1 School of Management, Wuhan University of Technology, Wuhan, P.R.China, 430070

2 School of Accounting, Dongbei University of Finance and Economics, Dalian, P.R.China, 116025

(E-mail: monheseabah@yahoo.com, edjoukou2015@yahoo.fr)

**Abstract:** Change is crucial for organizations in growing, highly competitive business environments. Among the employee's relationship, Communication has an important role because without clear information; it's impossible to understand each other. Shared Goals and Values, the core issue of companies, employees can't achieve organizational objectives if they didn't share them. Leadership style has a significant value. Choose the most suitable style to lead your employees is hot preoccupation nowadays. Change's theories describe the effectiveness with which organizations can modify their strategies, processes, and structures. Thus, the paper presents different variables apt to influence positively or negatively the change. To address this research, data has been collected from telecommunications, refinery, and services sectors through questionnaire and Smart PLS is the main tools and structural equation modeling, the techniques to analyze the data. Conclusions, limits and future research have been drawn in this paper.

**Key words:** Employee relationship; Enterprise structure change; Risk management; Human resources

### **1 Introduction**

In recent decades, performance has become the focused point of enterprises in the business sector. The business owner set up their strategies and design their structures to achieve the organizational goals. But, even if the performance has been reached, the leaders of the company should pay attention to several factors able to reduce their profit or disturb the ambiance in the workplace. With globalization and rapid transformation of business units, the change process became inevitable for the business survivor. Thus, we must consider many variables among them, the nature of Employee Relationship (ER). ER has been defined as the formal or informal relationship between two peoples or a group of individuals with converging characteristics, common goals, and the same vision. Kurt Lewin has introduced the concept of Organizational Structure Change; his work was based on social psychology and human behaviors when a company tries to improve his work manners or bring new ways, culture, and ideas. For him, the change is a process wished by the leader for the business needs (Kurt Lewin, 1947). In the change process provided by Kotter built on Lewin's work, the success of change is based on the involvement of employee because if one leader ignores the needs of his employee, this change will fail. Change is also a fact of organizational life, just as it is in human life (Kotter, 1996). An organization that doesn't change cannot survive long much less thrive in an unpredictable world. Several factors may make the organizational change necessary, including new

competition in the marketplace or new demands by customers (Kotler, 1999). When change is well planned and implemented, it brings many tangible benefits, including improved competitiveness, employee satisfaction. Mullins said that the change is not personal gain but make the organization stronger and better equipped for the future (Mullins, 2007). Therefore, the main question is, which are the factors that can predict enterprise structure change. To understand this question and address the right answer, this study aim will achieve the following objectives:

- To investigate the importance of enterprise structure change.
- To examine the effect of employee relationship on enterprise structure change in these sectors.
- To identify the obstacles that impact negatively on enterprise structure change's implementation.
- To provide recommendations on how to apply enterprise structure with limited risk.

Find out variables can impact organizational change; we need to move on the theoretical and empirical research.

## 2 Literature Review

The organizational change explains the movement of an organization from the known (current state) state to the unknown (desired future state) state. It is because the future of this change is uncertain and may concern the people's worth, coping abilities, and competency, so the people of the organization do not support change unless they are convinced against the status quo (Cummings, Worley, & Calhoun, 2009). According to Kotter, effective change efforts must begin with individuals and groups evaluating an organization (Kotter, 1995). In many studies, the effectiveness of organizational change has been associated with different variables. The critical review of change theories offers a constructive framework for managing organizational change throughout different stages of the process. Based mainly on Kurt Lewin change stages and others scholars, they pointed out the leadership's role, knowledge management and employee involvement as the main factor of organizational change success within the company (Hussain et al., 2016). Their study focused on change management for the state-owned enterprise, found that employee engagement is not correlated with the process. However, leadership style and individual readiness can predict the organizational change significantly (Mangundjaya, Utoyo, & Wulandari, 2015). Many authors have defined leadership style. It is considered a factor that has a major influence on the performance of organizations, managers, and employees (Wang et al., 2005). Leadership style, often called 'management style, describes the approach managers use to deal with people in their teams. There are many styles of leadership. Leaders can be classified in extremes as follows (Armstrong, 2009).

Charismatic/non-charismatic. Charismatic leaders rely on their personality, their inspirational qualities, and their 'aura'. They are visionary leaders who are achievement-oriented, calculated risk takers, and good communicators. Non-charismatic leaders rely mainly on their know-how, their quiet confidence, and their analytical approach to dealing with problems. Autocratic/democratic. Autocratic leaders impose their decisions, using their position to force people to do as they are told. Democratic leaders encourage people to participate and involve themselves in decision making. Enabler/controller. Enablers inspire people with their vision of the future and empower them to accomplish team goals. Controllers manipulate people to obtain their compliance. Transactional/transformational.

Transactional leaders trade money, jobs, and security for compliance. Transformational leaders motivate people to strive for higher-level goals.

Nisren Osama Al-Khozondar investigates the effect of employee relationship management (ERM) on the employees' performance in Telecommunication and Banking Sectors in Gaza. ERM main components are Human Resources Practices, Communication, Trust, Shared Goals and Values, and Leadership Styles (Nisren Osama Al-Khozondar, 2015). Shared goals and values are defined as the extent to which partners have beliefs in common about what behaviors, goals, and policies are important or unimportant, appropriate or inappropriate, and right or wrong (Herington et al., 2009). He is concluded that ERM components have a positive effect on the employee's performance and sharing goals and values with the employees are considered prerequisite and foundation to improve employee's performance. Communication in the institution refers to the extent to which the institution informs employees about important issues in the organization. Such important issues include values, strategies and changes that affect the institution and employees. Institutional communication can be done either formally through formal structures or informally using unstructured procedures. Communication with employees strengthens their identification with the institution and creates institutional solidarity due to trust among employees or between different departments (Chinomona & Sandada, 2013).

Thus, based on these researches, we can find a link between employee relationship and organizational performance. Since several years ago, change has been associated with organizational performance, because the change success can also predict the employee's performance. The study of Fadeyi & Oke, 2016 support this affirmation. In their findings, there is a positive correlation between aspects of change composed by the quality of change communication, participation, attitude of top management & readiness toward change, leadership style, and organizational performance. However, if many papers address the change and performance, it will be quite interesting to analyze the factors that can influence organizational change (Cummings, Worley, & Calhoun, 2009). Regarding these facts, achieve the enterprise structure change is becoming a daily problem for managers. For sure, many researches have been done in different countries, but in Cote d'Ivoire, we face a lack of research, investigate it and share some recommendations is therefore our little contributions to reduce this missing data. Employee relationship has replaced industrial relations as the term for defining the relationship between employers and employees. Nowadays, employee relationship is seen as focusing on both individual and collective relationships in the workplace, with an increasing emphasis on helping line managers establish trust-based relationships with employees. A positive climate of employee relations with high levels of employee involvement, commitment, and engagement can improve business outcomes as well as contribute to employee's well-being. Employee relationship in a change process can be seen as all actions from them apt to fail any change implementation. In this paper, Communication (COM), shared goals and values (SGV) and leadership style (LS) are the main independent variables. According to these variables, this research has five hypotheses define as:

H1: Shared goals and values directly impact enterprise structure change

H2: Shared goals and values have a positive relationship with leadership style

H3: Leadership style positively influence enterprise structure change

H4: Leadership style has a positive relationship with communication

H5: Communication significantly predict enterprise structure change

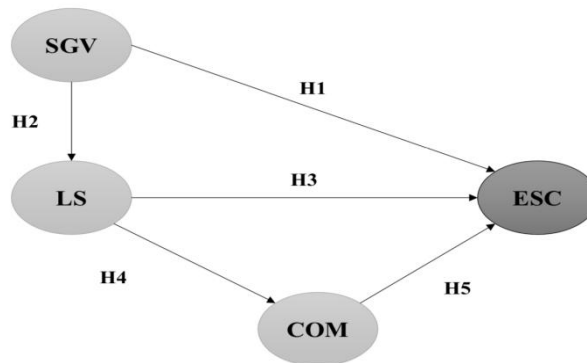


Figure 1 Conceptual Model

### 3 Data and Methodology

Mouton (Mouton, 2001) views research methodology as concentrating on the research process and the kind of tools and techniques to be applied. Firms operating in Côte d'Ivoire were considered as the population for the study.

#### 3.1 Data collection

This research used both qualitative and quantitative approach in the form of survey design to carry out this study. Data has been collected from employees of telecommunications, refinery, and services sectors through both google forms which is an online questionnaire and physical questionnaire address to people. 137 questionnaires were collected.

#### 3.2 Data analysis

After preliminary analysis to check if all the items have been filled, only 120 has been useful. The qualitative data collected is codified into quantitative following the Likert five scale from Strongly disagree to strongly agree where the higher value is, the more positive the respondent's attitude towards the subject's response to the question is. With the help of SPSS, we codified the data obtained. The codified data is imported into Smart PLS. Then, we drawn the theoretical model, which is the translation of the hypothesis in the scheme and calculated the path coefficient and model fit of this study. After running the PLS Algorithm, we found the Average Variance extracted (AVE), Composite Reliability (CR), and Alpha. These variables are the relevant indicators for the measurement model in structural equation modeling (SEM). We run also outer loadings to measure the item's quality. Using one-tailed test, the hypothesis has been checked through bootstrapping. The result appeared with P value, T-test, and the significance level, which determine if our hypotheses are supported or not.

### 4 Results

Smart PLS 3 (Boenningstedt, Germany) and IBM SPSS Statistics 24 (Armonk, NY, USA) were used in this study. Data analysis was conducted using smart PLS primarily because PLS-SEM is a preferred option due to its better predictive power over factor-based SEM and its ability to simultaneously estimate relationships between several independent as well as dependent variables in a structural model and multiple latent observed or unobserved variables.



Furthermore, PLS is believed to be a preferable approach for decision-making and management-oriented problems; it is also preferred when the study focuses on prediction.

The internal consistency reliability was established using composite reliability (CR) which has been recommended by scholars as being a better representative measure for reliability as compared to earlier practices that use Cronbach's alpha.

The outer loading analysis shows that all items selected for this study are equal or above 0.70. Keeping in mind that the minimum level of 0.40 is an acceptable value for item loading. Table 1 shows that the values ranged between 0.70 and 0.841, thus confirming sufficient reliability.

**Table 1 Item Loadings**

Constructs	ITEM	LOADINGS			
		COM	ESC	LS	SGV
Communication (COM)	COM1	0,772			
	COM2	0,825			
	COM3	0,807			
Enterprise Structure Change (ESC)	ESC1		0,775		
	ESC2		0,738		
	ESC3		0,802		
	ESC4		0,758		
	ESC5		0,729		
	ESC6		0,746		
	ESC7		0,782		
	ESC8		0,769		
Leadership Style (LS)	LS1			0,769	
	LS2			0,79	
	LS3			0,764	
	LS4			0,781	
Shared Goals and Values (SGV)	SGV1				0,742
	SGV2				0,841
	SGV3				0,7

To assess the construct validity by examining both the convergent and discriminant validity, 0.5 or higher was set as the acceptable value of average variance extracted (AVE). Table 2 shows that all the constructs had AVE values greater than 0.5 and ranged between 0.582 and 0.918, thus confirming convergent validity. We assessed the discriminant validity using Heterotrait-Monotrait (HTMT) criteria.

**Table 2 Reliability and Convergent Validity**

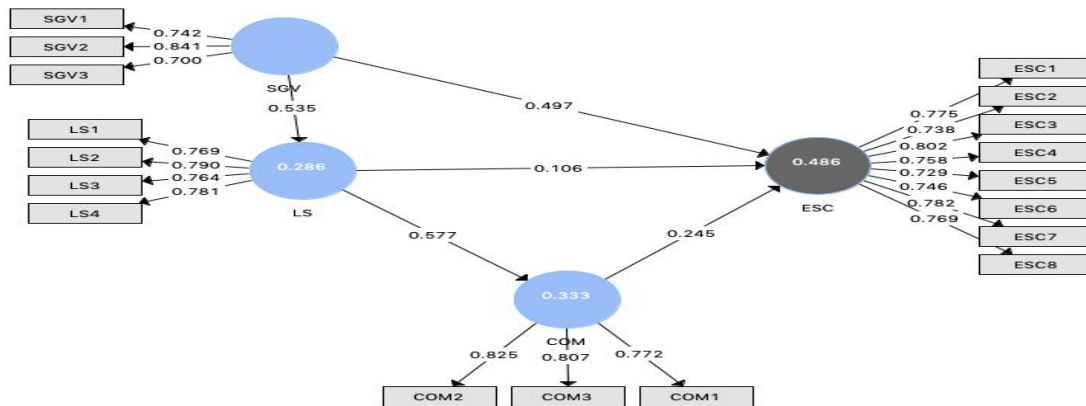
	Cronbach's Alpha	Rho_A	C.R	AVE
COM	0.723	0.728	0.844	0.643
ESC	0.897	0.902	0.918	0.582
LS	0.781	0.787	0.858	0.603
SGV	0.643	0.638	0.806	0.583

As shown in Table 3, all of the variables displayed acceptable discriminant validity using the HTMT test as well as bearing values below thresholds of 0.90.

**Table 3 Discriminant Validity Heterotrait-Monotrait Ratio (HTMT)**

	COM	ESC	LS	SGV
COM	0.802			
ESC	0.471	0.763		
LS	0.577	0.514	0.776	
SGV	0.331	0.635	0.535	0.763

To assess the structural model, a three-stage approach was carried out by the author. Firstly, the R<sup>2</sup> value was obtained for each latent variable. Secondly, a redundancy check of Q<sup>2</sup> was calculated by using a blindfolding function to ascertain the quality of predictive relevance. Thirdly, the bootstrap function was used to assess whether the path coefficients of the structural model are significant or not.



**Figure 2 Results of the Model**

As recommended by scholars,  $f^2$  values of 0.02, 0.15 and 0.35 indicate that the interaction term is low, medium, or large on the criterion variable respectively. A  $Q^2$  value of greater than zero implies that the model has good predictive relevance. Table 4 shows the results of the model obtained through PLS Algorithm function under smart PLS software.

Table 5 displays the values for  $f^2$  were obtained from the measurement model results and the  $Q^2$  values obtained through the blindfolding function. It is evident from the figure that the relationship paths from LS to ESC ( $f^2 = 0.012$ ), bear a low interaction because  $f^2 < 0.02$ . COM to ESC and SGV to ESC paths ( $f^2 = 0.078$ ;  $f^2 = 0.343$ ) have a medium interaction. Also, the SGV to LS path was strong enough with an  $f^2$  value of 0.401. The strongest interaction term was between LS and COM with a huge  $f^2$  value of 0.499.

**Table 4 Result of the Model – Mean, STDEV, T-values, P-values**

Hypotheses	Original Sample (O)	Sample Mean (M)	Standard Deviation (STDEV)	T Statistics ( O/STDEV )	P Values	Results
COM -> ESC	0.245	0.252	0.110	2.226	0.013	Supported
LS -> COM	0.577	0.578	0.087	6.647	<0.001	Supported
LS -> ESC	0.106	0.112	0.123	0.864	0.194	Not Supported
SGV -> ESC	0.497	0.488	0.117	4.246	<0.001	Supported
SGV -> LS	0.535	0.564	0.063	8.544	<0.001	Supported

**Table 5 Model Strength and Quality**

	F Square				R Square		Q Square	
	COM	ESC	LS	SGV	SSO	SSE	$Q^2 (=1-SSE/SSO)$	
COM		0,078			0,333	360.000	289.918	0.195
ESC					0,486	960.000	733.093	0.236
LS	0,499	0,012			0,286	480.000	406.384	0.153
SGV		0,343	0,401		360.000	360.000		

## 5 Conclusion

The study aim was to analyze the employee relationship on the effectiveness of enterprise structure change. Based on the literature review, we have pointed out three variables. After data

collection and analysis through Smart PLS, the five hypotheses of this research were supported excepted the relationship between leadership style and enterprise structure change. If in the literature, there is a strong relationship between these two variables, the lack of relationship in this case can be explain by the suitable leadership role adopted in these organizations. Thus, employee don't see the leadership style as an obstacle of change's failure. From this research, it will be evident that employee relationship (ER) can bring benefits to organizations. Succeed a change process means to facilitate communication with all stakeholders, train the employee directly involved, explain the change goals and share the same vision about it to reduce the employee resilience and adopted a suitable leadership style. ER can work by strengthening and increasing the relationship between organizations and their employees. To reap the required objectives from ER there is a need to implement them according to the enterprise structure change strategies. Change success in mainly focus on employee because they are the first affected by these actions. Manage the implementation of change effectively means to meet the employee needs and the desired state wished by the organization.

Discuss about this topic required to have a huge population which needs a long period of work. Therefore, the limited population of the research is our first limitation. Secondly, this study has been done in English but due to the population's location, it has been translated in French for the respondents. The communication bias can affect the quality of question and answer. Thirdly, the study was only based on three sectors. Some scholars introduce the concept of corporate culture and its role on organizational performance. Future research can be focus on the key role corporate culture in the change implementation and also determine the suitable corporate culture for change needs. And it will also help in developing effective communication channels and systems so that the information needs of employees are met.

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## Research on Early-warning and Control Strategies for Risk Conduction of Enterprise Financial Management System

Deng Xun<sup>1</sup>, Deng Mingran<sup>2</sup>

1 Wuchang Shouyi University, Wuhan, P.R. China, 430070

2 Wuhan University of Technology, Wuhan, P.R. China, 430070

(E-mail: dengxunmaster@163.com, dmr@whut.edu.cn)

**Abstract:** This paper expounds the basic definition of early-warning, prevention and control strategies for risk conduction of enterprise financial management system, puts forward the three components of risk source, risk conduction carrier and risk conduction path for risk conduction of enterprise financial management system, and sets corresponding early-warning indicators and qualitative risk early-warning values. Then the single-factor early-warning mode, multi-factor early-warning mode and comprehensive early-warning mode are used to timely and accurately issue corresponding levels of alarms to effectively prevent and control the risk conduction of the enterprise financial management system. The research on the early-warning, prevention and control strategies for risk conduction of enterprise financial management system has important theoretical research value and practical application value.

**Key words:** Risk conduction early-warning; Risk early-warning indicator; Qualitative risk early-warning value; Early-warning; Prevention and control strategy

### 1 Introduction

"Early-warning" means to taking the lead and taking precautions. Fritzpatrick (Fritzpatrick, 1932) was the first to study financial risk early-warning, and he put forward the univariate model of financial risk early-warning; Smith and Winakor (Smith and Winakor, 1935) also used an univariate model for analysis, and found the "labor capital/total assets" indicator had the highest discriminating ability. Beaver (Beaver, 1966) analyzed 30 financial ratio indicators for 79 failed companies and corresponding 79 successful companies between 1954 and 1964, found the three indicators, "cash flow/total debt", "net income/assets", "total debt/total assets", had good effect on financial risk early-warning, and the "cash flow/debt total" indicator had the best effect on financial risk early-warning. After the 1960s, many scholars conducted a lot of in-depth research on the early-warning model of enterprise financial risk. Altman (Altman, 1968) proposed the "I-score" model, and selected five financial ratio indicators to warn the enterprise financial risks separately based on theoretical research and empirical investigation; after that, the scholars adjust Altman's model by replacing indicator or correcting coefficient as needed, and applied the model to the per-existing control of financial risks in different industries. Domestic research on financial risk early-warning started late. Wu Shinong and Huang Shizhong (Wu Shinong and Huang Shizhong, 1987) introduced the analysis indicators and early-warning model of enterprise bankruptcy in China for the first time. Since then, the research on financial risk early-warning had gradually formed a certain system by Qi Lian (Qi Lian, 1990); Chen Jing (Chen Jing, 1999), Wu Shinong et al (Wu Shinong et al, 2001), Wan Xining et al (Wan Xining et al, 2005), Deng Xiaolan et al (Deng Xiaolan et al, 2006) and other scholars studied from the application of multivariate models.

There are few scholars at home and abroad who study the risk conduction of enterprise financial management system. Benston (Benston, 1986) considered that systemic risk occurred when a certain number of enterprises in the system fail simultaneously on the research of enterprise financial risk conduction; Davis et al. (Davis et al., 1999) and Jarrow et al. (Jarrow et al., 2001) studied the financial risk conduction of enterprises from the perspective of vulnerability, and considered that the failure of

one enterprise will lead to the failure of other companies, so ordinary financial fragility will occur; Jean Helwege (Helwege, 2010) had a more comprehensive research of enterprise bankruptcy and systemic risk after the subprime crisis, believed that the causes of the financial crisis included the conduction of relevant people and information conduction, and proposed relevant policy recommendations. Li Bingxiang and Tian Zhanjun (Li Bingxiang and Tian Zhanjun, 2006) specialized in enterprise financial risk conduction earlier in China, and constructed an analytical framework for the formation and conduction of enterprise financial risk on the basis of research. Shen Jun and Deng Mingran (Shen Jun and Deng Mingran, 2006) studied the financial risk conduction and its carrier; Yin Li (Yin Li, 2009) studied the financial risk conduction effect of enterprise groups under the framework of organizational failure; Chen Aizao (Chen Aizao, 2009) studied financial risk conduction of enterprises from the perspective of supply chain.

There are fewer scholars at home and abroad research on the risk conduction early-warning of enterprise financial management system. At present, Deng Mingran et al. (Deng Mingran et al., 2013) had studied in their works and discussed mechanism, functions, activity patterns, missed warning and false warning of the risk conduction in enterprise financial management systems. The research on early-warning prevention and control strategy for the risk conduction of enterprise financial management system was to warn, prevent and control the risks of risk source, risk conduction carrier and risk conduction path in the enterprise financial management system, and effectively prevents and controls the risk conduction of enterprise financial management system. The research has important theoretical research value and practical application value.

## 2 The Framework of Early-Warning, Prevention and Control Strategies for Risk Conduction of Enterprise Financial Management System

The early-warning, prevention and control strategy for risk conduction of enterprise financial management system refers that aimed at the risk conduction components of enterprise financial management system, establish risk early-warning indicators and their qualitative risk values, set up risk early-warning and alarm mode to issue a level alarm accurately, and prevent and control the risk conduction of enterprise financial management system effectively under the information asymmetry and uncertainty environment. The specific architecture is shown in Figure 1.

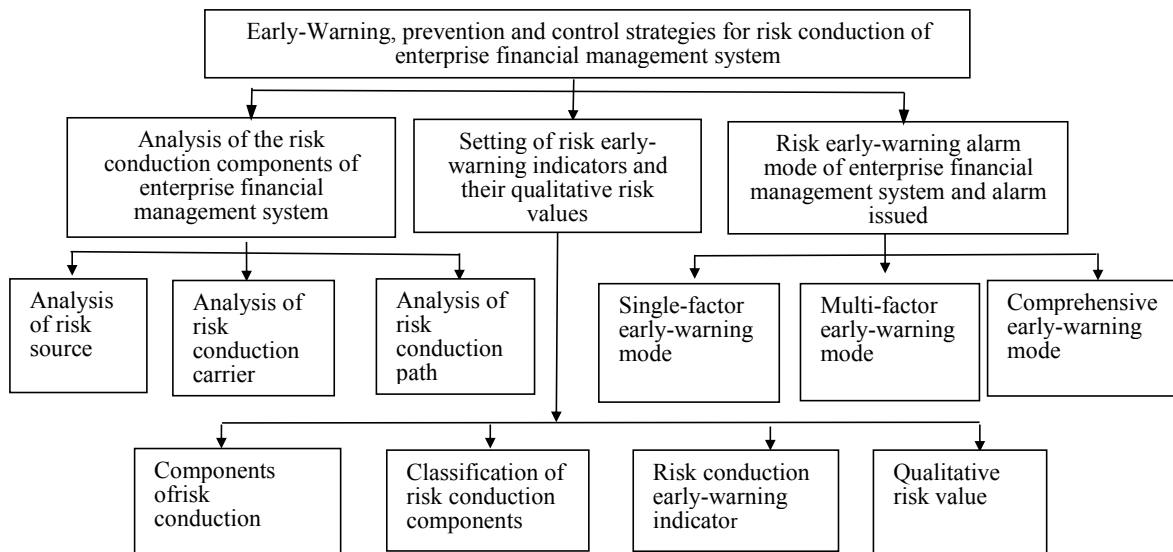


Figure 1 The Framework of Early-Warning, Prevention and Control Strategies for Risk Conduction of Enterprise Financial Management System

### 3 Analysis of the Components of Risk Conduction in Enterprise Financial Management System

The risk conduction of enterprise financial management system is a process that in the enterprise financial management system, the risk of enterprise financial management system is accumulated in the risk source, relies on a certain risk conduction carrier to spread, and spreads to all aspects of the enterprise financial management system through a certain risk conduction path, so that the possibility of the enterprise financial management goal is higher than the expected target and suffers losses. This process consists three main elements: risk source, risk conduction carrier and risk conduction path.

(1) Risk source is the source of the risk in enterprise financial management system, and it is the root of risk accident of the enterprise financial management system. According to the content cycle of enterprise financial management, it is divided into the funding risk source, the long-term investment risk source, the liquidity risk source and the profit distribution risk source.

(2) Risk conduction carrier is the carrier that carries or transmits the risk of the enterprise financial management system. According to the state of existence of the carrier, it is often divided into a capital carrier, a technical carrier, an information carrier and an accounting staff carrier.

(3) Risk conduction path refers to the route and way through which the enterprise financial management system conducts risk in the enterprise financial management activities. It is divided into the internal risk conduction path and the external risk conduction path of the enterprise according to the enterprise scope. The specific components are shown in Figure 2.

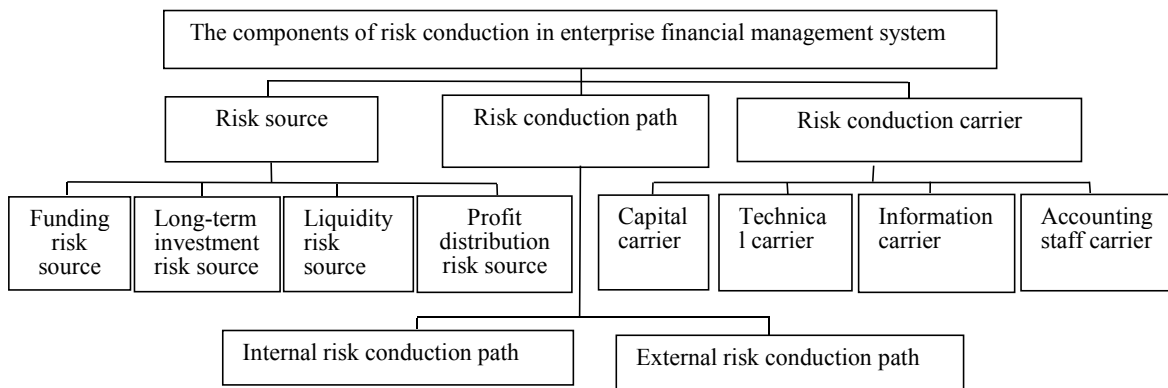


Figure 2 The Components of Risk Conduction in Enterprise Financial Management System

### 4 Setting the Risk Conduction Early-Warning Indicator and Qualitative Risk Value of Enterprise Financial Management System

According to Figure 2, under the premise of having known the components of risk communication in the enterprise financial management system, this research uses expert opinion method to set early-warning indicators and determine qualitative risk value for risk source, risk conduction carrier and risk conduction path, that is shown in Table 1.



**Table 1 Enterprise Financial Management System Risk Conduction Early-Warning Indicators and Qualitative Risk Value Table**

Risk conducti on compon ent	Classificati on of risk conduction component	Early-warning indicator					Qualitative risk value				
		A <sub>ij</sub> (t=1,2,3,4,5)					A <sub>ijt</sub> B				
A <sub>i</sub> (i=1,2,3)	A <sub>ij</sub> (j=1,2,3,4)										
Risk source	Funding risk source	A <sub>111</sub> Fundraising channel	A <sub>112</sub> Interest rate	A <sub>113</sub> Exchange rate	A <sub>114</sub> Fundraising amount	A <sub>115</sub> Fundraising opportunity	A <sub>111B</sub> Smoothness	A <sub>112B</sub> Social average interest rate	A <sub>113B</sub> Average exchange rate	A <sub>114B</sub> Demand	A <sub>115B</sub> Timeline SS
	Long-term investment risk source	A <sub>121</sub> Investment program		A <sub>122</sub> Portfolio investment	A <sub>123</sub> Investment project demonstration level		A <sub>121B</sub> Reliability	A <sub>122B</sub> Best combination		A <sub>123B</sub> Advanced and reasonable	
	Liquidity risk source	A <sub>131</sub> Account receivable amount		A <sub>132</sub> Inventory level	A <sub>133</sub> Cash balance	A <sub>134</sub> Fund budget level	A <sub>131B</sub> Strict credit approval	A <sub>132B</sub> Low inventory levels	A <sub>133B</sub> Meet daily needs	A <sub>134B</sub> Operatin g normally	
Risk source	Profit distribution risk source	A <sub>141</sub> Sales revenue limit		A <sub>142</sub> Price level	A <sub>143</sub> Accounts receivable managemen t level	A <sub>144</sub> Stakehold ers	A <sub>141B</sub> Increasi ng income	A <sub>142B</sub> Stable price	A <sub>143B</sub> Reflecti on of profits	A <sub>144B</sub> Good relationsh ip	
	Fund carrier	A <sub>211</sub> Funding line		A <sub>212</sub> Capital utilization quota	A <sub>213</sub> Capital recovery amount	A <sub>214</sub> Allocation of funds	A <sub>211B</sub> Develop a cash flow statement Ensure a smooth circulation of the capital chain				
Risk vector	Technical carrier	A <sub>221</sub> Hardware usage environment and management level			A <sub>222</sub> Software grade and application level		A <sub>221B</sub> Good environment, High level		A <sub>222B</sub> High grade, Skilled		
	Information carrier	A <sub>231</sub> Authenticity of original documents		A <sub>232</sub> Authenticity of accounting documents	A <sub>233</sub> Accuracy of accountin	A <sub>234</sub> Accuracy of financial statements		A <sub>231B</sub> True vouchers and accurate information			

g books						
Accounting staff carrier	A <sub>241</sub>	A <sub>242</sub>	A <sub>243</sub>	A <sub>241B</sub>	A <sub>242B</sub>	A <sub>243B</sub>
A <sub>24</sub>	Accounting staff business level	Loyalty of financial staff	Professionalism of financial staff	High level of business	High loyalty	Strong professionalism
Internal risk conduction path of enterprises	A <sub>311</sub>	A <sub>312</sub>	A <sub>313</sub>	A <sub>311B</sub>	A <sub>312B</sub>	A <sub>313B</sub>
Risk conduction path	Timeliness and accuracy of information	Departmental operational capability, risk control capability	Job capacity, mutual supervision ability	Timely and accurate	Strong ability	Strong ability
A <sub>31</sub>						
External risk conduction path of enterprises	A <sub>321</sub>	A <sub>322</sub>	A <sub>323</sub>	A <sub>321B</sub>	A <sub>322B</sub>	A <sub>323B</sub>
A <sub>32</sub>	Legitimacy of operation	Environment sensing	Degree of harmony	High level	Strong ability	Wide range

## 5 Risk Conduction, Early-Warning and Alarm of Enterprise Financial Management System

The relative research literatures always use fuzzy comprehensive evaluation method to determine the qualitative risk value of risk conduction and early-warning indicator of enterprise financial management system.

By fuzzy comprehensive evaluation method, the factors that affect the risk transmission of enterprise financial management system could be converted into clear numbers, we will get a comprehensive evaluation conclusion value to determine the risk level. Then alarm, if necessary.

An important part of the alarm transmission of enterprise financial system risk transmission is to set the alarm mode. Only by setting up a scientific and reasonable alarm mode can the risk communication of the enterprise financial system be effectively managed. The alarm mode has single factor warning, multi-factor warning, and comprehensive warning.

### 5.1 Single-factor early-warning mode

The single-factor early warning mode is a method that combines the characteristics of the industry in which the enterprise is located, collects empirical data that affects the value of the risk factors of the enterprise financial management system, and establishes a set of early-warning indicator systems to judge the risk of enterprise financing system. For example, A<sub>111B</sub> is the risk value (A<sub>111B</sub>) of the early-warning indicator to the financing source (A<sub>11</sub>) of the financing source (A<sub>11</sub>) in the risk source (A<sub>1</sub>), and then uses the expert opinion method to set its security area, as shown in the table. 2 is shown.

**Table 2 Single Factor Warning Safety Zone**

High risk area	Elementary risk area	Safe area	Elementary risk area	High risk area
(Ye,Yc)	(Yc,Ya)	(Ya,Yb)	(Yb,Yd)	(Yd,Yf)

The basic alarm criteria are:

When  $Y_a < A_{111}B < Y_b$ , no alarm is issued;

When  $Y_c \leq A_{111}B \leq Y_a$ , or  $Y_b \leq A_{111}B \leq Y_d$ , the first-level alarm is issued;

When  $Y_e \leq A_{111}B \leq Y_c$  or  $Y_d \leq A_{111}B \leq Y_f$ , the second-level alarm is issued;

When  $A_{111}B < Y_e$  or  $A_{111}B > Y_f$ , the three-level alarm is issued.

And so on, each situation can establish a corresponding security area for the alarm indicator's qualitative risk value and issue a corresponding level alarm.

**5.2 Multi-factor early-warning mode**

We can use model  $A_m = b_1 \cdot A_1 + b_2 \cdot A_2 + \dots + b_n \cdot A_n$ , to weighted algorithm to get value at risk of  $A_m$ . And then the security area is set by the expert opinion method, as shown in Table 3.

**Table 3 Multi-Factor Early Warning Security Zone**

High risk area	Elementary risk area	Safe area	Elementary risk area	High risk area
(Ze,Zc)	(Zc,Za)	(Za,Zb)	(Zb,Zd)	(Zd,Zf)

The basic alarm criteria are:

When  $Z_a < A_{111}B < Z_b$ , no alarm is issued;

When  $Z_c \leq A_{111}B \leq Z_a$ , or  $Z_b \leq A_{111}B \leq Z_d$ , the first-level alarm is issued;

When  $Z_e \leq A_{111}B \leq Z_c$  or  $Z_d \leq A_{111}B \leq Z_f$ , the second-level alarm is issued;

When  $A_{111}B < Z_e$  or  $A_{111}B > Z_f$ , the three-level alarm is issued.

And so on, each situation can use this method to establish a qualitative risk value security area of the corresponding alarm indicator and issue a corresponding level alarm.

**5.3 Comprehensive early warning mode**

The comprehensive early warning model consists of three elements: probability of risk factor risk occurrence in enterprise financial management system, called 'P'; possible risk loss of enterprise financial management system, called 'h'; uncontrollable degree of each risk factor, called 'x'. The risk comprehensive risk value is defined as:  $A = \sum_{i=1}^n p_i \cdot h_i \cdot x_i$

After that, we could set up setting up safety zone by using the expert opinion method, as shown in Table 4.

**Table 4 Comprehensive Warning Safety Zone**

High risk area	Elementary risk area	Safe area	Elementary risk area	High risk area
(Ce,Cc)	(Cc,Ca)	(Ca,Cb)	(Cb,Cd)	(Cd,Cf)

The basic alert criteria are:

When  $C_a < A < C_b$ , no alarm is issued;

When  $C_c \leq A \leq C_a$ , or  $C_b \leq A \leq C_d$ , the first-level alarm is issued;

When  $C_e \leq A \leq C_c$  or  $C_d \leq A \leq C_f$ , the second-level alarm is issued;

When  $A \leq C_e$  or  $A \geq C_f$ , the three-level alarm is issued.

## 6 Conclusions

The research on early-warning, prevention and control strategies for risk conduction of enterprise financial management system consists of three parts: analyzing the components of the risk conduction in enterprise financial management system, setting the risk conduction early-warning indicator and qualitative risk value of enterprise financial system, providing alarm mode and alarm issuance.

(1) The risk conduction of enterprise financial system consists of three elements: risk source, risk conduction carrier and risk conduction path. Risk source can be divided into funding risk source, long-term investment risk source, liquidity risk source and profit distribution risk source according to the content cycle of enterprise financial management system. Risk conduction carrier can be divided into capital carrier, technical carrier, information carrier and accounting staff carrier according to the state of existence of the carrier in enterprise financing system. Risk conduction path can be divided into internal risk conduction path and external risk conduction path of the enterprise according to the range of risk conduction path in enterprise financial management system.

(2) The enterprise financial system risk conduction early-warning indicators can be further subdivided according to the risk source, risk conduction carrier and risk conduction path of risk conduction in enterprise financial managements system. The early-warning indicator  $A_{ijt}$  and its corresponding qualitative risk value  $A_{ijt}B$  are set.

(3) The early-warning mode of risk conduction in enterprise financial management system includes single-factor early-warning mode, multi-factor early-warning mode and comprehensive early-warning mode. The programs of implementing early-warning for each early-warning mode are following: Firstly, we can get the qualitative risk value using the risk early-warning mode. Then, find out dangerous areas in safety zone table according to the qualitative risk values. Thirdly, issue the appropriate level of alarm according to the situation in dangerous areas to control the risk source, intercept the risk conduction carrier, break the risk conduction path, so that prevent and control the risk conduction of the enterprise financial management system effectively.

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# Risk Analysis and Control of Business Mode Transformation in HD Company

Yin Limei

School of Management, Wuhan University of Technology, Wuhan, P.R. China, 430070

(E-mail:1207412455@qq.com)

**Abstract:** Under the state's construction requirements for for-profit institutions to be transformed into enterprises and the environment of rapid development of information technology and continuous integration of economy, it is imperative for Guangxi Geology & Mineral Huadi Industry and Trade group Co., Ltd.(HD) to transform its business mode (BM). This paper mainly establishes a risk assessment system based on the possible risks in the process of HD's business mode transformation (BMT), and uses fuzzy analytic hierarchy process (FAHP) to conduct risk assessment. The results show that HD's business mode transformation risk (BMTR) is in medium risk state. Then, give some suggestions to improve the theoretical basis and technical support for business mode transformation risk analysis and control.

**Key words:** Business mode; Transformation risk; Risk analysis and control; Fuzzy analytic hierarchy process

## 1 Introduction

With the development of information technology such as cloud computing and big data, information technology and economy are constantly merging, and the competition among enterprises is also growing. At present, the competition among enterprises has changed from the original product competition to the competition of BM. BM is a comprehensive perspective describing how enterprises do business in the market (Zott, C, Amit, R and Massa, L, 2011). It is a structural template describing how enterprises deal with customers, suppliers and partners (Zott, C and Amit, R, 2008). Academics believe that BMs are not static, but dynamic (Demil, B and Lecocq, X, 2011). With market changes, the sustainability of BMs is uncertain, and the existing BMs will soon become obsolete. Therefore, enterprises must have sustained business mode innovation and transformation capabilities (Sosna, M, Trevinyo-Rodríguez, R N and Velamuri, S R, 2010). Clauß, T adopted strict methodological procedures to develop a set of comprehensive measurement standards for BMT(Clauß, T, 2017); Clauss, T et al. pointed out should rely on customer satisfaction, customer perception of BMT, to link BMT to customer value creation, to ensure the success of BMT activities (Clauss T, Kesting T, and Naskrent J, 2019). A good MD can create competitive advantages, obtain independent products, differentiated channels and information advantages, create guiding logic, link economic value to the realization of technological potential (Chesbrough, H and Rosenbloom, R S, 2002), and provide economic leverage for enterprises to achieve large-scale profits (Euchner, J and Ganguly, A, 2014). Therefore, it is very important to find a successful BM.

However, BMT a high-risk behavior. The more complex an enterprise is, the more risks it will bring. Even a slight change in its operation will bring risks and uncertainties to the enterprise. For

example, enterprises often face such risk as separating the definition of the value proposition from the development of BM, resulting in unrealistic value proposition in the economy. Meanwhile, the transformation of BM will also bring consistency and inertia risk to enterprises, organizations, business departments, teams and individuals (Makins, Q, Nagao, D and Bennett, N, 2012). In view of these risks, many scholars have carried out relevant research. Wu Jiazhen and Li Huabiao found that market risk, investment risk and human resource risk are the main risks affecting enterprise transformation through a large number of case studies (Wu Jiazhen, and Li Huabiao, 2012). Wu Lihua divided BMTR into general risk brought by macro-environment such as society and economy and industrial risk brought by industrial environmental change by analyzing the formation process of enterprise transformation risk (Wu Lihua, 2005). Some scholars used case analysis method to divide BMTR into industrial choice risk, business choice risk, process control risk and post-management risk according to the process of transformation. Therefore, it has great theoretical and practical significance to identify and analyze the BMTR.

It can be seen that in order to help enterprises to avoid risks and achieve success of BMT, scholars have made targeted research on the classification and research methods of BMTRs, but there are few reports on the comprehensive principle of risk identification. Based on the transformation of industrial and trade BM in HD, this paper uses FAHP to evaluate and analyze it from six categories: human resources risk, financial risk, technical risk, operational risk, market risk and environmental risk, aiming at providing theoretical basis and technical support for the risk assessment of BMT.

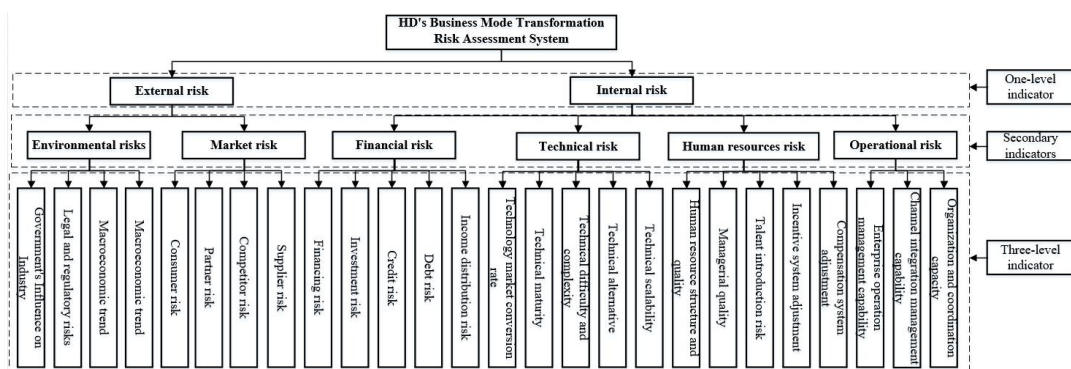
## 2 Method

This paper mainly uses FAHP. FAHP combines Fuzzy Mathematics (FM) with the traditional Analytic Hierarchy Process (AHP) skillfully. The steps of FAHP are as follows: (1) Establish a ladder hierarchy; (2) Perform expert scoring, construct an  $n * n$  judgment matrix, according to Satty's 1-9 scale table(1 means  $i$  and  $j$  have the same importance; 3 means  $i$  is slightly more important than  $j$ ; 5 means  $i$  is obviously important than  $j$ ; 7 means  $i$  is strongly important than  $j$ ; 9 means  $i$  is extremely important than  $j$ ; 2, 4, 6, 8 indicates the intermediate value of the above two adjacent levels; Reciprocal indicates the importance of comparing the order of exchange of two elements). (3) Find the maximum eigenvalue  $\lambda_{max}$  and the corresponding eigenvector  $V_i$  of each matrix, carry on normalization; (4) Conduct consistency testing, if the Consistency Ratio (CR) < 0.1, explain that the vector passes the consistency test, and the eigenvector  $V_i$  can be used as the weight of each risk index in the corresponding index layer (Consistency Index  $CI = \frac{\lambda_{max} - n}{n - 1}$ ,  $CR = \frac{CI}{RI}$ ); (5) Establish an evaluation set according to the risk level, score the risk level of each index, obtain the fuzzy matrix  $R_i$  of each index, and use the fuzzy comprehensive discriminant  $F_i = V_i R_i$ , calculates the results of each index evaluation; (6) Perform a hierarchical total ranking, and obtains importance-rankings.

## 3 Risk Assessment System

### 3.1 HD's BMTR composition

What factors and degree of influence on BMT of enterprise are issues that practitioners and risk





management scholars are concerned about, and also an important factor affecting the success of BMT. Scholars believe that both the external and the internal environment of the enterprise will have an effect on the BMT. According to previous research results and the actual situation of HD, BMTR of HD is divided into external risk and internal risk. External risks include two secondary indicators: environmental risks and market risks. Internal risks include financial risks, technical risks, human resource risk and operational risk. Under each secondary index, it can be divided into several third-level indicators. To sum up, the BMTR evaluation system of HD is constructed as shown in Figure 1.

Figure 1 HD's BMTR Assessment System

### 3.2 Comprehensive evaluation of HD's BMTR

#### 3.2.1 BMTR index weight determination

This article invites six experts who are familiar with the BMTR to score. Using the 1-9 scale table, the degree of importance of the indicators is compared in pairs. The judgment matrices of total risk, external risk, internal risk, environmental risk, market risk, financial risk, technical risk, human resource risk and operational risk are expressed as follows:  $A, C_{external}, C_{internal}, C_1, C_2, C_3, C_4, C_5$  and  $C_6$ .

$$C_1 = \begin{bmatrix} 1 & 0.33 & 2.37 & 1.78 \\ 0.32 & 1 & 2.58 & 1.47 \\ 0.42 & 0.39 & 1 & 1.44 \\ 0.56 & 0.68 & 0.69 & 1 \end{bmatrix} \quad C_3 = \begin{bmatrix} 1 & 1.91 & 0.25 & 1.88 & 4.03 \\ 0.52 & 1 & 0.37 & 1.88 & 2.61 \\ 4.00 & 2.70 & 1 & 0.93 & 2.93 \\ 0.53 & 1.06 & 1.08 & 1 & 2.83 \\ 0.24 & 0.38 & 0.34 & 0.35 & 1 \end{bmatrix} \quad C_6 = \begin{bmatrix} 1 & 3.33 & 3.33 \\ 0.30 & 1 & 1.65 \\ 0.30 & 0.87 & 1 \end{bmatrix}$$

$$C_2 = \begin{bmatrix} 1 & 3.50 & 3.25 & 2.20 \\ 0.29 & 1 & 1.04 & 1.24 \\ 0.31 & 0.96 & 1 & 3.17 \\ 0.45 & 0.81 & 0.32 & 1 \end{bmatrix} \quad C_4 = \begin{bmatrix} 1 & 3.14 & 3.42 & 2.42 & 3.00 \\ 0.32 & 1 & 2.50 & 4.86 & 2.21 \\ 0.29 & 0.40 & 1 & 1.28 & 2.00 \\ 0.41 & 0.21 & 0.78 & 1 & 2.50 \\ 0.33 & 0.45 & 0.50 & 0.40 & 1 \end{bmatrix} \quad C_{external} = \begin{bmatrix} 1 & 0.47 \\ 2.13 & 1 \end{bmatrix}$$

$$C_{internal} = \begin{bmatrix} 1 & 1.86 & 1.62 & 2.24 \\ 0.54 & 1 & 2.62 & 2.20 \\ 0.61 & 0.38 & 1 & 1.83 \\ 0.96 & 0.45 & 0.55 & 1 \end{bmatrix} \quad C_5 = \begin{bmatrix} 1 & 1.78 & 2.83 & 2.17 & 2.41 \\ 0.56 & 1 & 3.83 & 2.64 & 2.26 \\ 0.35 & 0.35 & 1 & 1.71 & 2.29 \\ 0.46 & 0.38 & 0.58 & 1 & 1.90 \\ 0.41 & 0.44 & 0.44 & 0.53 & 1 \end{bmatrix} \quad A = \begin{bmatrix} 1 & 0.38 \\ 2.60 & 1 \end{bmatrix}$$

Calculate the maximum eigenvalue ( $\lambda_{max}$ ) and eigenvector ( $W_i$ ) of each matrix, and perform consistency check and normalization. The results are summarized as shown in Table 1. the judgment matrices all have good consistency. Therefore, each component of the normalized processed feature vector can be used as the weight of each risk indicator in the corresponding index layer.

Table 1 Judgment Matrix Calculation Results and Consistency Test Results

Risk Factor	$\lambda_{max}$	CI	RI	CR	Consistency (CR<0.1)	Weighting of factors
External Risk	2	0	0	—	passing	$W_{external} = (0.3198, 0.6802)^T$
Internal Risk	4.1439	0.0480	0.90	0.0533	passing	$W_{internal} = (0.3726, 0.3104, 0.1867, 0.1303)^T$
Environmental Risk	4.2576	0.0859	0.90	0.0954	passing	$W_1 = (0.2480, 0.4295, 0.1566,$

Market Risk	4.2443	0.0814	0.90	0.0904	passing	$W_2 = (0.4862, 0.1632, 0.2211, 0.1296)^T$
Financial Risk	5.4447	0.1112	1.12	0.0993	passing	$W_3 = (0.2251, 0.1390, 0.3730, 0.1942, 0.0687)^T$
Technical Risk	5.4323	0.1081	1.12	0.0965	passing	$W_4 = (0.4064, 0.2696, 0.1227, 0.1186, 0.0826)^T$
Human Resource Risk	5.2848	0.0712	1.12	0.0636	passing	$W_5 = (0.3364, 0.3002, 0.1456, 0.1241, 0.0937)^T$
Operational Risk	3.0022	0.0011	0.58	0.0020	passing	$W_6 = (0.6245, 0.1965, 0.1790)^T$

Note:  $n = 2, RI = 0.58; n = 3, RI = 0.58; n = 4, RI = 0.9; n = 5, RI = 1.12.$

### 3.2.2 Fuzzy consistency judgment matrix construction

According to the HD's BMTR situation, select five evaluation levels to form a risk level evaluation set, namely:  $H = \{H_1, H_2, H_3, H_4, H_5\} = \{\text{Very High Risk, High Risk, Medium Risk, Low Risk, Very Low Risk}\}$ . Then, according to the evaluation set, distribute questionnaires to HD's employees at different levels for risk rating evaluation, and 78 questionnaires were recovered. The overall evaluation results are organized into the following fuzzy matrix.

$$\begin{aligned}
 R_1 &= \begin{bmatrix} 0.23 & 0.23 & 0.37 & 0.10 & 0.06 \\ 0.19 & 0.21 & 0.37 & 0.14 & 0.09 \\ 0.19 & 0.19 & 0.41 & 0.12 & 0.09 \\ 0.23 & 0.19 & 0.42 & 0.08 & 0.08 \end{bmatrix} & R_2 &= \begin{bmatrix} 0.12 & 0.22 & 0.47 & 0.09 & 0.10 \\ 0.18 & 0.19 & 0.44 & 0.10 & 0.09 \\ 0.21 & 0.26 & 0.44 & 0.04 & 0.06 \\ 0.15 & 0.18 & 0.47 & 0.13 & 0.06 \end{bmatrix} & R_3 &= \begin{bmatrix} 0.27 & 0.32 & 0.32 & 0.04 & 0.06 \\ 0.24 & 0.38 & 0.27 & 0.03 & 0.08 \\ 0.29 & 0.24 & 0.32 & 0.06 & 0.08 \\ 0.29 & 0.28 & 0.29 & 0.05 & 0.08 \\ 0.17 & 0.15 & 0.49 & 0.09 & 0.10 \end{bmatrix} \\
 R_4 &= \begin{bmatrix} 0.17 & 0.21 & 0.46 & 0.08 & 0.09 \\ 0.17 & 0.19 & 0.45 & 0.08 & 0.12 \\ 0.18 & 0.22 & 0.41 & 0.08 & 0.10 \\ 0.17 & 0.29 & 0.37 & 0.05 & 0.12 \\ 0.12 & 0.29 & 0.41 & 0.08 & 0.10 \end{bmatrix} & R_5 &= \begin{bmatrix} 0.13 & 0.38 & 0.32 & 0.08 & 0.09 \\ 0.15 & 0.27 & 0.38 & 0.12 & 0.08 \\ 0.09 & 0.26 & 0.45 & 0.12 & 0.09 \\ 0.12 & 0.17 & 0.47 & 0.15 & 0.09 \\ 0.12 & 0.13 & 0.47 & 0.17 & 0.12 \end{bmatrix} & R_6 &= \begin{bmatrix} 0.14 & 0.24 & 0.45 & 0.08 & 0.09 \\ 0.13 & 0.19 & 0.50 & 0.09 & 0.09 \\ 0.13 & 0.23 & 0.41 & 0.13 & 0.10 \end{bmatrix}
 \end{aligned}$$

### 3.2.3 Fuzzy comprehensive evaluation

According to the fuzzy synthetic discriminant  $F_i = W_i^T R_i$ , calculate the evaluation at all levels. Firstly, the evaluation results of environmental risk, market risk, financial risk, technical risk, human resource risk and operational risk of secondary indicators  $F_1, F_2, F_3, F_4, F_5$  and  $F_6$  are calculated.

$$\begin{aligned}
 F_1 &= W_1^T R_1 = (0.2066, 0.2085, 0.3846, 0.1170, 0.0809); F_2 = W_2^T R_2 = (0.1536, 0.2188, 0.4585, 0.0858, 0.0844) \\
 F_3 &= W_3^T R_3 = (0.2703, 0.2791, 0.3189, 0.0514, 0.0769); F_4 = W_4^T R_4 = (0.1671, 0.2219, 0.4363, 0.0777, 0.1037) \\
 F_5 &= W_5^T R_5 = (0.1280, 0.2800, 0.3896, 0.1150, 0.0898); F_6 = W_6^T R_6 = (0.1362, 0.2284, 0.4527, 0.0909, 0.0918)
 \end{aligned}$$

Secondly, according to  $F_1$  and  $F_2$ , the evaluation matrix of the external risk is established as  $F_{external}$ ; according to  $F_3, F_4, F_5$  and  $F_6$ , the evaluation matrix of the internal risk is established as  $F_{internal}$  and normalized.

$$F_{external} = \begin{bmatrix} 0.2066 & 0.2085 & 0.3846 & 0.1170 & 0.0809 \\ 0.1536 & 0.2188 & 0.4585 & 0.0858 & 0.0844 \end{bmatrix}$$

$$F_{internal} = \begin{bmatrix} 0.2703 & 0.2791 & 0.3189 & 0.0514 & 0.0769 \\ 0.1671 & 0.2219 & 0.4363 & 0.0077 & 0.1037 \\ 0.1280 & 0.2800 & 0.3896 & 0.1150 & 0.0898 \\ 0.1362 & 0.2284 & 0.4527 & 0.0909 & 0.0918 \end{bmatrix}$$

Thirdly, the  $W_{internal}$  and  $W_{external}$  are respectively multiplied by the internal and external risk assessment matrices  $F_{internal}$  and  $F_{external}$  to obtain the internal and external risk assessment results, that is,  $T_i = W_i^T F_i$ .

$$T_{external} = W_{external}^T F_{external} = (0.1705, 0.2155, 0.4349, 0.0958, 0.0833)$$

$$T_{internal} = W_{internal}^T F_{internal} = (0.1942, 0.2549, 0.3860, 0.0766, 0.0896)$$

Finally, calculate the evaluation results of the overall risk of HD's BMT.

$$T = W^T (T_{external}, T_{internal})^T = (0.1876, 0.2440, 0.3996, 0.0819, 0.0878)$$

According to the principle of maximum attribute, the maximum value corresponding level is the HD's BMTR level. In the system calculation results, the maximum value is 0.3996, so, the risk level of HD's BMTR is "medium-risk".

### 3.2.4 Total hierarchical sorting

The total ranking weight is the product of the third-level indicator risk weight and the second-level indicator risk weight. First, establish the X-axis as the three-level index single sorting weight, and the Y-axis is the Cartesian coordinate system of the three-level index total sorting weight; Then, construct a linear function of  $Y = bX$ , where b represents the secondary index single sorting weight. Therefore, the total ranking of external risks and internal risks is shown in Figure 2 and Figure 3.

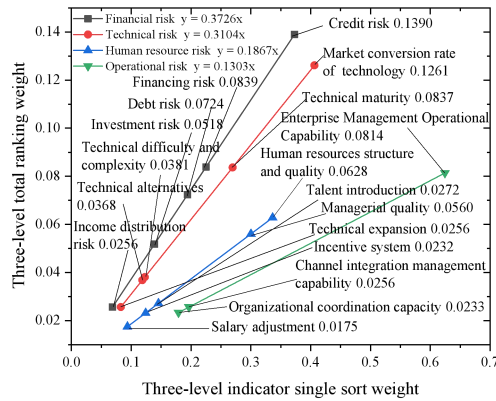
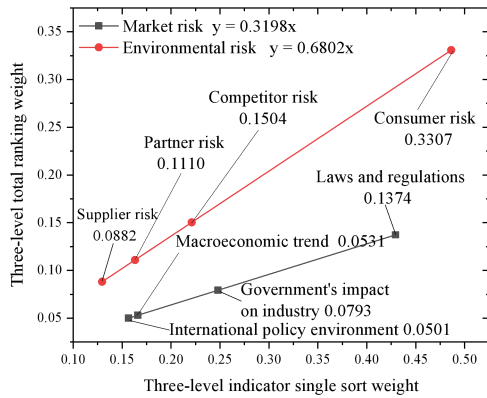


Figure 2 HD's BMT External Risk Total Ranking Figure 3 HD's BMT Internal Risk Total Ranking

At the total risk ranking map, the higher the point position on the ray, the greater the proportion of the corresponding risk, that is, the greater the impact on the BMT.

### 3.3 Analysis of system operation results

Judging from the final score of the above evaluation, HD's BMTR is in a medium-risk state. Internal risks have the greatest impact on HD's BMT; therefore, the first task is to prevent and control the internal risks of the enterprise, and financial risks and technical risks are the main reasons for

forming internal risks. In the internal risk, it should focus more on the financial risks by financing and creditor's ability, and technical risk by technology market conversion rate and technology maturity. In the external risk, the proportion of market risk is greater than the proportion of environmental risk. Therefore, when conducting external risk prevention and control, pay more attention to the market risks by consumers and competitors and the environmental risks by national laws and regulations.

#### **4 Suggestion**

To prevent and control the risk of HD's BMT, HD should identify the main causes of BMTRs, integrate limited resources, and manage key risk types in a targeted manner, thereby effectively reducing the risk of BMT and achieving a successful transformation of business Modes. Therefore, this paper gives the following suggestions for the risk assessment of HD's BMT:

For the external risks, first, focus on understanding the changes in consumer demand and willingness to consume, establish a market-oriented research department for consumers, track and investigate consumers, and then reposition and upgrade products and services. Second, fully grasp the similarities and differences between competitors and themselves, dig up potential competitors, strengthen core competitiveness building; Third, rationally analysis of the target partner's strength and risk control capability, scientifically select partners, strictly control alliances with enterprises, optimize resource allocation, achieve complementary advantages, and reduce the risk of partners. Finally, pay close attention to changes in the international policy environment and macroeconomic situation, fully understand the changes in national industry attitudes and related laws and regulations, set up a special forecasting department, scientifically predict economic trends and changes in laws and regulations.

For the internal risks, first, scientifically evaluate the risk control ability and solvency of investment lending transferee, carefully select investment and lending objects, fully integrate various financing methods, and improve corporate financing capabilities. Second, improve the commercial value and the maturity of technology, timely grasp the best time to enter the market, and maximize the industrialization of technology. Third, scientifically set up human resources structure and positions, strictly implement regular training, improve the ability and quality of employees. Fourth, strictly control the recruitment of talents to ensure a high-quality workforce. Finally, fully understand the advantages and disadvantages of different operating channels, improve the channel integration management capabilities, and ensure the healthy and orderly development of the multi-channel combined operation mode.

#### **5 Conclusion**

At present, many companies are focusing on business Mode innovation and transformation, with the aim of acquiring new market resources and discovering new economic growth points, thereby enhancing their competitive advantage. Based on this, this paper summarized the academic research results about business Mode, business Mode innovation and transformation and its risks. According to the actual situation of HD, the risk factors affecting the transformation of its business Mode were studied. It built a three-level Mode of HD's BMTR assessment. Combined with the fuzzy analytic hierarchy process, the evaluation results of HD's BMTR were in "medium-risk". Finally, several prevention and control suggestions were given for the internal and external risks of the enterprise to improve the success of HD's BMT. However, the empirical research in this paper still has some shortcomings. For example, when conducting fuzzy evaluation, only the severity of the impact of each

risk is considered, and the possibility of each risk is neglected. In response to this issue, further modifications will be made later in the study.

### Acknowledgement

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## Theoretical Analysis and Practical Exploration of the Prevention and Control Management of Integrity Risk in Universities

Yan Yan

Supervision Division of Discipline Inspection Commission, Wuhan University of Technology, Wuhan,  
P.R. China, 430070

(E-mail: 312243103@qq.com)

**Abstract:** In China, universities assume the functions of personnel training, scientific research, social service and cultural inheritance and innovation. From this point of view, level of university interior management and administrative ability affect the direct play of function. In recent years, with the rapid development of higher education in China, the integrity risk of internal management in universities has also increased, and it is particularly important to comprehensively strengthen the prevention and control of integrity risks in universities. This article studies and elaborates the concrete steps and implement of the prevention and control management of integrity risk in universities from the perspective of risk management, using the theory of process management, defines that strengthen overall integrity risk prevention and control management in universities generally go through risk screening, diagnosis and assessment, risk identification, risk response and disposal procedures on the basis of summary analysis of Process Reengineering, at the same time makes a deep interpretation of thoughts and methods of each process in order to provide enlightenment and reflection on further optimizing the integrity risk management and control in universities.

**Key words:** Universities; Integrity risk; Risk management; Process reengineering

### 1 Introduction

As an important means of modern management and measure of corruption control, the management level of integrity risk prevention and control directly determines the modernization process of university mechanism system and capacity, and even affects the realization of personnel training, scientific research, social service and cultural inheritance and innovation. We must have a deep understanding of the importance and urgency of strengthening the integrity risk prevention and control in universities, focus on effective integrity risk prevention and control, optimize the school-running environment, comprehensively improve the scientific level of school management, and strive to provide strong guarantee for accelerating the sustainable and healthy development of higher education.

From the point of current literature, domestic research focuses more on integrity risk prevention and control mechanism construction and mainly studies from the necessity and significance, the existence question and the reason, the optimization strategy and the way to carry out the comprehensive research of integrity risk prevention and control mechanism construction. While there is only a small amount of data available for reference lacking related studies on the integrity risk prevention and control management especially in higher education field from the perspective of risk management. Chen Shilin et al. proposed the basic principles and countermeasures for the prevention and control of integrity risks in universities combined with the current situation of anti-corruption and applied the risk management theory to the prevention and control integrity risks in universities (Chen Shilin, Li Zhihong, MA Guohong, 2014). From the perspective of risk management theory, He Xigeng discussed the

construction of anti-corruption risk prevention and control mechanism in universities from three aspects: the investigation of anti-corruption risk by power operation, the reduction of risk space by improving management system, and the prevention and control of anti-corruption risk by improving operation mechanism(He Xigeng, 2013). From the theoretical basis and connotation of risk management, Xu Maijin et al. studied the risk prevention and control mechanism and work system design of internal risk in universities(Xu Maijin, Zhang Huwei, 2014). Based on the risk prevention and control theory and taking some universities in Beijing as examples, Ma Weina et al. proposed the design ideas and countermeasures of the integrity risk prevention and control management information platform(MA Wei-na, HAO Ping, ZHOU Liang, 2012). The overseas research on the prevention and control of integrity risks is similar to that in China, mostly focused on the causes of integrity risks (corruption), the prevention and control measures of integrity risks and the system. For example, American scholars Rajeev k. Goel and Michael a.elson believe that "the risk of integrity is closely related to geographical factors, historical factors and the influence of the government. They also analyze the influence of historical and geographical factors on the breeding of corruption and the role of legal supervision and other policies adopted by the government in the prevention and control of the integrity risk "(Rajeev K. Goel, Michael A. Nelson, 2010). Daniel Treisman proposed in his research on the causes of corruption problems in different countries that "different forms of national integrity risk prevention and control can be caused by historical reasons, cultural reasons, economic level, influence of political system, interference of national policies and other factors"(Daniel Treisman, 2000). Seongcheol Kim et al. proposed in their related research on corruption prevention that "the introduction of electronic information science and technology to establish the e-government system, namely the network information platform, can improve the transparency of the integrity work of relevant government departments and better inhibit the breeding of corruption"(Seongcheol Kim, Hyun Jeong Kim, Heejin Lee, 2009). Dutch scholars Cyrille FiJnaut and Leo Huberts put forward the idea of "using legal means to curb the breeding of corruption" and explained the specific application and corresponding measures of "legal system" in the prevention and control of corruption risks. However, in general, due to the differences in region, environment, culture and other aspects, foreign universities have different models and practices in the prevention and management of integrity risks, which are also quite different from domestic universities.

Based on the above point and on the basis of theoretical analysis and practice summary combined with the actual situation of domestic universities, this paper will put forward the realization path and optimization measures for further strengthening and improving the prevention and control of integrity risk in universities from the perspective of risk management.

## **2 Theoretical Basis for the Prevention and Management of Integrity Risks in Universities**

From the perspective of management science, the essence of risk management is " to apply general management principles to manage an organization's resources and activities, and effectively control and deal with various risks faced by risk management subjects through the application of various risk management technologies, so as to achieve the goal of obtaining the maximum security guarantee at the minimum cost"(Shao Hui, Zhao Qingxian, Lin Na, 2010). From the understand of this definition, the integrity risk prevention and control management is using the principle of the related theories of management in accordance with the procedures and methods of risk management and the internal public power exercise in universities as well as the factors associated with the risk (including risk itself) to protect against, control and disposal, in order to reduce risk and improve the management efficiency of the daily management activities.

On the basis of Process Reengineering theory, integrity risk management of universities can be identified and assessed namely through exercise the power by probability subject, exercise process, leading system, management system and the external environment which may produce risk related factors and offer the ideas and measures of improving management and optimizing the integrity risk." The core of process reengineering is the reengineering of the management mode which goes through scientific management and ensure the efficient and accurate process execution, optimize the process through continuous improvement of the way of activities, so as to make the enterprise remain competitive" (Wu Jinsheng, 2012). Integrity risk control and management in universities should sort out, diagnose and evaluate all kinds of integrity risk and within the universities and the various factors may affect the integrity risk on the basis of the above theory and formulate verification methods of risk management so as to realize with the minimum cost to achieve maximum security risk prevention and control management goals.

### 3 Practical Approaches for Universities to Comprehensively Strengthen Integrity Risk Prevention and Control

Risk management is a continuous, cyclic and dynamic process. In order to achieve the goal of integrity risk management, it is necessary to solve a series of problems, such as what risks exist in universities, where the risks occur, the probability of the risks, the degree of impact caused by the risks, and what measures are taken to prevent and manage the risks. Therefore, universities should comprehensively strengthen the prevention and control management of integrity risks, generally through risk screening and identification, risk diagnosis and evaluation, risk response and disposal and other procedures according to the definition of process management theory.

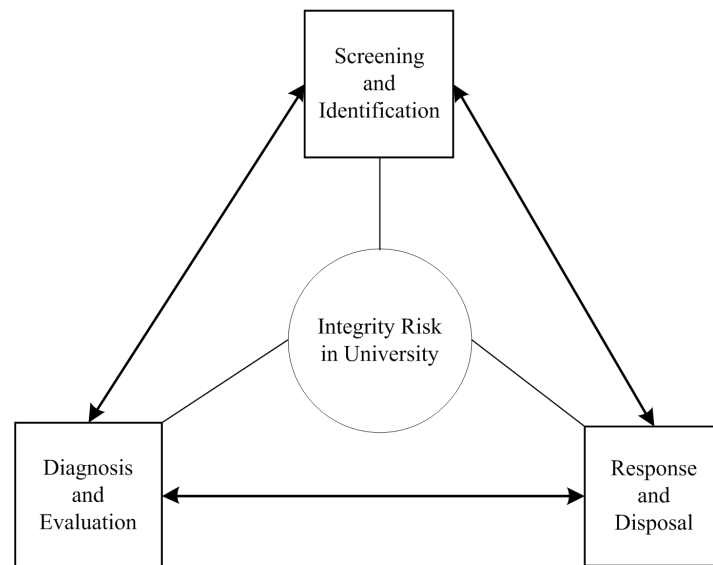


Figure 1 Schematic Diagram of Integrity Risk Prevention and Control Management in Universities

#### 3.1 Investigation and identification of integrity risk

The investigation and identification of integrity risks refers to the process of comprehensive and careful screening and screening of various work fields, units, departments, posts and personnel that may have the integrity risk in universities through certain methods and means, so as to obtain relevant risk



factors. It is easy to say that risk screening and identification is to find and determine the activities of risk information. "Risk identification is one of the key tasks of integrity risk prevention and control management and accurate and effective risk identification is the foundation of building an integrity risk prevention and management mechanism" (Zhang Lan, 2012). Risk screening and identification mainly solve two aspects of the problem, one is what the university internal integrity risk is? The second is where these integrity risks occur. As for the problem of finding out the risks, we should compare the classification of the four types of risks, focus on the investigation from the aspects of ideology, job responsibilities, rules and regulations, and external environment, and comprehensively identify them from both internal and external perspectives. As for the problem of finding out where the risk occurs, it should be carried out from the three levels of school, department (secondary unit) and specific post, focusing on the important matters, key areas and key links of the risk occurrence. See the table below for details.

**Table 1 Objects and Contents of the Investigation of Integrity Risks**

Object	Content
School	The integrity risks of the school leadership and its members in the top-level design of major matters decision-making, important personnel appointment and removal, major project arrangement and large amount of funds, as well as the decision-making procedure and decision-making system of daily management work
Departmental (secondary unit)	The department (second-level unit) shall exercise the independent right and discretion of running a school in the work of teaching management, scientific research management, student management, personnel management, fund management, graduate student enrollment and foreign cooperation in running a school
Specific position	The staff who exercise public power have the integrity risk in performing their duties, carrying out specific tasks and implementing rules and regulations

The simplest and most common methods to investigate and identify the risk of integrity are the comparison self-examination method and the random sampling method. Comparison self-examination method is to analyze and compare individual thought performance, job responsibility division, rules and regulations requirements and other elements related to the occurrence of risks one by one, and find out all integrity risks that have occurred or may exist. The random inspection method randomly checks and verifies the risk items, risk fields and risk links to ensure full coverage and no omission in the risk screening. It should be said that different units, different positions and different stages of integrity risk are not identical, therefore, screening and identification of the risk should be combined with practice, seeking truth from facts to find out the risks accurately and it can't literally expand boundaries, in particular to identify integrity rather than other types of risks, nor any risk of narrow scope and could not find out those hidden trouble in obvious problems.

### 3.2 Diagnosis and assessment of integrity risks

Risk diagnosis and assessment refers to the process of estimating, measuring and evaluating the probability of risk occurrence and the impact and loss degree caused by risk occurrence found in the early stage, which serves as the reference and basis for taking corresponding prevention and control

management measures. Its main purpose is to reduce the risk as much as possible, especially to prevent the occurrence of major risk accidents and at the same time to implement the risk prevention and control management measures and the management cost invested in a reasonable control.

The probability of risk is the possibility amount of risk. From the qualitative perspective, the identification of risk occurrence probability can be divided into five types: extremely low, low, medium, high and extremely high in the order of occurrence probability from low to high. The so-called risk impact degree is the loss caused by the occurrence of risk, including direct loss of economy and assets, as well as indirect loss of reputation and rights. For the determination of the degree of risk impact, it can also refer to the above ideas to divide the degree of risk impact into five types: extremely low, low, medium, high and extremely high. Correspondingly, we can also use a probability distribution, mathematical statistics and other empirical research methods to define the degree of risk probability and risk impact to a certain value and carries on the quantitative analysis of related numerical and make it reflected in the form of data. The greater the numerical value is reflects that the risk probability and impact degree is higher, while the lower the conversely it is. For example, we can use probabilistic risk assessment (also known as probabilistic risk analysis) to assess the probability and impact of risk occurrence. According to the definition of probabilistic risk assessment method:

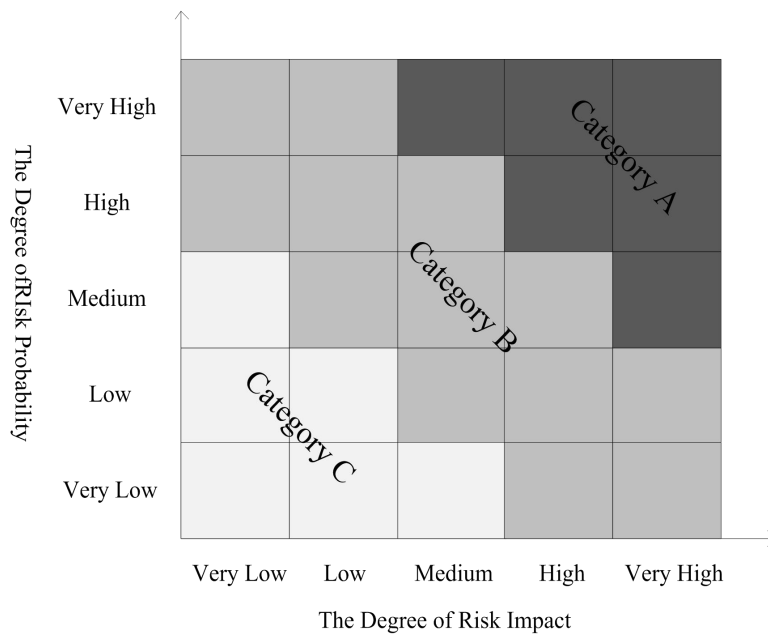
$$R = p * s$$

Where, R represents the risk rate (the standard or scale to measure the risk size), p represents the probability of the risk occurring within a certain period of time, and s represents the degree of impact or loss caused by the risk.

**Table 2 Qualitative Evaluation Criteria of Integrity Risk Grade**

Risk level	Probability of occurrence of risk	Degree of risk impact	Value at risk
Very low	Risks don't happen in general, they haven't happened in the past, and they're unlikely to happen in the future	Little or no loss, and no significant impact on the normal operation and management of the work	1
Low	Risks occasionally occur	Has had some impact, but to a lesser extent	2
Medium	Risks may occur if they are not paid attention to and can be avoided by taking appropriate measures	Will cause adverse effects, but the extent of the impact is manageable	3
High	Risks happen all the time	The loss is large, affecting the normal operation and management of the work	4
Very high	Risk can happen at any time, the occurrence of risk is almost inevitable	Cause irreparable loss to the unit and individual	5

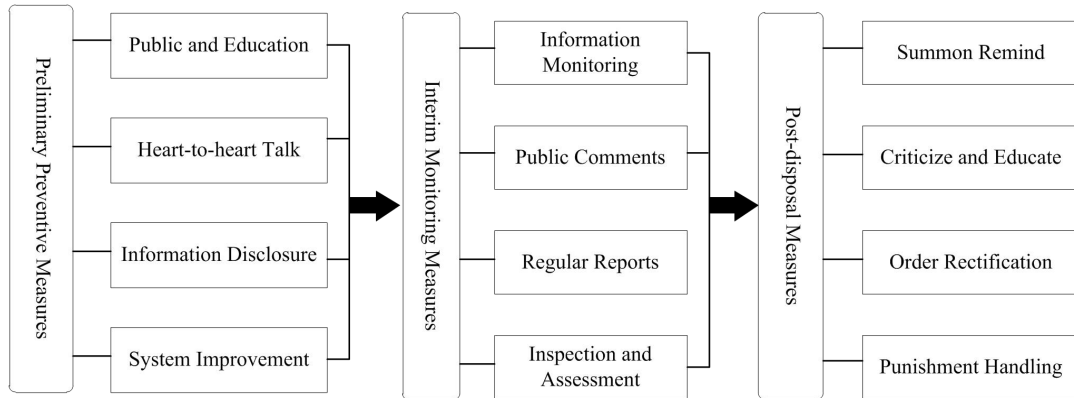
According to the degree of risk probability and impact on the target of comprehensive evaluation, in combination with the important degree of public power, the frequency of the power, the discretion of the factors such as size, our universities of the risk can be divided into three levels, namely, Category A, Category B and Category C, quantitatively calculated by applying the method of probabilistic risk assessment at the same time, we can conclude: Category A as the highest levels of integrity risk (risk value of 4 or less), the probability of occurrence of A risk is great which can cause serious consequences, and possibly break the law or the case constitutes crime. It is very necessary to draw high attention. Category B is the general level of integrity risk (4 risk value 12), such risk may or may not occur, the impact degree and loss brought by the controllable scope, need to take measures to strengthen prevention and management, try to avoid the occurrence of such risks. Category C is low-grade integrity risk (12 risk value 25), which is less likely to occur and will not cause serious consequences even if it does occur. It needs to be emphasized that no matter what kind of risks we are faced with, we cannot let down our vigilance and must do a good job in prevention and control and management, because the risks themselves are universal, potential, loss-making and changeable.



**Figure 2 Risk Evaluation Plot**

### 3.3 Risk response to integrity

Integrity risk response and disposal refers to the activities of taking appropriate prevention, monitoring and disposal measures to intervene and control risks according to different risk types on the basis of risk screening, identification, diagnosis and evaluation. According to the time stage of risk occurrence, we can effectively manage the risk of integrity from the three aspects of early prevention, middle monitoring and late disposal.



Fig

**ure 3 Integrity Risk in Universities Response and Disposal Basic Flow Diagram**

(1) Preliminary preventive measures. In view of the above classification of integrity risks in universities, preventive measures such as publicity and education, heart-to-heart talk, information disclosure and system improvement can be taken in the early stage to minimize the possibility of risk occurrence. First, make full use of the campus media to strengthen the publicity of integrity, carry out warning education in a planned way, and constantly enhance personal risk awareness, integrity awareness and self-discipline awareness. Second, regular development of heart-to-heart conversation activities, face-to-face communication, exchange of views, timely grasp the ideological dynamics. Third, vigorously promote the construction of integrity culture, let integrity culture into all aspects of work and life, and actively create a clean atmosphere of campus culture. Fourth, we will make more information disclosure, make management more transparent, and let the people oversee and exercise power in a transparent way. Fifth, we will improve rules and regulations, establish a long-term working mechanism for risk prevention and management, and plug loopholes in the occurrence of risks.

(2) Interim monitoring measures. In the middle stage of risk prevention and control, process management should be strengthened. Through information monitoring, public comments, regular reports, inspection and assessment, the integrity risks that have been screened out in the early stage, especially high-level integrity risks, should be supervised and managed. Information monitoring is mainly to use modern information means to timely collect and grasp risk information and carry out summary analysis. The public evaluation is mainly taken through the establishment of opinion boxes, supervision of the release of telephone and email, meetings, questionnaires, etc. so as to understand the public's opinions and suggestions on the prevention and control of integrity risk management. The regular report mainly refers to that the relevant responsible units and responsible personnel regularly report the work status of risk prevention and control management to the management department and leaders. The inspection and assessment are mainly taken to assess and evaluate the implementation of the system and the performance of duties so as to urge the continuous improvement and improvement of risk prevention and control management.

(3) Post-disposal measures. The post-disposal is mainly aimed at the situation that the risk of integrity has occurred. Timely measures should be taken to minimize the degree of risk impact and prevent the integrity risk from evolving into corruption or even crime. For this reason, we must take corresponding measures to control. For example, for those problems with small risk impact, we can interview relevant units and personnel, remind them and put forward work requirements. For problems with a high degree of risk impact, we may order rectification within a time limit and criticize and educate relevant units and personnel. For the problems with particularly significant risk impact degree, they shall be dealt with in strict accordance with relevant regulations, and certain economic

compensation or punishment shall be given when necessary.

#### 4 Conclusion

According to the above research, the author believes that the integrity risk prevention and control management in universities should comply with the ideas and methods of risk management theory and be concerned with the university internal integrity risk which may be produced or impacted by the risk of related elements, from risk screening and diagnosis and assessment, risk identification, risk response and disposal of three aspects of optimizing the risk prevention and control management process, taking concrete measures to integrity, risk for effective prevention and control and management. In future research, the author will continue to comply with the research ideas, taking the integrity risk prevention and control of management combined with the internal control management work and punishing and preventing corruption work. On the basis of systematic and in-depth analysis of the relevant theories of risk management, this paper will further propose more scientific and effective integrity risk prevention and control measures against corruption and provide beneficial inspiration and reference for accelerating the modernization of university management system and capability.

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## Risk Analysis of Ships Navigation Safety in Wuhan Port

Mao Senpeng, Jiang Feifei

School of Navigation, Wuhan University of Technology, Wuhan, P.R. China, 430070

(E-mail: 568773627@qq.com, 970386280@qq.com)

**Abstract:** Wuhan port is an important port for inland river navigation in China, we must pay more attention to the safety of vessels sailing within the port. Aiming at the present situation of navigation safety in Wuhan port, this paper employs the formal safety assessment method to analyze the risk of navigation safety of ships in Wuhan port. Based on the risk identification of human, ship and environment factors in Wuhan port, an evaluation index is constructed to obtain the risk level of ship navigation in Wuhan port according to the risk matrix, and a risk control option is proposed. The present paper would provide some references for the safety management department to ensure the safe navigation of ships in Wuhan port.

**Keywords:** Formal safety assessment; Risk identification; Risk assessment; Risk analysis

### 1 Introduction

According to statistics from the Ministry of Transport, Wuhan port has handled 13.33 million tons of cargoes loaded and unloaded in 2019 as of March 2019, 14.6 percent higher than that of the same period in 2018. In the face of the increasing navigable density, the safety risks of water traffic accidents are also increasing. Therefore, the risk analysis of navigation safety of ships in Wuhan port can effectively reduce the occurrence of traffic accidents in the port.

#### 1.1 Research status of ship navigation safety risk analysis

Risk analysis is one of the important parts of the research on ship navigation safety in port waters. So far, the commonly used safety assessment methods include fuzzy mathematical analysis, analytic hierarchy process (AHP), analysis network process (ANP), probability analysis and formal safety assessment method (FSA) (Fan Hong, 2004). Formal safety assessment (FSA) is one of the commonly used for safety assessment. As a technical tool of safety management, FSA method can be used for risk analysis in navigation safety management to comprehensively, reasonably and effectively improving ship navigation safety.

##### 1.1.1 Study on the risk analysis of ship navigation safety abroad

In the field of water traffic safety assessment, experts such as M.J. BARLATT from the UK and Kwik from Germany summarized the safety assessment index system and index factors, and achieved certain research results.

Britain is the first country to study the safety assessment of crew and passengers on high-speed catamarans (Wang Yunlong, 2011). Japanese scholar Hiroaki Kobayashi put forward the method of environmental safety assessment of navigation difficulty, which can quantitatively evaluate the operation difficulty of ships (Hiroaki Kobayashi, 1992). In recent years, IMO is researching and popularizing a new method for maritime Safety standards –FSA (Formal Safety Assessment), which takes risk analysis and Assessment as one of the most important steps for the FSA (Z Karaszewsky,

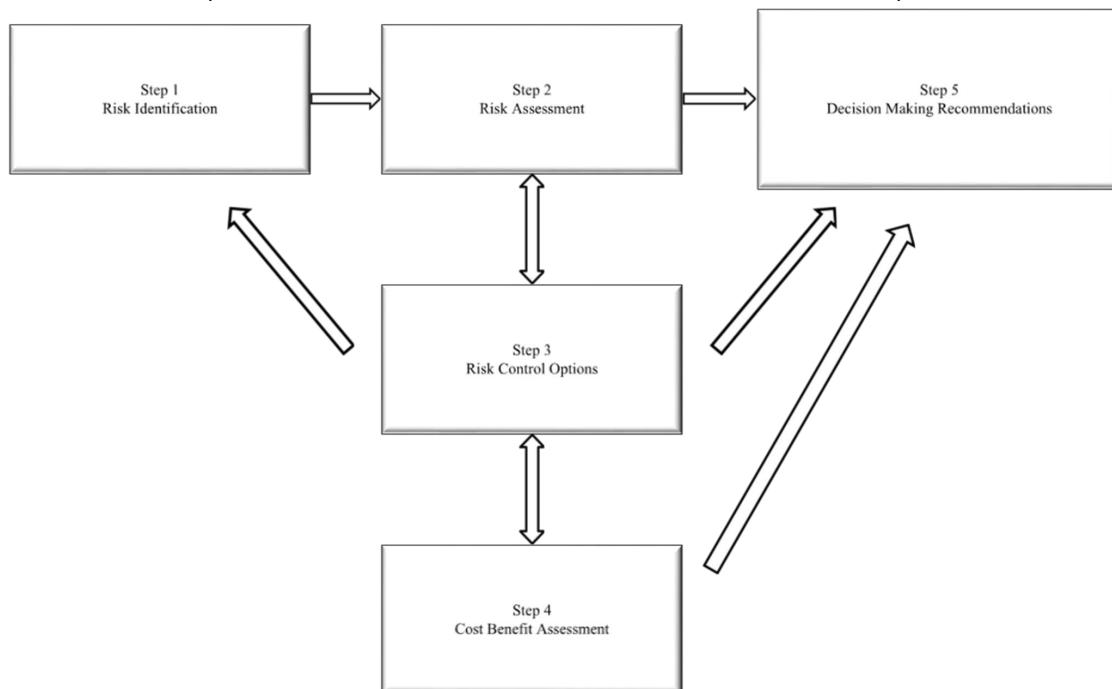
1995).

1.1.2 Study on the risk analysis of ship navigation safety in China

In November 1999, China Classification Society published the Guidelines for the application of comprehensive safety assessment, and cooperated with Shanghai Institute of Standards to apply FSA method to the risk assessment of high-speed ships in the Yangtze river (Chen Weijiong, 1998). The research on sea traffic in China started late, but many experts have done a lot of research on the evaluation of traffic safety of ships in port waters from different angles. Sun Ruishan, etc. put forward the system engineering theory based on "human, aircraft and environment" in the Airline safety assessment system (Fang Quangen, 2004). In the Formal assessment of the environmental risk of ship handling in harbor waterways, engineer Ma Hui made a quantitative analysis and evaluation with the method of grey statistical assessment. Wuhan University of Technology Fan Hong introduced the general situation of formal safety assessment, analyzed the sources of uncertain factors and various difficulties in the implementation in the Research on the Method of Ship Formal Safety Assessment (FSA) (Xu leping, 2000).

**2 Risk Analysis Based on FSA**

In the process of navigation, the safety status of ships has impacted on many aspects. By connecting inland and sea transport through Wuhan, the logistics boom on a larger scale will give a boost to the economy of the hinterland of central China. The formal safety assessment (FSA) is adopted for the navigation risk analysis of Wuhan port. FSA is a systematic and standardized analysis method, which is usually composed of five steps, including risk identification, risk assessment, risk control options, cost benefit assessment and decision making recommendations, as shown in Figure 1 (Jing Shi, 2019). Under the framework of FSA method, the present paper analyzed the risk of navigation safety of ships in Wuhan port, in combination with the specific situation of Wuhan port, following the steps of risk factor identification, risk assessment and risk control optionl



**Figure1 FSA Flow Chart**



## **2.1 Wuhan port risk identification**

### **2.1.1 Wuhan port people for the factors of risk identification**

In the research of ship navigation safety, human factor is a very important subsystem, nearly 80% of navigation accidents are caused by human factor. Human factors can be specifically divided into four aspects: safety awareness, experience and skills, strain capacity and physical quality of personnel involved in ship navigation. Combined with the actual situation of Wuhan port, the risk of navigation in the port is reflected as follows: on the one hand, some ship operators in Wuhan port have obvious weak safety awareness and insufficient responsibility awareness. On the other hand, the lack of highly educated seafarers and the low comprehensive quality of seafarers in the port leads to the lack of strain capacity and experience in dealing with emergencies when the ship encounters emergencies.

### **2.1.2 Risk identification of influential factors in Wuhan port**

The ship factor is one of the objective factors of water traffic accidents. Ship structure, ship size, ship equipment, ship age, sailing speed and other factors have an important impact on navigation safety. The increasing size of ships results in the turbine factory quality requirements, as well as the late turbine equipment maintenance requirements more stringent. Through the inspection of nearly 240 ships of Wuhan port authority, it can be found that the overall safety of the ships sailing in the port is in good condition. However, as time goes by, the stress structure of each part of the ship and the hull will gradually age, and its function and life will gradually fade, which makes surface traffic accidents more frequent. In order to save the operation cost, some port companies neglect the safety management of ships and cut corners on the daily maintenance of ships.

### **2.1.3 Wuhan port risk identification of environmental factors**

The environmental factors that affect the navigation of ships in port waters include hydrological and meteorological conditions at the time of navigation and navigation conditions within the port area. In terms of precipitation, temperature, water level, flow rate and fog condition, etc., the hydrological and meteorological conditions of Wuhan are good, and there is no history of freezing all year round in the port area. The ship is not easily affected by wind, waves, low visibility and other factors when sailing in Wuhan port, which has little impact on the risk generated in the process of sailing. The figure shows the distribution of part of the port area of Wuhan port. From the Figure 2, it can be seen that the Yangtze river is crossed by several bridges, with narrow water width and multiple bends in the channel, among which the channel width of the Yangtze river section is 80 meters at the narrowest point. With the increase of port throughput, the navigation density increases and the probability of collision increases. Due to the influence of the swirling current near the pier, it is difficult for passing ships to control their speed, which leads to frequent bridge collisions in Wuhan port.



Figure2 Distribution Map of Wuhan Port (Part)

## 2.2 Wuhan port of risk assessment

In the existing water traffic accidents, it is not difficult to find that the risk factors of personnel loss and property loss caused by ship stranding, hitting rocks and collision are diversified, and it is difficult to use the same standard in risk analysis. This paper adopts FSA method to systematize and quantify risk factors in risk assessment, and then measures the navigation risk of the ship (Peter Vidmar, 2018). There is a relationship of a double function between risk  $R$  and event occurrence frequency  $F$  and event severity  $N$ , namely Formula (1):

$$\text{Risk} = f(F, N) \quad (1)$$

The attributes of frequency and consequence degree are not single, so the risks are superposed.

$$\begin{aligned} \text{Risk}_{\text{status1}} &= f(F_{\text{status1}}, N_{\text{status1}}) \\ \text{Risk}_{\text{status2}} &= f(F_{\text{status2}}, N_{\text{status2}}) \\ \text{Risk}_{\text{total}} &= \text{Risk}_{\text{status1}} + \text{Risk}_{\text{status2}} \\ &= f(F_{\text{status1}} + F_{\text{status2}}, N_{\text{status1}} + N_{\text{status2}}) \end{aligned} \quad (2)$$

According to the general situation in the maritime industry and the practice of experts. And the application of Professor Fang Quangen of Shanghai Maritime University in the study of pilotage Safety in Shanghai Port. The frequency  $F$  is the ratio of the sum of the number  $C$  of the events in unit time to the sum of the ship activity  $Q$ , namely Formula (3):

$$F = \frac{\sum C_i}{\sum Q_i} \quad (3)$$

The frequency of events is divided into four levels: Frequent ( $F_4$ ), Probable ( $F_3$ ), Occasional ( $F_2$ )

and Rare ( $F_1$ ), which are used as the evaluation indexes in this paper (Li Faming,2013).

The severity  $N$  of the event is the ratio of the sum of the consequence  $S$  of the event in unit time to the sum of the number  $C$  of the event, namely Formula (4):

$$N = \frac{\sum S_i}{\sum C_i} \quad (4)$$

There are seven levels of consequence occurrence during the voyage of a ship. In this paper, four levels of Very Serious ( $S_7$ ), Severe ( $S_5$ ), General ( $S_3$ ) and Slight ( $S_1$ ) are selected as evaluation indicators.

The risk in the navigation of the ship is classified into levels, and the Figure 3 is obtained. In the lower left corner of the figure, the risk level of the light-colored area is  $R_2$ - $R_4$ , which represents the risk area that is allowed to be ignored. The risk level of the middle white area is  $R_5$ - $R_8$ , indicating the low risk area. The dark area in the upper right corner has a risk rating of  $R_9$ - $R_{11}$ , indicating a high-risk area (Jakub Montewka,2014). The above evaluation indexes can be used in the risk analysis of navigation safety of ships in Wuhan port. If the risk level is within  $R_2$ - $R_4$ , it is considered acceptable when the risk occurs; In the range of  $R_5$ - $R_8$ , it is considered that reasonable loss can be reduced when the risk occurs; In the range of  $R_9$ - $R_{11}$ , the risk is considered to be firmly forbidden. After the quantitative assessment of the risk factors of Wuhan port, it is concluded that the risk level of the ship navigation safety of this port belongs to the risk area which can be reasonably reduced.

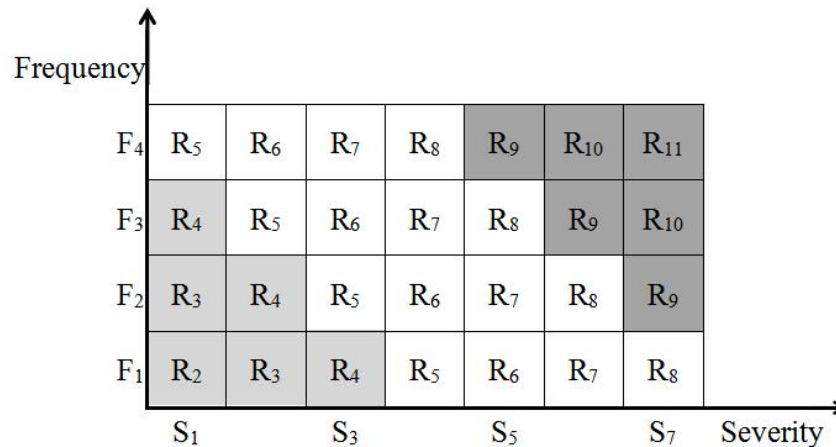


Figure3 RiskRating Diagram

### 2.3 Risk control options of Wuhan port

Through the risk identification and assessment of Wuhan port, it can be found that there is a lot of room for improvement in the navigation safety management of the port. The following control options are proposed for the prominent aspects of the problem:

(1) The comprehensive quality of the crew needs to be improved. To strengthen the awareness of the safety responsibility of the crew and establish a scientific and reasonable safety management system (SMS); Crew members are required to master various emergency rescue measures to reduce

man-made security risks in finitely from the root.

(2) Improving the navigation safety of ships and the VTS system of Wuhan port. On the one hand, we should pay more attention to the daily maintenance of ship equipment, and regular inspection of radar, fog clocks, firefighting equipment, and keep VHF communication unobstructed. On the other hand, we should increase investment in Marine equipment, accelerate the upgrading and introduction of more advanced equipment, and improve the anti-risk capability of ships in terms of technology and equipment.

(3) Improving the navigation environment of the port. Although there is less severe weather in Wuhan all year round, in order to improve the safety of navigation, the supervision department should strengthen the reminder of navigation ships. In addition, we can visit the ship and crew members to optimize the port route and stabilize the traffic order in the port waters to reduce, as far as possible, the ship collision caused by wind, fog, cyclone.

### 3 Conclusion

Through the analysis of risk identification, risk assessment and risk control scheme, this paper carried out risk analysis on the navigation safety of ships in the waters of Wuhan port, and came to the conclusion that the navigation safety risk existing in this port can be reasonably reduced, and put forward suggestions to reduce the navigation risk, so as to ensure the navigation safety of ships in Wuhan port. Based on the FSA, this paper made a quantitative analysis of the navigation risk of Wuhan port and classifies the risk level. In the follow-up study, more detailed decision-making suggestions can be obtained by combining with the cost-benefit evaluation.

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# Research on Risk Factors of Enterprise Product Innovation Design

Deng Jun

School of Urban Design, Wuhan University, Wuhan, Hubei, 430072

(E-mail: whuteach@126.com)

**Abstract:** This paper expounds that the risk of enterprise product innovation design exists objectively. It reveals that the risk concept of enterprise product innovation design consists of the risk of design strategy, the risk of design target, the risk of design process, the risk of design quality, the risk of design intellectual property and their sub-risks. This paper discusses the research on the risk concept of enterprise product innovation design, which lays the theoretical foundation and preconditions for the research of risk identification, risk management and risk transmission. This paper has important theoretical value and practical significance.

**Key words:** Enterprise product innovation design; Design risk; Design strategy risk; Design target risk

## 1 Introduction

Compared with the theoretical research on product innovation and risk management, the research on design risk theory is a term appearing in recent years, and mostly focuses on the fields of architectural design, engineering construction and so on. Ke Dong, from Tsinghua University, discuss the reasons for the existence of design risks, sources of risks, and forms of expression, identification methods and other issues, in his dissertation: "Market Risk Identification Design in SME Product Design Plan"(Ke Dong, 2006); Wan Zhang in Zhejiang University built a product development project risk identification system, identified the five main risk factors and 16 key risk factors of risk management of the mobile phone design company product development project, and calculated the weight between risk factors and risk consequence indicators his dissertation "mobile phone design company product development project risk identification and control research" (Wan Zhang, 2007); Zhisheng Li of Central South University proposed in "Managing Your Design Risks" (Zhisheng Li, 2007) The concept of design risk reveals the way to pay attention to the control of design risk and enhance the success rates of product innovation.

Enterprise product innovation is an exploratory activity that starts from the conception of new products and ends with the sales and delivery of new products. (Chen Hanqing, 2005) Design risks are ubiquitous in this exploratory activity. The design risk directly affects the success or failure of enterprise product innovation design activities. However, it is far enough from to study the risk of enterprise product innovation design in academia and business circles at home and abroad. Therefore, the research on enterprise product innovation design risk has very important theoretical research value and practical application value.

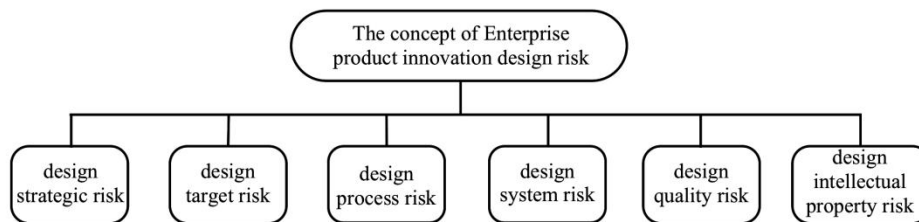
## 2 The Formation of Enterprise Product Innovation Design Risk Concept

There are many different opinions about the definition of product innovation. Academician Xu Qingrui of Zhejiang University believes that all technological innovation activities and the introduction

of new product development can be called product innovation; Professor Fu Jiayu of Tsinghua University believes that the purpose of product innovation is to obtain new or some improved, improved products, including the renewal of industrial equipment; Professor Shumei Ma, from the institute of modern manufacturing technology of Tongji university, believes that the so-called product innovation refers to the process of creating products with competitive advantages in the market in order to achieve business goals. Product innovation is mainly reflected in product design.

Product innovation design is a systematic and high-procedural enterprise production and management activity. The successful development of a new product will go through market research, development decision, design and implementation, manufacturing, sales, recycling and so on. (Xie Kefan, 1993) In this process, enterprises need to make strategies and set goals according to the information of market research. New products need to be designed based on the design process and design system; Design and product departments need to develop corresponding product quality standards to meet consumers demand; new products also need to be protected by intellectual property rights to ensure the continuous benefits of enterprise product innovation. (Feng Xiaoqing, 2001) To sum up, a successful development of a new product must go through making design strategy, design business objectives, design process flow, design production and management system, design product quality standards, design intellectual property rights protection and other links. In the design process of these links, due to the influence of subjective and objective factors, there are a lot of uncertainties, which make the actual achievement of the design and the design goal are too high, so that the design value suffers the possibility of loss, that is, the design risk.

The existence of enterprise product innovation design risk is not based on human will, and it exists objectively. Systematic analysis and identification are carried out from the perspective of system theory, which forms the risk concept of enterprise product innovation design. According to the experience of enterprise product innovation, the design risk concept consists of design strategy risk, design target risk, design process risk, design system risk, design quality risk, and design intellectual property risk. The specific content is shown in Figure 1.



**Figure 1 The Concept of Enterprise Product Innovation Risk Architecture Diagram**

### **3 The Essence of Enterprise Product Innovation Design Risk Concept**

As for the definition of risk, scholars at home and abroad discuss a lot, which can be summarized as follows: the lost chances and possibilities; the higher actual and expected results; the lost uncertainty; the probability of actual result is higher than expected target; things that have negative effects and are unexpected to happen. (Song Mingzhe, 2003)

The design risk involved in enterprise product innovation design is the possibility of loss of design value due to the influence of subjective and objective reasons, which leads to many uncertainties in the design process of enterprise product innovation design. Its essence makes the following analysis.

### **3.1 Risk of enterprise product innovation design strategic**

Enterprise product innovation design strategy is one of the components of enterprise production and management strategy, which is the development plan of enterprise design department and the long-term plan and strategy formulated by enterprises according to their own design work and the design criteria and directional requirements.

The production and operation strategies of enterprises are divided into enterprise levels, which are divided into company level strategy, business level strategy and functional level strategy. The realization of the enterprise product design strategy is affected by the strategy of each layer.

The company-level strategy is the core strategy of the company's highest level. It is directly related to the positioning and development of the enterprise, as well as the allocation of various resources and department setting of the enterprise, it has the most fundamental effect on the design strategy and thus forms the design strategy risk leadership decision-making risk.

Business strategy is the strategy of each business unit of an enterprise, which determines the performance, quality, delivery time, after-sales service and price of products. It has the most direct impact on design strategy, and forms the direct factor risk of design strategy risk.

The functional level strategy is the specific path and means to ensure that the various strategic objectives of the enterprise can be realized. The implementation of various tasks is guaranteed by formulating specific, precise and clear rules. It indirectly influences on design strategy, developing the indirect factor risk of design strategy risk.

The scientific, advanced, maneuverability and effectiveness of enterprise product innovation design strategy also directly affect the effect of design strategy, forming the design strategy risk internal factor risk.

The strategic risk of enterprise product innovation design consists of external factor risk (leadership decision-making risk, direct factor risk, indirect factor risk) and internal factor risk.

### **3.2 Risk of enterprise product innovation design target**

The enterprise product innovation design goal is based on its content composition, including the technical goals, artistic goals, functional goals, economic goals and market objectives of the design. Whether the design goal can be achieved is influenced by the production technology and management technology of its own technical goal, the art form and artistic function of the artistic goal, the coordination of the basic function, supporting function and additional function of the functional goal, the rationality of the cost and profit index of the economic goal, and the accuracy of the market segmentation and market positioning of the market goal. However, the establishment of these goals is influenced by the changes of design clients, design contractors, consumers, competitors, national policy and other factors, and there are many uncertainties. Thus, the technical goal risk, artistic goal risk, functional goal risk, economic goal risk and market goal risk of enterprise product innovation design goal risk appear.

According to the theory of the logical relationship of means and purpose, strategy is the means and methods taken in order to achieve the target; goals are the achievements and results expected by



individuals, departments or the whole organization, in the implementation of organizational planning, goals are both the starting point and the destination. The relationship between strategy and goals is so close that many organizations do not separate them in their actual planning and project operations.

XELIBRI, for example, which is the mobile phone brand that Siemens launched from February to December 2003. With a life span of just one year, the XELIBRI sold only 780,000 handsets in the first 10 months of its popularity, less than 2% of the global sales of the Siemens brand. In 2004, Siemens announced that it was suspending production lines of the XELIBRI series and cutting prices. The reason why the XELIBRI phones failed may be because, as Amy said, an American mobile phone user, "if the XELIBRI phones are targeted at high-level users, the price is a little lower and the functions cannot meet the needs of high-level users. But the XELIBRI phones are considered too expensive and unacceptable for the public. Obviously, Siemens made a wrong judgment when it established the market positioning of XELIBRI mobile phone. Even though the appearance design was excellent and the quality was excellent, it could not save the product from failure, because it did not really grasp the key to success in the design strategy and goal stage, so other design links were just in vain.



Figure 2 XELIBRI 1-8

### 3.3 Risk of enterprise product innovation design process

From the point of view of industrial production, the process refers to the steps from raw materials to finished products. From the perspective of design process content, it includes product demand and investigation, product development and design, product display and identification, product production and sales, product recycling and reproduction. Whether the design process can be achieved and smooth is affected by the uncertainty of the internal factors of each link and the uncertainty of the connection factors between the links.

The authenticity and accuracy of the data in product demand and market research links, the accuracy of the concept and detail design of product development and design process, the prototype test and evaluation of comprehensive, accuracy and objective fairness of product display and identification link, the scientificity and competitive strength of the products production and sales link production process, and the requirements for energy conservation and environmental protection in product recycling and reproduction process, the uncertainty of the internal factors in these links, lead to the inherent risk of each link of the design process.

The scientificity, integrity, timeliness and adaptability of the feedback mechanism in the upstream and downstream links of the process of the enterprise product innovation design, as well as the degree of cooperation among functional departments, result in the risk that each link of the design process connects with the other.

The risk within each link of the design process and the risk of each link connecting each other constitute the risk of the enterprise product innovation design process.

### **3.4 Enterprise product innovation design system risk**

In general definition, the system is a combination of several components that are interconnected and mutually constrained, with an organic whole with specific functions. (Wang Yingluo, 2005) Enterprise product innovation design system is a comprehensive system of cross-domain, cross-level and cross-department. This integrated system is divided into internal elements of the system and external elements of the system. External elements of the system include market environment elements, policy and regulation elements, and emergency elements and so on.

The personnel element specifically refers to the professional quality of the designer, which is directly related to the quality of the design scheme; the technical element means that the technical strength of the enterprise itself will lead to the realization of the level of design standards; the capital element refers to the funds required by the enterprise to provide the design project. Adequacy will lead to the quality of the design project and the speed of the progress; the fluctuation of these factors and their uncertainty lead to the formation of internal factor risks.

Market environment factors specifically refer to the changes and uncertainties of time, spatial factors, information factors, price factors, etc., which are the key to the result of enterprise product innovation; the elements of policies and regulations refer to the stability and persistence of policies and regulations, which are related to the survival and development of enterprise design system organization. Emergency elements refer to natural disasters, political turbulence, explosive news, etc. Related projects will lead to the breakdown of the enterprise design system, while non-related projects will lead to the instability of the design system. The changes and uncertainties of the above factors lead to the formation of risks of external factors of the system. (Cachon, G. P., Randall, T., Schmidt, G. M, 2007)

The risk of internal factors and external factors of design system constitute the risk of enterprise product innovation design system. (Gero Js, 2004)

### **3.5 Risk of enterprise product innovation design quality**

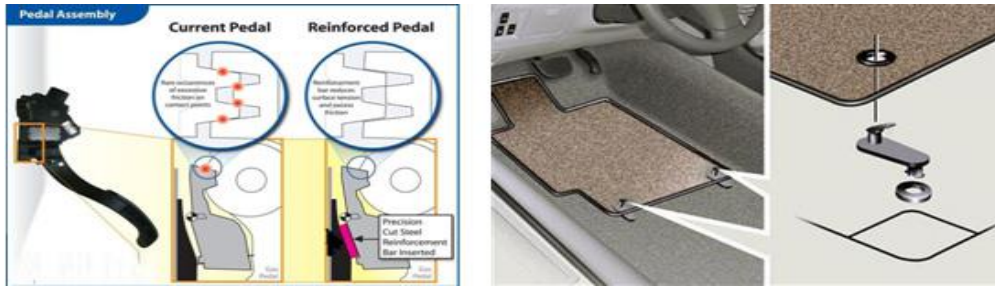
Design quality refers to determining the quality or quality level of the required design based on the user's purpose of use, economic status, and internal conditions of the enterprise. (Chen Xiaotan, Zhao Jianghong, 2006) This usually includes the quality of market research, design ideas/concepts, and design specifications.

Market research quality refers to the precision degree of clearly meeting the requirements of users' "adaptability" and formulating corresponding design quality standards in the research stage. (Nigel Cross, 2007) Design conception/concept quality refers to the level of achieving "adaptive" design quality standards based on the input of design information and the output of stage results; Design specification and quality refers to the conformity of the specific product scheme to the design quality standard of "adaptability". These involve the uncertainty of the realization degree of design quality requirements, which leads to the quality risk of enterprise product innovation design.

Product quality is an important guarantee to realize the value of products. The quality is directly related to the sales volume of products, and then affects the survival and development of enterprises. Design quality is the core element of product quality, design quality risk will greatly affect design quality, and design quality defects will bring incalculable huge losses to enterprises.

On February 12, 2010, a Nebraska consumer filed a lawsuit against Toyota motorcorporation in Los Angeles, demanding that Toyota should take responsibility and pay economic compensation for the death of her husband and the injury of her caused by the vehicle it manufactured. Toyota has recalled 9.1 million vehicles around the world (figure 3), dealing a heavy blow to Toyota and the Japanese

automobile industry as a whole.



**Figure 3 The Cause of Toyota Brake Door Accident**

### **3.6 Risk of intellectual property rights of enterprise product innovation design**

Intellectual property rights refer to the lawful rights to possess, use, dispose of and profit from intellectual work. The exclusive rights include copyright, invention patent, utility patent, design patent, trademark, service mark, manufacturer name, source name or country of origin.

From a broad perspective, design intellectual property rights refer to the rights to possess, use, dispose and profit obtained by means of trademark registration, application of invention patent, utility model patent and appearance design patent, which are formed by means of design, such as pattern, logo, modeling, structure, new concept/principle and application of new material. In a narrow sense, it refers to product design patent.

In the process of enterprise product innovation design, the design results without patent protection are easy to be imitated and cannot bring reliable value to enterprises, forming the risk of intellectual property rights of enterprise product innovation design.

Since domestic automobile enterprises and design companies are not strong in vehicle research and development and lack of experience, especially for small and medium-sized domestic automobile enterprises, imitation of successful models in the market has become the main way for them to start their business, mainly reflected in the appearance design of successful models. (I M Verstijen. J M Hennessey, 2010) In September 2007, on the first day of the Frankfurt auto show, auto weekly, Germany's most influential auto professional newspaper, published an article revealing that BMW group had sued Chinese SHUANGHUAN automobile and German dealers in Munich local court, while SHUANGHUAN SCEO models were on display at the Frankfurt auto show. (Deng Jun, 2011) BMW group argues that the SCEO model launched by SHUANGHUAN is similar in appearance to the X5 model of BMW's urban off-road vehicle, and that its low price has a market impact on the X5 model and infringes BMW's intellectual property rights, so it asks the Munich court to make the relevant ruling. In June 2008, the court in Munich ruled that SHUANGHUAN was infringing and banned German car dealers from importing the SHUANGHUAN SCEO models, which look like BMW X5 (figure 4). (Deng Jun,2011)



Figure 4 BMW X5 Model (left) Double-Ring SCEO Model (right)

#### 4 The Research Value of Enterprise Product Innovation Design Risk Concept

Research value 1, identify enterprise product innovation design risk and its connotation, and reveal enterprise product innovation design risk concept framework system (figure 5).

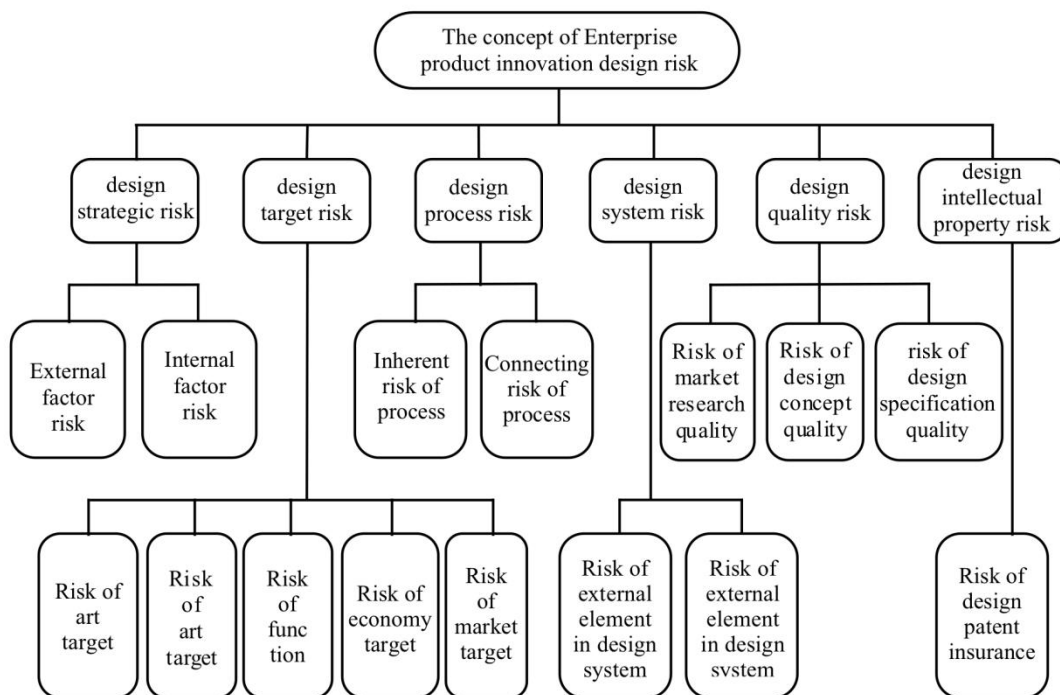


Figure 5 Composition Chart of Enterprise Product Innovation Design Risk View

The existence of enterprise product innovation design risk is not transferred by human will, but is an objective fact. Careful analysis of its causes and accurate identification of its risks is the premise of strengthening risk management, and on this basis to reveal the enterprise product innovation design risk concept and its framework system, which is a powerful measure to prevent risks and control risks.

Research value 2, provides the foundation and conditions for strengthening enterprise product innovation design risk management.

Domestic and foreign scholars have made a lot of achievements in risk management. It is generally believed that risk management should be carried out through risk identification, risk measurement, risk control and other links, and common methods and strategies for enterprise risk management such as risk identification, risk avoidance, risk sharing and risk transfer are put forward. The research on the risk concept of enterprise product innovation design identifies the risk of enterprise product innovation design and its framework system, which provides the foundation and conditions for strengthening the design risk management.

Research value 3, laid a foundation for the prevention and control of enterprise product innovation design risk transmission.

Enterprise product innovation design risk is dynamic, it will be in risk source, and under the influence of internal and external environment, relying on certain risk carriers, through a certain path or channels, diffusion and spread to every link of enterprise product innovation design and its business process, the realization of the product innovation design of the enterprise has reached the established goal. The research on the risk concept of enterprise product innovation design identifies the risk of enterprise product innovation design and its framework system, which lays a foundation for controlling the risk source, intercepting the risk transmission carrier, breaking risk conduction paths, and effectively preventing and controlling the risk transmission of enterprise product innovation design.

## **5 Conclusion**

The formation of enterprise product innovation design risk concept is expounded. Enterprise product innovation design risk concept consists of design strategy risk, design target risk, design process risk, design system risk, design quality risk and design intellectual property risk. The above risk events have certain order and primary and secondary relations, so the establishment of the risk concept is helpful for entrepreneurs and managers to judge the timing of risk control intervention.

The essence of enterprise product innovation design risk concept is discussed, and the framework system of enterprise product innovation design risk concept is constructed. The framework is helpful to clarify the influencing factors and specific meanings of various risk events, to locate the specific objects of risk control, and to clarify the impact scope of the control measures.

It reveals the three-point research value of enterprise product innovation design risk concept, and lays a theoretical foundation and prerequisite for the research of enterprise product innovation design risk identification, risk management and risk transmission. At present, relevant researches have been completed including: industrial product design risk assessment system, risk control strategy based on industrial product design risk assessment system, and design risk conduction control strategy based on dynamic coupling.

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# Internet Financial Risk Early Warning Based on Fuzzy Analytic Hierarchy Process

Yang Yuxin

School of International Education, Wuhan University of Technology, Wuhan, P.R. China, 430070

(E-mail: yangyuxin\_wut@163.com)

**Abstract:** Based on the analysis of the impact of big data on Internet Finance under the background of internet, this paper combs the current development of Internet Finance in China, finds out the similarities and differences between internet Finance and traditional finance, and through comparative analysis, clears up the unique risks of Internet finance. On the basis of these analyses, this paper takes full account of the characteristics of Internet finance. Starting from the concept of big data, with the help of fuzzy analytic hierarchy process and data as the core, it tries to construct an early warning system for Internet financial risk assessment. Then, empirical research based on this system shows that China's current Internet financial risk level is relatively high, mainly due to the uncertainty of Internet security. Finally, based on the research findings, this paper puts forward some suggestions on the measures to be taken at the level of Internet security, operation, business and law.

**Key words:** Internet finance; Big data; Risk warning; Risk assessment

## 1 Introduction

### 1.1 Research background and purpose

Internet has changed the world, and Internet finance is changing the world. The development of science and technology has led to the development of the Internet, and also provided opportunities for the emergence and development of Internet finance. With the continuous attention to the financial industry and Internet technology in China, the support for Internet finance from the policy perspective has become stronger and stronger, which has promoted the development of Internet finance in China at a very fast speed. But in addition to optimistic judgment, we still need to think about the risks of Internet finance rationally. After all, for the financial industry, controlling and avoiding risks is the most important thing.

There are endless Internet financial products, crowdsourcing, P2P, online finance, micro-lending and so on. These new financial situations help people who are unable to enter the financial industry to get what they want, so that people no longer need to look to finance but participate in it.

It has to be admitted that Internet finance has the same risks as traditional finance, but also because of the high-tech dependence, high dissemination and diffusion of the Internet itself, these risks have increased to a certain extent.<sup>[3]</sup> At the same time, due to the imperfect supervision system of Internet Finance and the imperfect laws and regulations, the risks of Internet finance have increased to some extent. But this cannot be a reason to curb the development of Internet finance, but rather to urge us to find out where these shortcomings and risks are, and find ways to promote their healthy development, rather than blindly suppress them. This is also the original intention of the current study of Internet

financial risk.

Based on this, it is necessary to establish an Internet financial risk assessment and early warning system. Effective evaluation and early warning system can enable the whole industry and industry institutions to identify risks as early as possible, avoid them as early as possible, and control them in advance. It can ensure the healthy development of Internet finance and avoid adverse consequences. On the other hand, with the development of Internet technology, people can forecast the trend more conveniently and accurately. In this technological background, with the help of the advanced Internet technology and concept of big data, it is most suitable to effectively prevent the risk of Internet finance. Therefore, based on this background, this paper tries to study how to use big data to prevent the risk of Internet finance, and to find an effective way to promote Internet finance to avoid risks and develop healthily.

## **1.2 Summary of domestic and overseas research**

With the rapid development of Internet finance, more and more people participate in the research of Internet finance. Among many factors, the risk of Internet finance and its management are still a hot issue of concern.

Sun Zhihan (Sun Zhihan, 2010) made a comparative analysis of nine micro-P2P credit websites in China, and put forward suggestions on risk and avoidance of website operation.

Yang Fengfei (Yang Fengfei, 2012) took the mortgage as the research object, and combined with SWOT analysis tools, concluded that the development of mortgage depends on its platform advantages, and that its risk prevention and control should also focus on online methods.

Xie Ping (Xie Ping, 2012) combed the concept of Internet finance in his research, and regarded Internet finance as a new financing mode.

Li Wenbo (Li Wenbo, 2013) analyzed the cost advantages of Internet finance in the process of operation, especially in the process of financing, and positively evaluated the potential of Internet finance development. However, he also reminded us that due to the lack of supervision, the risk of Internet finance must be paid attention to.

At the same time of the continuous development and economic growth of the network financial services industry, foreign scholars Garrer and Eve think that the further improvement of the network financial services is a necessary condition for economic growth. The quantity of the financial services quality can explain the economic growth rate to a certain extent, through which they can discuss the role of financial structure in economic growth.

Marcono (Marcono, 1973) and Eve (Eve, 1973) respectively published Goods Market and Capital in Economic Development and Financial Deepening in Economic Development, in which they put forward two representative theories of "Financial Suppression" and "Financial Deepening" which still have great influence.

Levin (Levin, 1997) pointed out that due to the development of information technology, people's ability to collect and process data has been greatly improved, which also created favorable conditions for empirical analysis, enabling it to play the role of statistical analysis technology. Relevant phenomena, in which the developed countries have basically developed a relatively perfect financial service system, can effectively promote economic growth. On the contrary, the rapid economic growth can also reflect the mature financial service system of the developed countries.



Of course, from the research abroad, we can see that the impact of Network Finance on foreign banking industry is limited, and it does not make small and medium-sized banks restless as the domestic "wolf" has come. This is closely related to the marketization of foreign interest rates. Most banks have long been rid of the development stage of relying on deposit-loan spreads to make profits. Therefore, foreign research on network finance mainly reflects the development of network finance.

## **2 Definition and Characteristics of Internet Financial Risk**

### **2.1 Definition of internet financial risk**

Internet finance refers to a new financial business model in which traditional financial institutions and Internet enterprises use Internet technology and information and communication technology to achieve financing, payment, investment and information intermediary services.

Internet finance is not a simple combination of Internet and financial industry, but a new mode and new business to adapt to the new demand naturally after being familiar with and accepted by users (especially for e-commerce) at the level of network technology such as security and mobile. It is a new field which combines traditional financial industry with Internet technology.

At present, the main Internet financial products and services are Alipay's payment services, Ali loans and other financing business, Yu Ebao and other financial services, bitcoin and other virtual currency business. These businesses are progressively advancing and gradually approaching the core of traditional financial services.

Therefore, internet financial risk is defined as the possibility of loss affected by the uncertainties of the above-mentioned Internet financial products and services.

### **2.2 Classification and main risk analysis of internet financial risk**

Network financial risks come from different aspects, mainly from the Internet and financial perspective, specifically, can be subdivided into the following categories:

#### **2.2.1 Technological Risks of Internet Finance**

Internet finance relies on the Internet. Further, at present, it mainly relies on computer software and hardware. Therefore, the security of computer hardware and software surpasses other factors and becomes the first factor to be considered in Internet financial security. The reasons of computer hardware mainly include man-made damage, service life and so on. The software may come from compatibility, virus and hacker attack. According to incomplete statistics, the energy of hacker attack activities is increasing by about 10 times every year. The risk brought by these factors is mainly due to the diffusion of the network, leading to the infection of the whole network. For traditional finance, viruses can infect only one or two computers, or a small LAN, with more consequences of data loss and damage. The impact of modern hacker attacks and viruses may be large-scale, and the consequences may be the system stops running, or even the tampering and diffusion of data, or even the leakage of commercial secrets. In network finance, such risks may be systemic.

#### **2.2.2 Business risk**

##### **(1) Payment and Settlement Risks**

The virtual nature of Internet finance makes the transaction and service of Internet finance break through the limitation of time and space, and people can complete financial transactions in any way at anytime and anywhere. This enlarges the regionality of the Internet financial business and opens the payment and settlement functions to a wider scope, which greatly increases the number of payment and settlement and consequently brings risks. On the other hand, the wider use of transnational and regional payment systems based on electronic technology has increased the possibility of financial institutions being "involved" by external risks, which has also led to an increase in risk to a certain extent. Information risk comes from information asymmetry. The openness of the Internet improves the transparency of financial institutions' business, but for financial institutions, it will be more difficult for them to choose and judge customers under the influence of Internet privacy protection policy, and their dominant position in information transmission will gradually disappear, which is facing greater moral hazard for financial institutions. On the other hand, network information transmission is faster, and is not limited by time and space. To a certain extent, traditional financial industry is facing greater risks, and the risk of sudden and volatility is stronger. For speculators, this is a good opportunity to make a fortune, but it may cause large fluctuations in financial markets, and even affect the economic operation of a country or a region. Similarly, there are market risks brought by irrational operation of international hot money.

## (2) Liquidity risk

Liquidity risk is the main risk in financial industry, which refers to the electronic currency that Internet financial institutions are unable to accept customers. The extent of such risks is affected by the size and balance of e-money issuance. Generally speaking, the larger the issuance scale, the greater the liquidity risk. This is mainly due to the lack of independence of electronic money, but also need to experience the link between issuance and settlement from electronic money to real money. This leads to liquidity crisis once the issuer's real currency reserve is insufficient.

## (3) Credit risk

This risk mainly refers to the risk that one side of the Internet financial transaction cannot fulfill the contract on time. Because of the virtuality of Internet finance, the physical characteristics of Internet financial institutions have been reduced, and the credit evaluation of both sides of the transaction depends entirely on the network, which makes it more difficult for both sides to verify each other's identity and the authenticity of the transaction, and leads to an increase in the level of credit risk. As far as China is concerned, the credit risk may also arise from the imperfection of the credit investigation system, which reduces the cost of breach of contract and increases the possibility of breach of contract. At the same time, for Internet financial institutions, it is also necessary to consider that once huge losses or security issues related to payment systems occur, they will often have a greater impact and impact on the public than traditional finance, and it will be more difficult to restore credibility. For the entire Internet financial system, once there is a security problem, regardless of the cause, it will seriously undermine public confidence in Internet finance.

### 2.2.3 Legal Risk

This risk is mainly due to the lack of legal system for Internet Finance in China. At present, China's legal system in the field of Internet finance is still based on the traditional financial industry. Various laws and regulations do not fully take into account the characteristics of Internet financial business and risk. At this time, the legal system of Internet finance has loopholes to drill, which also increases the number of illegal acts. Taking the network electronic contract as an example, how to judge its validity, how to judge its fairness like the traditional finance, how to investigate the responsibility of one party after breach of contract, how to claim compensation, these problems occurring on the Internet platform

cannot be explained and avoided by the traditional financial legal system. In addition, for transnational transactions, the standard of traditional financial law to determine rights, responsibilities and obligations is often the time and place of signing, but in the context of the Internet, how to determine the time, how to determine the position of both parties in the transaction, need to be fully considered.

#### 2.2.4 Other risks

Other risks, such as the conventional risks of traditional financial industry, such as market risks, financial derivatives trading risks, also exist in the field of Internet finance.

### 2.3 Characteristics of internet financial risks

Internet technology makes the risk of Internet finance more complex and changeable. Besides the characteristics of traditional financial risk, it also has its own characteristics:

**Strong dissemination:** The primary characteristics of Internet technology are openness and information sharing. The network structure, coupled with the development of mobile internet, makes the dissemination of Internet information broader, breaking through the time and space constraints of financial transactions.

**Instantaneity:** As mentioned earlier, one of the characteristics of the Internet is fast, which enables Internet finance to process information remotely and instantaneously. For some financial transactions that pursue speed, speed may lead to an increase in returns, but it also leads to irreparable errors when they occur.

**High Vitality:** Internet financial transactions take the Internet as the "trading market". The transaction is no longer a real currency but a "virtual number". Similarly, for the protection of privacy, the transaction objects, processes and objectives are more opaque, which makes the virtual nature of Internet finance higher.

**Complexity:** The Internet makes the strangers more intimate, and the degree of information sharing stronger. This increases the convenience of financial transactions, on the other hand, it also increases the possibility of information leakage. At the same time, the Internet has more nodes than traditional finance, and the explanation is more vague, so the financial risk is more complex.

Generally speaking, although the risk of Internet Finance seems to be a large part higher than that of traditional finance, it is still in a controllable range considering the proportion of Internet Finance in China's financial industry. China's Internet finance is still in the early stage of development, the proportion of new financial formats is smaller, but the momentum of development cannot be underestimated. Therefore, the risk prevention and management of Internet finance should start from a small place and be dealt with as soon as possible. We must not hold the idea of "development before governance". Once Internet Finance develops, it will be too late to deal with it. Once problems arise, the chain reaction will most likely impact the entire financial system.

## 3 Analysis and Establishment of Internet Financial Risk Warning Index System

### 3.1 Internet financial risk identification

In the process of analyzing Internet finance, relevant scholars also analyzed the risk types of Internet finance. [In fact, from the perspective of financial stability, Internet finance is ultimately a

virtualized financial trading platform, so there is still the need to analyze its risks.] Foreign research on the identification of Internet financial risk is mainly divided into two kinds of risks: liquidity. Risk and Credit Risk Online Transaction of E-Commerce includes services of many third-party credit institutions, including banks, credit card authorization agencies, consumer online privacy protection agencies and consumer confidence organizations, and introduces eBay's third-party payment service Richard Walton discusses insurance issues in B2C e-Commerce.

For liquidity risk management, it mainly focuses on the third-party payment of Internet Finance and network lending. [For third-party payment, Guo Shibang believes that because of the concealment of online payment and the absence of online transaction records, third-party payment constitutes an impact on the anti-money laundering system.] Wang Zhen and others analyzed the potential risks of third-party payment, and proposed to prevent money laundering. Policy Suggestions on Risk Xie Kai et al. pointed out the hidden danger of the flow of customer payment funds and put forward measures to prevent the risk of customer funds for online lending, Yang Kaisheng believed that in the investment and financial management business of Internet finance, there was a lack of provisions on prohibiting disguised deposit absorption of related products, strict requirements on the source and application of funds and supervision methods. Ronin pointed out that Internet enterprises began to develop online lending business while carrying out payment business. Lack of post-loan supervision and risk control led to the increase of non-performing loans, which made enterprises unable to operate normally.

In view of credit risk management, Weng Zhoujie and others think that the future development of P2P network lending in China is facing some obstacles, such as imperfect personal credit system, lack of relevant laws and regulations and poor self-discipline of the industry. Zhang Yuxi thinks that because most of the Internet financial services adopt new technologies, they are more likely to fail. Any system problems caused by any reason will bring to the Internet financial service providers. Li Wenbo and others pointed out that the domestic credit environment and credit information system are not conducive to the development of Internet finance. Some scholars also believe that network financial services and service institutions have very obvious virtual characteristics.

For technology risk management, Zhang Yusong and others believe that there are no matching standards or standards in the technical aspects of Internet finance, especially in the use of security technology. In the process of designing and using the financial system platform, there are not enough experimental tests. Li Wenbo and other studies show that there are potential risks in Internet financial technology, and the security of the platform is facing a test. Zhang Yuxi believes that the technical risks of Internet finance are mainly manifested in three aspects: first, systematic security risks. Second, the risk of technology choice. Thirdly, technical support risk.

In view of legal risk management, Xinping pointed out that many Internet finances are actually between "legal" and "illegal", and a slight carelessness may touch the "illegal absorption of public deposits" or "illegal fund-raising" high-pressure line. There are also some scholars who identify legal risks from many aspects. First, they violate the relevant laws and regulations of the state and the aspects not covered by the laws and regulations that appear in the network. Second, there is a lack of legal provisions on network finance. The representatives are Weng Zhoujie, Li Wenbo and so on.

In summary, scholars believe that the liquidity risk of Internet finance mainly comes from the third-party payment risk and the network lending risk. Credit risk mainly comes from personal credit and the credit risk brought by the technology risk of Internet finance. Technical risk mainly comes from hackers and viruses attacked by the imperfect supporting measures of Internet system, while legal risk mainly comes from the attack against interconnection. The laws and regulations of online finance are not perfect. Because Internet finance is still in its infancy, the research on risk identification and risk prevention of Internet Finance by relevant scholars is not perfect, and further research is still needed.

### 3.2 Internet financial risk management

In the aspect of risk management of Internet finance, foreign academics have conducted in-depth discussions on the development of Internet finance, Internet financial risks and risk control and supervision of Internet finance. Karne Furst conducted a survey of all commercial banks in the US financial market and concluded that banks carrying out electronic financial services have a wider range of sources of liabilities, and their income is also transferred from interest income to intermediary business income.

Profit level and asset quality are relatively high. Anait K. Pamlhatur believes that banks will face operational risk, security risk, legal risk and reputation risk in carrying out online banking business. As banks enter the field of online banking, an innovative and forward-looking risk management method is indispensable. With the emergence of online banking, early self-regulation measures will evolve into an increasingly detailed review.

Compared with foreign scholars' risk management methods, domestic research on Internet financial management methods mainly focuses on liquidity risk, credit risk, technical risk and legal risk risk management.

For liquidity risk management, most of the literature on third-party payment will focus on the management of deposit funds. Xiong Jianyu suggests that China should establish and improve the access and exit mechanism of third-party payment companies, standardize the operation activities of third-party payment companies, and ensure the safety of trading funds. Ba Shusong put forward suggestions on the impact of cross-border business of third-party payment institutions on the existing regulatory system: first, to implement access system and strict credit management; second, to actively respond to the macro-currency of third-party payment institutions to create pro-cyclical risks; third, to strengthen the active supervision of third-party payment business; fourth, to strengthen the protection of financial consumers' rights and interests, and to strengthen precipitation. Safety management of funds. Wang Yifei believes that in terms of fund management, risk control of Internet financial products needs to be considered from two perspectives: one is the risk control of the products issued by the institutions themselves, and the other is the help of the institutions to manage the risks of financial products consumers. He Hong analyzed the risk management of Internet financial network lending from two perspectives of capital management and consumers.

In view of legal risk management, Wang Yuanyue's research shows that in the absence of relevant laws and regulations and supervision, networked private lending has brought many negative impacts on the stable development of economy and society, which urgently needs to be included in the scope of supervision and standardized management. It is pointed out that the legislation of network finance should be strengthened, and "Information and Communication Service Standard Law", "Data Protection Law", "Electronic Funds Transfer Law" should be enacted as soon as possible, so as to clearly define the rights and obligations of the relevant subjects of network lending finance. Wang Zhanjun advocated drawing lessons from foreign developed countries' policies in risk management, introducing a series of special rules, such as "International and Domestic Electronic Commerce Signature Law", "Network Information Security Steady Operating Guide", "Electronic Banking Business Security and Steady Procedure", to actively guard against the risks of Internet financial transactions, in order to protect the rights and interests of Internet financial consumers. In the actual operation of supervision, we should comprehensively improve the ability of supervisors to grasp the operation status of network financial business and predict the risks of network financial business, enhance the systematicness and foresight of macro-control, and strengthen the standardization of network financial supervision, so as to improve the modernization, scientificization and legalization level of network financial supervision.

Aiming at technology risk management, Yin Zhiyong pointed out that we should improve the level of technology prevention of computer network system in Internet financial enterprises, improve the computer security management system of bank financial system, and formulate the overall plan and unified technical standards for the development of network finance. In view of credit risk management, He Hong points out that it is necessary for us to build an effective horizontal cooperative monitoring system, which is the basic way to promote the steady development of Internet finance and prevent the credit risk of Internet finance.

In summary, in order to achieve effective risk management of Internet finance, we need to speed up the construction of relevant laws and regulations of Internet finance, including the revision and improvement of the financial legal system, the basic legal legislation related to the development of Internet finance, and the formulation of relevant department rules and national standards of Internet finance. Secondly, we should build a scientific and orderly Internet financial supervision system, strengthen the cooperation of international Internet financial supervision, strengthen the comprehensive supervision of international criminal activities such as money laundering by means of Internet banking through international cooperation of Internet financial supervision, and form a supervision system that can effectively guarantee the healthy operation of Internet Finance and be responsible for global Internet finance. Finally, we should encourage traditional industries to boldly try Internet finance, so that traditional industries will usher in new opportunities.

## **4 Establishment of Internet Financial Risk Warning System**

### **4.1 Construction method of early warning index system**

Qualitative method means that researchers choose early warning indicators to construct early warning indicators system according to their subjective understanding of the connotation of indicators information and previous experience.

Quantitative method refers to the preliminary selection of indicators in a wider range, the collection of data according to the preliminary indicators, and then the use of statistical analysis and other data analysis methods to analyze the data, select indicators of high relevance or importance to build early warning index system.

In summary, the warning index system constructed by qualitative method often has strong explanatory ability, but the effectiveness of this kind of method depends on personal knowledge and experience, which is greatly influenced by subjective factors and lacks scientific basis and persuasion. The index system constructed by quantitative method usually has a wide range of information content and good objectivity, but data analysis methods such as t-test often result in information loss of part of the data, which leads to the reduction of the effectiveness of the index system, and the index system constructed by quantitative method often has weak explanatory ability.

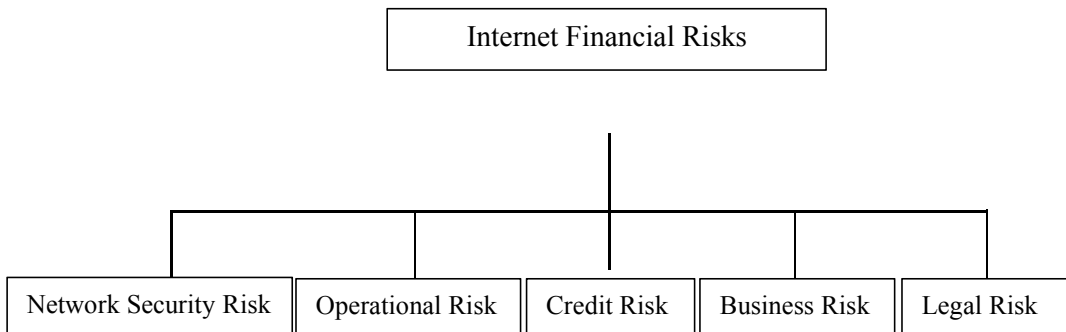
### **4.2 Selection of internet financial risk early warning index system**

Internet financial risk assessment is a multi-criteria decision-making problem. In multi-criteria decision-making problems, attribute values and related weights are expressed by fuzzy numbers. A fuzzy number is a convex fuzzy set, which is represented by a given sequence of real numbers and is graded from 0 to 1. The most commonly used fuzzy numbers are triangular and trapezoidal ones. The membership degree of fuzzy sets is smooth and progressive. The membership degree of fuzzy set is expressed by membership function. In a given model, the variables expressed by fuzzy language are

used in the fuzzy set, such as "Internet financial risk is high" or "project cost is high". The membership function of a fuzzy set expresses the fuzziness of each element and range. In most cases, it is a set of unit intervals. In real life, fuzzy linguistic values can be expressed in terms as well as in terms of fuzzy numbers. This expression is more appropriate in qualitative judgment than in definite value. Terminological risk is a qualitative and vague concept, which can be defined by vague language rather than numerical value.

The model established in this paper adopts the form of grading table of Internet financial risk indicators, and assigns the scores determined by each indicator according to the weight of risk indicators. In building the model, it is not enough to determine only the first-level indicators and scores. Under each indicator, more detailed options should be determined as the second-level indicators. According to the second-level indicators, the impact of the indicators is scored. The total score of each second-level indicators is the score of Internet financial risk indicators. The determination of secondary indicators is a tedious and complex work, which mainly depends on the relationship between past research data and real risk situation and the experience judgement of Internet finance related practitioners. The secondary indicators and values of the model are determined on the basis of referring to the relevant research results at home and abroad and consulting the opinions of many risk assessment professionals in Internet finance. Finally, five first-level risk index systems (network security risk, operational risk, credit risk, financial business risk, legal and reputation risk) and 17 second-level indicators are selected to construct the evaluation index system of Internet financial risk.

Firstly, the weights of Internet financial risk indicators are determined by using the fuzzy AHP method. Firstly, the hierarchical structure is established. Establishing hierarchical structure generally includes target layer, criterion layer, index layer, and even sub-index layer. The target layer of this model is Internet financial risk assessment. The standard layer includes five first-level indicators: network security risk, operational risk, credit risk, financial business risk and legal risk. Under the five first-level indicators of the criterion level, several second-level indicators are set up, totaling 17 second-level indicators, which constitute the index level. The details are shown in the following figure:



**Figure 1 Hierarchical Chart of Risk Assessment of Internet Finance**

The second step is to construct a fuzzy judgment matrix. Fuzzy judgment matrix refers to the matrix formed after the establishment of hierarchical structure, which needs to determine the importance of each factor at the next level affecting a factor, and determine an important score by comparing two or two of these factors. This model is assigned according to 1-9 scale method, as follows:

**Table 1 1-9 Scaling Method**

Scale	Meaning
1	I is as important as J
3	I is slightly more important than j
5	I is obviously more important than j
7	I is more important than j
9	I is more important than j
2、4、6、8	The median value of the adjacent judgment above indicates the ratio of J to I. Their reciprocal

The third step is to test the consistency of the fuzzy judgment matrix. The fuzzy judgment matrix that does not satisfy the consistency is adjusted accordingly. According to the properties of the fuzzy consistent matrix, the concrete steps of checking and adjusting the consistency of the judgement matrix are as follows:

(1) Determine an element with high accuracy of judgment and high accuracy of importance score, such as factor I, and get the importance score of  $b_{i1}, b_{i2}, b_{i3}, \dots, b_{in}$

$$\omega_i = \frac{\sum_{j=1}^n i, j}{n\alpha_i} + \frac{1}{n} - \frac{1}{2\alpha_i}, i = 1, 2 \dots n$$

The fourth step is hierarchical total ordering. On the basis of hierarchical single ranking, the relative importance weights of each factor in the index layer relative to the target layer are calculated. The weight value is the product of the weight of each index relative to the criterion layer and the weight of the criterion layer relative to the target layer.

#### **4.3 Empirical study on internet financial risk assessment based on fuzzy analytic hierarchy process**

With the rapid development of modern society and economy, all walks of life are in a state of fierce competition. Although Internet finance is only a new industry, it is also facing potential challenges from all sides. [9] At this time, the prevention of its risks is particularly important. In order to clearly identify the key factors affecting the Internet financial risk, modern comprehensive assessment and decision-making are becoming more and more quantitative. With the increasing complexity and uncertainty of objective things and the fuzziness of people's risk perception, the realistic risk prevention has not only stayed at the static, accurate and balanced level of problem decision-making. When people take corresponding preventive measures against certain risks, it is very likely that the uncertainty of estimation will lead to the waste of manpower and material resources.

The key risk factors were not even contained. Therefore, it is of great significance to analyze and determine the risk factors affecting the Internet by using AHP and fuzzy mathematics.



4.3.1 Determine the main factors and the secondary indicators of each main factor

According to the analysis in the previous chapter, the author summarizes the sub-risk factors of Internet financial risk as follows:

**Table 2 Interlinked Risk Assessment Index Set of Our Finance**

Objects of evaluation	first-level indicators	second-level indicators
Internet Financial Risk	Network Security Risk U1	Risk of network tampering
		Web page hanging risk
		Phishing risk
		Site Backdoor Risk
		Risks from Innovation of Payment Method
	Operational risk U2	Inter-industry Linkage Risk
		Consumer Operational Risk
	Credit risk U3	Internal fraud risk
		External fraud risk
		Liquidity risk
	Business Risk U4	market risk
		Interest rate risk
		Legal Liability Risk
		Risk of Subject Qualification
	Legal and Reputation Risk U5	Virtual currency risk
On-line money laundering risk		
Reputation risk		

4.3.2 Establishment of Assessment Set

In this paper, the author classifies the risk evaluation criteria of Internet finance as "high", "high", "medium", "low" and "very low". The evaluation set is:  $V=\{V1, V2, V3, V4, V5\}=\{\text{high risk, high risk, medium risk, low risk, very low risk}$ . Among them, the basis for the division of these standards is as follows:

**Table 3 The Basis for The Division Of Standards**

Classification	Identification	Description
5	Very high.	Once it happens, it will seriously affect social and economic development, affect the operation of the organization, cause great losses, and affect badly.
4	High	Once it happens, it will have a greater economic and social impact once it occurs, which will have a negative impact on the organization and operation within a certain range.
3	Middle	Once it happens, it will cause certain economic and social impacts, but the impact is not wide and deep.
2	Low	Once it happens, will have an impact within the organization, and can be quickly dealt with and resolved.
1	Very low	Once it happens, it will not have a significant impact. Simple measures can make up for it.

Those experts who are invited to grade the risk level should take into account both the probability of risk occurrence and the loss once the risk occurs.

#### 4.3.3 Determining the Weight of Risk Assessment Elements

In this paper, the 1-9 annotation method is used to construct the judgment matrices based on the comprehensive consideration of the opinions of 30 experts, as follows:

**Table 4 The Judgment Matrices**

U	U <sub>1</sub>	U <sub>2</sub>	U <sub>3</sub>	U <sub>4</sub>	U <sub>5</sub>
U <sub>1</sub>	1	5	3	3	5
U <sub>2</sub>	1/5	1	3	3	1/3
U <sub>3</sub>	1/3	1/3	1	1/5	1/3
U <sub>4</sub>	1/3	1/5	1/3	1	1/3
U <sub>5</sub>	1/5	3	3	3	1

That is to say, for the risk of Internet finance, the judgment matrix A of the first-level index is as follows:

$$A = \begin{bmatrix} 1 & 5 & 3 & 3 & 5 \\ 1/5 & 1 & 3 & 3 & 1/3 \\ 1/3 & 1/3 & 1 & 1/5 & 1/3 \\ 1/3 & 1/5 & 1/3 & 1 & 1/3 \\ 1/5 & 3 & 3 & 3 & 1 \end{bmatrix}$$

Similarly, each secondary index matrix A I is as follows:

$$A_1 = \begin{bmatrix} 1 & 1/3 & 1/5 & 3 \\ 3 & 1 & 1/3 & 3 \\ 5 & 3 & 1 & 7 \\ 1/3 & 1/3 & 1/7 & 1 \end{bmatrix} \quad A_2 = \begin{bmatrix} 1 & 1/3 & 5 \\ 3 & 1 & 7 \\ 1/5 & 1/7 & 1 \end{bmatrix} \quad A_3 = \begin{bmatrix} 1 & 3 \\ 1/3 & 1 \end{bmatrix};$$

$$A_4 = \begin{bmatrix} 1 & 3 & 7 \\ 1/3 & 1 & 5 \\ 1/7 & 1/5 & 1 \end{bmatrix}; \quad A_5 = \begin{bmatrix} 1 & 1/9 & 3 & 1/3 & 1/5 \\ 9 & 1 & 7 & 5 & 3 \\ 1/3 & 1/7 & 1 & 1/5 & 1/7 \\ 3 & 1/5 & 5 & 1 & 1/3 \\ 5 & 1/3 & 7 & 3 & 1 \end{bmatrix}$$

For matrix A, the maximum eigenvalue  $\lambda_{max} = 5.291$ ,  $CI = 0.0728$ ,  $RI = 1.120$ ,  $CR = 0.065 < 0.10$  can be calculated, which indicates that the matrix has passed the consistency test. According to the corresponding calculation formula, the eigenvectors corresponding to the maximum eigenvalues are  $A = (0.443, 0.083, 0.149, 0.267, 0.058)$ . That is to say, the weights of the first-level risk indicators {u1, u2, u3, u4, u5} are 0.443, 0.083, 0.149, 0.267 and 0.058, respectively. From the same calculation process, the weight of each factor of matrix A 1 can be calculated as  $A1 = (0.124, 0.241, 0.571, 0.065)$ ; the weight of each factor of matrix A2 is  $A2 = (0.637, 0.105, 0.258)$ ;

The weight of each factor in matrix A3 is  $A3 = (0.333, 0.667)$ .

The weight of each factor in matrix A4 is  $A4 = (0.649, 0.279, 0.072)$ .

The weight of each factor in matrix A5 is  $A5 = (0.061, 0.516, 0.036, 0.128, 0.259)$ .

#### 4.3.4 Multilevel Fuzzy Evaluation

Thirty professionals with similar work nature and long experience in Internet finance were invited to rate the single-factor risk level, as shown in Table 4.2.

**Table 5 Single-Factor Evaluation Results**

First level index (Weight)	Secondary Indicators (Weight)	Evaluation Results				
		Relatively high	High	middle	Low	Very Low
Network	Risk of network tampering	0.6	0.25	0.10	0.05	0

Security Risk (0.443)	(0.124)					
	Web page hanging risk (0.241)	0.4	0.3	0.15	0.1	0.05
	Phishing risk (0.571)	0.75	0.1	0.1	0.05	0
	Site Backdoor Risk (0.065)	0.4	0.3	0.15	0.1	0.05
	Risks from Innovation of Payment Method (0.637)	0.3	0.2	0.2	0.15	0.15
Operational risk (0.083)	Inter-industry Linkage Risk (0.105)	0.2	0.3	0.3	0.1	0.1
	Consumer Operational Risk (0.258)	0.15	0.2	0.4	0.15	0.1
Credit risk (0.149)	Internal fraud risk (0.542)	0.6	0.15	0.15	0.1	0
	External fraud risk (0.089)	0.3	0.4	0.2	0.05	0.05
	Liquidity risk (0.649)	0.4	0.25	0.15	0.15	0.05
Business Risk (0.267)	market risk (0.279)	0.15	0.5	0.2	0.15	0
	Interest rate risk (0.072)	0.05	0.4	0.4	0.4	0.05
	Legal Liability Risk (0.061)	0.05	0.4	0.3	0.2	0.05
Legal and Reputation Risk (0.058)	Risk of Subject Qualification (0.516)	0.05	0.15	0.25	0.30	0.25
	Virtual currency risk (0.036)	0	0.2	0.2	0.4	0.2
	On-line money laundering risk (0.128)	0.1	0.5	0.3	0.1	0
	Reputation risk (0.259)	0	0.05	0.15	0.5	0.3

The main factor fuzzy matrix of the secondary index can be obtained from the single factor evaluation result table

$$R_1 = \begin{bmatrix} 0.60 & 0.25 & 0.10 & 0.05 & 0 \\ 0.40 & 0.30 & 0.15 & 0.10 & 0.05 \\ 0.75 & 0.10 & 0.10 & 0.05 & 0 \\ 0.40 & 0.30 & 0.15 & 0.10 & 0.05 \end{bmatrix}$$

$$R_2 = \begin{bmatrix} 0.30 & 0.20 & 0.20 & 0.15 & 0.15 \\ 0.20 & 0.30 & 0.30 & 0.10 & 0.10 \\ 0.15 & 0.20 & 0.40 & 0.15 & 0.10 \end{bmatrix}$$

$$R_3 = \begin{bmatrix} 0.6 & 0.15 & 0.15 & 0.1 & 0 \\ 0.3 & 0.4 & 0.2 & 0.05 & 0.05 \end{bmatrix}$$

$$R_4 = \begin{bmatrix} 0.4 & 0.25 & 0.15 & 0.15 & 0.05 \\ 0.15 & 0.5 & 0.2 & 0.15 & 0 \\ 0.05 & 0.4 & 0.4 & 0.1 & 0.05 \end{bmatrix}$$

$$R_5 = \begin{bmatrix} 0.4 & 0.15 & 0.25 & 0.30 & 0.25 \\ 0.3 & 0.25 & 0.20 & 0.10 & 0.15 \\ 0.1 & 0.5 & 0.30 & 0.10 & 0 \\ 0 & 0.05 & 0.15 & 0.5 & 0.30 \end{bmatrix}$$

According to the fuzzy comprehensive evaluation formula  $B_i = A_i * R_i$ , the evaluation results of each secondary index can be calculated.

As follows:

$$B_1 = (0.625, 0.1799, 0.1154, 0.0654, 0.0153)$$

$$B_2 = (0.2508, 0.2105, 0.2621, 0.1447)$$

$$B_3 = (0.3999, 0.3168, 0.1834, 0.0667, 0.0334)$$

$$B_4 = (0.3050, 0.3306, 0.1820, 0.1464, 0.0360)$$

$$B_5 = (0.0738, 0.1816, 0.2196, 0.3068, 0.2182)$$

Thus, the main factor evaluation matrix of secondary indicators can be obtained as follows:

$$B = \begin{bmatrix} 0.6250 & 0.1799 & 0.1154 & 0.0654 & 0.0153 \\ 0.2508 & 0.2105 & 0.2621 & 0.1447 & 0.1318 \\ 0.3999 & 0.3168 & 0.1834 & 0.667 & 0.0334 \\ 0.3050 & 0.3306 & 0.1820 & 0.1464 & 0.0360 \\ 0.0738 & 0.1816 & 0.2196 & 0.3068 & 0.2182 \end{bmatrix}$$

According to formula  $B = A * R$ ,

$$B = (0.4430, 0.2432, 0.1615, 0.1078, 0.0450)$$

According to the principle of maximum membership, the level corresponding to the maximum value is the level of networked financial risk. From the above results, we can see that the maximum value is 0.443, and the corresponding risk level is "very high". In addition, the main risk of Internet

finance is network security risk. This conclusion also confirms the subjective judgment of experts. In addition, credit risk and technical operation risk also account for a large proportion, indicating that these risks are more obvious.

#### **4.4 Model running results analysis**

After collecting and analyzing a lot of data, we can see that the risk of Internet finance is still very high. In the five first-level indicators set in this paper, we can know that network security risk occupies the largest weight. If we want to better develop Internet finance, we must do a good job in preventing network security risks. The second is business risk, which is more consistent with the facts. Because Internet finance itself is the product of the integration and innovation of network technology and financial business. For these financial business risk prevention, we can learn from the traditional financial business in risk prevention measures. Secondly, credit risk, all financial activities are the evaluation of credit in the final analysis. As Internet finance, it also faces huge credit risk. Then there are operational risks and legal risks. These risks are important, but they are relatively small in this model.

Specifically implemented to the secondary indicators, the calculation results can be obtained, for network security risks, phishing risk is the most important factor. In fact, according to the data released by the National Internet Emergency Response Center, phishing is also the most important factor that causes the loss of consumer property every year. Secondly, the risk of website hanging horse, the trend of network tampering, and finally the risk of website backdoor. The overall risk state is also at a high risk, which needs to be paid close attention to.

For operational risk, the most critical factor is the risk brought by the innovation of payment mode. The innovation of various kinds of Internet terminal equipment leads to the change of people's payment mode, which is easy to cause risks when the external situation changes. Secondly, the operational risk of consumers, in view of consumers' lack of awareness of the potential risks hidden by the rapid development of Internet technology, is likely to be exploited by malicious programs. Finally, the industry-related risk will also have a greater impact on operational risk. However, the overall operational risk is in a medium state. Among credit risks, external fraud risk is more prominent. Overall, it is in a high-risk state. Among the financial business risks, the most important factor is liquidity risk. Secondly, market risk and interest rate risk. If the funds cannot be well circulated, it will bury a deep hidden danger to Internet finance. Overall, it is in a state of high risk.

Finally, in the legal and reputation risk, the subject qualification risk occupies a relatively important position. Secondly, reputation risk, followed by money laundering risk and virtual currency risk, and finally the risk of legal lag. Overall, they are in a state of high risk.

In summary, the first-level and second-level indicators involved in Internet finance are analyzed sequentially, and an overview result is obtained. According to the results of the risk assessment, when taking risk prevention measures, we can focus on a more comprehensive macro-control.

## **5 Conclusion**

The construction of Internet financial risk management system needs to consider many angles. According to the risk evaluation index system of this paper, combined with the above evaluation results, the related measures of Internet financial risk prevention can be divided into the following directions: network security, operation, credit risk, market risk and legal and reputation risk. To construct a three-dimensional framework of Internet financial risk management system, to analyze and discuss the key

factors affecting Internet financial risk management, to implement targeted guidance and control measures, and to achieve effective control of Internet financial risk through non-rigid ways such as technology, legal (reputation) means and management functions

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# Research on Network Security Evaluation of Big Data Center Based on Rough Set

Liu Bin

School of Electrical and Electronic Engineering, Wuhan Polytechnic University, Wuhan, P.R.China,  
430023

(E-mail: 443748171@qq.com)

**Abstract:** In the 21st century, information technology has entered a big data era. Under this environment, new technical requirements and challenges have been put forward for the network security of big data Center, especially how to effectively evaluate the network security. It has always been the focus of industry research. In this paper, by studying the traditional network security evaluation method, combining with the related characteristics of big data Center, and using the theoretical knowledge of rough set, the paper puts forward a network security evaluation method based on rough set. The method can be reduced from a large number of dynamic data at high latitudes, and the core values that can represent the network security attributes can be screened out, so that the security of network security can be carried out.

**Key words:** Rough set; Big data; Network security; Evaluation

## 1 Introduction

The current information technology has entered a new era - the era of big data. Its data types are diverse, its structure is complex and it also has the characteristics of dynamic change. According to the particularity of the network environment established by big data center (Sun Zepeng, 2017), Sun Zepeng puts forward some thoughts on the current construction of big data center, especially how to ensure data security when enterprises are faced with the massive data of multi-source and heterogeneous, which has been studied at home and abroad. Big data center network security requirements and traditional ways are different, how to evaluate network security has always been the focus of research (Liu Wenyan, 2018), there is no evaluation standard in the world. Liu Wenyan has done some research on the mainstream network security evaluation models, especially on the main models: attack tree, attack graph, attack chain, attack surface, network infectious disease model, Petri net, automaton and so on. These analyses are based on complex evaluation parameters, index data, and the establishment of model is time-consuming. Because of the intensive coupling degree, it is difficult to modify. In view of the above problems, the paper starts with the network security requirements of big data centers, and studies the elements of network security evaluation. By introducing the relevant theoretical knowledge and methods of rough set (Pawlak Z, 1982), we can quickly and concisely establish a big data center network security evaluation model on the basis of meeting the requirements, so as to quickly keep up with the changing pace of network security.

## 2 Analysis of Network Security Model Requirements

Overall, big data generally refers to large-scale, massive unstructured data and semi-structured data, which have Volume, Velocity, Variety, Value, Veracity and other characteristics. The goal of big data center network security is to achieve three security attributes, confidentiality, integrity and availability (Jeff Kaliverisky, 2008).

### 2.1 Network security analysis of big data center



Firstly, data integrity is one of the three characteristics of data security. The function of data integrity is to ensure that the data is correct and effective. It is considered by all information systems. Although the cloud storage service provider of data as a service is much more advanced than the general integrator in technology, database server and other aspects, it still cannot guarantee that 100% of the data system does not fail. Therefore, data integrity failures occurring in traditional system storage may also occur in big data centers. These faults can be roughly divided into the following two categories:

- (1) Faults caused by equipment problems. Such as BIT Decay, tape failure, etc.
- (2) Faults caused by software defects.

Secondly, for big data centers based on cloud computing environment, data access control issues need to become more complex, and it is difficult to ensure that cloud service providers can adhere to 100% of its service treaties. At the same time, important sensitive data of users should also be kept secret for cloud service providers.

Finally, the virtualization of big data centers also brings some problems, VMM (Virtual Machine Manager) is attacked(Hai Jin, 2013). VMM is attacked mainly from the following two aspects:

- (1) From outside of VMM. Attackers use Rootkit and other means to gain root privileges, leaving behind backdoor assemblies to collect data. The intruded host is intercepted by Rootkit and gets all the hardware requests from users.
- (2) From the client virtual machine. Domain 0 is the control domain of virtual machine in virtual machine system. The controlled client virtual machine utilizes the application program to avoid the detection and control of VMM and access Domain 0 directly, thus controlling all other virtual machines.

In addition, attacks on big data networks include attacks on covert channels (that is, attacks on covert channels generated by various error messages) and malicious code attacks.

Similarly, traditional network attacks also threaten big data centers. These threats are manifested in: Attacks against network application vulnerabilities; Attacks against SaaS mode, DDOS (Distributed Denial of Service) attack(Maqsood, 2014), Man-in-the-middle attack, etc. As there are so many dangers in the network security of big data centers, it is necessary to establish an effective evaluation model for network security.

## 2.2 Analysis of current network security evaluation model

The current main network security situation evaluation system model is shown in figure 1.

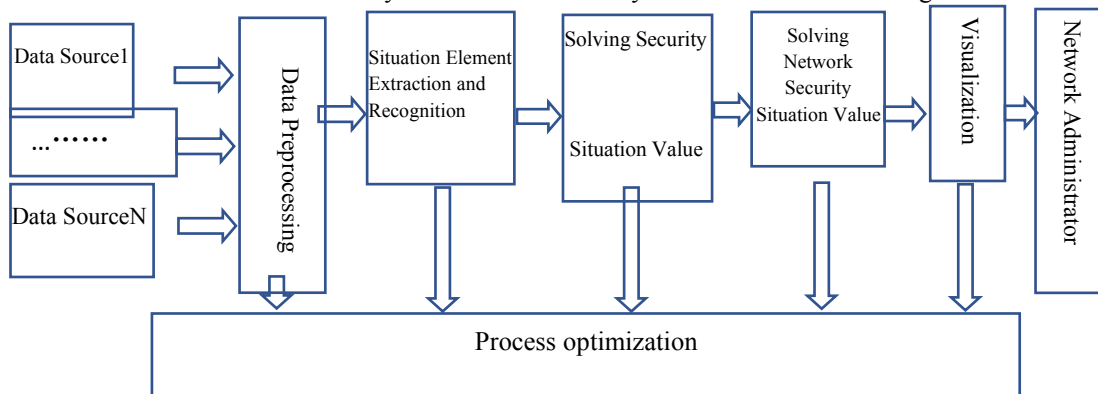


Figure 1 Network Security Situation Evaluation System Model

We analyze it from the abstract level, extract and identify the situation elements through the preprocessed multi-source data, so as to determine the type of network attacks. According to the attack type, the security situation value can be obtained by calculating, and the security situation value can reflect the degree of network destruction, so it can be submitted to the network administrator visually.

The roles of each module are as follows:

- (1) Data source module: mainly collects attack information and environmental information generated in cloud computing system.
- (2) Data preprocessing module: preprocesses the collected information and keeps them in a uniform format when stored.
- (3) Security situation element extraction module: determine the type of attack.
- (4) The calculation module of the security state value: determines the damage degree of the attack type to the network.
- (5) The security situation value is calculated by the level analysis: the operation status of the network is displayed.
- (6) Visualization module: dynamic display of the security situation of cloud computing network.

The most important is the extraction of security situation elements, which is related to the efficiency of network security evaluation model. However, network security data has a series of characteristics, such as high-dimensional, dynamic and stochastic, which reflect its uncertainty. How to obtain valuable information from large-scale dynamic data with strong uncertainty is one of the most important research contents in this field. Although some methods mentioned above can obtain certain security situation elements in some aspects, there is no good solution to the uncertainty of large-scale data network. The case results in the failure of the security evaluation model to assess the network security risk in a timely and comprehensive manner. The evaluation model based on rough set theory(Pawlak Z, 1998) studied in the paper is just a useful attempt in this field.

### **3 Proposal of Rough Set Model**

Rough set theory is proposed by Polish scholar Pawlak. It mainly describes inaccurate knowledge by upper and lower approximate operators. It is an intelligent mathematical tool to deal with inconsistent and uncertain information. This theory can not only model the nonlinear and discontinuity function relations, but also have high objectivity and can effectively deal with big data. Its basic theory is as follows.

If a set is exactly equal to any union set of the basic set, it is called a clear set, otherwise it is called a rough set. It can find hidden knowledge and show the laws that exist within things. rough set theory has the following basic concepts:

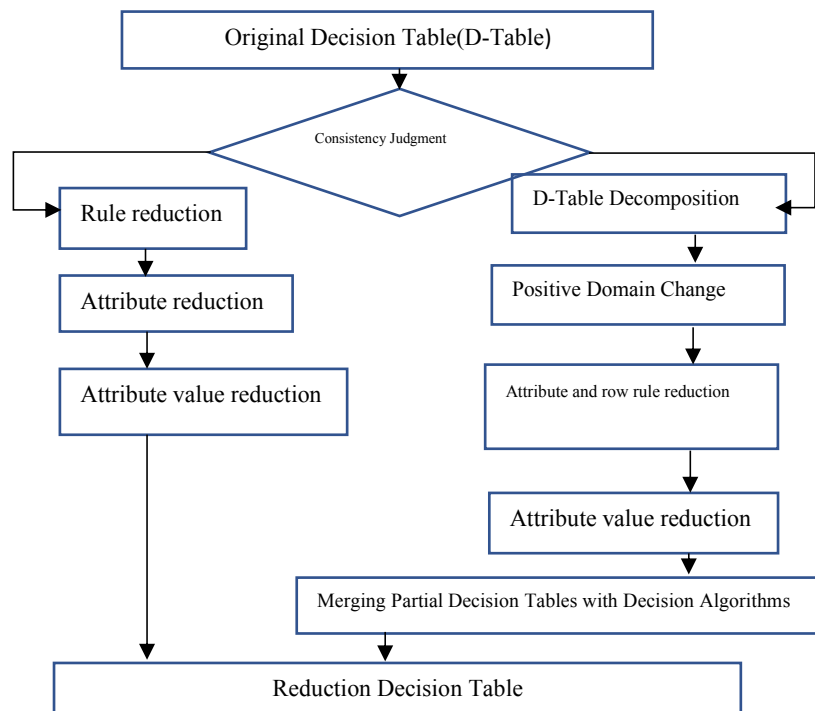
- (1) Information system. The information system is quaternion  $K = (U, A, V, P)$ . Where  $U$  is the set of objects,  $A$  is the set of attributes,  $V$  is the range, and  $P$  is a mapping.
- (2) Knowledge. Knowledge is a classification ability. The ability to classify certain things

according to their different characteristics can be regarded as some kind of "knowledge". It is composed of objects that are indistinguishable from each other in the domain. "something" here means anything we can talk about, such as time, process, object, etc.

(3) The upper and lower approximations of the set. Let  $U$  be a domain,  $I$  be a set of equivalence relations in  $U$ , then  $X \subseteq U$ , then: The maximum set that can be judged by existing knowledge of all objects that must belong to  $X$  is called the lower approximation of set  $X$  with regard to  $I$ , which is recorded as:  $I_*(X) = \{x \in U, I(x) \subseteq X\}$ . The smallest set of objects that may belong to the  $X$  according to the existing knowledge is the upper approximation of the set  $X$  with respect to the  $I$ , which is recorded as:  $I^*(X) = \{x \in U, I(x) \cap X \neq \emptyset\}$ . For an exact set, its upper approximation is equal to the lower approximation; then, when the upper approximation is not equal to the lower approximation, it is a rough set.

In rough set theory, the establishment of network security evaluation universe  $U$  is to collect samples of evaluation data sets. According to the existing experience and network security standards (Ma Li, 2019), we have selected more than 30 indicators from network security data, including security information such as host monitoring system, to provide the original data to participate in the evaluation. There is a certain relationship between these data.

Rough set theory is a discrete system, it is necessary to discretize the evaluation data, and then reduce the attributes of the above discretized data. As a result, we retain the attributes of host class, topological location and other attributes, and remove the attributes of operating system class. The whole process of Rough Set Reduction (Chen Xinying, 2016) of Network Security evaluation Model is shown in Figure 2.



**Figure 2 Rough Set Reduction Process of Evaluation Model**

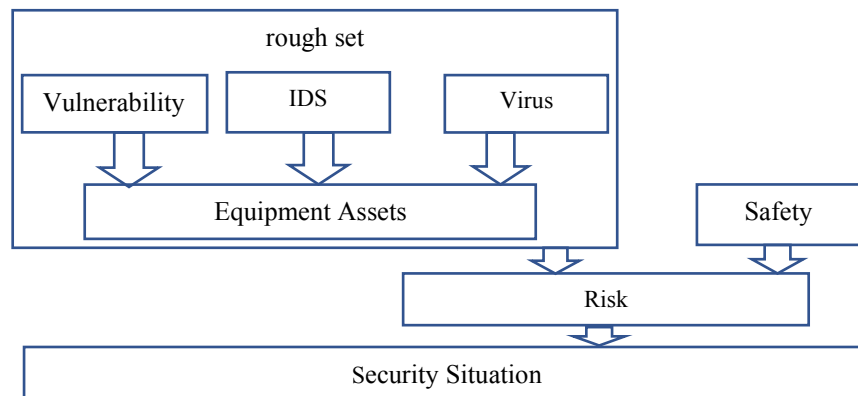
We use the same method to reduce the attributes of vulnerability-threat discrete sample table. As a result, we retain the attributes of vulnerability level and attack type, and remove the attributes of vulnerability risk level.

In the decision table, if we choose to delete a record, we will get the following three results:

- (1) Conflict in decision-making. Then the attribute value can not be deleted and its original attribute value needs to be restored.
- (2) Duplicate records and no conflict occurred. Then the attribute can be deleted and marked as "!".
- (3) There were no duplicate records or conflicts. Then we need to confirm whether it can be deleted by the next judgment, and mark it as "?".

In summary, the reduction algorithm of attribute values in decision table is as follows:

- (1) According to the three cases mentioned above, the attribute values in the information table are marked correspondingly.
- (2) Delete duplicate records that appear, and then validate tags one by one. Records. If there is a record that all its attribute values are marked as "?" If the decision is made by an unmarked judgment, change "?" to "!" Otherwise, the original value will be restored.
- (3) Delete marked as "!" And duplicate records of occurrences.
- (4) When two records are identical, delete "!" Less records. After reduction, a new information table is obtained. Because of the one-to-many relationship, it is necessary to merge in a one-to-many manner. Finally, the decision table of network security evaluation is obtained. According to the decision rules, our network security evaluation model is shown in figure 3.



**Figure 3 Network Security Evaluation Model**

The model is explained as follows:

- (1) Equipment Assets: the hardware part of the network.
- (2) Vulnerability/Vulnerability: Risks due to vulnerability or vulnerability.
- (3) IDS: risk caused by potential intrusion events.
- (4) Virus: risks caused by potential viral events.
- (5) Safety measures: various safety measures adopted to protect assets from damage.
- (6) Risk: According to the state of risk, get the security situation.

The selection of network security situation elements will directly affect the reliability of evaluation. According to the theory of Rough set, the paper proposes an evaluation model, which is divided into three layers from top to bottom: the feature layer of situation elements, the semantic understanding layer of situation elements and the decision layer of situation elements. The main function of the first layer is to obtain a certain amount of information, and then preprocess the collected information through data fusion technology. The second layer is to analyze the types of attacks, mainly through the correlation analysis of the upper data. The last layer is to determine the degree of risk hazards caused by various types of attacks and their impact on network services.

#### 4 Conclusion

With the continuous development of network technology, network security in big data centers will become a hot spot of continuous research, and network security evaluation will become one of the key technologies with good development prospects. The paper studies the network security evaluation model based on rough set, and puts forward some solutions. In the future work, there are still many places to consider, such as: how to build an evaluation test environment(Zhu Yeqing, 2016), whether to form a general evaluation model, and so on, are the direction of our efforts.

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# Analysis of the Project Management of EPC Project General Contracting

Pei Linyu, Xu Dongming

School of Civil Engineering, Henan University of Science and Technology, Luoyang, P.R. China, 471000

(E-mail: 630379838@qq.com, 676823546@qq.com)

**Abstract:** In recent years, the rapid development of China's economy has promoted the expansion of construction projects. The increasing complexity of architectural functions has led to increasing difficulty of project management. In order to solve these challenges, the project management model of EPC (Engineering Procurement Construction) has been gradually popularized and has been widely applied in China. In this work, a comparison between the characteristics of the traditional mode and the EPC general contracting mode has been processed, based on the systematic elaboration of the project management theory. The project management of EPC general contracting can be summarized into three main points, which are design management, procurement management, construction management. The detailed analysis has been demonstrated based on these main points of management. Moreover, the existing problems in EPC management, experienced by the owner and the contractor, has been analyzed and put forward corresponding conclusions on relevant problems.

**Key words:** EPC engineering; General contracting mode; Project management; Traditional mode

## 1 Introduction

### 1.1 Research ideas and contents

In EPC project, the scope of the general contractor contracts covers design, procurement, construction and commissioning phase. For example, the overall planning, organizing and implementing specific work of the entire construction project, can effectively solve the low-efficiency information exchange issues between design, procurement, construction and cross-matching. Simultaneously, it can achieve the goals of the comprehensively managing the project progress, quality, cost, safety (Zhao Jinxiang, 2019). Since EPC projects commonly are large-scale, complex and with varied management contents, continuous innovation is needed to control all aspects of the project in the implementation process (Yang Junjie, 2014). The international common contracting modes include EPC (Design-Procurement-General construction contract), Design-General construction contract, BOT (Build-Operation-Transfer), PPP (Public-Private-Partnership), PM (Project Management), PMC (Project Management construction), etc.

This work aims at the international and domestic construction market environment. The purpose of this paper is to summarize the operational EPC project management method, according to the project progress, quality, safety, cost and other management theories, by utilizing reasonable analysis methods. This will not only contribute to the management of the company's construction projects, but also put forward management methods for other EPC projects for reference and promotion.

### 1.2 Research status of EPC

The general contracting mode of projects started early, with a sound legal system, mature market

environment and a large number of experienced general contracting enterprises (Lu Fengli, 2015). At present, the mode has been used by the relevant UN organizations, World Bank, Asian development bank and so on. The construction project management norms and contract texts formulated by the international federation of consulting engineers (FIDIC) are generally recognized and widely adopted by international financial organizations and many countries (She Jianming, 2012). The research on the general contract management of EPC project is also relatively early. There are also mature management methods. In recent years, James P. Lewis has summarized the theories of engineering management, elaborated the theories of engineering management abroad in detail, and summarized the development of engineering management methods (Zhou Yuliang, 2010).

At the end of the 1990s, the general contracting of engineering gradually became popular in China. The relevant management theories also began to prevail. The risk management of EPC project is very important. The procurement of EPC projects directly affects the quality, progress, investment and even safety of the projects (Qin Hongbo, 2017). Based on the engineering practice, Li Xiaofei summarized the procurement methods and details of the general contracting project, which provided the direction for the project procurement (Li Xiaofei, 2014). The construction management of EPC is the last opportunity to realize the final product. He Chengqi summarized the methods of project planning and control by compiling, tracking, analyzing and controlling the progress (He Chengqi, 2013). EPC cost management is the core of EPC management. Most of the current researches focused on analyzing the management of EPC general contracting project from a single perspective in EPC management, but were lack of overall study on the integration of each module. Therefore, this paper attempts to discuss EPC general contracting project management from the perspectives of design, construction and procurement.

## **2 Overview of EPC Project General Contracting Mode**

### **2.1 Definition of EPC project general contracting mode**

EPC is the abbreviation for Engineering, Procurement, and Construction. In EPC mode, the engineering includes site selection, overall plan, organization, implementation, coordination and specific drawing design of the whole project. The procurement includes procurement of general building materials, procurement of various specialized equipment that can meet the project's usage function, and Procurement of materials needed during the commissioning and trial operation after the project is completed. The contents of the construction include construction, installation, equipment debugging, commissioning and trial operation.

### **2.2 Features of EPC general contracting mode**

EPC general contract has the following main characteristics:

(1) The owner entrusts the EPC general contractor with the overall package of specific work such as project design, procurement, construction and trial operation to organize and implement, while the owner is only responsible for the overall, principle and target management and control. In the EPC general contracting mode, the contractor (Owner) is not too involved in the specific management of the project, but gives the general contractor great authority and freedom to the work within the scope of the contract, and the general contractor will lead the completion of most of the specific implementation work.

(2) The owner shall only sign the general contracting contract with the EPC general contractor. The design, procurement, construction or trial operation of the project shall be fully undertaken by the general contractor or partially entrusted to a qualified subcontractor at the discretion of the general contractor. The subcontractor shall enter into subcontracts with the general contractor without having a direct contractual relationship with the owner. The general contractor shall be liable to the owner for the quality, safety and time limit of the subcontracted work, and the subcontractors shall be jointly and severally liable.

(3) The owner may send a management team to the project or hire a professional project management company as an agent of the owner to manage the project. This kind of management is principled and phased management by objectives without involving too many specific affairs.

(4) The owner transfers the management risk of EPC to the general contractor, reducing its management responsibility and risk. The general contractor of the EPC general contracting project shall be responsible for the whole process of "design, purchase and construction" of the construction project, and for the quality of the construction project and the performance of all professional subcontractors of the construction project. The general contractor is the first person responsible for the EPC general contracting project.

### **2.3 Comparison between traditional mode and EPC general contracting mode**

#### 2.3.1 Traditional mode

Traditional Delivery Method mainly refers to DBB (Design. Bid. Build) mode. This mode is based on the construction unit as the core, contracting out various work contents to the participating units, which only has a contractual relationship with the construction unit and are directly responsible to the construction unit. If all the construction, decoration and installation projects are entrusted to a contractor, it is called the general contractor for construction. If the construction project, decoration project and installation project are directly entrusted to different contractors by the construction unit, it is called the construction parallel contracting mode (Cai Junling, 2015).

#### 2.3.2 Differences between traditional mode and EPC general contracting mode

The differences between general contracting mode and traditional mode are as follows:

##### (1) Different application scope

The traditional model is suitable for general housing construction projects with relatively simple and clear project content, no great technical difficulty and sufficient construction funds.

The EPC mode is not only applicable to general housing construction projects, but also to large industrial projects, such as large transportation hub, electric power, mining, metallurgy, petrochemical and other projects. Most of the projects applicable to EPC mode are characterized by large project volume, high professional and technical requirements, large capital demand, heavy coordination and cooperation tasks of relevant majors, and a high proportion of professional equipment and materials in the total investment.

##### (2) Different capital requirements

The traditional model requires the owners to raise sufficient construction funds in advance to



facilitate the smooth progress of the project. The requirement of cash flow to owner is higher.

In EPC mode, there are BT, BOT and other financing construction modes. BT mode is adopted, that is, the construction is financed by the contractor in the survey, design and construction stage, and the owner repurchases after the completion. Using BOT mode, after completion, the contractor shall obtain a certain period of management rights, and then hand them over to the owner after the expiration of the operating period. In this way, the capital pressure of the owners in the construction phase of the project can be effectively reduced and the capital flow tension of the owners can be alleviated.

### (3) Different management structures

In the traditional mode, the owner is at the core of project management, and the survey, design, construction, equipment and material suppliers form contract relations with the owner respectively, but there is no direct economic contact between them, so the owner needs to undertake a lot of coordination and decision-making work. In the EPC mode, the owner signs a contract with an EPC general contractor (or EPC consortium contractor) with a clear and single contractual relationship. Compared with the traditional model, the project management task of the owner is greatly reduced. The owner only needs a few managers to manage the whole project.

### (4) Different bidding methods

In the conventional model, survey, design, construction and procurement should be divided into public bidding, and the whole project can only be completed by multiple bidding. Moreover, since the next stage of bidding mostly requires the work results of the previous process, the time delay is relatively long, which will consume a lot of energy, time and costs of the owner. In EPC mode, the owner only needs to conduct one bidding to determine the general contractor for survey, design, construction and procurement, which greatly saves time, energy and costs.

## **3 Key Points of Project Management of EPC General Contract**

### **3.1 Design management**

Design as the initial project planning, and throughout the whole process of engineering construction in EPC project, design documents as the basis of engineering procurement, construction, design, procurement and construction of a reasonable crossover and mutual cooperation have a basic role. The procurement needs to conduct bidding or inquiry based on the equipment and materials requisition and inquiry technical documents provided by the design, while the design is responsible for technical review and review of the manufacturer's technical documents and drawings. Therefore, in the whole construction process, design management needs to be reviewed and controlled, and the role of reasonable cross-coordination of design in construction and procurement in terms of schedule, cost, quality and safety is an important work content.

### **3.2 Purchasing management**

In the product construction cycle of the general contracting project, the procurement stage is the beginning of the actual manufacturing and engineering entity formation process, including

professional subcontracting, material and equipment, service and labor procurement (Li Guozhi, 2015). On the one hand, based on design documents, the procurement process needs to firstly compile procurement list (equipment and materials) and technical requirements (professional subcontracting, services and labor), then analyze relevant requirements and prices, and finally conduct bidding or inquiry through a market survey. On the other hand, it is necessary to ensure that the subcontracting has a reasonable overlap with the project construction after the purchase and the supplier. Therefore, the monitoring and management of the quality of acquisition work and acquisition results are related to the construction, completion and acceptance of the project, which ultimately reflect the quality of the whole project. For example, the coordination between the time of purchasing qualified equipment and materials (including delivering to construction site) and the construction schedule is the guarantee of the construction schedule. The levels of procurement cost also directly affect the construction cost.

### **3.3 Construction management**

Construction management is an important part of EPC construction stage. It is divided into construction preparation management, construction operation management, construction finalization management-three stages. In the stages construction management ready to join the design phase, within the established time limit for a project, construction progress plan, quality management planning and cost management schemes, safety management, human resource planning, communication and coordination, etc., to complete the construction scheme, construction organization design, etc., in order to guide the construction management implementation. In this stage, the selection of construction subcontractors is also completed. Subcontractors with corresponding strength and similar construction experience are selected through bidding.

Construction management is according to the stage of planning implementation. It includes subcontracting for management, coordinating the relationship between the design, package and the owner. Construction management includes checking the construction actual situation regularly. People find out the reason of the deviation by comparing actual situation and planning, and its influence to the construction process. And then find out the adjusting measures to correct deviation, try our best to ensure accomplish quality, progress, cost and safety goals. The implementation of construction management is mainly to control the progress, quality, cost and safety by taking corresponding control measures and methods (Cao Jiming, 2011).

The end of construction management is after the completion of construction. It includes organizing the project department's management personnel to carry out the handover procedures, and checking and accepting the achievements of project quality, cost, progress and safety, and evaluating the construction management effect of the project. In the process of construction management, real-time monitoring of the impact of changes in external factors on the internal and external aspects of the project, adjusting and correcting the deviation in time.

## **4 Status Analysis of EPC General Contracting Project Management**

### **4.1 Problems existing in EPC general contract project management**

EPC contracting mode can take into account the interests of both the owner and the contractor. In China, some EPC general contracting projects have been put into practice, but this mode is not mature, exposing certain problems.

#### 4.1.1 Problems of the owner

From the perspective of the owners, most owners have not realized the real connotation of EPC. On the one hand, the decision-making layer of the owner does not know about EPC mode, and is conservative in whether the project adopts EPC mode or not. On the other hand, in terms of the specific management level of the owner, even in EPC projects, many managers are unwilling to give up their management power and have a strong desire for control, which to some extent restricts the effectiveness of the internal coordinate system of the general contractor.

#### 4.1.2 Contractor's problems

The contractor side includes design, survey, construction, material and equipment suppliers and so on.

From the perspective of design units and survey units, in the traditional mode, if the subsequent process loss is caused by its own problems, the loss shall be borne by the owner, which will lead to the weak responsibility of some survey and design personnel. In EPC projects, the output value of intellectual labor of investigation and design only accounts for a very small part of the whole project, but it will have a great impact on the subsequent construction of engineering entities and equipment procurement.

Construction units, in the traditional mode, can wait for the completion of the design drawings and drawings after review before starting construction, once there are any problems in the design can be pushed to the owner responsibility and consequences.

### **4.2 Suggestions on EPC general contract project management**

#### 4.2.1 Recommendations to the owner

The owner shall strengthen the understanding of various construction modes, deeply analyze the advantages and disadvantages of EPC mode, and boldly adopt EPC mode for construction of qualified projects, so as to obtain the best technical and economic benefits.

#### 4.2.2 Recommendations to contractors

With EPC contractor for construction enterprises to take the lead in the process of project implementation, the most important thing is to adopt the method of contract, economic means to arouse the enthusiasm of survey and design personnel. The construction enterprise, as the lead party, shall have the right to speak in the contract payment of the design and investigation party, and can decide on the corresponding reward and punishment measures. At the same time, in EPC projects, construction units must take the initiative to strengthen contact with design units. From the construction period, cost, construction scheme and other aspects to improve efficiency, reduce risks, and finally earn profits for themselves.

## **5 Conclusion**

As a contracting mode is vigorously promoted in China recently, EPC project general contracting mode has been well applied in many projects. Helping the owner to realize the requirements of

investment, progress and use, it also brings the general contractor benefits from integrated management of large-scale projects. Utilizing this mode can save the investment, reduce the length of the working period, and have a better realization of various indexes expected by the owners. However, the research on EPC general contracting mode in China is still at the initial stage and not profound enough.

On the basis of consulting a large amount of literature, this paper makes a deep analysis of project management under EPC general contracting mode, and mainly obtains the following results: the characteristics of EPC general contracting mode are studied and analyzed, and the differences between this mode and other general contracting modes are compared and analyzed. The project management characteristics and existing problems of EPC engineering are studied and analyzed comprehensively. The specific optimization measures of EPC general contracting project management are put forward.

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# **Evaluation of the Influencing Factors of PPP Contract Performance in Urban Underground Integrated Pipe Gallery Based on Grey Relation-TOPSIS Method**

Wu Yifan, Fang Jun

School of Civil Engineering and Architecture, Wuhan University of Technology,

Wuhan, P.R. China, 430070

(E-mail: wyfsheung@qq.com, 172050328@qq.com)

**Abstract:** Although the introduction of the PPP model has effectively promoted the construction of urban underground integrated pipe gallery, it also faces obstacles to contract fulfillment. From the perspective of contract management, this article takes the PPP project contract of urban underground integrated pipe gallery as the research object. First of all, the influencing factors that hinder the performance of the contract are classified according to the contract formation stage and contract performance stage. Then, based on the grey correlation-TOPSIS method, the contract performance evaluation model of PPP project in urban underground integrated pipe gallery is constructed. Finally, the domestic real case is selected to verify the validity of the model. The results show that the model can identify the factors hindering the performance of the contract and the corresponding influence degree.

**Key words:** PPP project in urban underground integrated pipe gallery; Contract management; Contract performance; Grey correlation-TOPSIS method

## **1 Introduction**

The urban underground integrated pipe gallery is a tunnel space where centralized drainage, heat, electricity, gas, communications and other municipal pipelines are laid under the urban roads for unified monitoring and management. The organic combination of the PPP model and the urban underground integrated gallery project must take into account their respective particularities and adaptability, and overcome a series of problems arising from this to ensure the smooth development of the project.

For the risk management research of PPP projects, HHM method, RFRM method and AHP method were used to construct a risk sharing model for PPP project in urban underground integrated pipe gallery (Zhao Jia, 2016). The interaction between risk factors of PPP project in urban underground integrated pipe gallery based on ISM-MICMAC model were analyzed, and the result showed that there was a progressive relationship between risk factors (Zhou Xianhua et al, 2017). The risk management capabilities of public organizations' PPP projects were identified based on the IRM method (Bianca B.M. Keers, Paul C. van Fenema, 2018). The strategic behavior of Chinese investors' overseas investment by portraying the ownership structure of enterprises, investment motives and the quality of host institutions were reflected from the perspective of risk management methods (Subhan Ullah, Zheng Wang, 2019).

For the research on Contract Management of PPP projects, Due to the long duration of PPP

contracts, it was necessary to consider the changes in the scope of social expectations (Jose M. Viegas, 2010). As for the contract flexibility, the government subsidy mechanism which would be separated from construction and operation was benefit from it (Wang Xiao, Gao Shenyuan, 2016). Besides, the grey correlation analysis method was used to screen out the key factors affecting the contract management of PPP projects (Ma Haifeng, 2017).

For the research on the relationship governance of Contractual subjects in PPP projects, it was believed that there had been a positive interaction between contract governance and relationship governance of the construction project (Luo Yazhuo, 2011). In order to verify the relationship between relationship management and management performance, the performance evaluation system was constructed to explore the dimension of then in PPP project management (Tian Binfan, 2017). As for the project cooperation, incorporating the sustainability of public-private partnerships into the performance appraisal of PPP projects was proposed (Marlies Hueskes et al,2017). And some quantitative analysis method like structural equation model were also used to empirically analyze the relationship between relationship governance, PPP project control and project performance (Li Xiaoguang et al, 2018).

## **2 Construction of Contract Performance Evaluation Index System**

The PPP project contract system of urban underground integrated pipe gallery is quite large. In addition to the most core and representative franchise agreement, it also includes a series of contracts signed or performed in different stages of project implementation. This article uses the questionnaire survey method to identify the influencing factors hindering the contract performance of PPP project in urban underground integrated pipe gallery, and classifies them according to the contract formation stage and contract performance stage. The final evaluation index system of PPP project in urban underground integrated pipe corridor contract performance is shown in figure 1.

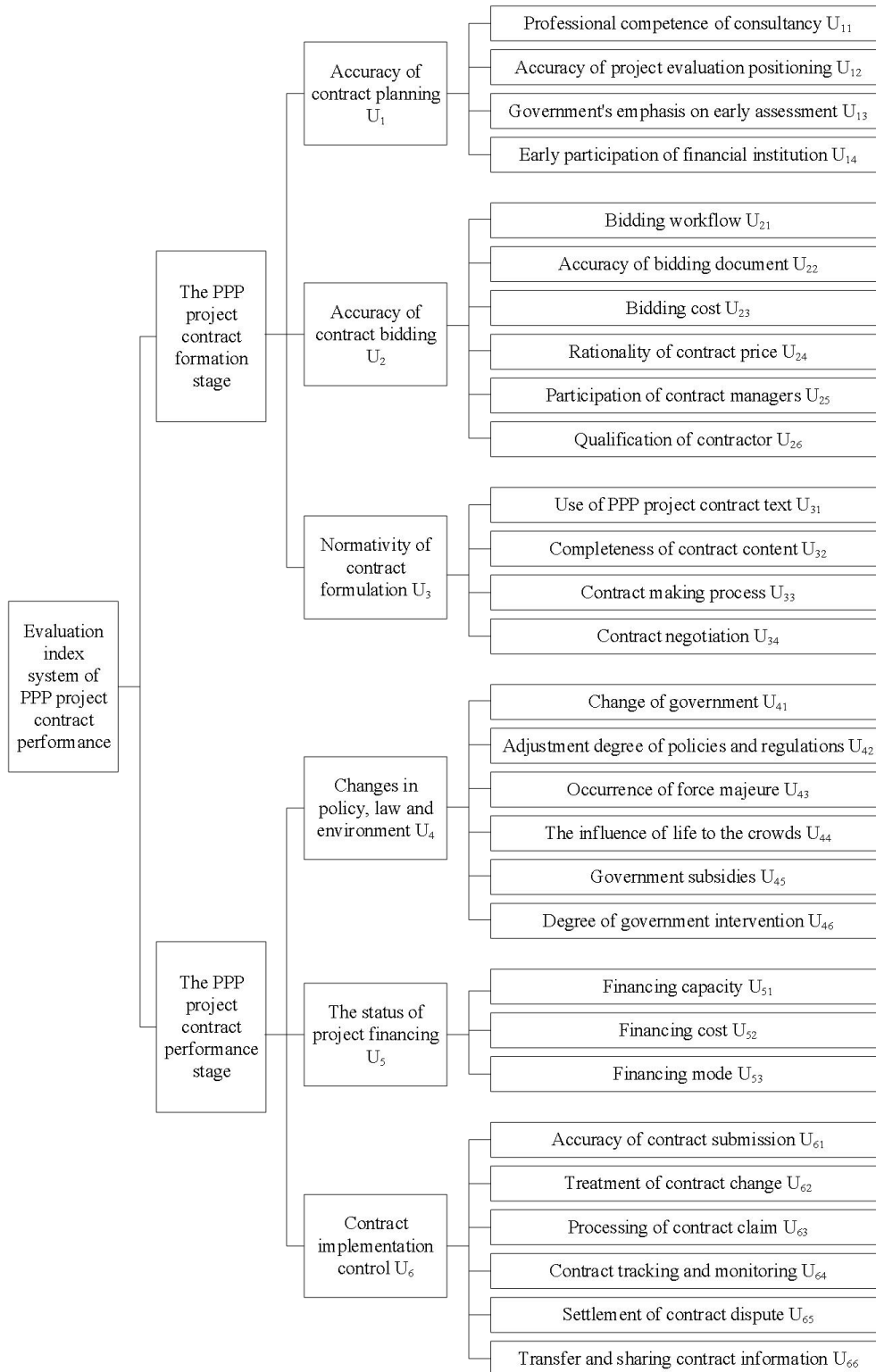


Figure 1 Evaluation Index System of Contract Performance

### 3 Construction of Contract Performance Evaluation Model

#### 3.1 Overview of grey relation-TOPSIS model

Grey relational analysis is a tool to judge whether the connection is close or not according to the similarity of geometric shape of sequence curve. The closer the curve is, the greater the correlation between the corresponding sequences will be. The TOPSIS method is often used in multi-objective decision-making. Its core idea is to calculate the distance between the selected decision-making scheme and the positive and the negative ideal solution, and rank the schemes according to the relative sticking schedule, so that the selected scheme is closer to the optimal solution. Through the combination of the two, we can overcome the limitation of small sample size and evaluate objectively from the two dimensions of optimum and worst, so as to improve the accuracy of the final results.

#### 3.2 Grey relevance-specific steps of TOPSIS model application

##### 3.2.1 Determining the index weight

In this article, the weight of index is determined by the method of entropy weight, and the data are processed by the range method. Due to the limitation of the length of the article, I will not elaborate on it here.

##### 3.2.2 Computing weighted standardized decision matrix

Weighted standardized decision matrix:

$$Z = (z_{ij})_{m \times n} (i = 1, 2, 3, \dots, m; j = 1, 2, 3, \dots, n)$$

$$Z_{ij} = w_j \times y_{ij} \quad (1)$$

$$Z = (Z_{ij})_{m \times n} = \begin{bmatrix} Z_{11} & Z_{12} & \dots & Z_{1m} \\ Z_{21} & Z_{22} & \dots & Z_{2m} \\ \vdots & \vdots & \vdots & \vdots \\ Z_{n1} & Z_{n2} & \dots & Z_{nm} \end{bmatrix} \quad (2)$$

##### 3.2.3 Determining the positive and negative ideal solutions

The positive and negative ideal solutions of weighted standardized decision matrix  $Z$  are determined  $Z_j^+$  and  $Z_j^-$ .

$$Z_j^+ = \left\{ \max_{1 \leq i \leq m} z_{ij} \right\} \quad (3)$$

$$Z_j^- = \left\{ \min_{1 \leq i \leq m} z_{ij} \right\} \quad (4)$$

##### 3.2.4 Computing Euclid distance

The Euclid distances  $d_j^+$  and  $d_j^-$  from each index to positive ideal solution  $Z_j^+$  and negative ideal solution  $Z_j^-$  are calculated respectively.



$$d_j^+ = \sqrt{\sum_{i=1}^m (z_{ij} - z_j^+)^2} \quad (5)$$

$$d_j^- = \sqrt{\sum_{i=1}^m (z_{ij} - z_j^-)^2} \quad (6)$$

### 3.2.5 Calculating grey relational coefficient

The grey relational coefficient matrices  $\xi^+$  and  $\xi^-$  of each index with positive ideal solution  $Z_j^+$  and negative ideal solution  $Z_j^-$  are calculated respectively.

$$\xi^+ = \frac{\min_i \min_j |z_{ij} - z_j^+| + \rho \max_i \max_j |z_{ij} - z_j^+|}{|z_{ij} - z_j^+| + \rho \max_i \max_j |z_{ij} - z_j^+|} = \frac{\rho w_j}{w_j - z_{ij} + \rho w_j} \quad (7)$$

$$\xi^- = \frac{\min_i \min_j |z_{ij} - z_j^-| + \rho \max_i \max_j |z_{ij} - z_j^-|}{|z_{ij} - z_j^-| + \rho \max_i \max_j |z_{ij} - z_j^-|} = \frac{\rho w_j}{z_{ij} + \rho w_j} \quad (8)$$

Where  $\rho \in [0, 1]$  is the relational coefficient, and the smaller the coefficient, the greater the resolution. Therefore, grey relational coefficient matrix:

$$\xi^+ = (\xi^+)_{m \times n} = \begin{bmatrix} \xi_{11}^+ & \xi_{12}^+ & \cdots & \xi_{1m}^+ \\ \xi_{21}^+ & \xi_{22}^+ & \cdots & \xi_{2m}^+ \\ \vdots & \vdots & \vdots & \vdots \\ \xi_{n1}^+ & \xi_{n2}^+ & \cdots & \xi_{nm}^+ \end{bmatrix} \quad (9)$$

$$\xi^- = (\xi^-)_{m \times n} = \begin{bmatrix} \xi_{11}^- & \xi_{12}^- & \cdots & \xi_{1m}^- \\ \xi_{21}^- & \xi_{22}^- & \cdots & \xi_{2m}^- \\ \vdots & \vdots & \vdots & \vdots \\ \xi_{n1}^- & \xi_{n2}^- & \cdots & \xi_{nm}^- \end{bmatrix} \quad (10)$$

### 3.2.6 Calculating the grey relational degree

The grey relational degrees  $r_j^+$  and  $r_j^-$  of each index with positive ideal solution  $Z_j^+$  and negative ideal solution  $Z_j^-$  are calculated respectively.

$$r_j^+ = \frac{1}{m} \sum_{i=1}^m \xi_{ij}^+ \quad (11)$$

$$r_j^- = \frac{1}{m} \sum_{i=1}^m \xi_{ij}^- \quad (12)$$

### 3.2.7 Dimensionless data processing

The dimensionless Euclid distance  $D_j^+$  and  $D_j^-$ , grey relational degree  $R_j^+$  and  $R_j^-$  are obtained by dimensionless processing of Euclid distance  $d_j^+$  and  $d_j^-$ , grey relational degree  $r_j^+$  and  $r_j^-$ .

$$D_j^+ = \frac{d_j^+}{\max_j d_j^+} \quad (13)$$

$$D_j^- = \frac{d_j^-}{\max_j d_j^-} \quad (14)$$

$$R_j^+ = \frac{r_j^+}{\max_j r_j^+} \quad (15)$$

$$R_j^- = \frac{r_j^-}{\max_j r_j^-} \quad (16)$$

### 3.2.8 Computing relative closeness

The dimensionless Euclid distance  $D_j^-$  and grey relational degree  $R_j^+$ , Euclid distance  $D_j^+$  and grey relational degree  $R_j^-$  are merged to get  $S_j^+$  and  $S_j^-$  respectively.

$$S_j^+ = \alpha D_j^- + \beta R_j^+ \quad (17)$$

$$S_j^- = \alpha D_j^+ + \beta R_j^- \quad (18)$$

In the formula,  $\alpha$  and  $\beta$  represent the preference level of decision makers for different types of data, usually  $\alpha + \beta = 1$ , and  $\alpha \in [0, 1], \beta \in [0, 1]$ . Subsequently, the final evaluation value of  $C_j^+$  is determined.

$$C_j^+ = \frac{S_j^+}{S_j^+ + S_j^-} \quad (19)$$

Ranking the actual completion rate of each index in the project, the greater the  $C_j^+$ , the smaller the performance of the contract will be hindered. On the contrary, the smaller the  $C_j^+$ , the greater the obstacles to contract performance.

## 4 Empirical Analysis

The total construction investment of an underground integrated management PPP project in Nanjing core area of Jiangsu Province is about 4.319 billion yuan. BOT mode is adopted for operation, and the duration of cooperation is 25 years. The total length of the integrated pipe gallery is about 53 kilometers, including 31.29 kilometers for the main line and 22.12 kilometers for the branch line.

This article invites 10 contract managers and project managers with rich experience to participate in the scoring. "0" means "unimportant", and the corresponding score is 1. "1" stands for "general important", and the corresponding score is 2 to 4. "2" stands for "very important", and the corresponding score is 5. According to the actual situation of project implementation, the original matrix  $R$  is obtained by scoring the indexes listed in figure 2.1.

$$R = \begin{bmatrix} 4 & 4 & 4 & 3 & 4 & 3 & 4 & 4 & 3 & 5 \\ 4 & 5 & 2 & 4 & 2 & 4 & 3 & 4 & 5 & 4 \\ 5 & 4 & 5 & 5 & 5 & 5 & 5 & 5 & 5 & 3 \\ 4 & 4 & 3 & 4 & 3 & 4 & 5 & 5 & 4 & 5 \\ 1 & 2 & 1 & 3 & 2 & 1 & 1 & 3 & 1 & 3 \\ 4 & 4 & 4 & 5 & 4 & 3 & 5 & 4 & 5 & 4 \\ 3 & 3 & 4 & 4 & 4 & 3 & 3 & 3 & 5 & 3 \\ 3 & 2 & 4 & 3 & 2 & 3 & 2 & 4 & 3 & 3 \\ \vdots & \vdots & \vdots & \vdots & \vdots & \vdots & \vdots & \vdots & \vdots & \vdots \\ 4 & 4 & 4 & 4 & 3 & 4 & 4 & 4 & 4 & 2 \end{bmatrix}$$

Standardized matrix  $Y = (y_{ij})_{m \times n}$  is obtained by processing the data in the original matrix  $R$  with range method.

$$Y = \begin{bmatrix} 0.5 & 0.5 & 0.5 & 0 & 0.5 & 0 & 0.5 & 0.5 & 0 & 1 \\ 0.333 & 1 & 0 & 0.333 & 0 & 0.333 & 0.667 & 0.333 & 1 & 0.333 \\ 0 & 0.5 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 1 \\ 0.5 & 0.5 & 1 & 0.5 & 1 & 0.5 & 0 & 0 & 0.5 & 0 \\ 1 & 0.5 & 1 & 0 & 0.5 & 1 & 1 & 0 & 1 & 0 \\ 0.5 & 0.5 & 0.5 & 0 & 0.5 & 1 & 0 & 0.5 & 1 & 0.5 \\ 1 & 1 & 0.5 & 0.5 & 0.5 & 1 & 1 & 1 & 0 & 1 \\ 0.5 & 1 & 0 & 0.5 & 1 & 0.5 & 1 & 0 & 0.5 & 0.5 \\ \vdots & \vdots & \vdots & \vdots & \vdots & \vdots & \vdots & \vdots & \vdots & \vdots \\ 0 & 0 & 0 & 0 & 0.5 & 0 & 0 & 0 & 0 & 1 \end{bmatrix}$$

Determining index weight by entropy weight method as follows.

$$\omega = (0.031, 0.024, 0.020, 0.026, 0.026, 0.026, 0.026, 0.040, 0.026, 0.028, 0.033, 0.028, 0.026, 0.053, 0.029, 0.028, 0.040, 0.022, 0.034, 0.028, 0.021, 0.028, 0.035, 0.040, 0.028, 0.037, 0.024, 0.028, 0.163)$$

The weighted standardized decision matrix  $Z = (Z_{ij})_{m \times n}$  is obtained by formula (1) and formula (2).

$$Z = \begin{bmatrix} 0.016 & 0.016 & 0.016 & 0 & 0.016 & 0 & 0.016 & 0.016 & 0 & 0.031 \\ 0.008 & 0.024 & 0 & 0.008 & 0 & 0.008 & 0.016 & 0.008 & 0.024 & 0.008 \\ 0 & 0.010 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0.020 \\ 0.013 & 0.013 & 0.026 & 0.013 & 0.026 & 0.013 & 0 & 0 & 0.013 & 0 \\ 0.026 & 0.013 & 0.026 & 0 & 0.013 & 0.026 & 0.026 & 0 & 0.026 & 0 \\ 0.013 & 0.013 & 0.013 & 0 & 0.013 & 0.025 & 0 & 0.013 & 0.025 & 0.013 \\ 0.026 & 0.026 & 0.013 & 0.013 & 0.013 & 0.026 & 0.026 & 0.026 & 0 & 0.026 \\ 0.020 & 0.040 & 0 & 0.020 & 0.040 & 0.020 & 0.040 & 0 & 0.020 & 0.020 \\ \vdots & \vdots & \vdots & \vdots & \vdots & \vdots & \vdots & \vdots & \vdots & \vdots \\ 0 & 0 & 0 & 0 & 0.082 & 0 & 0 & 0 & 0 & 0.163 \end{bmatrix}$$

The positive idea solution  $Z_j^+$  and negative ideal solution  $Z_j^-$  of the index are determined by formula (3) and formula (4) respectively.

$$Z_j^+ = (0.030, 0.024, 0.020, 0.026, 0.026, 0.026, 0.025, 0.026, 0.040, \dots, 0.163)$$

$$Z_j^- = (0, 0, 0, 0, \dots, 0)$$

The Euclid distances  $d_j^+$  and  $d_j^-$  of positive ideal solution  $Z_j^+$  and negative ideal solution  $Z_j^-$  of the index are determined by formula (3-5) and formula (3-6) respectively.

$$d_j^+ = (0.062, 0.050, 0.057, 0.054, 0.048, 0.048, 0.034, 0.050, \dots, 0.231)$$

$$d_j^- = (0.048, 0.052, 0.060, 0.049, 0.051, 0.050, 0.050, 0.049, \dots, 0.182)$$

The grey relational coefficient matrices  $\xi^+$  and  $\xi^-$  are calculated by formula (7), formula (8), formula (9) and formula (10) respectively. Where,  $\rho$  take 0.5.

$$\xi^+ = \begin{bmatrix} 0.508 & 0.508 & 0.508 & 0.333 & 0.508 & 0.333 & 0.508 & 0.508 & 0.333 & 1.000 \\ 0.429 & 1.000 & 0.333 & 0.429 & 0.333 & 0.429 & 0.600 & 0.429 & 1.000 & 0.429 \\ 0.333 & 0.500 & 0.333 & 0.333 & 0.333 & 0.333 & 0.333 & 0.333 & 0.333 & 1.000 \\ 0.500 & 0.500 & 1.000 & 0.500 & 1.000 & 0.500 & 0.333 & 0.333 & 0.500 & 0.333 \\ 1.000 & 0.500 & 1.000 & 0.333 & 0.500 & 1.000 & 0.333 & 0.500 & 1.000 & 0.500 \\ 0.500 & 0.500 & 0.500 & 0.333 & 0.500 & 1.000 & 0.333 & 0.500 & 1.000 & 0.500 \\ 1.000 & 1.000 & 0.500 & 0.500 & 0.500 & 1.000 & 1.000 & 1.000 & 0.333 & 1.000 \\ 0.500 & 1.000 & 0.333 & 0.500 & 1.000 & 0.500 & 1.000 & 0.333 & 0.500 & 0.500 \\ \vdots & \vdots & \vdots & \vdots & \vdots & \vdots & \vdots & \vdots & \vdots & \vdots \\ 0.333 & 0.333 & 0.333 & 0.333 & 0.502 & 0.333 & 0.333 & 0.333 & 0.333 & 1.000 \end{bmatrix}$$

$$\xi^- = \begin{bmatrix} 0.492 & 0.492 & 0.492 & 1.000 & 0.492 & 1.000 & 0.492 & 0.492 & 1.000 & 0.333 \\ 0.600 & 0.333 & 1.000 & 0.600 & 1.000 & 0.600 & 0.429 & 0.600 & 0.333 & 0.600 \\ 1.000 & 0.500 & 1.000 & 1.000 & 1.000 & 1.000 & 1.000 & 1.000 & 1.000 & 0.333 \\ 0.500 & 0.500 & 0.333 & 0.500 & 0.333 & 0.500 & 1.000 & 1.000 & 0.500 & 1.000 \\ 0.333 & 0.500 & 0.333 & 1.000 & 0.500 & 0.333 & 0.333 & 1.000 & 0.333 & 1.000 \\ 0.500 & 0.500 & 0.500 & 1.000 & 0.500 & 0.342 & 1.000 & 0.500 & 0.342 & 0.500 \\ 0.333 & 0.333 & 0.500 & 0.500 & 0.500 & 0.333 & 0.333 & 0.333 & 1.000 & 0.333 \\ 0.500 & 0.333 & 1.000 & 0.500 & 0.333 & 0.500 & 0.333 & 1.000 & 0.500 & 0.500 \\ \vdots & \vdots & \vdots & \vdots & \vdots & \vdots & \vdots & \vdots & \vdots & \vdots \\ 1.000 & 1.000 & 1.000 & 1.000 & 0.498 & 1.000 & 1.000 & 1.000 & 1.000 & 0.333 \end{bmatrix}$$

The grey relational degree  $r_j^+$  and  $r_j^-$  are calculated by formula (3-11) and formula (12) respectively.

$$r_j^+ = (0.505, 0.541, 0.417, 0.550, 0.700, 0.552, 0.783, 0.617, 0.567, 0.533, 0.472, 0.533, 0.583, 0.400, 0.517, 0.533, 0.433, 0.767, 0.467, 0.533, 0.800, 0.533, 0.453, 0.433, 0.533, 0.450, 0.613, 0.533, 0.417)$$

$$r_j^- = (0.629, 0.610, 0.883, 0.617, 0.5667, 0.568, 0.450, 0.550, 0.567, 0.800, 0.739, 0.533, 0.517, 0.933, 0.583, 0.800, 0.833, 0.500, 0.867, 0.800, 0.533, 0.533, 0.819, 0.833, 0.533, 0.783, 0.476, 0.800, 0.883)$$

$D_j^+$  and  $D_j^-$  are obtained by formula (13) and formula (14) respectively.

$$D_j^+ = (0.139, 0.053, 0.061, 0.089, 0.131, 0.091, 0.237, 0.106, 0.120, 0.148, 0.181, 0.104, 0.107, 0.319, 0.121, 0.148, 0.237, 0.057, 0.194, 0.170, 0.091, 0.104, 0.208, 0.220, 0.104, 0.189, 0.077, 0.148, 1.000)$$

$$D_j^- = (0.266, 0.284, 0.330, 0.272, 0.278, 0.274, 0.272, 0.272, 0.272, 0.268, 0.266, 0.268, 0.274, 0.289, 0.267, 0.268, 0.272, 0.302, 0.267, 0.268, 0.308, 0.268, 0.267, 0.272, 0.268, 0.268, 0.281, 0.268, 1.000)$$

Then,  $R_j^+$  and  $R_j^-$  are obtained by formula (15) and formula (16) respectively.

$$R_j^+ = (0.589, 0.631, 0.487, 0.642, 0.817, 0.914, 0.720, 0.662, 0.622, 0.551, 0.622, 0.680, 0.625, 0.429, 0.554, 0.571, 0.464, 0.821, 0.500, 0.571, 0.857, 0.571, 0.486, 0.464, 0.571, 0.482, 0.657, 0.571, 0.446)$$

$$R_j^- = (0.665, 0.645, 0.933, 0.652, 0.599, 0.600, 0.476, 0.581, 0.599, 0.846, 0.762, 0.571, 0.554, 1.000, 0.625, 0.857, 0.893, 0.536, 0.929, 0.857, 0.571, 0.571, 0.878, 0.893, 0.571, 0.839, 0.510, 0.857, 0.946)$$

$S_j^+$  and  $S_j^-$  are calculated by formula (17) and formula (18) respectively, Where,  $\alpha$  and  $\beta$  are 0.5.

$$S_j^+ = (0.428, 0.458, 0.409, 0.457, 0.548, 0.594, 0.496, 0.467, 0.447, 0.410, 0.444, 0.474, 0.450, 0.359, 0.410, 0.420, 0.368, 0.562, 0.383, 0.420, 0.583, 0.420, 0.376, 0.368, 0.420, 0.375, 0.469, 0.420, 0.723)$$

$$S_j^- = (0.402, 0.349, 0.497, 0.371, 0.365, 0.346, 0.357, 0.344, 0.360, 0.497, 0.472, 0.338, 0.330, 0.659, 0.373, 0.502, 0.565, 0.296, 0.561, 0.514, 0.331, 0.338, 0.543, 0.557, 0.338, 0.514, 0.293, 0.502, 0.973)$$

Then, the final value of relative closeness  $C_j^+$  is calculated by formula (19).

$$C_j^+ = (0.515, 0.567, 0.451, 0.5552, 0.600, 0.632, 0.582, 0.576, 0.554, 0.452, 0.485, 0.584, 0.576, 0.352, 0.524, 0.455, 0.395, 0.655, 0.406, 0.450, 0.638, 0.554, 0.410, 0.398, 0.554, 0.422, 0.615, 0.455, 0.426)$$

Finally, the relative closeness  $C_j^+$  of each index can be ranked,  $U_{44} > U_{51} > U_{22} > U_{64} > U_{21} > U_{32} > U_{23} > U_{24} = U_{33} > U_{12} > U_{25} = U_{52} = U_{62} > U_{14} > U_{41} > U_{11} > U_{31} > U_{42} = U_{65} > U_{26} > U_{13} > U_{46} > U_{66} > U_{63} > U_{53} > U_{45} > U_{61} > U_{43} > U_{34}$ .

From the ranking results of the relative closeness of the indexes, we can see that the leading indexes such as "the degree of impact on people's life", "financing ability" and "the accuracy of bidding document" have less obstacles to contract performance, while "the accuracy of contract submission", "occurrence of force majeure" and "contract negotiation" have greater obstacles to contract performance.

## 5 Conclusion

Based on the idea of contract management, this article identifies and categorizes the influence factors that hinder the normal performance of the contract according to different stages. Through the construction of the evaluation index system of PPP project contract performance of urban underground integrated pipe gallery, the further screening of the evaluation indexes is completed. Then, the contract performance of PPP project of urban underground integrated pipe gallery is constructed by grey relation-TOPSIS method. The situation evaluation model evaluates the performance of a specific project contract, and verifies the validity of the evaluation model. The deficiency of this article lies in the small number of samples obtained in the later stage, which may lead to errors in the results, and then affect the accuracy of the final evaluation.

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## Risk Assessment for College Students' Sudden Death Based on AHP

Huang Tingting<sup>1</sup>, Xia Jijia<sup>2,3\*</sup>

1 Wuhan University of Technology Hospital, Wuhan, P.R.China, 430070

2 School of Management, Wuhan University of Technology, Wuhan, P.R.China, 430070

3 School of Safety Science and Emergency Management, Wuhan, P.R.China, 430070

(E-mail: htt.xing@163.com, 18838772997@163.com)

**Abstract:** As for the current situation and reasons of college students' sudden death (CSSD), a risk assessment exploration is necessary. First, index system for the sudden death of college students is established referring to literature learning. Then, the priority factors affecting the sudden death risk of college students are obtained by Analytic Hierarchy Process (AHP). Finally, aiming at the prevention of CSSD risk, combined with quantitative analysis and risk management theory, evaluation methods and risk control strategy are proposed.

**Key words:** Risk assessment; AHP; Sudden death; College students

### 1 Introduction

Sudden death is one of most serious disease of human beings. The World Health Organization (WHO) defines sudden death as that people who are generally healthy or seemingly healthy, in a short period of time, sudden death due to natural diseases is sudden death. In recent years, college students' sudden deaths (CSSD) have occurred frequently. The types of the cases were mostly sudden death from sports, sleep or drinking. On April 26, 2018, a college student in Tianjin suddenly fell to the ground when he participated in the physical fitness test. On the morning of May 7, 2018, a senior student in Changsha died after three convulsions in an Internet cafe. On January 10, 2019, a sophomore boy in a university in Zhejiang died suddenly during the final review. The doctor initially identified the death because of sudden cardiac death. The frequent deaths of college students bring great losses to school and families. It is of great social and practical significance to strengthen the prevention of sudden death risk of college students.

Analytic Hierarchy Process (AHP), proposed by Professor Saaty in the United States in the 1970s, is a hierarchical weighted decision analysis method combining qualitative analysis and quantitative analysis. At present, the academic community has carried out some research on the CSSD. FENG Dazhi investigated and obtained cause of sudden deaths among college students, and proposed related prevention and monitoring measures (Feng Dazhi, 2012). Xie Qingzhi conducted data collection and analysis of CSSD, using modern risk management methods (Xie Qingzhi, 2013). Harmon K G concluded that sudden cardiac death is the main medical reason for student athletes to die during exercise through cases study of CSSD through the National Collegiate Athletic Association (NCAA) database (Harmon K G, 2011). By analyzing the reasons and response plans of the cases, the conclusions lack universality. To assess the risk of CSSD and early warning mechanism are not systematically analyzed. Based on the current situation and causes of CSSD, factors affecting the risk of CSSD from four aspects including Family History, Illness History, Psychological Quality and Physical Quality, are discovered. These could help construct index system. Then the priority factors of the factors influencing the risk of CSSD can be extracted by AHP. After all, some risk control strategies for CSSD are proposed.

## 2 Risk Assessment Model

The semi-quantitative method was used to quantitatively evaluate the risk of CSSD (Li Songchen, 2014). The product of risk index indicates the risk of CSSD, which is related to systemic risk and expressed by equation (1).

$$R(i, j) = E \cdot S \cdot C \quad (1)$$

In equation (1),  $E$ ,  $S$ , and  $C$  are three risk indexes;  $R(i, j)$  is risk value.  $E$  indicates the probability of risk.  $E$  ranges from 0.1 to 1.  $S$  indicates the severity, which ranges from 1 to 10.  $C$  indicates the consequences, which ranges from 1 to 100.  $C = 1$  means no injury. If sudden death happens,  $C = 100$ . The specific values of severity  $S$ , consequence  $C$  and risk value  $R(i, j)$  can be determined according to Table 1.

**Table 1 Risk Source**

$S$		$C$		$R(i, j)$		
$S$	Severity	$C$	Severity	$R(i, j)$	Risk level	Degree of risk
1	Slight	1	No injury	(0, 20]	Level 1	Slight risk
2	Serious	15	Mild injury	(20, 60]	Level 2	Common risk
4	More serious	30	Serious injury	(60, 170]	Level 3	Significant risk
7	Very serious	50	Huge injury	(170, 350]	Level 4	High risk
10	Extremely serious	100	sudden death	(350, +∞)	Level 5	Great risk

## 3 The Risk Index System for CSSD Based on AHP

### 3.1 Analysis of the factors influencing the CSSD risk

Chen Chujie concluded that the sudden death of sports death among college students was mainly caused by sudden cardiac death, which accounts for 70%, followed by brain-related deaths of about 15% (Chen Chujie, 2016). Main causes include heat stroke, asthma, post-exercise cardiac abnormalities, myocarditis, poor lifestyle and organ failure (Wang Yunfeng, 2014; Xia Jiaoyang, 2018; Liu Huiying, 2013). Maron B J evaluated a database from both the U.S. National Registry of Sudden Death in Athletes and the National Collegiate Athletic Association (2002-2011) (Maron B J, 2014). From the above analysis, the factors influencing the CSSD mainly include individuals and families. Personal factors are dominant. Personal factors are mainly in disease, psychology, and lifestyle. Family factors are mainly genetic diseases and major injuries.

### 3.2 Construction of index system

The evaluation index in the risk of CSSD are divided into three layers, namely the target layer, the criterion layer and the program layer. With deep summary of relative literatures, the factors affecting CSSD risk into four index: Family, Illness, Psychological quality and Physical quality. Family medical history is an invisible 'killer' that affects CSSD. Some CSSD are caused by diseases or defects derived



from parents. Therefore, family  $Q1$  is an important factor affecting CSSD, including hereditary disease, non-genetic disease, physical disorder, and non-accident early death. Illness  $Q2$  refers to individual cases, including hereditary disease, congenital non-genetic disease, cardiovascular non-genetic disease, and non-accidental syncope. Psychological quality  $Q3$  reflects the college students' ability to resist stress, including mood swings, depression, suicidal, and frustration. Physical fitness  $Q4$  is one of direct cause of sudden death, including health status, exercise load, physical disorders, and bad hobby. The index system of factors affecting the risk of CSSD is constructed as figure 1.

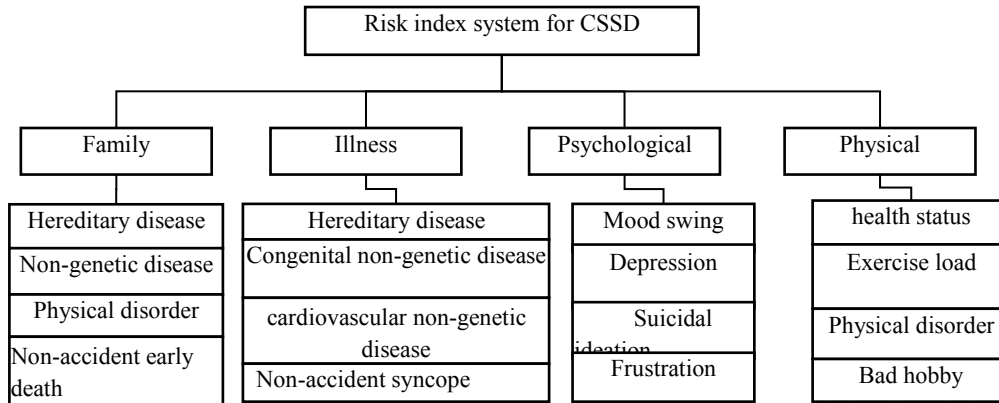


Figure 1 Risk Index System for CSSD

## 4 CSSD Risk Assessment

### 4.1 Weight setting

According to the hierarchical structure, elements of the program layer are compared with each other. And make a judgment based on the relative importance of the index to the target layer, and the judgment value  $A$  is given to form a judgment matrix. Generally, the index  $B_i$  ( $i = 1, 2, \dots, m$ ) belonging to the index  $A_k$  ( $k = 1, 2, \dots, n$ ) has a judgment matrix of  $m$ -dimensional square matrix.

$$B = \begin{bmatrix} b_{11} & b_{12} & \cdots & b_{1m} \\ b_{21} & b_{22} & \cdots & b_{2m} \\ \vdots & \vdots & \vdots & \vdots \\ b_{m1} & b_{m2} & \cdots & b_{mm} \end{bmatrix}$$

Where:  $b_{ij}$  ( $j=1,2,\dots,m$ ) is the index discriminant scale of  $B_i$ , and the index  $i$  is compared with the index  $j$ , and the relative importance degree to the index  $B_i$  is usually determined by the 1 ~ 9 scale method.

Following the principles of objectivity and authenticity(Qu Zhengeng, 2019),6 experts were invited to evaluate the index. A geometric average is used to sort out the comparison matrix at each

level. Each index weight is determined according to formulas  $\bar{\omega}_i = \sqrt[m]{\prod_{j=1}^m b_{ij}}$  and  $\omega_i = \frac{\bar{\omega}_i}{\sum_{i=1}^m \bar{\omega}_i}$ .

The maximum eigenvalue of the judgment matrix is determined by equation (2). Compare the size of the weight product of the criteria layer and the program layer to obtain the comprehensive ranking of

the program layer indexes. In the analytic hierarchy process, the consistency problem is tested. The object of the test is the consistency of the maximum eigenvalues  $\lambda_{\max}$  and  $m$  of the judgment matrix, which is  $CI = \frac{\lambda_{\max} - m}{m - 1}$ ,  $CR = \frac{CI}{RI}$ .  $RI$  is an average random consistency test index and is a fixed constant,  $m = 4$ , here  $RI = 0.9$ . It is generally believed that when  $CI < 0.1$ ,  $CR < 0.1$  the data in the constructed judgment matrix is legal and acceptable, otherwise the judgment matrix needs to be reconstructed. The values of  $\omega_i, \lambda_{\max}, CI, CR$  are listed in Table 2.

$$\lambda_{\max} = \frac{1}{m} \sum_i^m \left( \frac{(AW)_i}{\omega_i} \right) \quad W = (\omega_1, \omega_2, \dots, \omega_m)^T \quad (2)$$

**Table 2 Index Weights and Consistency Test**

	$\omega_i$ (comprehensive sort)				$\lambda_{\max}$	$CI$	$CR$
$Q_i$	0.0539	0.1425	0.4018	0.4018	4.0079	0.0026	0.0029
$Q(1, j)$	0.4367(10)	0.0724(16)	0.1716(14)	0.3193(13)	4.0899	0.0300	0.0333
$Q(2, j)$	0.0478(15)	0.1415(12)	0.2785(7)	0.5322(2)	4.0716	0.0239	0.0265
$Q(3, j)$	0.0905(9)	0.5443(1)	0.3146(5)	0.0506(11)	4.1468	0.0489	0.0544
$Q(4, j)$	0.0927(8)	0.3856(3)	0.1823(6)	0.3394(4)	4.0247	0.0028	0.0091

It can be seen from the table that the factors influencing the risk of CSSD are mainly manifested in depression in psychological quality, non-accident syncope in the illness history, exercise load in physical fitness and bad hobby. Finding the main influencing factors affecting the CSSD, it also grasps the main contradiction of the risk of CSSD, and can effectively promote the prevention and control of sudden death in colleges and universities.

#### 4.2 Evaluation method

If matrix  $B$  is judged as consistent, comprehensive weights can be set as the weights of each index. And the expert scores are used to evaluate the overall risk of sudden death. The evaluation can be expressed as equation (3).

$$SDR = \sum_{i=1}^n \left( \omega_i \sum_{j=1}^m R(i, j) u(i, j) \right) \quad (3)$$

Where  $SDR$  is the comprehensive evaluation value of CSSD risk. And  $n$  is the amount of index in the criterion level.  $\omega_i$  is the weight of the index of the criterion level,  $m$  is the amount of index in program layer,  $R(i, j)$  is the risk value of the index in program level,  $0 < R(i, j) \leq 100$ ;  $u(i, j)$  is the weight value in program level. The overall risk assessment criteria are shown in Table 3.

**Table 3 SDR Value Evaluation Criteria for the Comprehensive Evaluation Value for CSSD Risk**

SDR	Level	Severity	Measure
$(100, +\infty]$	A	Extremely high	Multiple Response
$(60,100]$	B	High	Focus observation
$(20,60]$	C	Significant	Observation object
$(0,20]$	D	Low	keep it as it is

### 4.3 Case application

Through the stochastic sampling test of 30 college students, some effective  $R(i,j)$  are formed. Two typical sample are shown in matrix  $R^1(i,j)$  and  $R^2(i,j)$ .

$$R^1(i,j) = \begin{bmatrix} 0.1 & 1 & 0.1 & 0.1 \\ 0.1 & 0.1 & 0.1 & 0.1 \\ 4 & 0.1 & 0.1 & 30 \\ 1 & 30 & 0.1 & 2 \end{bmatrix} \quad R^2(i,j) = \begin{bmatrix} 0.1 & 60 & 0.1 & 0.1 \\ 0.1 & 0.1 & 0.1 & 0.1 \\ 30 & 60 & 30 & 60 \\ 30 & 30 & 0.1 & 105 \end{bmatrix}$$

It can be seen from the  $R^1(i,j)$  that the most damage suffered comes from the ‘frustration’ and ‘load’ of life. The second is ‘Mood swing’, which is in line with the living conditions of most college students. According to equation (3), the SDR value is 5.7783, the risk level is D. That is, measures should be taken to maintain original state. It can be seen from  $R^2(i,j)$  that the damages are a lot of physical and psychological injury in life, especially bad lifestyle. Through the overall risk evaluation, SDR value is 38.9600, which means the risk level is C. Correction of individual bad habits is urgent. Some special supervision may be necessary.

### 5 Conclusion

Based on the comprehensive data collection and analysis of CSSD, risk and factors of CSSD are identified. A risk index system of sudden death composed of three-level indexes is constructed. Using this index system, to assess and early-warning the risk of sudden death for college students is feasible. The priority of the program level indexes is obtained to guide the colleges to prevent the sudden death of students based on AHP. This can minimize the occurrence of the CSSD.

In summary, the prevention of sudden death risk among college students is an important work. Colleges and universities should examine the risk of sudden death among college students continuously. Combining scientific risk control strategies with novel risk assessment methods could help safety supervision for college students.

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## Research on Network Culture Security Management in Universities from Network Public Opinion

Li Huiyuan<sup>1</sup>, Zhang Yan<sup>2</sup>

1 School of Automation, Wuhan University of Technology, Wuhan, P.R. China, 430070

2 School of Energy and Power Engineering, Wuhan University of Technology,

Wuhan, P.R. China, 430063

(E-mail: 372414291@qq.com, zhangyant1223@163.com)

**Abstract:** With the development of network technology and the popularization of we-media, network public opinion has an important impact on the security of network culture in universities. The network culture security in universities is an epitome of that in society. Based on the investigation of the current situation of network culture security in universities in Wuhan which are operated directly under the Ministry of Education, this paper analyses the problems and their causes of network culture security in universities from the network public opinion. On this basis, it explores the guiding ideologies, working principles, management concepts, guarantee mechanisms and implementation path of network culture security management in universities.

**Key words:** Network public opinion; Universities; Network culture; Security management

### 1 Introduction

With the development of network technology and the popularization of we-media, the network has become an information source and a broad platform for the public to express their feeling and opinions. Network public opinion has an important impact on the safety of network culture, which has aroused the great attention of the Chinese government. In the first meeting of the central leading group on network security and informatization, Xi pointed out that doing a good job in online public opinion is a long-term task, and it is necessary to innovate and improve online publicity, apply the law of the Internet communication, carry forward the main theme, stimulate positive energy, vigorously cultivate and practice the core socialist values, grasp the timing, degree and efficiency of online public opinion guidance, and make cyberspace clear. The National Informatization Development Strategy 2006-2020 calls for advocating network civilization and building a positive and healthy network culture in an all-round way.

As an important social group using Internet, university students have a wide range of knowledge, strong curiosity and acceptance ability, and they generally use we-media, which leads to rich channels, fast speed and wide coverage of network public opinion in universities. Universities are national personnel training bases, and their network culture security is an epitome of that of society. Therefore, it is important to study the network culture security management in universities from the network public opinion.

The network public opinion is getting increasingly academic attention. The research focuses on six major themes: network public opinion handling mechanism, characteristics, impact, related groups, media in universities, as well as network public opinion and ideological and political education in universities, (Li Wenqing, et al., 2019).

There have been a lot of studies about the network culture security in recent years, however studies on that in universities are still few. The network culture security management in universities is generally studied combining the undergraduate ideological and political education, such as Xie Kemin et al. studied the impact of network culture security on ideological and political education of university students (Xie Kemin, et al., 2012), and Liu Ning explored the countermeasures of promoting ideological and political education with the construction of network culture in universities (Liu Ning, 2014). There are also some studies on the use of firewall (Ma Tao, et al., 2012), big data (Zhao Jian, 2016) and other technologies to improve the network culture of universities.

However, there are few studies based on the connection of the network culture security in universities and the network public opinion. Li Aimin proposed the management mechanism of network public opinion based on campus network culture security (Li Aimin, 2012). Deng Yongfa put forward strategies to improve network culture security from the aspects of mechanism, legal system, integration of resources and technology from the network public opinion (Deng Yongfa, 2010). However, without considering the particularity of universities, the strategies he gave could not be fully applicable to universities.

## **2 Network Public Opinion and Network Culture Security in Universities**

In 2007, Liu Yi put forward the concept of network public opinion in his monograph-*An Introduction to Internet Public Opinion Research*, which is the first monograph on the theory of network public opinion in China. That is, "the sum of different emotions, attitudes and opinions expressed and disseminated through the Internet" (Liu Yi, 2007).

Hu Ting holds that "network public opinion in universities refers to the attitudes, opinions, emotions or behavioral tendencies expressed by university students on the Internet through certain channels on issues, events or phenomena concerned with or related to their own interests within a certain period of time on campus." (Hu Ting, 2014) The content of network public opinion in universities covers social stability, school reputation, campus security, management decision-making, rights and interests of teachers and students, etc.

Network cultural security is a state in which the content of network cultural information cannot damage the national cultural interests in the process of production, dissemination and consumption, and can provide a positive and sustained impetus for the national cultural value system, as well as the security of material technology, system and regulations, network spiritual accomplishment and other aspects in order to ensure this security state (Yao Weijun, et al., 2010). Network culture security includes network security, such as network information dissemination security and storage security; Network system security, such as network security regulations and regulations; Network subject security, mainly refers to the security of people's ideology. Network culture security in universities is the refinement of the concept of network culture security.

The influence of network public opinion on network culture security in universities has two sides. The positive influence includes the spread and development of campus network culture, the construction of a harmonious campus, and university students' understanding and thinking of the world. The negative

effects are mainly reflected in three aspects. Firstly, university students are generally open-minded and credulous, and they may overreact under the guidance of bad public opinions. Secondly, the negative online public opinion, including pornography culture, violence culture and cult culture, has brought huge obstacles to establish a correct worldview, outlook on life and values. Thirdly, some university students spend most of their time on network communication, which is likely to lead to personality deviation and loneliness and depression.

### 3 A Case Study on the Current Situation of Network Culture Security in Universities from the Network Public Opinion

Through questionnaire survey, interview and other means, this paper conducted a survey-The Current Situation of Network Culture Security in Universities for students in 7 universities in Wuhan which are operated directly under the Ministry of Education. The questionnaire mainly focuses on the network behavior of university students, the participation and identification of online public opinions, and the management of network culture security in universities. In the survey, 482 questionnaires were sent out and 453 valid questionnaires were collected, with the effective rate of 94.0%.

#### 3.1 Network behavior of university students

Research shows that more than 90% of the students spend more than 2 hours online every day, with 4-6 hours accounting for the largest proportion (35.23%), and 8.94% of the students spend more than 8 hours on the Internet. 79.69% of the students surf the Internet for Browsing WeChat, weibo, etc., with 68.42% for chatting, 65.21% for study and 59.76% for reading news, as shown in Figure 1. 12.28% of the students think that the online information is highly credible, and 55.72% will judge the credibility according to the situation. It can be seen that university students spend a long time online, and trust network information. The Internet has become an important channel for them to obtain information.

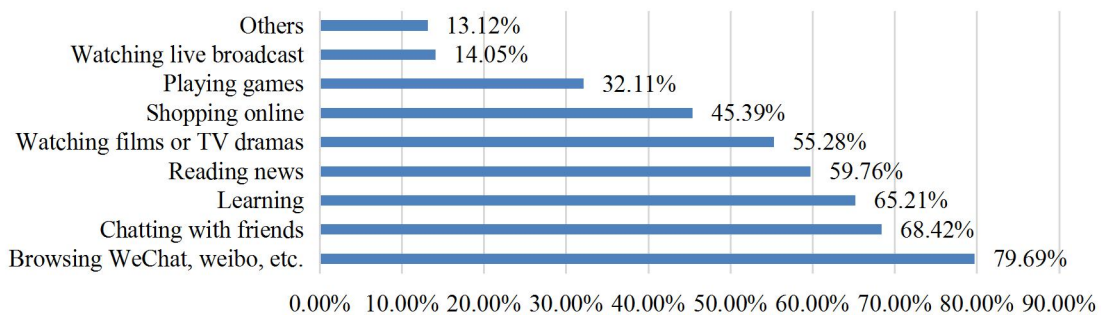
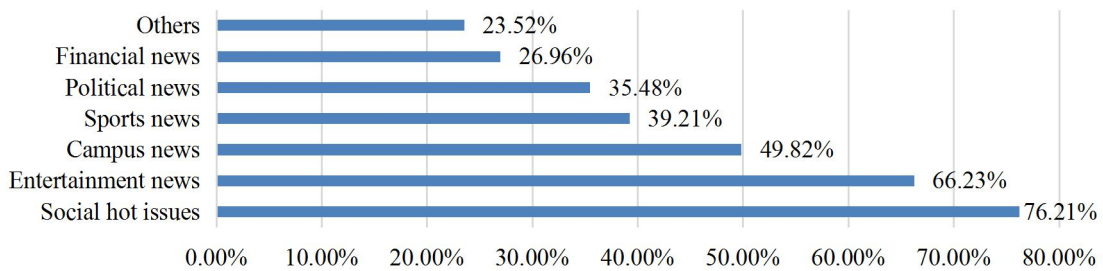


Figure 1 The Things University Students Do Online

#### 3.2 Participation and identification of online public opinions

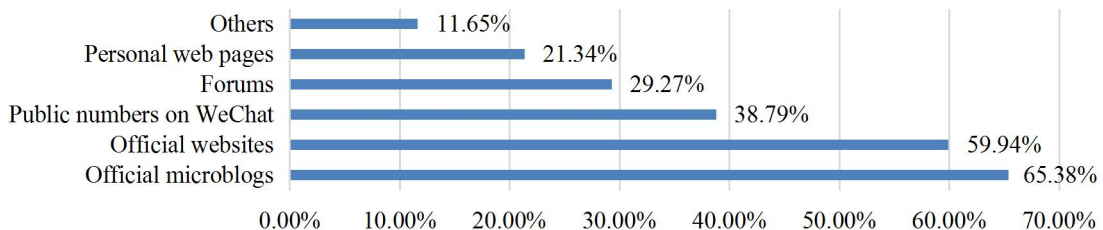
According to the survey, students pay the most attention to social hot issues online, accounting for 76.21%, followed by entertainment events and campus news, accounting for 66.23% and 49.82% respectively, as shown in Figure 2.



**Figure 2 The Internet News University Students Most Concerned About**

As for whether they will reprint or comment on news after reading it, 21.03% of the students say they never do it, 71.96% of them do so occasionally, and 10.01% of them do it often. Regarding the attitude towards social hot issues on the Internet, 17.76% of the students will follow and comment, 78.5% of them occasionally follow but do not comment, and only 3.74% of them neither follow nor comment. 68.22% of the students say they will consider the impact of their own comments when making online comments, but there are still 11.21% say they will never do so, and 20.56% of them say they will not when making anonymous comments. It can be seen that most university students pay attention to public opinions and have their own opinions. Most students generally choose to be onlookers, but some students make comments regardless of the impact.

Facing hot issues, 65.38% of the students choose to believe the information and opinions from official microblogs, followed by that from official websites and public numbers on WeChat, as shown in Figure 3. 79.25% of them think that online public opinions have an impact on their thoughts and behaviors.



**Figure 3 University Students' Trust in Various Sources of Information and Opinions on the Internet**

### 3.3 Management of network culture security in universities

83.28% of the students know their university's new media platforms such as WeChat and weibo, but only 46.94% of the students read them regularly or occasionally. It can be seen that new media public platforms have been set up in universities, but still need to be strengthened.



## **4 Problems and Their Causes of Network Culture Security in Universities from the Network Public Opinion**

On the whole, university students can deal with online public opinions reasonably, and the overall safety of network culture in universities is good, but there are some problems worthy of attention. First, useful information on the Internet coexists with false and harmful information, and university students trust network information and are easily affected. Second, Students express and forward opinions through we-media, which promotes the generation and dissemination of online public opinions. Third, the effective network culture security management still needs to be strengthened. Combined with the survey results, the causes of the problems are analyzed.

Firstly, western countries use the Internet for Cultural infiltration, and university students are the main objects. All along, western forces have been trying to divide and westernize China through cultural infiltration, such as publishing remarks advocating western capitalism and denigrating socialism on BBS, carrying out subtle publicity and edification through QQ group, weibo, WeChat and other new media platforms, or spreading the ideology and culture of capitalism through films, animation, online games. They try to destroy the core value system of socialism in China, so as to eliminate the political identity of university students to the socialist country and the ruling communist party.

The second is the mental immaturity of university students. University students have a strong sense of subjectivity and are willing to express their unique opinions. In addition, they lack social experience, and are easy to make irrational or incorrect judgment, and some even act excessively.

The third is the backwardness of network ideological and political education in universities. Some universities do not take ideological and political education as a job through the whole process of education and teaching. Some universities have conservative ideas, fail to innovate educational methods, and propaganda workers are lack of confidence and ability to control the cyberspace, which makes the network ideological and political education lag behind.

The fourth is the lack of network public opinion management in universities. Some universities do not pay enough attention to the supervision of online public opinion, and lack the awareness and measures of public opinion warning. There is no management system of network public opinion in some universities. The management of network public opinion in most universities is in charge of student affairs office, network center, youth league committee, etc., with unclear division of labor. Some universities fail to introduce advanced network monitoring and information filtering technology, and lack effective network supervision technology.

## **5 Countermeasures of Network Culture Security Management in Universities from Network Public Opinion**

### **5.1 The guiding ideologies of network culture security management in universities**

First, we should take the national policies and social ethics as the guidance to grasp the correct direction of network public opinion guidance. In 2015, Notice of the Department of Ideological and Political Work of the Ministry of Education on Carrying Out the Second Batch of Special Pilot Work of Network Culture Construction in Colleges and Universities pointed out: “in order to further explore the mechanism and path of network culture construction in colleges and universities, promote the network dissemination and promotion of core socialist values, and enhance the targeted effectiveness of network ideological and political education, we should give full play to the educational function of network

culture, and strive to build a number of demonstration bases of network culture construction in colleges and universities.”

Second, we should take the law of network development as the guide and give scientific guidance to network public opinions. The network has its own inherent norms and self-discipline mechanism, which is not enough to maintain the normal operation and development of the network as the network environment has become more and more severe and complex. Therefore, in the process of network culture security management in universities, on the one hand, it is necessary to follow the inherent norms and self-discipline mechanism of the network, guide students to establish the awareness of network self-discipline, and regulate their network behavior consciously; On the other hand, mandatory intervention and legal means should also be used appropriately.

Third, we should take the growth rules of university students as the guide and exert the positive effect of network public opinion. In the network culture security management, students' needs to learn knowledge, broaden their horizons, improve their abilities and abilities in cyberspace should be met. Their opinions can be expressed, their grievances vented and their rights exercised.

### **5.2 The working principles of network culture security management in universities**

The first principle is people-oriented. We should take students as the real subject of education, respect students, understand students, and trust students, but do not blindly listen to students.

The second principle is timeliness. In the face of public opinion events, universities should release effective information in a timely manner, and continuously release the latest situation. It can prevent other malicious information from distorting the facts of the event.

The third principle is openness. We should insist on the initiative, timely and authoritative information disclosure. Especially in the face of public opinion events, information disclosure can enable students to understand the origin of the event, so as to relieve students' extreme emotions.

The fourth principle is objectivity. Universities should ensure the objectivity and authenticity of the information released and establish good credibility of the management department.

The fifth principle is effective guidance. It is necessary to pay close attention to the ideological trends of students, and provide timely information disclosure and ideological guidance.

### **5.3 The management concepts of network culture security management in universities**

Firstly, it should be made clear that the management of network culture security in universities is not to maintain stability, but to promote campus harmony.

Second, it is people, but not information, that play a dominant role in the formation and evolution of network public opinions.

Third, in the face of complex network public opinion, the management of network culture security in universities no doubt lies in the guidance not in the obstruction.

### **5.4 The guarantee mechanisms of network culture security management in universities**

Firstly, rules and regulations need to be improved. The responsibilities of each department need to be clarified. It is necessary to form an accountability mechanism to hold departments and individuals responsible for negative effect.

Secondly, the construction of organization and team needs to be strengthened. In the organizational construction, a vertical system of "university-major-class" and a horizontal system of student organizations and associations are needed. In the construction of team, it is necessary to set up special network culture security management personnel, and form a network culture security management team, including technical experts, leaders, teachers, counselors and students, and constantly train them to improve their working ability.

Thirdly, effective technical guarantees are necessary. Network information technology plays an important role in the security of network culture. Universities should strengthen the investment and construction of software and hardware to advance the science of network culture security management.

### **5.5 The implementation path of network culture security management in universities**

The implementation path of network culture security management in universities includes five aspects: information publishing, transmission, coordination, guidance and supervision.

In the process of information publishing, it is necessary to adhere to the principle of open, transparent, fast and smooth, set up information release agency, and make full use of campus network platform.

In the process of information transmission, it is necessary to quickly collect and analyze the universal, important and influential information among students, and make effective feedback on the basis of comprehensive analysis of the information.

In the process of information coordination, in accordance with the requirements of adhering to responsibilities, integrating resources and reducing costs, the linkage mechanism between departments should be established to ensure close cooperation and coordination among departments.

In the process of information guidance, it is necessary to cultivate "opinion leaders", and establish a long-term mechanism of network public opinion guidance, so as to create a positive network culture atmosphere in universities.

In the process of information supervision, information technology should be used to collect, sort out, evaluate, warn and deal with the network public opinions of universities, so as to realize the supervision of network public opinions of universities and improve the level of network culture security of universities.

## **6 Conclusion**

Based on the investigation of the current situation of network culture security in universities, this paper pointed out the core problems and reasons, and put forward the countermeasures of network culture security management in universities.

The validity and reliability of the countermeasures will continue to be studied, and pilot projects will be done to get broader conclusions and establish a network security management system in universities.

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## Is the Importance of Sustainable Development Goals Universal Across Development Stage of Economies?

Yuko Hayashi<sup>1</sup>, Frans Stel<sup>2</sup>

1 Graduate School of Innovation and Technology Management, Yamaguchi University, Yamaguchi, 755-8611, Japan,

2 Faculty of Behavioural, Management and Social Sciences, University of Twente, the Netherlands.

(E-mail: hayashiy@yamaguchi-u.ac.jp, f.g.stel@utwente.nl)

**Abstract:** In recent years, the importance of sustainable development has increased since the world community endorsed the 2030 Agenda for Sustainable Development and its 17 Sustainable Development Goals (SDGs) designated by the United Nation in 2015. For higher education students who study deeply in specialized fields, it is necessary to consider how their knowledge and academic research can contribute to the sustainable development of society. However, not many such studies have been conducted yet. In this study, we explore an international comparative survey on students' awareness of the SDGs using questionnaires from more than 20 countries from developed countries and emerging economy countries. The study also suggests evidence that some sustainable priorities are universal and there are some inter-country variability. For example, in both developed and emerging countries, items such as climate change, water, and food that are closely related to basic life were given high priority. Our analysis highlights similar patterns of importance of SDGs in emerging and advanced economies. However, the SDGs will be defined and operationalized differently in different countries due to divergent situations of emerging and advanced economies. Therefore, customized approaches are needed to implement the sustainable development goals. In addition, more attention should be given to lowly ranked sustainable items as waste and pollution, availability of resources and inequality of wealth and income. These items are undervalued, but have huge consequences.

**Key words:** SDG; Sustainability; Questionnaire survey; Environment; Student

### 1 Introduction

Since 17 Sustainable Development Goals and 169 targets has been designated in "Transforming Our World: The 2030 Agenda for Sustainable Development"(The United Nations, 2015) , people's sensitivity for sustainability has grown stronger. What has been regarded as a problem in developing countries, such as hunger and poverty, is found out to be closely related to various problems in developed and emerging countries such as excessive production, consumption and environmental destruction(Zhou and Moinuddin, 2017). Therefore, the SDGs cannot be achieved without comprehensive consideration including among whole world. The attitudes of companies, investors and customers are also changing. After the 2008 stock market crash, investors began to focus not only on short-term investments but also on ESG investing that contributes to the global environment in the long term (European Commission, 2012)

. There has been a tendency to increase investment in companies aiming for sustainable development goals. Customers began to realize that their purchasing behavior had an impact on the environment. If Companies sell non-sustainable products and do not care for the environment, customers refrain from purchasing. Therefore, the SDGs can be an incentive for companies to develop sustainable product, process, and service. The United Nations put a priority on the policy "STI (Science, Technology, and Innovation) for SDGs" in order to accelerate to achieve SDGs as a future blue print of the world(IATT, 2018). Without STI, the earth cannot support 9 billion people in the world in 2050. In addition to these industry and government movements, activities for the SDGs are also expanding in the academic and educational fields. In Japan, many schools adopt the concept of SDGs in primary and secondary education.

It is also important for the students in higher education institutions, where the students' specialty would be more narrowed and profound, to consider how the knowledge and skills that students are learning will contribute to the sustainable development goals of society. However, there are few studies on the students' awareness of SDGs. Therefore in this study, we conducted an international comparative survey of awareness of SDGs through websites in more than 20 countries from developed countries and emerging economy countries.

## **2 Analytical Method**

This study is based on the "Agenda for the Future" questionnaire survey asking how cultural, personal, and social values are associated with environmental concerns and we excerpt answers to the priority of sustainable development goals. This paper explores the question: are the priorities of sustainable development goals different from emerging countries to developed countries? How are they different? Sustainable priorities are examined by developed countries and emerging economies.

### **2.1 Survey period**

"Agenda for the Future" questionnaire survey was conducted from 2015 to 2018. The survey is still ongoing to increase the number of countries and students.

### **2.2 Survey method**

We asked the respondents to prioritize these items on their mobile phones or laptops through a short questionnaire using Qualtrics software. By not using paper format, it is considered that there are advantages such as collecting data in one database and analyzing it quickly, or performing it remotely. Questions were conducted in Japan, Brazil, and Indonesia in their native language, and in other countries in English. The reason for the translation is to make the understanding of the question clearer than in English.

### **2.3 Survey targets**

Students from around the world who are enrolled in doctoral, master's, and bachelor courses were targeted. Each survey should include approximately 100 students attending university to secure the same quality of students. We use researchers' networks to find universities to accept the questionnaire survey in their classes so that there is a possibility to have bias to choose targeted universities.

## 2.4 Survey content

The response time was about 15 minutes. All respondents gave explicit consent to involve their opinion in our analysis. In the first section, questions were asked about priorities for sustainable development goals. We asked pre-graduate and graduate university students to assist the World Economic Forum to formulate an Agenda for the Future. We grouped the 17 Sustainable Development Goals of the United Nations into 10 sustainable priorities so that students can recognize to answer easily. The correspondence is shown below (Table 1). For example, as Goal 11: "Sustainable cities and communities" in SDGs is difficult to understand for students, we extracted concise and important idea from Goal 11 and set, "Population: growth & ageing" as an example of priority ranking. However, as each item's concept of "Priority Ranking" and "Sustainable Development Goals" are similar but exactly same, we cannot treat them as completely equal items. Consequently, we should be careful to translate the result of the questionnaire survey to sustainable development goals.

We asked the respondents to prioritize these items sorting descending way by dragging items on through a short questionnaire using Qualtrics software. Incomplete, double, or inconsistent answers have been removed from the analysis.

**Table 1 Sustainable Priorities Derived from UN Sustainable Development Goals**

10 sustainable priorities	...derived from SDG goals
Food: availability & safety	Goal 2: no hunger Goal 3: good health and well-being
Human rights & labor conditions	Goal 4: quality education Goal 5: gender equality
Poverty & income inequality	Goal 1: no poverty Goal 10: reduced inequalities
Population: growth & ageing	Goal 11: sustainable cities and communities
Religiously driven activism	Goal 16: peace and justice
Water: availability & purification	Goal 6: clean water & sanitation Goal 14: life below water
Waste & pollution reduction	Goal 12: responsible consumption & production Goal 15: life on land
Climate change, global warming, Co2 emissions, ozone layer	Goal 13: climate action
Energy: availability & use	Goal 7: affordable and clean energy
Resources usage, availability of raw materials, re-use, recycling	Goal 8: decent work and economic growth Goal 9: industry, innovation and infrastructure

### 3 Results and Discussion

#### 3.1 Simple aggregation

The research took place in the period 2015-2018 in the context of sustainability awareness courses that were then part of their study programs. During this period, a total of 1194 students in 12 datasets participated in questionnaire surveys. Each dataset has approximately 100 bachelor, master, or doctoral courses students from Netherlands, Brazil, Japan, and other countries. In some countries, not all questions are included in all datasets due to time constraints of their programs. After screening of the data, 996 responses could be included in the analysis. Of the respondents, 25.1% was born in the Netherlands, 13.5% in Brazil, 12.0% in India and 10.9% in Japan. These four countries account for 61.5% of the total respondents. The other respondents had 37 nationalities. Developed countries accounted for 52.0% including- Netherlands, Japan, Singapore, Finland, and Germany. Emerging economy countries accounted for 48.0% including Brazil, India, Turkey , Mexico, Nepal, China, and East Europe Countries. Considering that the total number of valid responses was 996, and the Netherlands accounts for a quarter, we conclude that there is a bias, if we take population into consideration. However, we keep on expanding participants from all over the world in order to increase accuracy. In total, 54.2% males and 45.8% females participated in the research. Participants were, on average, 26 years old (average birth year 1993).

#### 3.2 Comparison of between advanced countries and emerging countries

We compared developed countries with emerging countries in ranking priorities for sustainable development goals across the globe as the figures below. Standard Errors, which were used as an indicator of universality of sustainable issues on the horizontal axis , were culcurated from Standard Dviations. On the vertical axis, we used the importance of sustainable priorities. The error bars of a chart shows the 95% Confidence Intervals. A priority border was 5.5 which was middle of the 10 ranking and boader of universality was set on 0.23 which was the average of Standard Errors.

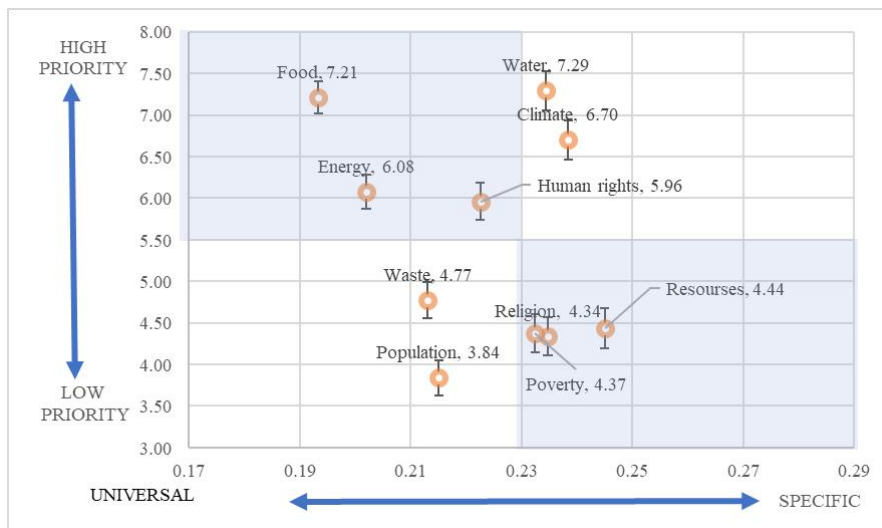


Figure 1 Sustainable Priorities in Advanced Countries



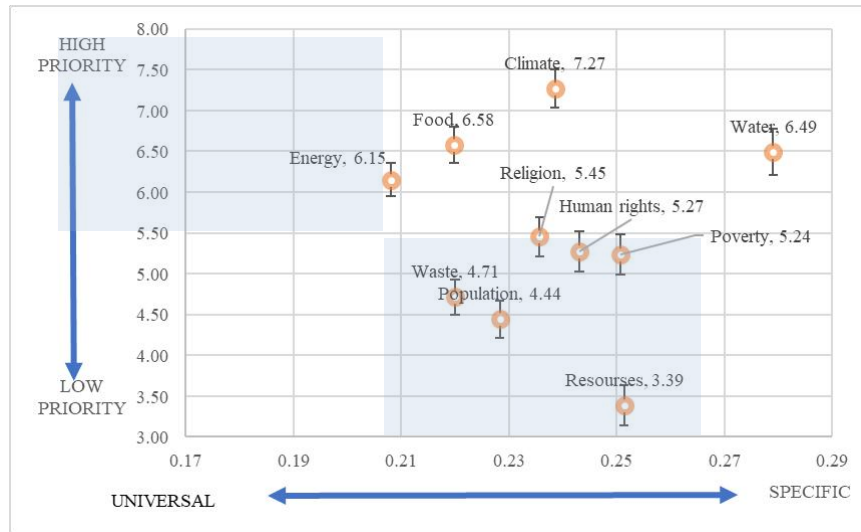


Figure 2 Sustainable Priorities in Emerging Countries

We categorized the rankings in a 2x2 table in which we juxtapose importance (high/low) and universality (high/low), as is summarized in Figure 3.

<p>I. Universal high priorities:</p> <ul style="list-style-type: none"> <li>• food</li> <li>• energy</li> <li>• human rights (in developed economies)</li> </ul>	<p>II. Less-universal high priorities:</p> <ul style="list-style-type: none"> <li>• water</li> <li>• climate change</li> </ul>
<p>III. Universal low priorities:</p> <ul style="list-style-type: none"> <li>• waste</li> <li>• population</li> </ul>	<p>IV. Less-universal low priorities:</p> <ul style="list-style-type: none"> <li>• human rights (in emerging economies)</li> <li>• poverty/ inequality</li> <li>• religion</li> <li>• resources</li> </ul>

Figure 3 Sustainable Priorities Across Advanced and Emerging Countries

In our survey, universal high priorities are food and energy (and partly human rights). In developed countries, water ranked first, food ranked second, and climate change ranked third (Figure 1). The top three in emerging countries, is climate change, food and water (Figure 2). Although the

rankings are different, it can be seen that issues that are directly related to survival are given high priority.

**Food** gets a high priority with low standard errors in both developed countries and emerging countries(Figure 3), which indicates that food is regarded as an important universal goal. The food item involves food availability and food safety. In the whole food chain - from farm, to processing and supermarket- ca. 30 percent of food is wasted(WWF, 2014). A large part of food waste is due to consumer behavior. In addition, in many production chains, food is wasted: by producers, retailers, restaurants, supermarkets and end-users. This is a waste of food money, and energy. Furthermore, it causes additional CO<sup>2</sup> emissions from transport and disposal. According to KPMG research (2014), the food industry would have no profits if they had to pay the full cost of their negative environmental side-effects or externalities, such as pollution, CO<sup>2</sup> emissions. Food prices are a significant issue in developing countries like India and perceptions that growing food prices for people are likely to result in community unrest(KPMG, 2014). In India, not enough food is available, resulting a relatively high prevalence of stunting (low height-for-age) in children under 5 years of age(Sachs et al., 2017). It indicates that there are excessive food in some places and shortage of food in other places. India might have problems not only in food production, but also food supply chains. We conclude that food is an important issue. Consequently, solving food-related problems - e.g. lack of availability, food waste, food security, and improper food distribution – is essential to sustainable development..

**Energy** ranked is ranked high in both developed countries and emerging countries(Figure 1, Figure2). It is recognized as an important issue after three issues that are directly related to survival. Energy consumption is increasing rapidly due to simultaneously increasing population and development levels. World energy-related carbon dioxide emissions are expected to grow dramatically, especially in non-OECD countries, according to the World Energy Outlook of the International Energy Agency. Because of higher global energy demand, energy prices may rise. The necessity to become more energy-efficient and use more alternative and renewable sources of energy will grow.

**Human rights** are moral principles or norms that describe certain standards of human behavior and are regularly protected as natural and legal rights. In 2019, geopolitical tensions and competition have intensified resulting in increasingly politicized discussion about human rights(World Economic Forum, 2019). In advanced economies human rights are prioritized slightly above average, in emerging economies slightly below the average of all ten sustainable priorities.

Less-universal high priorities are water and climate change(Figure 3).

In our survey, water is highly prioritized, although opinions vary. We argue that this variation is caused by differences in access to water in emerging economies in contrast to developed countries, where water availability and sewage is nationwide available. Water is highly related to other goals since water lies at the heart of everything that is important for human life: food, sanitation, energy, production of goods, transport and the biosphere. Water supports human's basic life. Without drinking water, humans cannot live. Safe drinking water, is an essential ingredient to human health. Water is imperative to agricultural food production. Water control is important to protect people's lives and property from floods and typhoons which are related to climate. Lack of water leads to poverty. Water scarcity for many businesses can be a major risk to growth and development(KPMG, 2012). The 2030 Water Resources Group (2010) estimates that the global demand for freshwater will exceed supply by 40 percent by 2030 assuming average economic. In terms of waste, sewage problems in toilets and household wastewater becoming more important, and water pollution problems that are also affected

by industrial waste lead to increased human health problems as well.

Climate change is important, although the priority is varying in our survey. Climate change is the source of many high impact/high likelihood risks, as defined in the World Risk reports of 2018 and 2019: due to climate change, several high impact / high probability events may occur: extreme weather, natural disasters, water and food crises, and ultimately interstate conflicts or weapons of mass destruction (Figure 6)(World Economic Forum, 2018a). Therefore, further education of consequences of climate change is relevant. Climate ranks first priority in emerging countries and ranks third priority and second lowest standard error in developed countries. Emerging countries may have more direct and serious damage than developed countries because they lack the resilience, strength, and flexibility to protect from natural disasters.

In the universal low priorities quadrant, issues of waste and population are considered (Figure 3).

**Waste** gets a universally low priority (Figure 1,2). In emerging countries, it can be fully expected that waste will increase along with economic growth, therefore, it is desirable to take measures in advance. Waste problems can cause biodiversity loss and ecosystem collapse, a high impact / high probability risk (Figure 5). For instance, micro-plastics has become a major social problem which has been detected in the human body and the EU has issued a ban on them. Plastic garbage in ocean leads to micro plastics in food chains and yet unanticipated health risks.

Although **Population** ranks 9th in emerging countries, population explosion affects immensely the levels of consumption: a growing population leads to growing consumption and larger ecological footprint and excessive non-sustainable use of natural resources. Especially in Africa and parts of Asia (India), population growth is estimated. India has 1.39 billion population representing 18 per cent of the world's population and is the second most populous country after China (1.44 billion). United Nation report said that around 2027, India is projected to overtake China as the world's most populous country, while China's population is projected to decrease by 31.4 million, or around 2.2 per cent, between 2019 and 2050(United Nations, 2019). A growing population in an area suffering from climate change, more extreme weather conditions and resource scarcity, will lead to large-scale involuntary migration and subsequent interstate conflicts.

At the same time, a shrinking population may cause economic problems. Population ranks the last priority in developed countries, but aging society becomes serious problem in near future. As is illustrated in Figure 4, in developed countries in 2035 one fourth of the population are aged above 65 years. Japan, as a front runner, has problems with the declining birth rate and aging population which mainly causes a shrinking of total labor force, increase in social welfare expenses and shortages in welfare-related care jobs. The huge population of China is more rapidly aging than other countries. The working proportion of the population is known as the 'dependency ratio'. This ratio is one of the indicators of sustainable development as defined by the World Economic Forum(World Economic Forum, 2019). A lower dependency ratio jeopardizes future economic growth. Some economic structural reform should be needed to keep the aging society.

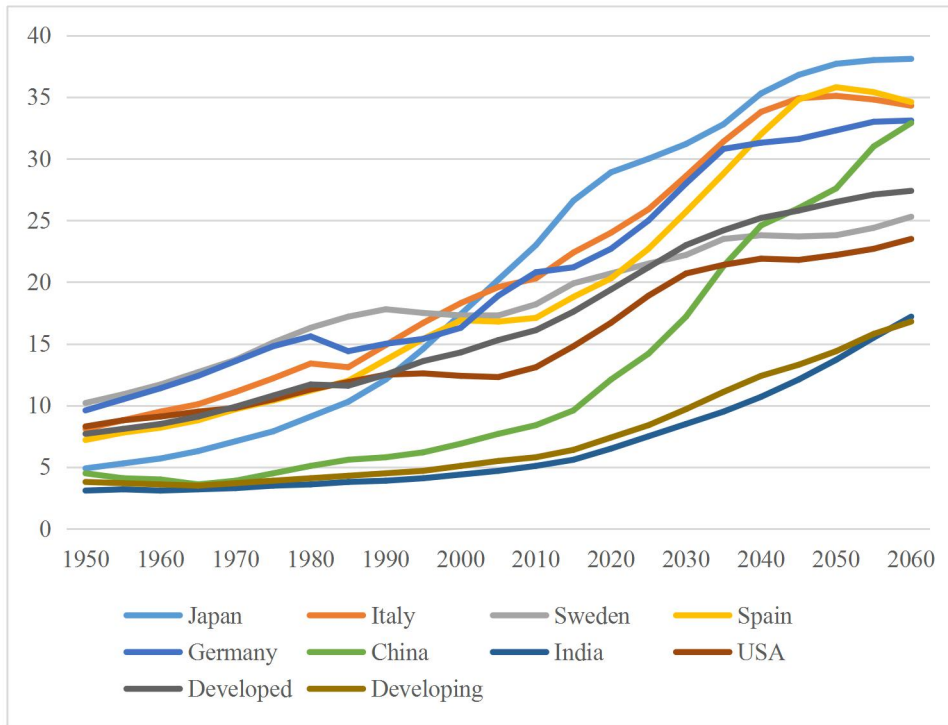


Figure 4 World Aging Rate (population >65 years of age)

Source: UN World Population Prospects, 2015

In the less-universal low priorities quadrant, the items of poverty/ inequality, human rights (emerging economies), resources and religiously driven terrorism are mentioned (Figure3).

**Poverty/ inequality** gets low priority (Figure1,2). Income inequality and poverty is becoming a growing problem in many advanced economies, while in most emerging economies these issues have improved although their absolute levels of inequality and poverty remain much higher in emerging economies(World Economic Forum, 2018a). In both, advanced and emerging economies, wealth is significantly more unequally distributed than income. Wealth inequality is rising in many economies. Poverty and inequality are sources of sustainable risks because they lead to social instability and consequently the risk large-scale involuntary migration, terrorist attacks and man-made environmental disasters (e.g. burning tropical forests). In addition, large-scale involuntary migration may lead to interstate conflicts. In Figure 5, we visualize these trends, based on the assessment of the World Risk Report 2019 of the World Economic Forum.(World Economic Forum, 2019)

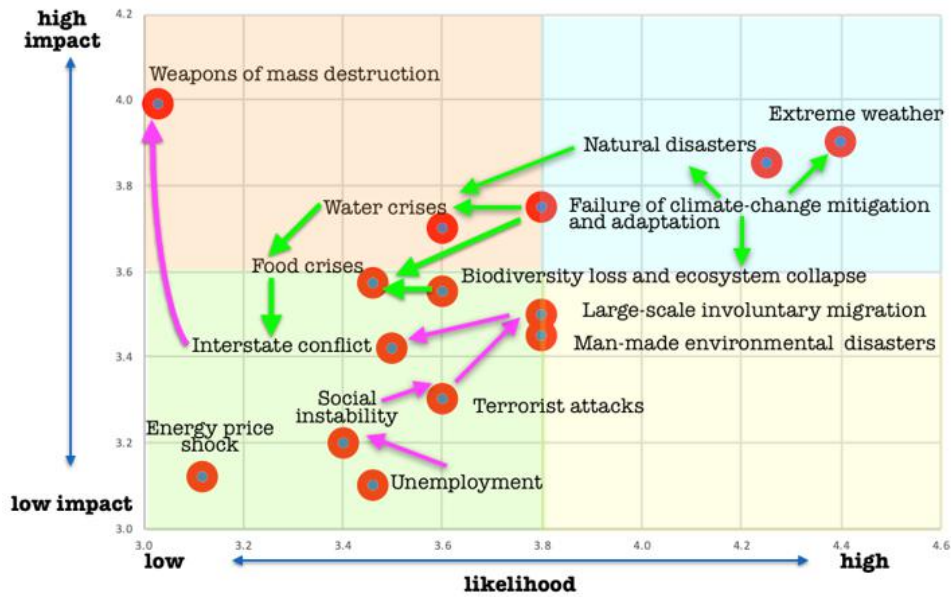


Figure 5 Global Risk Trends and Their Likelihood Related to One Another

The availability of resources get a low priority: still much more resources are used than is available in the long term. According to KPMG (2012), resource shortages can be expected (KPMG, 2012). Because the resources on which businesses rely will become more difficult to access, they will tend to become costlier (World Economic Forum, 2018b). Resource use has grown faster than the population. Shortages of a number of key resources are becoming more and more apparent, from arable land, fresh water and metals to fossil fuels. Companies, consumers and governments, need to prepare themselves for a world where raw materials may be in short supply and subject to price volatility, higher prices and potential disruption to supplies. For example, marine fish stocks face the risk to become over-exploited, especially in Asia. Growing soil erosion might lead to reduced agricultural or biofuel productivity. There are also concerns about supplies of fertilizing minerals such as potassium and phosphorous and rare-earth minerals such as neodymium, yttrium and cerium (KPMG, 2012).

**Religiously driven terrorism** or activism is lowly prioritized (Figure 1, 2). This is in accordance with the global risk report 2019 (World Economic Forum, 2019): terrorist attacks are rated with a below average likelihood and impact. Terrorist attacks are related to social instability and state collapse. In turn, social instability is related to unemployment or underemployment, poverty and income inequality.

#### 4 Conclusion

In this study, we made a comparative study of sustainable priorities in various emerging and advanced countries. In both type of societies climate change, water, food and energy are highly prioritized while items of waste and pollution reduction, population, income inequality and availability of resources get less emphasis. Although relative priorities are comparable in different countries, the

interpretation differentiate between countries, e.g. in some countries availability of water might prevail, while in other countries the purification, avoiding excessive levels of water, or water treatment and sewage issues might be more relevant.

Due to the fact that in developed countries and emerging countries similar items are prioritized, we conclude that a sense of urgency of a climate change, water, food and energy issues is shared around the globe. A common awareness is important in order to have sufficient inclination to collaborate globally in order to solve sustainable problems related to these issues.

Both in emerging and advanced societies, issues related to waste and pollution reduction, population, income inequality and availability of resources are relatively lowly rated. Still, these issues have huge consequences and related to global risks. Waste is related to resource availability, biodiversity, food-security, clean water and air. Population is related to consumption, ecological footprint, carbon dioxide emissions, but also to sustainable growth. Income inequality and poverty are related to social instability and consequently the risk large-scale involuntary migration, terrorist attacks and man-made environmental disasters (e.g. burning tropical forests). The availability of resources is associated with biodiversity, interstate conflicts, large-scale involuntary migration. Because of these consequences, more attention should be given to education of the widespread effects of these low prioritized items.

This study is not without limitations. First, our study used self-assessment methods. These self-reports might differ from actual behaviors in real negotiations (Ajzen, 1991). Subsequent research using actual behavior would provide for a more realistic understanding of prioritizing sustainable behavior compared to self-report. Second, we only asked students to respond. Increasing our database to a wider sample of population would provide a better understanding of sustainable priorities. Third, an increase of sample size to more cultures will increase the statistical power of our conclusions.

We suggest three avenues for further research: to include demographic variables, personality characteristics, and social attitudes in the analysis of sustainable priorities. First, age and gender might be of impact to the selection of sustainable priorities. Second, personality characteristics as honesty and agreeability might influence the priorities. Third, social attitudes as the Social Dominance Orientation might be of importance to assessment of sustainable items.

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## Cash Crop Innovation System and Networks: Findings from Smallholder Cocoa Farmers in Ghana

Patience Pokuaa Gambrah, Yu Qian

School of Economics, Wuhan University of Technology, Wuhan, P.R.China, 430070

(E-mail: [patiencegambrah@yahoo.com](mailto:patiencegambrah@yahoo.com), [yuqian@whut.edu.cn](mailto:yuqian@whut.edu.cn))

**Abstract:** This paper uses household and informant survey data from Ghana to: understand the managerial structures that influence change in cocoa production systems. We examined how innovation system networks are operating in the smallholder cocoa production and also identify interventions for strengthening innovation capacity. Results obtained from the study shows that, public sector actors are the major players in the cocoa production system and they also play a major role in marketing linkages. We also find out that the private sector actors also play certain key functions in the network. Again it was observed that, there exist differences in the innovative (IG) and non-innovative (NG) networks, with IG showing larger access to inputs, production, information, credits and markets. We also found out that, vital institutions which could build up the stakeholders' capability to identify, implement and acclimatise sustainable practices were not involved in the processes. We therefore, recommend for a policy reform of the current cash crop system to find solutions to the institutional and policy matters that restrain current cash crop innovation system.

**Key words:** Innovation capacity; Social network analysis; Cocoa production system; Institutional settings

### 1 Introduction

Agriculture is considered as the most central part to African economic development (John W. McArthur and Jeffrey David Sachs, 2019), but its sustainable development faces a lot of setbacks. Inadequate innovation capacity (CalestousJuma, 2011), low productivity (United Nations Development Program, 2012), dwindling natural resources and climate change (Thomas S. Jayne, et al 2010) have all made agricultural development not realise its full potential (United Nations Development Program, 2012).

Similarly, in Ghana the agriculture sector is characterised as experiencing sluggish rate of technological change (World Bank, 2017) and the slow emergence of alternative official and structural arrangements to boost growth and development. This means that diffusion of new knowledge in agricultural technologies only is not sufficient to deal with the above-mentioned challenges. Instead, it is imperative to understand the range of actors and ways of improving their capacity and thus follow fresh agricultural innovation systems of importance. We begin by rethinking cocoa production as part of a bigger dynamic system of cash crop innovation. The background we are using for our analysis is innovation systems method which permits us to explore the capability to innovate. The idea of innovation systems by (Andy Hall et al, 2001) and (Norman Clark, 2002) offers an alternative structure to the linear technology diffusion model. We concentration on innovation capacity (Andy Hall, 2009) other than on the diffusion of innovation (Everett M. Rogers, 1983). Innovation capacity emphasises on policy and development mediations that put together knowledge and information so as to support an unceasing process of innovation. Innovation is defined as the technique for creating, retrieving and using knowledge and information to generate new products, processes, services, and many others, which fulfils social and economic goals (Andy Hall et al, 2001). The problem is partly concerned with developing new knowledge, but it is also about the capability to activate available knowledge, and how to use this knowledge. This moves the importance from technology and agricultural techniques to networks, linkages and institutional settings that allows the assimilation of different knowledge bases, and enable the alteration of recommended technologies to meet the necessities of the local context.

The innovation system idea is offered as a basis for examining the idea of innovation capacity. World Bank (2006a) offers the four-theme analytical framework to examine agricultural innovation capacity. Which includes: Actors; Attitudes and Practices of the main actors; Pattern of interaction; and Enabling environment. In the smallholder farmers' network, actors are private firms or government institutions which help in the whole production process. The various institutions, which shape how these actors interact and learn cannot be ignored, as they set the rules of engagement (Douglass C. North, 1990).

SNA is a very useful tool for investigating social structures. As a tool which can be applied in



many fields, we examine, in particular, its effect in the innovation system. It is important in understanding innovation systems because of its analytical emphasis on relationships and interactions within social structures, and its ability to use knowledge flows and other traits contained within such interactions (David J. Spielman et al, 2009). This paper examines how cocoa smallholders innovate; how their social networks contribute to innovation processes; and how those decisions, networks, and processes are influenced by policy and market-driven factors in Ghana as a case study.

The paper is structured as follows: the next section describes the methodology used, emphasizing on the study area, the data collection process and the social network analysis (SNA) methods used. Then we present the results and discussion in the following section and conclude the paper in the last section.

## 2 Data and Methodology

The SNA of smallholder cocoa farmers involved both quantitative and qualitative data and a combination of different approaches.

### 2.1 Study area

This study was conducted in two Locations, one in the SefwiWiawso Municipality in the Western North Region and the other in the Asutifi North District in the Ahafo Region all in Ghana. The study focused on innovations that were introduced by the Ghana government/COCOBOD over 10 years (2007-2017). During this period the government was involved in implementing an integrated cocoa development program via packages of mass spraying, improved seedlings, fertilizer distribution, marketing and capacity building at the local level which has produced hopeful livelihood improvement results. The data collection was conducted in eight villages, four from each of the two Locations. Households were selected through a stepwise process. A systematic random sampling was employed to select households from each village. Accordingly, a total of 144 households were selected from the two Locations in the eight enumeration sites for household survey. Households for additional study in the focus group discussions (FGD) was selected from each location based on a rough table created from the household survey data. The four homes with the maximum scores and the four homes with the minimum scores was selected for distinct focus group interviews and were denoted as innovative group(IG) or non-innovative group(NG), respectively. As shown in Table 1, these groups statistically differed, with IG exhibiting higher mean values. This allowed us to recognize groups that, according to the survey data, were generally supporting the various innovations.

**Table 1 Descriptive Statistics for Focus Group Participants**

Attributes	Mean(IG)	SD(IG)	Mean(NG)	SD(NG)	Standard error	p-value
Mean family size (no.)	9.95	2.31	8.23	1.13	0.4560	0.0004
Mean age (years)	49.32	8.70	48.7	9.60	2.2900	0.7875
Mean education(years)	4.38	2.35	3.45	1.50	0.4930	0.0638
Mean land ownership size(ha)	10.85	1.71	10.48	1.40	0.3910	0.3473
Mean cocoa trees(no.)	100	2.20	99.4	1.88	0.5120	0.5170
Mean land size allocated for production	9.20	1.25	9.12	1.22	0.309	0.7964
Mean land size allocated private production	5.33	2.31	5.21	1.21	0.462	0.7958

Subsequent from the FGD interviews at each site, another semi-structured dialogs was done with key actors found within the FGD partakers and an institutional ranking exercise was also done. The data obtained was then used to conduct our social network analysis of each site.

## 3 Data Analysis

Based on the available data obtained from farmers and other players, we built network matrices for the data. These matrices were the basis for our social network analysis. After importing the network matrices as a table into UCINET (Stephen P Borgatti et al, 2002), we then analyzed our data.

## 4 Results and Discussion

We performed a network analysis of innovation actors in the smallholder cocoa production system, and examined the central players, the underlying collaborative relationships and its implication.

**4.1 The actors in cocoa production innovation system**

We identified various actors in the system and they were made up people including a range of public, private and civil society organizations. There were a total of 25 actors with a web of 369 ties taking part in the innovation systems network (Figure1). The density, which is an indicator for the level of connectedness of a network for the innovators network, was 0.615, i.e. about 61.5% of all possible direct linkages are present. Furthermore, the degree of centralization of the whole network is low (0.418), showing that only 41.8% of the links were reciprocated. Thus, this indicates that actors are not well connected. Which means that, there is a possibility to increase the interconnections between actors in this network, which could help in improving the productivity of the cocoa sector.

**4.2 Role of public service providers in linkage facilities**

It was found that the public sectors play a central role in the cocoa production innovation system. The measures of centrality that was used to examine the centrality of the actors in the network from Figure 1 and Table 2 reveals four main institutions which play a key role in the smallholder innovation process. By their order of degree centrality, we have: CBC, NGO, FCA and LFA. They are all private service providers which are closely connected with smallholder households and they operate around an intertwined network of agencies.

**Table 2 Measures of Centrality of Actors in the Network**

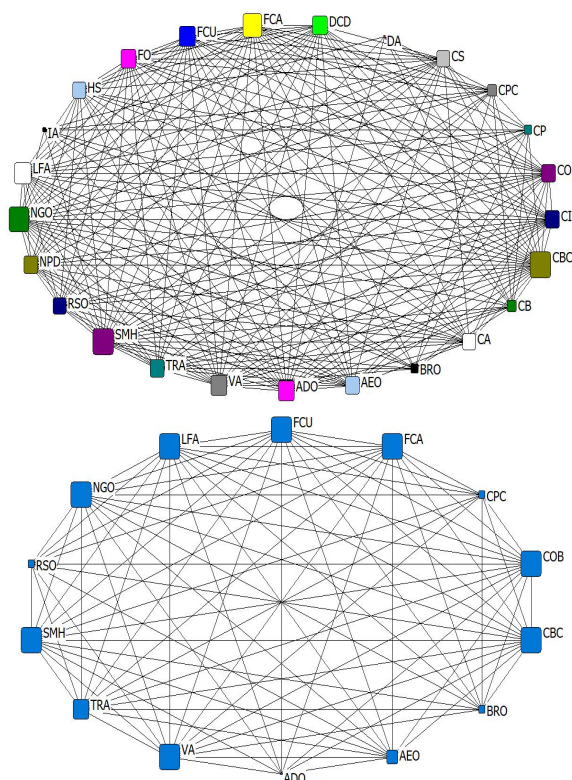
Actors	N Degree	NOut-degree	NIn-degree	N Closeness	Normalized Betweenness
Smallholders(SMH)	1	0.583	1.000	1.000	0.049
Inspection activity(IA)	0.375	0.292	0.250	0.615	0.002
Disinfestation Activities (DA)	0.292	0.208	0.208	0.585	0.000
Cocoa Beans (CB)	0.583	0.458	0.542	0.703	0.012
Cocoa Products (CP)	0.500	0.500	0.167	0.667	0.006
Hybrid Seed Pods (HS)	0.708	0.583	0.667	0.774	0.000
Cocoa Seedlings (CS)	0.708	0.583	0.583	0.774	0.000
CODAPEC & Hi-Tech					
Cocoa Disease and Pest Control(CODAPEC) (COD)	0.75	0.708	0.500	0.800	0.004
Field Operations (FO)	0.792	0.708	0.792	0.828	0.005
Cocoa Agronomy (CA)	0.708	0.667	0.500	0.774	0.001
Cocoa Development/ Improvement (CI)	0.750	0.667	0.542	0.800	0.001
Capsid, Black Pod and CSSVD Control (DCD)	0.792	0.708	0.625	0.828	0.005
New Products Development (NPD)	0.750	0.625	0.708	0.800	0.001
Farmers' cooperative union(FCA)	0.917	0.833	0.917	0.923	0.021
Farmers credit union (FCU)	0.833	0.833	0.250	0.857	0.010
Cocoa Buying Companies (CBC)	1.000	1.000	1.000	1.000	0.049
NGO	0.958	0.875	0.833	0.960	0.032
Religious social organization (RSO)	0.708	0.458	0.708	0.774	0.001
Brokers (BRO)	0.500	0.417	0.375	0.667	0.004
Traders (TRA)	0.750	0.542	0.625	0.800	0.013
Local Farmers' Association(LFA)	0.875	0.583	0.875	0.889	0.017
Village Administration(VA)	0.833	0.708	0.750	0.857	0.013
Zonal/district agriculture office (ADO)	0.833	0.667	0.792	0.857	0.032
Agriculture extension officers(AEO)	0.750	0.708	0.750	0.800	0.001
Cocoa processing companies (CPC)	0.583	0.458	0.417	0.706	0.012

Nevertheless, a high level of accessibility does not automatically show good-quality service. This suggests that there are still chances of improving the services of these actors.

**Table 3 Role of Public Sector Actor**

Attributes	N Degree	N Out-degree	N In-degree	N Closeness	Normalized Betweenness
Smallholders (SMH)	1.000	0.846	1.000	1.000	0.012
COCOBOD(COB)	1.000	0.923	1.000	1.000	0.012
Farmers' cooperative union(FCA)	1.000	1.000	1.000	1.000	0.012
Farmers credit union(FCU)	1.000	1.000	0.462	1.000	0.012
Cocoa Buying Companies (CBC)	1.000	1.000	1.000	1.000	0.012
NGO	1.000	0.923	0.846	1.000	0.012

Religious social organization (RSO)	0.769	0.615	0.769	0.813	0.000
Brokers (BRO)	0.769	0.692	0.538	0.813	0.000
Traders (TRA)	0.923	0.769	0.769	0.929	0.006
Local Farmers' Association(LFA)	1.000	0.692	1.000	1.000	0.012
Village Administration(VA)	1.000	1.000	0.923	1.000	0.012
Zonal/district agriculture office (ADO)	0.692	0.615	0.615	0.765	0.000
Agriculture extension officers(AEO)	0.846	0.769	0.846	0.867	0.003
Cocoa processing companies (CPC)	0.769	0.538	0.615	0.813	0.000



**Figure 1 SMH Cocoa Farmers Network**

**Figure 2 Role of Main Public Sector Actor**

(Note: The size of each node is determined by the node's degree centrality. Please refer Table 2 for the abbreviations)

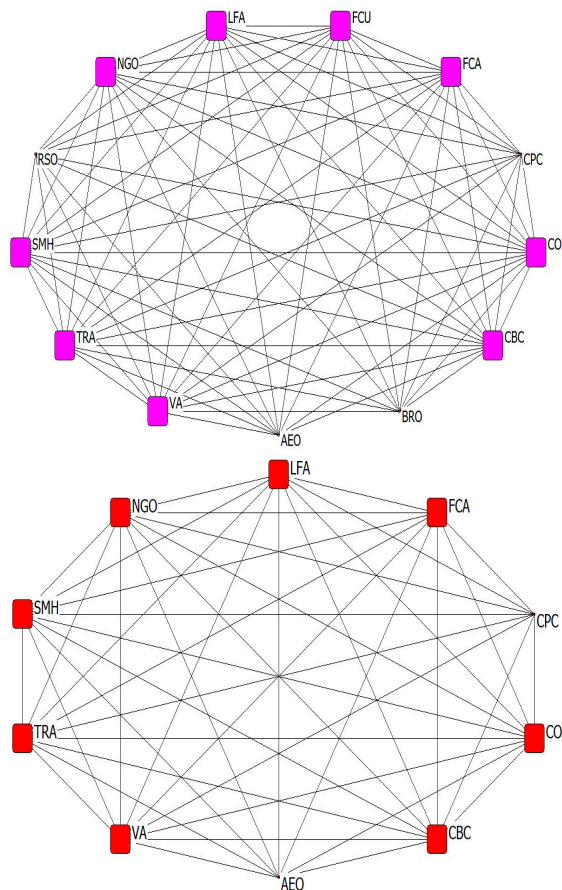
From Table 3 and Figure 2, it is evident that, COCOBOD is a key actor when it comes to the innovation system of smallholder cocoa farmers. They serve as a link between government, the private sector, and the farmers to bring the best out of Ghana's cocoa. They deal less when it comes to buying the beans directly from the smallholder farmers. The marketing actors which are dominantly private sector actors like CBC, FCA and traders, have some sort of high connection (Figure 2). In spite of the lack of isolated actors (Figure 1 and 2), some of the actors are not widely involved in relationships with all the other actors but have an outlying position within the network, who are typically private sector actors. This has revealed a strong case that, the interventions and innovations employed by the government is yielding positive results, but there is still opportunity to allow the entry and input of private sector actors. This means that, in addition to the formation of enabling rules, laws and regulatory environment for private service delivery and public support for private sector growth is important.

#### 4.3 Differences between innovators and non-innovators

Figure 3 and 4 provide a generalized overview of the typical networks for IG and NG based on aggregated data from eight case study sites.

**Table 4 Descriptive Measures for IG and NG**

Measure	Innovative Group	Non innovative group
Ego network size (no. of nodes)	13	10
Ego network density	0.846	0.922
Asymmetric	0.205	0.111
Standard deviation	0.361	0.268
Average degree	10.154	8.300
Degree centralization	0.182	0.097



**Figure 3 Innovators Network Node Degree**

**Figure 4 Generalised Networks for Non-Innovators**

(Note: The size of each node is determined by the node's degree centrality. Please refer Table 2 for the abbreviations)

The innovators network has 13 actors and the NG network has 10. Innovators have more members in their network than non-innovators: this means innovators have comparatively bigger access to formal and informal information, inputs, credit and markets than NG who depend more on public service and public institutions (Figures 3 and 4 and Table 3).

The study showed that the smallholder cocoa production innovation network does not include Universities, seedlings associations, R&D private and NGO cocoa advisory service providers and agro industries. The connections between the Private sector actors which includes traders, brokers, input suppliers, and companies are weak (Figure 1).

A study done by (Tilman Altenburg et al, 2008) revealed that, innovative capacity in a sector depends on the quality and density of collaborative connections between actors. These include public and private outfits which carry out research, train, advice, finance, coordinate and regulate. It is, therefore, vital for an innovative network to encompass all direct and indirect actors from the point of production to the point of consumption of the cocoa products either as recipients of support or as lending support and service to ensure program success.

## 5 Conclusion

Our findings propose that, the possibility of innovation system is not yet fully realised. Innovations follow a linear path of supply-driven technology dissemination through the public sector. Hence, additional deliberations are required. Effort to boost farmers to produce the secondary part of the cocoa instead of selling the primary beans should also be encouraged in order for farmers to earn more from their produce. Again to encourage innovation, the public sector can support interactions, joint actions, and wider public private partnership programs. This study also opens a wide door for further study on the role of different networks in the cocoa sector and the impacts of different networks on productivity and adoption of innovations of the cash crop sector both at local and national level.

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## Application of Entropy Based TOPSIS in Analysis of Sustainability Performance of Sri Lankan Hotels

PR Weerathunga<sup>1\*,3</sup>, Cheng Xiaofang<sup>2</sup>, WHMS Samarathunga<sup>3,4</sup>, KMMCB Kulathunga<sup>2</sup>

1\* School of Management, Wuhan University of Technology, Wuhan, P.R. China, 430070

2 School of Management, Wuhan University of Technology, Wuhan, P.R. China, 430070

3 Faculty of Management Studies, Rajarata University of Sri Lanka, Mihintale, Sri Lanka

4 School of Tourism, Sichuan University, Chengdu, P.R. China;

(E-mail: weerathungaroshan@gmail.com\*, cxf2010611@163.com, maduranga99a@gmail.com, manoj.susl@gmail.com)

**Abstract:** Sustainability is the limelight of many industries, especially in developing countries. In the hospitality industry, in particular, sustainability plays a pivotal role since it contributes immensely to the economy of a country. However, the hospitality industry is increasingly facing various challenges due to the uncertainty and instability in the business environment. Thus, the central focus of this study is to evaluate the sustainability performance of Sri Lankan hotels industry. For this purpose, 25 hotels were selected from the hotels listed in the Colombo Stock Exchange (CSE). In order to determine the sustainability performance of the selected hotel, we identified 18 indicators that represent the economic, environmental, and social and governance sustainability. Then, we developed a multidimensional sustainability performance index system and using entropy-based TOPSIS, the values of the individual indicators were aggregated. Eventually, we rank the hotels based on the TOPSIS scores, which represent the sustainability performance of hotels. The resulted TOPSIS scores reveal that the Sri Lanka hotels' sustainable performance is moderately high. This indicates that there is a growing tendency to adopt more sustainable practices among hotels companies in Sri Lanka. Recently, stakeholders in the state and private sector have paid much attention to the tourism industry because it has tremendous potential and many prospects, and the same is reflected in our results. While we are providing important implications for managers and policymakers, our findings urge the hotels with a low-level sustainability performance to go for more sustainable practices.

**Keywords:** Sustainability performance; Hotel industry; Entropy-based TOPSIS; Sri Lanka

### 1 Introduction

Despite the recent downturn, the tourism industry is the most vibrant and robust sector in the Sri Lankan economy, with the exponential growth in the number of visitors arriving and the burgeoning foreign exchange earnings. A satisfactory political and economic stability maintained in the nation after the end of the tragic war of 30 years in 2009, combined with the increasing reputation of the Island as a popular tourist destination, has caused the growth of the tourism industry at a pace never achieved in history (Jayawardhana, Silva, & Athauda, 2015; Kularatne, Wilson, Månsson, Hoang, & Lee, 2019). Over the past decade, the hotel sector has also shown significant growth as an integral of the tourism industry in terms of infrastructure development and level of sophistication. SLTDA report (2017) shows that the number of Tourist Hotels has increased from 245 in 2008 to 401 in 2017. Similarly, No. of rooms has also been tripled during the last decade. Apart from the tourist hotels, the other supplementary establishments which provide the accommodation facility have also increased from 513 units in 2008 to 1693 units in 2017. However, because of high capital investments and increased competition, corporate hotels are more inclined to make profits than to be more socially responsible. Nevertheless, corporate hotels' obligation goes beyond merely creating profit to take care of their employees, the environment, and the society at large.

At the global level, with the realization of the increasing importance of corporate social responsibility, a growing number of hotels companies have moved towards a value-based stakeholder management approach. Such approach enables the managers to maximize the economic value for all stakeholders- shareholders, employees, creditors, suppliers, customers, and society as a whole- by building a strong coalition of all interest groups surrounding the company (Wagner & Svensson, 2014). Moreover, the natural and socio-cultural environment being an important aspect of the tourist destination, hotels can gain a competitive advantage by displaying their accountability towards the

social and environmental impact of their operations. (Assaf, Josiassen, & Cvelbar, 2012; Cvelbar & Dwyer, 2013; Wagner & Svensson, 2014). Therefore, sustainability performance for the hotel industry is increasingly important.

Given the great emphasis on sustainability performance, the main purpose of our study is to empirically analyse the sustainability performance of Sri Lankan corporate hotel sector. For this purpose, listed hotel companies were selected, and the required data was obtained from annual reports and websites. Sustainability performance of each hotel was determined using the author developed a multidimensional evaluation index. Finally, Hotels are ranked based on the sustainable performance score obtained using one of the popular Multi- Criteria Decision-Making approaches (MCDM): Technique for Order Preference by Similarity Ideal Solution (TOPSIS).

## 2 Evaluation of Sustainability Performance

### 2.1 Development of sustainability performance evaluation Index

The crucial stage in developing the Sustainable Performance Evaluation Index is to identify appropriate indicators. Since the company's sustainability performance consists of three dimensions, namely Economic, social and governance, and environmental, the indicators should be drawn to cover all the aspects. Following a comprehensive analysis of sustainability literature and experts' opinion, we recognized eighteen indicators, as shown in Table 1. Moreover, these indicators were divided into two groups as positive contributors and negative contributors. Furthermore, the values for the indicators were determined based on the information disclosed in the annual reports and the official web sites of hotel companies.

**Table 1 Sustainability performance Evaluation Indicators**

Dimension	Indicator	Description	Measurement	Contribution
Economic Sustainability	C1	Five years' Revenue Growth	$(\text{Revenue}_t - \text{Revenue}_{t-5}) / \text{Revenue}_{t-5}$	Positive
	C2	Market Share	Hotel's Revenue / Industry Revenue	Positive
	C3	Operational cost to total assets	Cost / Total Assets	Negative
	C4	Amount of donations and charitable contribution to the total revenue	Donation / Total Assets	Positive
	C5	Benefits provided to employees out of Income earned	Staff Cost / Total Assets	Positive
	C6	Number of social initiatives to uplift the living condition of local community		Positive
	C7	Number of Initiatives to promote education, health, culture etc.		Positive
	C8	Number of initiatives to ensure guests' privacy, health & safety, and foods safety		Positive
	C9	Analysis of employees based on gender, age, and region and number of initiatives to increase employee welfare (i.e., occupational health, training & education, evaluation, promotion, and recognition & rewards)	Seven Assessment Levels on a 1 to 7 Scale, where 1 is the lowest and 7 is the highest	Positive
Social and Governance Sustainability	C10	Number of initiatives taken and discussion of supply chain management		Positive
	C11	Awards and certification in recognition of the social contribution of the hotel	1 score for each award and certification	Positive
	C12	Number of committees related to governance	1 score for each committee	Positive
	C13	Number of board of directors'	1 score for each board	Positive

Environmental Sustainability	C14	meetings held during the year Gender diversity in the director board	meeting Ratio of female to male directors	
	C15	Method adopted to reduce energy and water consumption, greenhouse gas emission and initiative to preserve natural resources	Seven Assessment Levels on a 1 to 7 Scale, where 1 is the lowest and 7 is the highest	Positive
	C16	Methods and processes adopted to reuse, recycle effluents and waste.		Positive
	C17	Awards and certification in recognition of environmentally friendly operations.	1 score for each award and certification	
Other	C18	Level of non-compliance to Law and regulation related social, economic and environmental areas	Five Assessment Levels on a 1 to 5 Scale, where 1 is the lowest and 5 is the highest	Negative

## 2.2 Sustainability performance Score

Use of Multiple Criteria Decision Making (MCDM) methods-for instance, Analytical Hierarchy Process (AHP) Data Envelopment Analysis (DEA) Technique for Order Performance Similarity to Ideal Solution (TOPSIS) is common in the literature on performance assessment. Hsu (2013) used the TOPSIS technique to suggest an investment analysis model based on different financial ratios. Initially, he selected 21 indicators as economic measurement factors and lowered them using dimension reduction methodology to ten most representative factors. Similarly, Deng, Yeh, & Willis (2000), Wang (2009), Seçme et al. (2009) used the TOPSIS technique to assess financial and non-financial performance. Number of other researches also used TOPSIS as an MCDM strategy to evaluate and rank financial and non-financial performance of various industries (Bulgurcu, 2013; Chang, Lin, Lin, & Chiang, 2010; Ertuğrul & Karakaşoğlu, 2009; Kaynak, Altuntas, & Dereli, 2017; Kumar, 2016; Weerathunga, Xiaofan, & Samarathunga, 2019). In light of the previous studies, the sustainability performance of hotels was evaluated using the TOPSIS method developed by (Hwang & Yoon, 1981). This method is used for four reasons. First, the logic behind TOPSIS is rational and easily understandable, second the calculation process is straightforward, third TOPSIS allows us to determine the best alternative based on a number of criteria using a simple mathematical process and fourth each criterion can be weighted based on different rationales.

The application of the TOPSIS method need to determine appropriate weights for each criterion considered in sustainable performance evolution process. For this purpose, Entropy method as proposed by Shannon (1948) was used. Entropy method is one of the most popular methods for determining weights for indicators (Hsu, 2013). Employing entropy method needs to follow certain steps as mention below.

**Step 1:** Normalization of  $m \times n$  evaluating matrix

$$A = [x_{ij}]_{m \times n} \quad (1)$$

Where,

$m$  = Number of alternatives,  $i=1, 2, \dots, m$

$n$  = Number of criteria,  $j = 1, 2, \dots, n$

$x_{ij}$  = the performance indicator of  $i^{\text{th}}$  alternative with respect to  $j^{\text{th}}$  criteria.

The original matrix  $A = (x_{ij})$  should be normalized to the evaluation matrix  $R = (r_{ij})$ , where  $r_{ij}$  is the normalized valued of  $i^{\text{th}}$  alternative with respect to  $j^{\text{th}}$  criteria, and  $r_{ij} \in [0,1]$ . The initial values can be normalized using one of two methods (Chang et al., 2010) below depending on the nature of the data.

For the positive value:



$$r_{ij} = \frac{\max_i x_{ij} - x_{ij}}{\max_i x_{ij} - \min_i x_{ij}}, \quad (2)$$

For the negative value:

$$r_{ij} = \frac{x_{ij} - \min_i x_{ij}}{\max_i x_{ij} - \min_i x_{ij}}, \quad (3)$$

Consequently, we have following normalized evaluation matrix

$$R = [r_{ij}]_{m \times n} \quad (4)$$

**Step 2:** Calculation of weights for each criterion based on entropy.

Weights can be calculated as follows according to (Chang et al., 2010);

- Compute the  $p_{ij}$  values using formula (6)

$$p_{ij} = -k \frac{X_{ij}}{\sum_{n=1}^m} p_{ij}, \ln p_{ij}, \forall j \quad (5)$$

- computed the  $d_i$  value using formula (7)

$$d_i = 1 - E_j, \forall j \quad (6)$$

- Calculated weights ( $w_j$ ) for each criterion using formula (8). One condition must be satisfied,  $\sum_{j=1}^n w_j = 1$ .

$$w_j = \frac{d_{ij}}{\sum_{j=1}^n d_{ij}}, \forall j \quad (7)$$

Third, we calculated the TOPSIS score for each alternative (hotels) using entropy weights obtained in the in the previous section. TOPSIS score is representative of the best alternative from a set of finite alternatives. The best alternative is decided based on the closeness to the positive ideal solution and farthest to the negative ideal solution.

Following is the procedure for TOPSIS score calculation:

**Step 1:** Obtain the original matrix as shown in equation (1).

**Step 2:** Construct the normalized matrix  $[r_{ij}]_{m \times n}$ .

Since data for each evaluation criteria contain in the original matrix does not have uniform dimension, we normalized the data using following procedures in line with Y.-J.Wang (2009) and Y.-J.Wang & Lee (2007).

Positive contributors are normalized as:

$$r_{ij} = \frac{x_{ij}}{\sqrt{\sum_{n=1}^m x_{ij}^2}}, \quad (8)$$

Negative contributors are normalized as:

$$r_{ij} = \frac{\frac{1}{x_{ij}}}{\sqrt{\sum_{n=1}^m \left(\frac{1}{x_{ij}}\right)^2}}, \quad (9)$$

**Step 3:** The normalized decision matrix  $[r_{ij}]_{m \times n}$  is converted to weighted normalized decision matrix as follows.

$$V = (v_{ij})_{m \times n} = \begin{bmatrix} w_1 r_{11} & w_2 r_{12} & \dots & w_n r_{1n} \\ w_1 r_{21} & w_2 r_{22} & \dots & w_n r_{2n} \\ w_1 r_{31} & w_2 r_{32} & \dots & w_n r_{3n} \\ \vdots & \vdots & \dots & \vdots \\ w_1 r_{m1} & w_2 r_{m3} & \dots & w_n r_{mn} \end{bmatrix} \quad (10)$$

Where,  $w_j, j = 1, 2, \dots, n$ . is entropy weights for each criteria calculated from equation (8), and  $\sum_{j=1}^n w_j = 1$ .

**Step 4:** Determined the positive ideal solution and negative ideal solution by using equation (12) and (13) respectively.

$$A^+ = \{v_1^+, v_2^+, \dots, v_n^+\} = \{(max_i v_{ij} | j \in J), (min_i v_{ij} | j \in J)\} \quad (11)$$

$$A^- = \{v_1^-, v_2^-, \dots, v_n^-\} = \{(max_i v_{ij} | j \in J), (min_i v_{ij} | j \in J)\} \quad (12)$$

**Step 5:** Calculated distance (separate measures) for each company for each period from positive ideal solution,  $d_a^+$  and negative ideal solution,  $d_a^-$  as follows:

$$d_a^+ = \sqrt{\sum_{n=1}^n (v_{ai} - v_i^+)^2}, a = 1, \dots, m, \quad (13)$$

$$d_a^- = \sqrt{\sum_{n=1}^n (v_{ai} - v_i^-)^2}, a = 1, \dots, m, \quad (14)$$

**Step 6:** Calculated closeness coefficients for each company for each period separately by using following formula.

$$C_i = \frac{d_a^-}{d_a^+ + d_a^-}, a = 1, \dots, m \quad (15)$$

The calculated value of  $c_i$  is indicative of multidimensional sustainability performance score for each hotel company in our sample. The higher value of  $c_i$  indicative of higher sustainability performance whereas lower value of  $c_i$  indicates lower sustainability performance.

### 2.3 Sample and data

In order to select an appropriate sample of hotels companies for our performance evaluation, the annual reports and the web sites of the all 39 hotels listed under Hotels and Travel sector in the Colombo Stock Exchange at the year-end 31<sup>st</sup> December 2018 were analysed. This process allows us to identify 25 hotels that match with evaluation criteria in the study. The rest of the hotels were excluded from the analysis since they have not disclosed sufficient information related to their sustainable performance. The information required for performance analysis were extracted from both web sites and the annual reports published at the end of 2017/2018 financial year.

## 3 Results

Table 3 presents the sustainability performance scores and the respective ranks for each hotel in our analysis. The performance scores are calculated using TOPSIS method. Two different methods – entropy weights, equal weights- were used to determine the weights for the selected criteria in each dimension of sustainability performance. The process of determining entropy weights are presented equations (1) to (7). By equations (8) to (15), the TOPSIS scores were obtained.

**Table 3 Sustainability Performance Score and Respective Ranks of the Hotels**

Hotel	Entropy Weights		Hotel	Equal Weights	
	Score	Rank		Score	Rank
Hotel A	0.710	1	Hotel A	0.758	1
Hotel B	0.657	4	Hotel B	0.674	5
Hotel C	0.651	5	Hotel C	0.680	4
Hotel D	0.391	21	Hotel D	0.474	22
Hotel E	0.462	15	Hotel E	0.546	13
Hotel F	0.434	17	Hotel F	0.551	12
Hotel G	0.585	7	Hotel G	0.499	19
Hotel H	0.409	19	Hotel H	0.514	17
Hotel I	0.528	10	Hotel I	0.540	15
Hotel J	0.691	2	Hotel J	0.743	2
Hotel K	0.169	25	Hotel K	0.195	25
Hotel L	0.434	16	Hotel L	0.542	14
Hotel M	0.539	9	Hotel M	0.523	16
Hotel N	0.411	18	Hotel N	0.509	18
Hotel O	0.367	23	Hotel O	0.421	23
Hotel P	0.515	11	Hotel P	0.622	7
Hotel Q	0.563	8	Hotel Q	0.591	9
Hotel R	0.327	24	Hotel R	0.401	24
Hotel S	0.491	12	Hotel S	0.611	8
Hotel T	0.468	13	Hotel T	0.567	11
Hotel U	0.408	20	Hotel U	0.481	21
Hotel V	0.386	22	Hotel V	0.483	20
Hotel W	0.464	14	Hotel W	0.572	10
Hotel X	0.664	3	Hotel X	0.716	3
Hotel Y	0.621	6	Hotel Y	0.641	6

According to the results presented in Table 3, 11 hotels have TOPSIS score above 0.5 under the entropy weights. When equal weights are used in the weighting process, 18 hotels' scores go beyond 0.5. Both of these results indicate the sustainability performance in the selected hotel are moderately high. The top three hotels under entropy weights are Hotel A, J, and X having sustainability scores of 0.710, 0.691, and 0.664. The ranking of these top three hotels is same under the equal weights but with different scores. Practically, these three hotels are the largest hotels in term of size and its operations. They have established the best practices within their companies in order to achieve sustainable development. The analysis of their official websites and annual reports revealed that they have fully adopted the Global Reporting Initiative (GRI) guidelines in disclosing their information to the stakeholders. Moreover, these hotels have been recognized with different awards and certification for their achievements in an effort of sustainable development.

#### 4 Conclusion

The hotel sector as an integral part of the tourism industry is paramount to the economic growth of Sri Lanka. Therefore, the main aim of this study was to analyze the sustainability performance of the hotel sector in Sri Lanka. Our analysis was carried out using the information disclosed by hotel companies in their annual reports and official websites. In order to identify the commitment of hotels towards sustainable development, first, we developed a sustainable performance evaluation index following previous studies and experts' opinion. We identified 18 indicators that could represent the different dimension of sustainable performance such as economic, environmental, and social and governance. Then, each hotels' annual reports of the financial year 2017/18 and websites were analyzed against the developed sustainability index. Following this process, the initial decision matrix was constructed. We use entropy based TOPSIS in determining the sustainability scores for each hotel. The results of the study indicate that the sustainability performance in selected hotels is moderately high. This may be because of the increased attention of different stakeholders of the tourism industry. Moreover, fierce competition in the hotel industry following the recent tourism boom in the country

urge the hotel companies to be more vigilant about their operation. As a result, hotels managers have paid more attention to stakeholder-oriented business practices.

The main contribution of this study is the proposed novel approach to determining the sustainability performance of the hotel industry. Moreover, for the best of our knowledge, this is the first attempt to analyze the sustainability of Sri Lankan hotel industry using such a quantitative approach. This research offers significant perspectives for hotel executives, owners, and other hotel sector stakeholders. According to results, certain hotels have a low level of sustainability performance. These hotels should concentrate more on sustainability practices to level up with their peers. Policymakers should encourage hotels through the development of appropriate strategies to adopt sustainable practices.

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## Historical Heritage and Sustainable Urban Development: Challenges imposed on owners and managers of listed historical buildings in the city of São Paulo

Arnoldo Jose de Hoyos Guevara<sup>1</sup>, Fernanda Cardoso Romão Freitas<sup>1</sup>,  
Fabiane Domingues de Magalhães de Almeida<sup>1</sup>, Alcides Garcia Junior<sup>2</sup>

<sup>1</sup>Pontificia Universidade Católica - São Paulo, Brazil

<sup>2</sup> Universidade de São Paulo

(E-mail: arnoldodehoyos@yahoo.com.br , f-cromor@hotmail.com ,  
almeifabi@ig.com.br,escolapaulistaderestaur@gmail.com)

**Abstract:** The worldwide concern regarding sustainable urban development has been increasing as the populations of countries increase and demand more consumption of the already scarce natural resources. According to the United Nations, it is estimated that 55% of the world population lives in urban centers, with the perspective of surpassing 68% in 2050. In Brazil, 84% of the population today live in the cities. One of the goals of sustainable development is to make cities more sustainable and inclusive and, to accomplish such goal, many variables need to be accomplished, among which is the strengthening of efforts to protect and safeguard cities' cultural heritage, for the present and future generations. Seeing as São Paulo is the 10<sup>th</sup> urban city in the world and its historical heritage preservation policies are recent and in the process of being outlined, this research strives to answer: What are the main challenges identified by owners/managers of listed historical buildings in São Paulo, which stand in the way of conserving/preserving their properties? Results revealed that the main challenges are a lack of knowledge about what interventions can be done to the property, lack of knowledge on incentive laws and more feasible ways for the conservation of historical sites and dealing with excessive bureaucracy. Such results contribute to the implementation of urban development policies focused on the sustainable goal of safeguarding the city's cultural heritage, in order to propitiate advancements in preserving the memory and identity of the city through the conservation of properties listed as historical heritage.

**Keyword:** Historical heritage; Historic building; Sustainable development

### 1 Introduction

Today, most of Brazil's population lives in urban areas, according to the last census, 84% of Brazilians live in the cities. The rapid urbanization process in Brazil generated the metropolization phenomenon, that is, the urban occupation that goes beyond the cities' limits <sup>13</sup>(IBGE – Brazilian Institute of Geography and Statistics, 2010).

In this scenario of urban transformation, the cities' sustainable management if one of the great 21<sup>st</sup> century challenges, thus, significantly and innovatively transforming urban space management is essential in order to reach sustainable development.

Among the SDG's – Sustainable Development Goals – there is the “Sustainable Cities and Communities” SDG <sup>14</sup>(UNITED NATIONS, 2015) which aims to make cities sustainable and inclusive. Among the targets established in this SDG, target 11.4 stands out since it contemplates the strengthening of efforts to protect and safeguard cities' cultural heritage. That is, in order to ensure sustainable urban development, the preservation of historical heritage is highly relevant and indispensable. (LEMOS,1981; LEITE, 2012; FIGUEIREDO, 2014).

In the scope of preservation, it is necessary to consider that there is also a preservation of meanings, identities and traditions of a location and the individuals who live there; consequently, there is preservation of citizenship and the right to memory for future generations. The efforts are in a sense of

<sup>13</sup>IBGE - Instituto Brasileiro de Geografia e Estatística. (2010) Censo 2010. [R] Retrieved June, 19, 2019, from <https://agenciadenoticias.ibge.gov.br/agencia-sala-de-imprensa/2013-agencia-de-noticias/releases/13937-asi-censo-2010-populacao-do-brasil-e-de-190732694-pessoas>.

<sup>14</sup> NAÇÕES UNIDAS (2015) ODS - Objetivos de Desenvolvimento Sustentável. [R] Retrieved June 15, 2019, from <https://nacoesunidas.org/pos2015/>.

preserving not only what is tangible, but the intangible as well, and safeguarding the cultural and immaterial heritage of a society. (FONSECA, 2005; FIGUEIREDO, 2014; UNITED NATIONS, 2015; <sup>15</sup>IPHAN – Institute of National Historical and Artistic Heritage, 2015).

In this scenario, the search for ways of making feasible the heritage conservation has been a challenge. Today, the city of São Paulo has around 3,600 sites listed as historical heritage, which are mainly located in the central area. The preservation policies have been consolidated since the creation of the Department of Historical Heritage of São Paulo in 1975, which has since strived to take the first steps towards the path of identifying and listing all historical buildings. <sup>16</sup>(DPH-SP – Department of Historical Heritage of São Paulo, 2019; SOMEKH, 2017).

Listing a site as historical heritage is understood to be the administrative act set forth by the public power, which can be the federal, state or municipal administrations, with the goal to preserve, through law enforcement, assets with historical, cultural, architectonic and environmental value to the population, preventing that they are ever destroyed or demeaned <sup>17</sup>(IPHAN– Institute of National Historical and Artistic Heritage, 2019).

Seeing as any movement towards solving a problem starts with a diagnosis, this research allows property owners to have a voice. Therefore, this study's general goal is to learn the main challenges identified by owners/managers of listed historical buildings in São Paulo and find out which factors affect their ability to conserve/preserve their properties.

With the intention of achieving such goal, the following specific goals were outlined: identifying if it is an onus to manage or to own a listed historical property; identifying the positives and negatives of managing or owning a listed historical asset; identifying if they are aware of legislation regarding their properties; identifying if they know of or make use of incentive laws for preservation; identifying if, in the owners' or managers' perception, their properties are economically or culturally valued for being listed as historical heritage.

This exploratory research is justified by its contribution to diagnosing the challenges of preserving historical heritage in the city of São Paulo, subsidizing possible actions from public and private powers towards preserving the city's memory for future generations, reaching SDG target 11.4.

The second article on the Venice Charter, which deepened and diversified the worldwide guidelines for maintaining historical and architectural heritage through the resolutions on the II<sup>nd</sup> International Congress of Architects and Technicians of Historic Monuments in 1964, states that preserving this group of assets requires the collaboration of all sciences, therefore it is not simply a multidisciplinary subject, but it is also interdisciplinary (IPHAN– Institute of National Historical and Artistic Heritage, 2019).

This research was structured as follows: Firstly, there will be a conceptualization on historical heritage and the importance of preserving material assets in order to preserve the immaterial, thereafter, we will discuss how and why this historical heritage must be inserted in the sustainable development theme. After that, there will be a discussion on the methods chosen for this research and, finally, a demonstration of the study's main results.

## 2 Historical Heritage – Preserving the City's Memory

The actions and studies focused on preserving historical heritage materialized in buildings and public-private monuments have a double-sided role to society. When we preserve a building for its historical or architectural meaning we act for the preservation of culture, life stories, past relived in memories and the many meanings this material/immaterial intersection represents and revives in the collective imaginary. Added to that is the fact that civilizations' future evolution lies on preserving our traditions. The monuments and historical assets are witnesses to our story and past traditions and, hence, are an essential element to the development of people, as well as economic and social development

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<sup>15</sup> IPHAN- Instituto do Patrimônio Histórico e Artístico Nacional. (2015) Política do Patrimônio Cultural Material. [R] Retrieved June 18, 2019, from [http://portal.iphan.gov.br/uploads/ckfinder/arquivos/publicacao\\_politica\\_do\\_patrimonio.pdf](http://portal.iphan.gov.br/uploads/ckfinder/arquivos/publicacao_politica_do_patrimonio.pdf).

<sup>16</sup> Departamento de Patrimônio Histórico de São Paulo (2019). Institucional. [R] Retrieved June 27, 2019, from [https://www.prefeitura.sp.gov.br/cidade/secretarias/cultura/patrimonio\\_historico/preservacao/institucional/index.php?p=332](https://www.prefeitura.sp.gov.br/cidade/secretarias/cultura/patrimonio_historico/preservacao/institucional/index.php?p=332).

<sup>17</sup> IPHAN- Instituto do Patrimônio Histórico e Artístico Nacional. (2019). Recomendação Paris de Obras Públicas e Privadas. [R] Retrieved June 27, 2019, from <http://portal.iphan.gov.br/uploads/ckfinder/arquivos/Recomendacao%20de%20Paris%201968.pdf>.

(FONSECA, 2005; UNITED NATIONS, 2015).

<sup>18</sup>Le Goff (1984) states that the documents and monuments are the repositories of collective memory. The life stories and collective memory remain anchored in houses' walls and historical buildings' facades. In this sense we can talk about an urban ecology that is actively working to maintain and settle the cities' dynamics. "The conversion of the material city as an object of historical knowledge was motivated by the transformation of the urban space that followed the Industrial Revolution" (CHOAI, 2001 p.179).

In Brazil, however, the matters referring to material heritage are much more recent and frequently restricted to specific fields of knowledge, such as architecture. If we consider that the SPHAN (National Historical and Artistic Heritage Service), a federal organ which was pioneer in dealing with matters related to heritage, was only created and started functioning in 1937, it can be assumed that studies about this Brazilian cultural dimension have many gaps, precisely since it is so new. Concerning the fields of knowledge, the gaps are also present. Studies involving the conservation of material heritage, whether it's historical or architectural, are common within those specific fields, however, they are rare in the fields of sociology, anthropology and other areas of applied social sciences.

This first step in creating an institution for the protection of national historical heritage was taken by the administration of the then president Getúlio Vargas, through the promulgation of Law number 378, which has the following information on its article number 46: <sup>19</sup>"Art. 46. The National Historical and Artistic Heritage Service is now created, with the function of promoting, all over the country and permanently, the listing, conserving, enrichment and knowledge of historical and artistic national heritage." (LAW NUMBER 378, 1937).

Significant changes only occurred in 1979 with the creation of the National Pro-Memory Foundation, establishing a new way of working, based on a wider and more updated conception of cultural assets. After that, SPHAN (National Historical and Artistic Heritage Service) becomes IPHAN (Institute of National Historical and Artistic Heritage), linked to the Ministry of Culture (MUTTER, 2012, p. 75).

All the changes in this historical cycle had contributions from Brazilians. The landmark of Brazilian involvement in the internationalization of preservationist policies was the approval of the document "Recommendation Concerning the Protection, at National Level, of the Cultural and Natural Heritage" on National Congress, also known as "Paris Recommendations", promoted by the Unesco in November 16<sup>th</sup>, 1972.

Years after the beginning of discussions in the international scope and after over 80 years in Brazil, historical heritage was finally understood in its importance for the cities, it started to be studied and widespread and it started to be taken into consideration in the planning process for cities' growth dynamics. (FONSECA, 2005; CARDOSO, 2007)

In sight of how important the preservation of assets listed as historical heritage is to the cities and to the future of a society, we can say that the agenda for preserving such heritage must be linked to sustainable urban development, not only so that civil society fully comprehends and becomes aware of the importance of this action, but also so that innovative preservation management mechanisms are established through partnerships and public-private investments.

### 3 Urban Sustainable Development and the Preservation of Historical Heritage

The worldwide concern regarding sustainable urban development has been increasing as the populations of countries increase and demand more consumption of the already scarce natural resources. It is estimated that 55% of the world population lives in urban centers, with the perspective of surpassing 68% in 2050 <sup>20</sup>(UNITED NATIONS, 2018).

Therefore, sustainable and inclusive development is in the contemporary agenda for world leaders

<sup>18</sup> LE GOFF, J. (1984) Documento/Monumento in: Memória-História. Lisboa: Imprensa Nacional/Casa da Moeda. [R] Retrieved June 26, 2019, from <https://www.ufib.edu.br/ppgcom/images/Hist%C3%B3ria-e-Mem%C3%B3ria.pdf>.

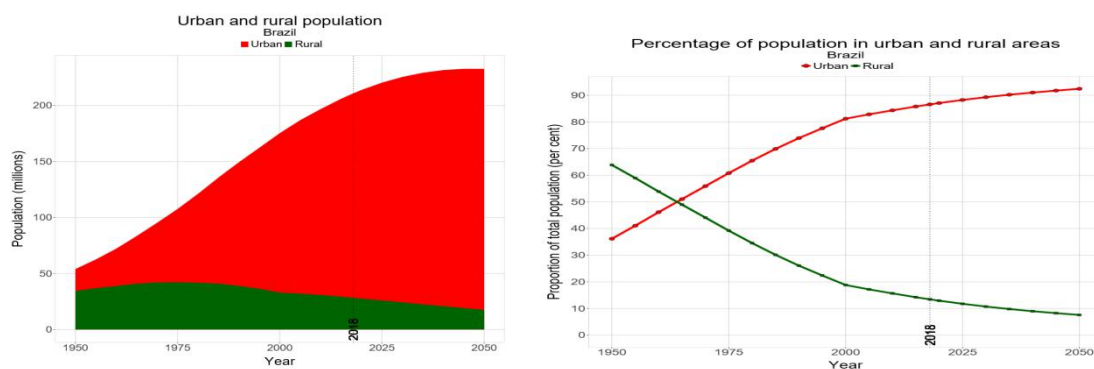
<sup>19</sup> Law nº378 (1937). Da nova organização ao Ministério da educação e Saúde Pública. [R] Retrieved June 18, 2019, from <https://www2.camara.leg.br/legin/fed/lei/1930-1939/lei-378-13-janeiro-1937-398059-publicacaooriginal-1-pl.html>.

<sup>20</sup> NAÇÕES UNIDAS (2018) World Urbanization Prospects. [R] Retrieved June 20, 2019, from <https://population.un.org/wup/Country-Profiles/>.

through the UN and the SDGs (Sustainable Development Goals), which have the objective of supplying mankind's current needs, without compromising the planet's capability to tend to future generations <sup>21</sup>(UNITED NATIONS, 2015).

For Leite (2005), sustainable urban development is one of the greatest challenges for current and future megacities in the 21<sup>st</sup> century, but that can also bring countless opportunities. The redevelopment of these cities in an intelligent way can make them more sustainable, optimize their infrastructure and improve their spaces. In this context, technological advancements may contribute to a more participatory management, with e-governance systems providing clear and efficient information to optimize populations' urban lives.

In Brazil, urban territory development was marked by accelerated population growth in industrialized centers, who were in search of better socioeconomical conditions for their families and were mostly composed of people coming from rural areas and foreign immigrants. Currently, 84% of the population is urban (figure 01), estimated to reach 92% in 2050 <sup>22</sup>(IBGE - Brazilian Institute of Geography and Statistics, 2010; UNITED NATIONS, 2018) and the city of São Paulo, the focus of this research, is the 10<sup>th</sup> biggest urban city in the world, where approximately 11 million people live <sup>23</sup>(IBGE, 2010).



**Figure 1 Urban Population**  
Source: United Nations (2018)

The established infrastructures and services were not able to keep up with the demanded Brazilian development growth, so the territorial occupation was unorganized, evolving with no efficient and sustainable urban planning. According to Villaça (1999), the urbanization process in Brazil went through a number of phases since the end of the 19<sup>th</sup> century, when it had its first phase, which featured embellishment plans based on European tradition. Since then, several interventions created by different administrations were implemented to deal with sanitation, mobility, housing and space occupation (Villaça, 1999; <sup>24</sup>WRI Brazil – World Resources Institute Brazil, 2019). However, it was only during the country's democratization period, with the promulgation of the Constitution (1988) and the City Statute <sup>25</sup>(Law number 10,257, 2001) that more blunt guidelines were established so that urban planning would start being recognized as a political process with social participation.

These guidelines legitimized the Master Plan as an instrument for city planning and its review every 10 years has been leading cities with over 20 thousand inhabitants to reevaluate their urban development model, creating policies for more sustainable expansion and utilization of already existing spaces (LAW

<sup>21</sup> NAÇÕES UNIDAS. (2018) World Urbanization Prospects – Release. [R] Retrieved June 20, 2019, from <https://population.un.org/wup/Publications/Files/WUP2018-PressRelease.pdf>.

<sup>22</sup> IBGE - Instituto Brasileiro de Geografia e Estatística. (2010). Pessoas em áreas urbanas. [R] Retrieved June 19, 2019, from <https://agenciadenoticias.ibge.gov.br/agencia-sala-de-imprensa/2013-agencia-de-noticias/releases/13937-asi-censo-2010-populacao-do-brasil-e-de-190732694-pessoas>.

<sup>23</sup> IBGE - Instituto Brasileiro de Geografia e Estatística. (2010) Relatório áreas urbanizadas no país. [R] Retrieved June 19, 2019, from [https://www.ibge.gov.br/apps/areas\\_urbanizadas/](https://www.ibge.gov.br/apps/areas_urbanizadas/).

<sup>24</sup> WRI Brasil (2019) Políticas urbanas para cidades mais sustentáveis. [R] Retrieved June 22, 2019, from <https://wribrasil.org.br/pt/o-que-fazemos/projectos/politicas-urbanas-para-cidades-mais-sustentaveis>.

<sup>25</sup> Constituição da República Federativa do Brasil (1988) Constituição da República Federativa do Brasil - Contêm as emendas constitucionais posteriores. Brasília, DF: Senado, 1988.



number 10,257, 2001); and in 2015, the country takes another step in the urbanization process with the creation of the Metropolis Statute <sup>26</sup>(Law number 13,089, 2015), which constitutes guidelines so that metropolitan regions and urban agglomerations can promote the creation of Integrated Urban Development Plans for “the organization, planning and execution of public functions of common interest”. (LAW number 13,089, 2015)

In the city of São Paulo, the ruling <sup>27</sup>PDE – Strategic Master Plan, in English - (2014) is a municipal law that guides sustainable development and growth for the city until 2030 and one of its strategies is focused on the “preservation of heritage and cultural stimulation” and it names 4 types of Special Culture Preserving Zones, focusing on the preservation of assets that hold historical, landscape, environmental, social or cultural interest in the city.

This strategy converges to the fulfillment of what was set out on the “Declaration of Amsterdam” in 1975, which instituted a model of preserving, conserving and revitalizing the European historical heritage, giving direction to an integrated urban planning, with society’s participation, and which already clarified its importance to our resource economy and the combat against waste <sup>28</sup>(IPHAN - Institute of National Historical and Artistic Heritage, 2015).

In Somekh’s view (2016), the PDE – Strategic Master Plan - (2014) can restructure the city in order to make it more compact, with efficient mobility mechanisms, reducing the consumption of natural resources and, with that, thrusting the preservation of historical heritage “within a perspective that is contemporary and values the identity of the city of São Paulo with the creation of new instruments, such as the APC ZEPECs - Special Culture Preserving Zones – and the Cultural and Creative Territories” (SOMEKH, 2016, p.214).

The city of São Paulo currently has 3,600 buildings listed as historical heritage (SOMEKH, 2017) and it has some municipal laws that promote the feasibility of restoring historic properties. <sup>29</sup>Law number 10,598/1988 (Urban Territorial Tax - IPTU - Exemption Law), <sup>30</sup>Law number 12,350/1997 (Facade Law), <sup>31</sup>Law number 15,598/2013 (Program to Support Cultural Projects) and <sup>32</sup>Decree number 57,667/2017 (Adopt an Artistic Work Project), that allow the owner or manager of these properties to have discounts or exemptions on their IPTU tax (Urban Territorial tax) for an undetermined period of time, discount on municipal taxes and enveloping of the building during construction in order to obtain a sponsorship for the restoration. Even though these laws have been in force for a while, very few buildings have benefited from these legislations and most of them are in varied levels of degradation.

The goal of this research is to try to understand the reasons why the owner or manager of these historic São Paulo buildings cannot preserve them, once it is possible to find examples in European countries, which have been working with the preservation theme for many decades now, that show how the preservation of heritage can be tied to contemporary modernity. We can observe, in different parts of the globe, movements in the most different formats that seek to make the preservation of historical heritage feasible and to requalify urban landscape.

Barcelona was a city that pioneered innovative management for preserving their cultural historical heritage. In 1986, mayor Pasqual Maragall started the program: “*Barcelona, posa’t guapa*” (Barcelona, make yourself beautiful). In order to engage the people from Barcelona, the solution was a practical action: every citizen who requested a technical report, which is a document detailing the specific conservation of a property, would have it free of charge, containing the studies on the deficiencies found in the building facade’s conservation, and just in the first 02 years of the campaign, city hall issued 6

<sup>26</sup> Law nº 13.089 (2015). Estatuto da Metrópole. Retrieved June, 15, 2019, [R] from <https://www2.camara.leg.br/legin/fed/lei/2015/lei-13089-12-janeiro-2015-780060-publicacaooriginal-145925-pl.html>.

<sup>27</sup> PDE - Plano Diretor Estratégico (2014). Plano Diretor Estratégico. [R] Retrieved June, 10, 2019, from <https://gestaourbana.prefeitura.sp.gov.br/marco-regulatorio/plano-diretor/>.

<sup>28</sup> IPHAN - Instituto do Patrimônio Histórico e Artístico Nacional (2015). Declaração de Amsterdam 1975. [R] Retrieved June 19, 2019, from <http://portal.iphan.gov.br/uploads/ckfinder/arquivos/Declaracao%20de%20Amsterda%CC%83%201975.pdf>.

<sup>29</sup> Law nº10.598 (1988). Lei de Isenção de IPTU 1988. [R]Retrieved June, 19, 2019, from <http://legislacao.prefeitura.sp.gov.br/leis/lei-10598-de-19-de-agosto-de-1988/consolidado>.

<sup>30</sup> Law nº12.35 (1997). Lei das Fachadas 1997. [R]Retrieved June 15, 2019, from : <http://legislacao.prefeitura.sp.gov.br/leis/lei-12350-de-6-de-junho-de-1997/consolidado>.

<sup>31</sup> Law nº 15.948 (2013). Programa de Apoio a Projetos Culturais 2013. [R]Retrieved June 15, 2019, from <http://legislacao.prefeitura.sp.gov.br/leis/lei-15948-de-26-de-dezembro-de-2013/>.

<sup>32</sup> Decreto nº 57.667 (2017). Programa Adote uma Obra Artística. [R]Retrieved June 15, 2019, from <http://savim.org.br/decreto-no-57-6672017-programa-adote-uma-obra-artistica/>.

thousand technical restoration reports. For the accomplishment of such task, city hall partnered with universities that made professionals available for this work.

A second step in the program was to find financial resources to execute the restorations. Between 1988 and 1992, only 4.9% of all sponsored cultural activities in Spain were patrimonial restorations of buildings or monuments, that is, the numbers were not favorable. However, the huge campaign developed by city hall through the media and the support of public figures and artists made millions of citizens engaged with the cause, which is why the sponsor had guaranteed positive repercussion in terms of corporate identity. Whoever sponsored the restoration of the facades of historic buildings would be able to use the construction protection screen to announce the deed, keeping in mind that Barcelona was already implementing the clean city law, but, whoever sponsored the restoration work would be within the exception of the law. Back then, 600 historic properties were restored under this model, which was then replicated throughout other European countries. (VIANA, 2012).

In 2014, the city of Paris also created a public-private partnership program, the Reinventing Paris program offered 23 large municipal properties to the private initiative, the concurrent teams needed to gather incorporators, investors to make the restorations feasible. 76 projects were selected in the beginning of 2016 and city hall collected 600 million euros<sup>33</sup>(MISSIKA, 2019).

Other initiatives can become effective tools in the local reality, today there are many movements that must be studied such as the<sup>34</sup>Heritage Fund (2019), which is the biggest financier dedicated to heritage in the United Kingdom, many forms of Impact Investments, which are “investments made in companies, organizations and funds that intend to have measurable social and environmental impact along with financial return”<sup>35</sup>(GIIN, 2018, p.02), which can add to their scope the cause of preserving historical assets bringing efficiency into resource management.

Initiatives such as these are more present every time on the agenda of private companies, which have, in the last few years, shown interest in ideas such as creating a shared value (PORTER; KRAMER, 2011), conscious capitalism, social responsibility in companies<sup>36</sup>(WBCSD, 2000; MARREWIJK, 2003; HENDERSON, 2001) and sustainable development (WCED, 1987; SACHS, 1994).

## 4 Methods

This research is exploratory, because it studies a problem which still has very incipient studies in Brazil and because this nature of research seeks to determine tendencies and to identify new environments and fields to be studied more in depth (GIL, 2007; SAMPIERI et al., 2013).

We opted for the *in loco* field research as the technical procedure applied in this paper, because according to Gil (2007), field studies look for a in-depth analysis of the proposed questions. We chose the quali-quantitative approach and not purely quantitative, because according to Sauerbronn and Avrosa (2010) the qualitative research is used in an interpretative constructivist approach, a view which seeks comprehension and the meanings of a phenomenon.

It is important to highlight that this research originates from a Data Driven perspective, that is, data oriented, because the field research, as well as primary data collection, was carried out by the Escola Paulista de Restauro (São Paulo Restoration School), through a partnership with a private company that acts in the cause for conservation and restoration of assets listed as historical heritage in São Paulo and that ventured to understand the hindrances for conserving historical assets, thus, the data collection preceded a theoretical substantiation.

On the data driven perspective, primary data collected through interviews are analyzed with the goal of generating categories of analysis (CHARMAZ, 2006).

The first step on this research was identifying and defining the research problem and creating an interview protocol, the second step was a random selection of assets listed as historic heritage in São

<sup>33</sup> MISSIKA, JL. (2017) La profondeur, nouvelle dimension de l'urbanisme parisien. In: MairieParis, reinventer.paris: Les dessous de Paris. Retrieved November, 04, 2017, from <http://www.reinventer.paris>.

<sup>34</sup> Heritage Found (2019). Quem somos. [R] Retrieved June 29, 2019, from <https://www.heritagefund.org.uk/about/what-we-do>.

<sup>35</sup> GIIN - Global Impact Investing Network (2018). Annual Impact Investor Survey. [R] Retrieved February 13, 2018, from [https://thegiin.org/assets/GIIN\\_AnnualImpactInvestorSurvey\\_2017\\_Web\\_Final.pdf](https://thegiin.org/assets/GIIN_AnnualImpactInvestorSurvey_2017_Web_Final.pdf).

<sup>36</sup> WBCSD - World Business Council for Sustainable Development (2000). How we drive sustainable development. New York. [R]Retrieved June 28, 2019, from <https://www.wbcd.org/>.

Paulo and identifying the respondent subject for the research and, then, they were interviewed, on the fourth step is when the data analysis took place in order to obtain the categories of analysis and the fifth and last step is the discussion of the research's findings.

The first questions for the elaboration of a questionnaire used on step 01 started from the empirical formulation from day to day treatment with questions regarding the maintenance of listed historical buildings. The goal was to inquire people to settle several assumptions such as: Is it an onus to live in, manage or own a listed historical building? Do people value the fact that they are contributing to the maintenance of the memory and history of a location? What do they actually know about the legislation that protects their property? How were their restoration experiences? These concerns led us to create the thematic axes which guided the questionnaire.

We chose one with a random base of 100 historical assets from the city of São Paulo. The sample was obtained through the Geo Sampa tool, which is a georeferencing tool that maps the city's listed historical buildings.

We sought to establish several selection criteria in order to guarantee diversity on the sample, thus, it was defined that the sample should contemplate a relative geographical diversity, by neighborhood or city zone, and we also considered the type of property, residential, commercial, industrial and Social Organizations. The last criteria established was regarding who manages the property: individual management or professional management.

Up until the elaboration of this article, there had already been 78 interviews and we established a limit of 50 interviews for the elaboration of this partial analysis.

The data analysis, as well as the conclusions, will be shown on the next section.

## 5 Main Results

In this section we will present the data analysis obtained after the manual codification process carried out on the fourth step of this research. This analysis was made through the observation of incidents mentioned by the participants, from where we were able to extract the categories of analysis as a way of answering what the biggest challenges are when conserving buildings listed as historical heritage in São Paulo from the perspective of the owners/managers of these properties.

We identified that the majority of the listed historical buildings included in this research are located in the central area of the city. As to the type of property, for the most part, 44% are residential properties, 28% are commercial properties and 18% are properties that belong to social organizations. The second item we observed shows the type of management, that is, what type of structure manages the property and, therefore, is directly handling matters regarding the listed property when any type of intervention to the property may happen. In this sample's case, the majority of the properties are managed by the owners themselves or by the co-owners, that is, individual management.

In order to check if the implicit common sense assumption that preserving and conserving a historic asset is a burden to its owners who, unaware of the legislation, consider the maintenance of their property an action that involves many duties, we tried to identify through the participants' speech if managing or owning these assets is positive or negative. So, 46% see it as something negative, 44% see it as something positive and 10% are indifferent.

We asked the participants if they were aware of the incentive laws that conduct the listed property cases in São Paulo. Then, it was found that 84% of the considered sample did even not know one of the existing laws. As to those who were aware of the legislation, about the use of such instruments in the city of São Paulo, most of the opinions were positive: *"It is fair because we are conserving a good of the city and the financial incentive helps in the maintenance."*

It is important to notice that the participants' lack of knowledge on incentive laws and feasibility indicate a need for an initial action that favors awareness and dissemination.

Starting from the idea that when we preserve a listed historic asset, we are not only preserving the material aspect, but also the memory and culture of a location (FONSECA, 2005; FIGUEIREDO, 2014; UNITED NATIONS, 2015; IPHAN - Institute of National Historical and Artistic Heritage, 2015), we tried to understand whether owners and managers were aware of the reason why their property was listed by the preservation organs.

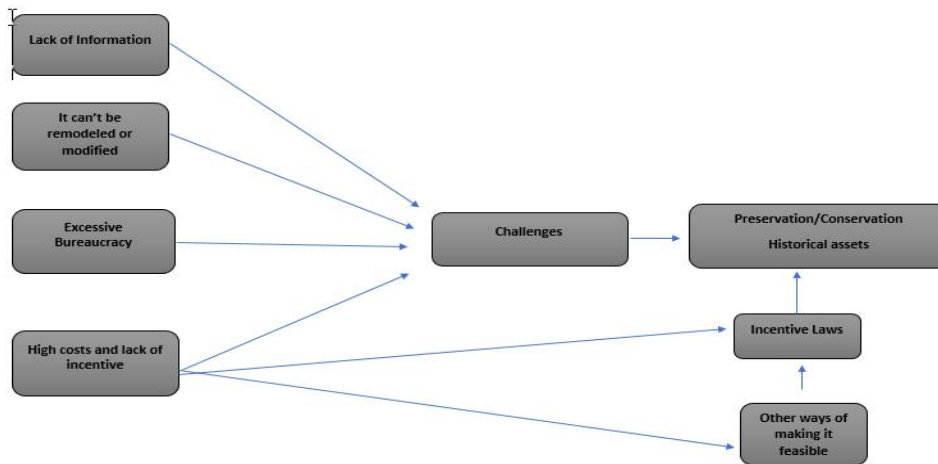


**Figure 2 Reason for Listing**  
Source: Created by the authors, 2019

The participants demonstrated through evidences a great frequency in mentions of the “historic value” and “architectural value” categories; however, there are also expressive mentions of the “I don’t know” category.

The entire data analysis process, from codification until the frequency analysis on the established categories followed the established flow to comply with the goals of this research, which are to identify the main challenges, from the perspective of owners/managers’ of listed historical buildings in São Paulo, that prevent them from conserving/preserving their properties.

On that sense, figure 03 shows the dynamics between the main identified challenges to be deal so that the final goal of the issue established here, which is precisely conserving and preserving historical assets in the city of São Paulo, is reached.



**Figure 3 Map of the Dynamics for the Preservation of São Paulo’s Historical Heritage.**  
Source: Created by the authors, 2019.

The most frequent negative aspect mentioned by the participants was the affirmation that the property cannot be remodeled or modified. The participants stated that: “Cannot be modernized, so commercially no one gives value”.

The second most frequent negative aspect mentioned is the challenge imposed by the excess of bureaucracy, as it is demonstrated by the participants: “In order to do a restoration, it is necessary to consult CONPRESP (DPH), and there is a lot of bureaucracy. It has no benefits, only standards to comply with”.

We can deduce by the evidence that the experiences owners and managers had with the city

management organs were not positive in terms of the necessary help in obtaining approvals for interventions on their properties. Keeping in mind that in our sample, the asset management is mostly carried out by its owners.

The third most frequent aspect mentioned, even though in a smaller scale when compared to the other two bigger challenges mentioned above, was about the high costs and lack of financial incentive. The participants stated that: *“In addition to the cost of restoration that uses expensive and very specific materials, it still has the cost of the projects, you are hampered by the high costs involved in the work and, on the other hand, there is no counterpart of the State”*.

The economic and financial challenge for the participants is significant and the incident responses show that the participants know very little about the laws and ways of incentive that exist for conserving historical assets. Once again, we highlight the importance of developing actions for the awareness and information of property owners and managers.

Today, in São Paulo, we have some ways of incentive and feasibility of conservation and restoration of listed historical buildings. In one of the questions we sought to understand the participants' vision regarding two of these laws through the thematic axes “Incentive Laws.

Economic assistance is mentioned by most participants who consider the laws to be positive, followed by the importance of taking care of and keeping the properties well conserved. Out of our 50 analyzed cases here, 26 viewed these aspects as positive. In cases where the mention is negative or neutral, most mentions occur from a lack of both knowledge and dissemination of the laws for the people who need them the most: the owners. Others question if the contributed values would be enough to cover the maintenance and restoration costs.

The studied sample of 50 historical buildings totals an area of around 374 thousand m<sup>2</sup> that needs to be conserved and restored in the city.

## 6 Conclusion

The results of this study allowed us to identify the main challenges faced by managers and owners of properties in the city of São Paulo for the conservation of historical assets.

The fact that several owners/managers do not even know the reason why their property is considered historical heritage is an indicator that it is still necessary to make efforts to spread information and awareness to signal the importance of the city's historical assets to the owners and managers of these properties and to society in general. What we can deduce through the initial results of this field research is that a second step, which is just as important as the beginning of the listing process, would be the start of a movement spreading awareness and information to the owner/manager about the meaning of listing, awareness on the importance of that building for the city's memory and guidance regarding what can be modified or not in that property.

Recently, the DPH - Department of Historical Heritage - tried to focus their objectives on the so-called “valorization pillar” for understanding that creating social and economic value for cultural assets is essential and these are important actions towards overcoming challenges in favor of conserving and preserving assets (SOMEKH, 2017; DPH 2019).

Other initiatives surfaced regarding the valorization of historical heritage, such as “the creation and regularization of the Heritage Journey, the São Paulo Cultural Value Stamp and the Restoration Factory initiative, which suggested the promotion of social cohesion in areas with great incidence of listed historical buildings in the city” (SOMEKH, 2016, p.239).

Once owners and the civil society have full understanding of how important this preservation action is, the question that must be asked is how to make urban development projects that contemplate the revitalization of neighborhoods and historical buildings economically feasible and how to do that in a city like São Paulo, without unleashing other urban phenomena such as the gentrification that happened in large cities? (CARDOSO, 2007).

The results from this research show that not even the participants know the incentive laws and, that way, they cannot discuss the effectiveness of their applicability.

Many existing ways and models of network feasibility (VIANA, 2012; MISSIKA, 2019; GIIN, 2018; HERITAGE, 2019) must be studied and adapted to the reality of the city of São Paulo.

The so-called Impact Investments (GIIN, 2018) can be a strong mechanism to be used in favor of the creation of a sustainable economic feasibility network, after all, the more democratic and modern the conservation policies are, the closer we will be to the accomplishment of new economic ways that make

them sustainable.

Finally, it is understood that the challenges towards preserving the city's historical heritage must be surpassed through the creation of this network that may include professionals from many fields of knowledge, because a complex problem requires multidisciplinary solutions and innovative sustainable management.

This research reaches here its general goal by identifying the main challenges owners/managers of listed historical buildings in São Paulo go through when preserving their properties. The conservation of historical heritage meets the goals for sustainable development towards more inclusive cities (UNITED NATIONS, 2015). However, since we are talking about initial exploratory studies with partial results, it does have limitations and identifiable gaps.

As a suggestion for future researches in order to fill the gaps identified in this research, we suggest: studies with the previous managers for the Municipal Department of Historical Heritage aiming to identify the main challenges and limitations within this preservation organ; researches alongside property owners who used or are using some of the incentive laws in force in the city in order to understand the applicability potential of these incentives; researches on the applicability effectiveness of international experiences for a possible nationwide replication and, finally, it would be ideal to widen the sample having one specific central neighborhood in São Paulo as pilot to understand in more detail the existing dimensions and variables that impede the preservation of these assets.

Our initiative while researchers must function so that we start new discussions and promote more researches on urban development management for restoration and preservation of São Paulo's heritage through articulations between civil society and the public and private sectors.

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## Research on Innovation Performance Analysis of Financial Policy : from the Perspective of Technology-based SMEs

Wan Guochao<sup>1</sup>, Zhang Lingzi<sup>2\*</sup>, Tang Ling<sup>1</sup>

1 School of Management, Chengdu University of Information Technology, Chengdu, P.R.China, 610100

2 School of Accounting, Chongqing University of Technology, Chongqing, P.R.China, 401320

(Email: [wgc@cuit.edu.cn](mailto:wgc@cuit.edu.cn), [tangling@cuit.edu.cn](mailto:tangling@cuit.edu.cn), [429664217@qq.com](mailto:429664217@qq.com))

**Abstract:** This paper empirically tests the allocation efficiency of financial policies by using DEA super-efficiency model. Based on the time series data of science and technology SMEs in Sichuan Province from 2011 to 2017, this paper estimates and analyzes the impact of financial policies on innovation performance of science and technology SMEs from a meso-level perspective. The results show that the overall innovation performance level of small and medium-sized science and technology enterprises in Sichuan Province in 2012-2013 and 2016-2017 is relatively ideal. The allocation of financial policies is relatively effective in 2013 and 2017. In 2011, 2014 and 2015, due to scale factors, the resource allocation capacity is relatively poor, the problems of redundant input and insufficient output is quite obvious, the overall innovation efficiency is low, and there was still much room for improvement in the role of policies.

**Key words:** Technology-based SMEs; Financial policies; Data envelopment analysis; Innovation performance

### 1 Introduction

Innovation-driven development of small and medium-sized science and technology enterprises is an important force to adapting to the new economy, new formats and new changes. It is the leader of innovation activities, the key focus to cultivating "unicorn" enterprises, and plays an important role in adjusting industrial upgrading and promoting economic development. Small and medium-sized science and technology enterprises in Sichuan Province have occupied the first place in the western provinces in terms of scale. Their rapid development, high technological content and strong competitiveness have long become the backbone of Sichuan's technological innovation and the new force of economic



growth. Therefore, precise support for small and medium-sized science and technology enterprises in Sichuan Province and improvement of the innovation quality of small and medium-sized science and technology enterprises are not only the need to implement inclusive science and technology innovation policies, but also the national strategic need to cultivate new dynamic and new formats. Under this background, it is even more urgent to use policies to support the fission growth of technological SMEs' innovation.

Compared with scientific and technological innovation activities of enterprises above designated size, scientific and technological small and medium-sized enterprises have many shortcomings in financing channels, resource allocation and other aspects due to their own development restrictions, which requires the government to give special preferential treatment to scientific and technological small and medium-sized enterprises in terms of financial support policies. Relevant studies also show that fiscal policy is not only an important tool for the government to regulate macro-economy, but also the most effective way for governments to support small and medium-sized enterprises to carry out innovation activities. Financial investment in science and technology plays an important incentive role in improving the national innovation ability and promoting the construction of an innovative country. Financial support policies are closely related to the healthy and stable development of small and medium-sized science and technology enterprises. However, whether the financial support policy can effectively promote the innovation activities of small and medium-sized science and technology enterprises; Whether the innovative funds for the development of small and medium-sized enterprises can give full play to market traction; How to scientifically evaluate the supporting effect of fiscal policy on innovation activities. In order to solve the above problems, this paper takes the medium-sized data of small and medium-sized scientific and technological enterprises in Sichuan Province as the research subject, and explores the performance impact of financial support policies for small and medium-sized scientific and technological enterprises, which has certain reference significance for improving the effectiveness of financial policies, strengthening the effective use of financial funds, and promoting the rational allocation of scientific and technological resources.

## **2 Literature Review**

Through combing the existing literatures, it is found that in many research results at home and abroad, there are two ways to explain the relationship between financial R&D support and enterprise innovation. One is that government financial support has crowding-out effect on the scientific and technological innovation activities of small and medium-sized enterprises(Goolsbee, 1998; David et al., 2000). Second, government R&D funding has an incentive effect on technological innovation of enterprises. Highly market-oriented competition can stimulate the production of more new technologies, thus realizing the scale effect of social technological innovation(Arrow K, 1962). Panel data and random model are used to study the impact of science and technology incentive policies on R&D input-output(Zhu Pingfang et al., 2003). Government subsidies have a u-shaped effect on enterprises' scientific and technological innovation activities (Zhou Ming et al., 2017). Through

empirical analysis, this paper analyzes and calculates the performance of fiscal and tax policies supporting independent innovation in China, and puts forward policy Suggestions to optimize fiscal and tax support(Jia jia, 2017). In the different development stages of the enterprise life cycle, the government subsidy effect in the seed stage is the most significant(Gao Song et al., 2011). A performance evaluation system based on four aspects of economic benefits has been established(Jiang Hui et al., 2017). This paper studies the innovation driving factors of small and medium-sized science and technology enterprises by multi-case method(Su Jin et al., 2104). The -DSPE model is refined, which is the mechanism model of government support behavior affecting innovation performance of SMEs (Zheng ye et al., 2017). However, among the numerous studies, there is still room for research on the evaluation of the innovation efficiency of small and medium-sized science and technology enterprises by financial support policies, and the corresponding performance evaluation methods and mechanisms need to be improved. Therefore, this paper collects authoritative network data sources released by Sichuan provincial government departments by hand, and discusses the impact of financial support policies on the innovation performance of small and medium-sized science and technology enterprises in combination with Sichuan statistical yearbook, and puts forward the optimization path of financial support policies on the basis of empirical analysis.

### 3 Research Design

#### 3.1 Research methods and models

The performance level of financial support policies is a proportional relationship with the goal of improving the scientific and technological innovation capability, the investment index of fund projects, procurement policies, tax incentives and other policies of all levels of government, and the output index of innovation results. Under the existing financial support policy, the more innovative output results, the higher the performance of the financial support policy; At the same level of innovation output, the lower the investment in support policies, the higher the performance of financial support policies. Data envelopment analysis, DEA) is an effective method to evaluate the relative effectiveness of multi-index input and multi-index output. For the effectiveness evaluation of most similar decision-making units with input and output, it is superior to avoid the main factors and simplify the algorithm. This

$$\left\{ \begin{array}{l} \min \quad \theta e - \varepsilon \left( e^{\wedge T} s^- + e^T s^+ \right) = V_{D_\varepsilon} \\ s.t. \quad \sum_{j=1}^n x_j \lambda_j + s^- = \theta x_{j_0}, \\ \quad \quad \sum_{j=1}^n y_j \lambda_j - s^+ = y_{j_0}, \\ \quad \quad \lambda_{j_0} \geq 0, \quad j = 1, 2, \dots, n, \\ \quad \quad s^- \geq 0, \quad s^+ \geq 0, \end{array} \right.$$

empirical study adopts the super-efficiency model of DEA method. Compared with the traditional CCR or BCC model, the super-efficiency DEA model can further analyze the efficient decision-making units. Suppose that the input and output data are  $(x_j, y_j)(j = 1, 2, \dots, n)$  The mathematical form of the super-efficient DEA model is as follows:

Among them,  $s^-$  is the relaxation variable,  $s^+$  is the residual variable.  $\varepsilon$  is a non-Archimedes infinitesimal and the optimal solution of linear programming is  $\lambda^0, s^{-0}, s^{+0}, \theta^0$ .

### 3.2 Variable analysis

The evaluation of innovation efficiency is a complicated and comprehensive process. The index evaluation system includes two aspects: innovation input and innovation output.

#### 3.2.1 Financial support policy input indicators

The following three indicators are selected as indicators of financial support policy input. (1) Financial allocations for science and technology. Financial science and technology appropriation is the most important way for financial revenue to support enterprises to carry out independent innovation activities, accounting for about 2% of public financial expenditure in Sichuan Province. Therefore, financial science and technology appropriation is selected to represent the level of policy input. (2) research and development expenditure. Research and development expenditure is the use of government funds to fund research and development activities of enterprises, to provide financial guarantee for research and development activities of enterprises, and to play a role in stimulating and guiding research and development expenditure of the whole society. Referencing the practice of existing documents, R&D funds are used to express innovation input. (3) the scale of government procurement for small and medium-sized technological enterprises. As an administrative act, the scale of government procurement is manifested in supporting the independent innovation activities of small and medium-sized enterprises, improving the independent innovation level of enterprises, and promoting enterprises to embark on an innovation-driven development path (Bai Yanfeng et al., 2012). The government directly supports and encourages the development of some key industries, not only plays a guiding role in industrial structure adjustment and scientific and technological innovation, but also is an important means to make up for market demand risk defects. Therefore, the government procurement scale of small and medium-sized scientific and technological enterprises is selected as the input index.

#### 3.2.2 Financial support policy output indicators

The following three indicators are selected as output indicators of fiscal support policies. (1) Number of patent applications. Patents are generally regarded as the direct result of technological innovation and an important manifestation of enterprises' ability to break through core technologies. In this empirical study, the application volume of invention patents of small and medium-sized science and technology enterprises is selected as the output index, which reflects the ability of enterprises to use external resources to carry out independent innovation activities and eliminates the interference of government approval behavior. (2) Number of small and medium-sized technological enterprises. The growth of the number of small and medium-sized science and technology enterprises is an important indicator that directly reflects the effect of government financial support and can make up for

the shortage of patents in measuring innovation output. (3) High-tech output value. Considering the important role of scientific and technological innovation in small and medium-sized scientific and technological enterprises and the actual effect of input factors, high-tech output value is selected to represent the economic effect of policy input and the market value of innovation results. The problems described in this paper have 6 decision-making units, 3 input indicators and 3 output indicators. The specific meanings of the indicators are shown in Table 1.

**Table 1 Table on Selection of Input-Output Variables for Innovation Performance**

Indicators	Indicator meaning	Indicator code	Indicator unit
Input index	Financial allocations for science and technology	$x_1$	Calculate/ hundred million=100M
	Government R&D funds	$x_2$	100M
	Small and Medium-sized Enterprises Government Purchasing Scale	$x_3$	100M
Output indicator	Patent application	$y_1$	number
	Number of small and medium-sized technological enterprises	$y_2$	Ten thousand
	High-tech output value	$y_3$	100M

### 3.2.3 Research objects and data

The empirical research is mainly based on the contents involved in the evaluation indicators of Sichuan Province from 2011 to 2017, evaluates the impact of Sichuan Province's financial support policies on the innovation performance of small and medium-sized science and technology enterprises, and proposes policy optimization paths. The data comes from the Sichuan Statistical Yearbook, an authoritative data source published on the official websites of the Sichuan Provincial Science and Technology Department, the Finance Department, the Industry and Commerce Bureau, the Intellectual Property Office and other competent departments.

## 4 Results

Using super-efficiency DEA model and Max DEA software to solve the linear programming, the evaluation results of Sichuan province's financial support policies on the innovation performance of small and medium-sized science and technology enterprises are obtained. The evaluation results after sorting are shown in Table 2. The evaluation results show that, from 2011 to 2017, Sichuan financial support technology-based SMEs have performed well in innovation performance, with an average comprehensive efficiency of 1.1063. The average value of pure technical efficiency and scale efficiency are 1.2608 and 0.8775 respectively. The performance of scale efficiency is obviously lower than pure technical efficiency. This also shows that while further improving the innovation ability and management level of financial support for small and medium-sized science and technology enterprises, we should focus on breaking through the short board of scale management and allocate reasonable support funds according to the characteristics of small and medium-sized science and technology enterprises at different stages of development. We should not only avoid the shortage of funds, but also prevent the problem of excessive investment of funds.

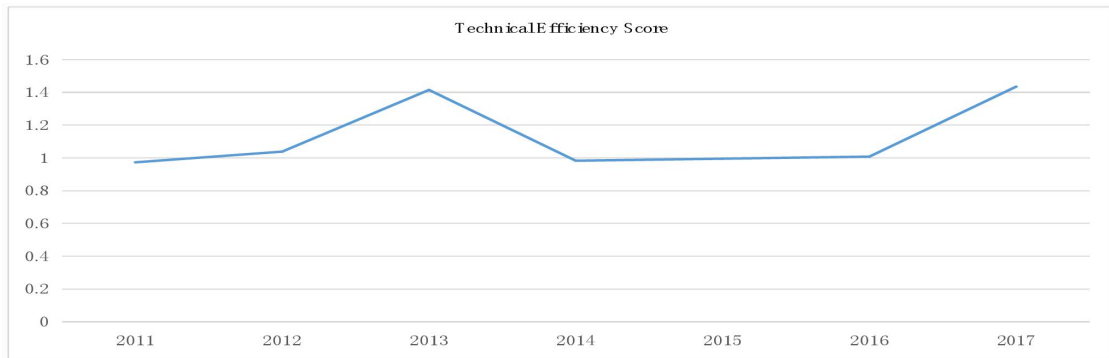
**Table 2 Results of Innovation Performance Evaluation from 2011 to 2017**

	Overall Efficiency (CRS)	Pure Technical Efficiency (VRS)	Scale Efficiency Score	RTS
2011	0.9734	1.2712	0.7657	Increasing
2012	1.0388	1.0729	0.9683	Increasing
2013	1.4153	2.4259	0.5834	Decreasing
2014	0.9832	0.9839	0.9993	Decreasing
2015	0.9958	1.2769	0.7798	Decreasing
2016	1.0084	1.011	0.9975	Decreasing
2017	1.4356	1.2049	1.1914	Decreasing
Mean value	1.1063	1.2608	0.8775	

### 4.1 Comprehensive efficiency analysis

As can be seen from fig. 1, the overall efficiency of financial support for innovation of small and medium-sized science and technology enterprises is fluctuating upward. In 2011, the score was the lowest, but it also reached 0.9734, which was close to the DEA effective level. After reaching the first peak of 1.4153 in 2013, there was a certain decline, but then it stabilized and rebounded. The efficiency climbed year by year, reaching a score of 1.4356 in 2017, which was the maximum value during the study period. This shows that the financial

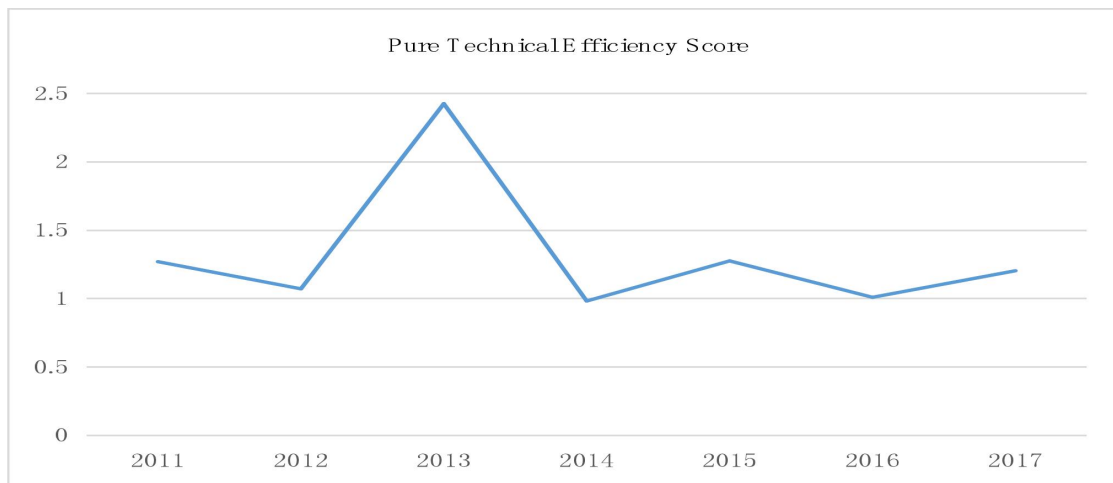
support for small and medium-sized science and technology enterprises in Sichuan Province has made steady progress and achieved relatively ideal results.



**Figure 1 Comprehensive Efficiency of Sichuan Province's Financial Support for Innovation of Small and Medium-sized Science and Technology Enterprises from 2011 to 2017**

#### 4.2 Pure technical efficiency analysis

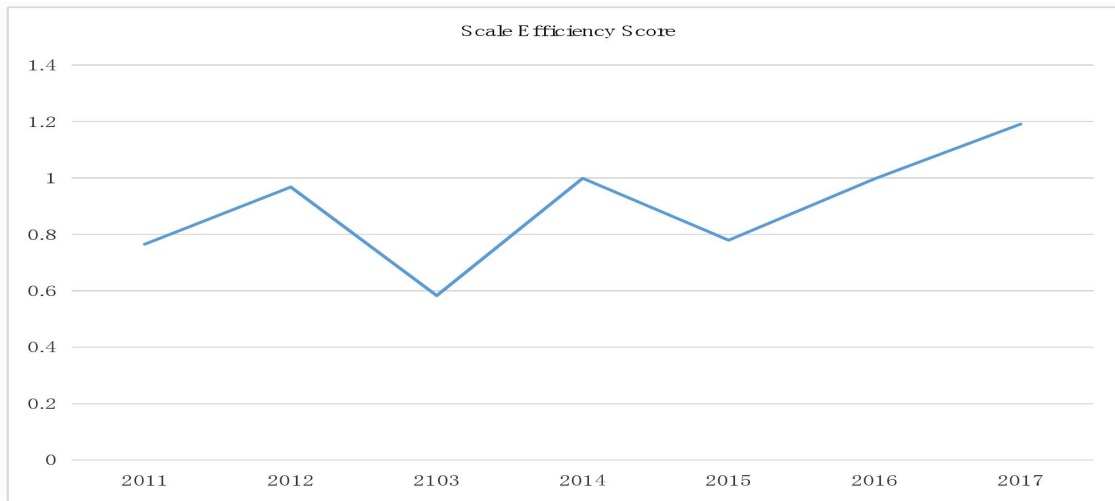
As can be seen from fig. 2, in terms of pure technical efficiency of financial support for innovation of small and medium-sized science and technology enterprises, the performance in other years is basically the same except for 2013, which fluctuates within a narrow range among communities, and only scored slightly less than 1 in 2014, while the other years are all greater than 1. This shows that Sichuan Province has performed well in creating a good environment for entrepreneurship development, scientific management and use of supporting funds.



**Figure 2 Pure Technical Efficiency of Sichuan Province's Financial Support for Technological SMEs' Innovation from 2011 to 2017**

### 4.3 Scale efficiency analysis

Scale efficiency measures whether the current scale is in an optimal state. The smaller the scale efficiency, the greater the deviation from the optimal scale. As can be seen from fig. 3, although the scale efficiency of Sichuan province's financial support for technological SMEs' innovation is not high, the overall trend is fluctuating and rising. During the research period, it has been greatly improved, indicating that the scale of financial expenditure is gradually rationalized.



**Figure 3 Scale Efficiency of Sichuan Province's Financial Support for Technological SMEs' Innovation from 2011 to 2017**

### 4.4 Projection analysis

In order to further find the causes of poor efficiency performance in low-efficiency years, explore the situation of input redundancy and output insufficiency in that year, and provide specific suggestions and improvement schemes for decision makers to improve efficiency, projection analysis is further carried out on the three years of efficiency loss in 2011, 2014 and 2015, and Table 3 is compiled according to the calculation results of Max DEA software. As can be seen from Table 3, the situation in these three years is relatively similar. Among the input factors, government research and development funds have the greatest room for improvement and the most serious losses, reaching 26.68% in 2011. It means that at the level of innovation scale in that year, the relative redundancy of government R&D investment is the biggest reason for low innovation efficiency. Among the output factors, the number of patents authorized and the number of small and medium-sized scientific and technological enterprises have the greatest room for improvement, with the number of patent applications improving by 34.54% in 2011. This shows that the number of small and medium-sized scientific and technological enterprises in Sichuan Province in 2011 is relatively small and the

scientific research achievements are relatively scarce, resulting in an unreasonable output ratio. Therefore, we should focus on improving performance by effectively using government research and development funds, encouraging innovation and entrepreneurship, and encouraging invention and creation.

**Table 3 Input-output Projection Analysis in Low Efficiency Years**

	Input redundancy rate			Output insufficiency rate		
	Financial allocations for science and technology	Government R&D funds	Small and Medium-sized Enterprises Government Purchasing Scale	Number of patent applications	Number of small and medium-sized technological enterprises	High-tech output value
In 2011	2.66%	26.68%	2.66%	34.54%	14.70%	2.66%
In 2014	1.68%	6.72%	1.68%	31.28%	16.01%	1.68%
In 2015	0.42%	2.90%	0.42%	22.69%	9.13%	0.42%

Note: according to the calculation results of Max DEA software.

## 5 Conclusion

Through this empirical study, the following conclusions can be drawn: the overall innovation performance level of Sichuan science and technology SMEs in 2012-2013 and 2016-2017 is relatively ideal, and the allocation of financial policies is relatively effective in 2013 and 2017. However, in 2011, 2014 and 2015, the allocation of resources is relatively poor due to scale factors, and the problems of input redundancy and insufficient output are obvious, resulting in low overall innovation efficiency. Through further analysis of non-DEA effective annual projections, it is found that the reason for relative redundancy at the current scale level is that the allocation ratio among financial science and technology allocation, government R&D investment and government procurement scale of small and medium-sized enterprises is unreasonable. On the basis of reducing government R&D funds, financial investment should appropriately increase financial science and technology allocation and government procurement scale of small and medium-sized enterprises to obtain more output. Based on the above evaluation results, the targeted optimization path is put forward from four aspects: strengthening precision cultivation, establishing fault tolerance and error correction mechanism, improving innovation and entrepreneurship ecology, and developing together with points and areas.



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# Prediction Model of Energy Development Trend Based on SVM

Lin Hui

School of Science, Wuhan University of Technology, Wuhan 430070, P. R. China

(E-mail: 463600152@qq.com)

**Abstract:** Increasingly serious energy problems require people to improve the utilization efficiency of renewable energy. In this paper, we study the problem of predicting the energy development trend in China. Concretely, we establish a prediction model of energy development trend based on support vector machine (SVM), and use the genetic algorithm (GM) to solve this model. Moreover, according to the data of energy utilization in the year from 2007 to 2017, we make an empirical analysis by using this prediction model and obtain the prediction result of energy development trend, that is, the share of coal in energy use is declining, and the proportion of oil and natural gas and other new energy sources are rising.

**Key words:** Energy development; Trend prediction; SVM; GM

## 1 Introduction

In order to achieve the social goals of economic development, China has adopted a series of measures including vigorous development of renewable energy to improve the supply of resources. Strengthening the development and utilization of renewable energy is the main method to cope with the increasingly serious energy and environmental problems, and is also an important way for human society to achieve sustainable development (Wang, 2008; He, 2013). As an important part of renewable energy, biomass energy comes from all organic substances formed by photosynthesis directly or indirectly using green plants, including animals, plants, microorganisms, and excreta and metabolites produced by these organisms (Dunjic et al., 2016; Zhong et al., 2019). The biomass suitable for energy use is generally divided into four types: agricultural biomass, forestry biomass, livestock manure, municipal waste and wastewater (Tsai et al., 2017). By analyzing China's energy structure in recent years, we introduced the current energy use situation and determined the development trend of energy utilization by predicting the utilization of major energy sources in the next few years.

There are many methods for predicting time series on energy sources. For example, the AR(p) model is proposed to predicting the energy consumption structure (Sohrabi and Zarepour, 2019), and the AR(q) Nonlinear Regression Models (Liu and Wei, 2004) and the ARMA(p, q) model (Kocak, 2017) are established to predict the energy development trend. These models are more suitable for linear prediction, and not suitable for nonlinear time series prediction. For solve this problem, neural network technology provides a powerful tool for nonlinear time series prediction. The EU energy system is analyzed by means of artificial neural networks (Damir et al., 2019). The recurrent neural network model is presented to forecast the electric energy consumption based on the traditional neural network model (Zagrebina et al., 2019). However, the conventional neural network has some defects such as local minimum and lack of theoretical guidance for the number of nodes in the hidden layer network, which weakens their prediction ability. Therefore, in this paper, we establish a prediction model energy

development trend based on SVM (Xu et al., 2019), and the method of GA (Shojaedini et al., 2019) is used to automatically search and determine the parameters through genetic optimization for the prediction of energy use in China.

## 2 Data Collection and Preprocessing

The energy classification mainly includes renewable energy and non-renewable energy. The biomass energy we studied is contained in renewable energy. China is a country with a large energy consumption. The main energy sources are coal, oil and gas, and some new energy sources are gradually expanding, including nuclear energy, wind energy, hydropower and biomass.

We extracted China's energy consumption in the China Statistical Yearbook <sup>37</sup> from 2007 to 2017 and unified the dimensions as shown in Table 1.

We will show China's energy utilization from 2013 to 2017 in Table 2.

From Table 2, we can see that among the energy used in China, coal accounts for about 60% of the total, oil accounts for about 20%, natural gas accounts for about 5%, and the rest of the energy accounts for about 15%. In the process of continuous development, the proportion of coal energy continues to decrease, and the proportion of oil, natural gas and other new energy sources continue to increase.

**Table 1 The Use of Energy (Unit: Ten Thousand Tons of Standard Coal)**

Year	Total amount	Coal	Petroleum	Gas	Other
2007	311442.0	225795.5	52945.1	9343.3	23358.2
2008	320611.0	229236.9	53542.0	10900.8	26931.3
2009	336126.0	240666.2	55124.7	11764.4	28570.7
2010	360648.0	249568.4	62752.8	14425.9	33900.9
2011	387043.0	271704.2	65023.2	17804.0	32511.6
2012	402138.0	275464.5	68363.5	19302.6	39007.4
2013	416913.0	280999.4	71292.1	22096.4	42525.1
2014	425806.0	279328.7	74090.2	24270.9	48116.1
2015	429905.0	273849.5	78672.6	25364.4	52018.5
2016	435819.0	270207.8	80626.5	27020.8	57963.9
2017	449000.0	271196.0	84412.0	31430.0	61962.0

<sup>37</sup><http://www.stats.gov.cn/tjsj/ndsj/2018/indexch.htm>

**Table 2 Energy Use Ratio**

Year	Coal (%)	Oil (%)	Natural gas (%)	Other (%)
2017	60.4	18.8	7.0	13.8
2016	62.0	18.5	6.2	13.3
2015	63.7	18.3	5.9	12.1
2014	65.6	17.4	5.7	11.3
2013	67.4	17.1	5.3	10.2

### 3 Energy Development Trend Prediction

#### 3.1 The prediction model based on SVM

The impact of different parameters of support vector machine (SVM) model (Xu et al., 2019) on the power load forecasting was studied, and a short-term power load forecasting system was studied with SVM model whose parameters were optimized by genetic algorithms. The parameters for SVM model were determined through genetic algorithms to get the optimum parameter values, and these parameter values were used in the SVM model and genetic algorithm-support vector machine (GA-SVM) model was obtained, which was used to make short power load forecasting.

For the training sample set  $(x_i, y_i)$  (where  $i=1, 2, \dots, n$ ;  $x_i \in R_n$ , is the input variable;  $y_i \in R$ , which is the corresponding output value). The basic idea of support vector machine regression theory is to find a nonlinear mapping  $\varphi$  from the input space to the output space. Through this nonlinear mapping, the data  $x$  is mapped to a high-dimensional feature space  $F$ . And linear regression is performed in the feature space with the following estimation function:

$$f(x) = [\omega \times \varphi(x)] + b \quad (1)$$

$$\varphi: R^m, \omega \in F \quad (2)$$

where  $b$  is the threshold. The function approximation problem is equivalent to the following function:

$$R_{reg}(f) = R_{emp}[f] + \lambda \|\omega\|^2 = \sum_{i=1}^s C(e_i) + \lambda \|\omega\|^2 \quad (3)$$

where  $R_{reg}[f]$  is the objective function;  $s$  is the number of samples;  $\lambda$  is the adjustment constant;  $C$  is the error penalty factor;  $\|\omega\|^2$  reflects the complexity of  $f$  flatness in high-dimensional space. Considering that the linear  $\varepsilon$  insensitive loss function has good sparsity, the following loss function can be obtained.

$$|y - f(x)| = \max \{ 0, |y - f(x) - \varepsilon| \} \quad (4)$$

The empirical risk function is:

$$R_{emp}^\varepsilon[f] = \frac{1}{n} \sum_{i=1}^n |y - f(x)| \quad (5)$$

According to statistical theory, the support vector machine determines the regression function by minimizing the following objective functions:

$$\min \left\{ \frac{1}{2} \|\omega\|^2 + C \sum_{i=1}^n (\xi_i^* + \xi_i) \right\} \quad (6)$$

$$y_i - \omega \cdot \varphi(x) - b \leq \varepsilon + \xi_i^*$$

$$\omega \cdot \varphi(x) + b - y_i \leq \varepsilon + \xi_i$$

$$\xi_i, \xi_i^* \geq 0$$

where  $C$  is the weight parameter used to balance the model complex term and the training error term;  $\xi_i^*$  and  $\xi_i$  are relaxation factors;  $\varepsilon$  is the insensitive loss function. This problem can be translated into the following dual problem:

$$\max \left[ -\frac{1}{2} \sum_{i,j=1}^n (a_i^* - a_i)(a_j^* - a_j) K(X_i, X_j) + \sum_i a_i^* (y_i - \varepsilon) - \sum_{i=1}^n a_i (y_i - \varepsilon) \right] \quad (7)$$

$$\sum_{i=1}^n a_i = \sum_{i=1}^n a_i^*$$

$$0 \leq a_i^* \leq C$$

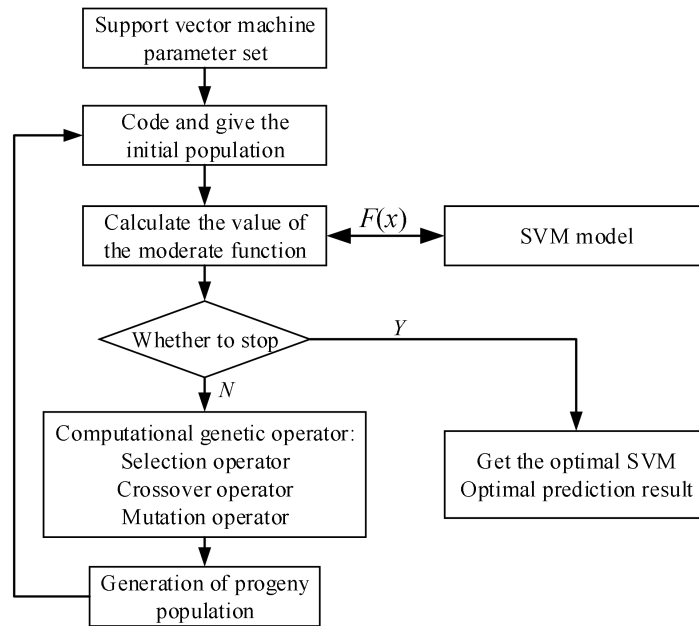
$$0 \leq a_i \leq C$$

By solving the above problem, we can get the support vector machine regression function:

$$f(x) = \sum_{i=1}^n (a_i - a_i^*) K(X_i, X) + b \quad (8)$$

### 3.2 Solving model by GA

We combine genetic algorithm (Shojaedini et al., 2019) and support vector machine (GA-SVM) to propose a method for automatic selection of support vector machine parameters. The relationship between different choices and prediction accuracy is obtained by various parameters, so as to find out the relationship between prediction accuracy and parameters, and reduce the complexity of calculation. The steps of model establishment are shown in Figure 1 as follows.



**Figure 1 Operating Flow Diagram of GA-SVM**

Through the above methods, we forecast China's main energy use, and derive the consumption of coal, oil, natural gas and other energy sources from 2018 to 2023 and the proportion of total energy. The forecast result is shown in Table 3.

By the empirical analysis of the prediction model above, we obtain the prediction result of energy development trend, that is, the share of coal in energy use is declining, and the proportion of oil and natural gas and other new energy sources is rising.

**Table 3 The Forecast Result**

Year	Coal (%)	Oil (%)	Natural gas (%)	Other (%)
2023	48.77	20.90	9.84	20.30
2022	50.56	20.60	9.18	19.60
2021	52.56	20.30	8.68	18.40
2020	54.53	20.00	8.20	17.20
2019	56.48	19.70	7.72	16.10
2018	58.39	19.30	7.27	15.00

## 4 Conclusion

In this paper, we established an optimization model for predicting the energy development trend based on SVM and GA, and make an empirical analysis of this prediction model according to the the data of energy utilization in the year from from 2007 to 2017. From the prediction results, we provide the following principles, directions and policy suggestions for the future development and utilization of

biomass energy in China on the basis of comprehensive consideration of China's national conditions, agricultural conditions and resource characteristics.

(1) Principles of development and utilization. We should adapt measures to local conditions and take the road of diversified development. Biomass energy is a structural system composed of biogas, crop straw, solidified, gasified and carbonized forest product and liquid biomass fuel, among which liquid biomass fuel can be divided into corn, rapeseed and potato. In short, the biomass raw materials and the products are diverse. China's natural conditions are complex. To achieve integration with rural economic development, China's biomass energy industry must follow the path of diversification of raw materials and products and adapting to local conditions.

(2) Development and utilization direction. Biogas engineering, biomass carbonization technology etc. are the main directions for the development and utilization of biomass energy in China in the future. Biogas refers to organic matter that undergoes microbial fermentation under anaerobic conditions to produce a methane-based combustible gas. The operation mechanism of the biogas industry is to use waste from rural production and living processes to produce biogas, biogas slurry and biogas residue through anaerobic reaction of biogas digesters, and then use them in all aspects of production and life to form a benign Industrialization cycle chain. China's biogas production resources are very rich. In addition to livestock and poultry manure, straw and rural organic waste, the relative concentration of organic waste produced by agricultural product processing and bioenergy processing, as well as urban organic waste, will increase. Modern biogas production, processing and application are an emerging direction of biogas projects compared to traditional rural biogas digesters, and their prospects cannot be estimated. Modern biogas production and processing technologies and facilities, power stations, gas stations and vehicles using biogas, as well as commercial operating systems have matured. While consolidating, developing and improving the production and application of traditional biogas, China will focus on introducing and developing industrialized and large-scale modern biogas production and application technologies to increase commodity rates.

(3) Biomass carbonization technology. Biomass carbonization refers to the process of producing biomass and by-products through a certain process and chemical reaction. Biomass carbonization not only saves energy, but also effectively utilizes resources, turns biomass into treasure from waste, and effectively solves the three problems in rural areas, improves the living conditions of farmers, improves the quality of life, and narrows the gap between urban and rural areas. It has accelerated the pace of building a new socialist countryside in China, and it has opened up new avenues for the use of energy in China.

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## A Ranking for the Sustainable Development Goals Focusing on the 5Ps

Arnoldo de Hoyos Guevara, Agris L. Dumpe  
Pontifical Catholic University of Sao Paulo, Brazil  
(E-mails: dehayos@pucsp.br, agris.dumpe@grupofolha.com.br)

**Abstract:** Moving strategically toward the 2030 Agenda for Sustainable Development, the UN organized a Sustainable Development Solutions Network (UNSDSN) and a Platform (HLPF) in order to harness the so-called Data Revolution that could help to achieve systemically the 17 Goals, by attaining local and globally the corresponding targets. For this purpose, there is a need to keep joining efforts and know-how to develop an appropriate framework and roadmap. This paper represents a contribution for monitoring the SDG based on the 5Ps People, Planet, Prosperity, Peace and Partnership; by using data from the Iberoamerican Foresight Network Observatory (ORIBER).

**Key words:** RIBER; SDGs; 5Ps; Ranking of countries

### 1 Introduction

There is a great need to consider ways to foster strategic foresight that may help, not only governments, but also the private sector and civil society to get involved collaboratively taking care of the present and future conditions regarding the five key development drivers related to the SDG : People, Planet, Prosperity, Peace and Partnership. On this paper we'll be presenting some of the alternatives going on that may contribute to the High-Level Political Forum (HLPF, 2019) that is the central platform for follow-up and review of the 2030 Agenda for Sustainable Development, based on connecting studies regarding 15 Sustainable Development Challenges developed for the Iberoamerican region and the 5Ps. Our work, being interdisciplinary, may also contribute on harnessing insights regarding Social-Ecological Systems Research for Monitoring Sustainable Development as being developed at the Stockholm Resilience Center by Selomane et al (SELOMANE, 2019), particularly nowadays where think-thanks networks like the Millennium Project and Plataforms may become involved with E-Governance as recommended by the UN(UN, 2018); and already being implemented in places like Estonia (HEATH, 2019).

The SDGs could more easily reached if regionally institutional radars were developed so that farther future-oriented decision-making processes may be more effective. The futures-oriented information research has nothing to do with predictions or incremental trends. Forecasting and trends do not guarantee innovative ideas and disruptive innovation because they analyses the past to predict the future and relies on continuity. The landscape of analysis is now more volatile, uncertain, complex and ambiguous (VUCA) and needs disruptive answers that require anticipatory and collective intelligence systems. Actually the UN Inter-Agency and Expert Group on the SDG Indicators (IAEG-SDGs<sup>38</sup>) may be moving in that direction using new dashboards, frameworks and cross matrixes approaches, particularly now with the UNSDN fostering a Data Revolution (UNSDN, 2019), and the strong support of Jeffrey Sachs and the Sustainable Development Solutions Network (SACHS,2018).

Actually and as mentioned by Weitz (WEITZ, 2017), the Stockholm Environmental Institute (SEI) has being working in developing a practical approach for gaining a systemic and contextual perspective on the SDGs, that may help to understand interactions, synergies and trade-offs among them and hence strategically become more systemically efficient; and as indicated at SEI <sup>39</sup>: *How the Sustainable Development Goals (SDGs) interact with each other is a key question in the implementation of the 2030 Agenda. Understanding these interactions is vital for prioritizing action and anticipating knock-on effects.* This kind of approach has already being tried focusing implementing the 2030 Agenda in Latin America by the independent Research Forum IRF (BARKET, 2017).

### 2 The Iberoamerican Foresight Network - RIBER

A few years ago ( 2014 ) an Iberoamerican Foresight Network – RIBER<sup>40</sup> was started, as regional subgroup of the Millennium Project Think-Thank, with the purpose of joining forces helping the

<sup>38</sup> <https://unstats.un.org/sdgs/iaeg-sdgs/>

<sup>39</sup> <https://www.sei.org/projects-and-tools/projects/disentangling-interactions-sustainable-development-goals/>

<sup>40</sup> <https://www.pucsp.br/catedrainacysachs/riber.html>

Iberoamerican Region to overcome development hardships seeking new ways to foster Sustainable Development, something that Jorge Máttar from CEPAL was also starting doing together with Daniel Perroti from ILPES at that time; and more recently (2016) these two organizations organized an International Course on Strategic Foresight for dealing with the UN SDGs consisting basically in: Defining the Problem and identifying the relevant variables concerning the structural system; develop alternative scenarios; and design and build up a strategic foresight sustainable development model. Moreover actually already a year before UN SDGs were defined, the RIBER had build up an Observatory (ORIBER<sup>41</sup>) and was working on this kind of model based on 15 SDGs (GPS), somehow related to the 17 UN SDGs as we are going to show next and applying to 132 countries divided into 3 Regions: Iberoamerican (AIBER, 21 countries) Advanced Economies (AVECO, 27 countries) and Others (OTHERS, 84 countries)

SDGs Ranking of Countries based on the GPS through the 5 P's of Sustainable Development Goals (SDGs).

The first step was to relate the RIBER 15 SDGs to the 17 UN SDGs as shown in the following Table 1.

**Table 1 Relating the RIBER 15 SDGs with the UN 17 SDGs**

RIBER 15 SDGs	UM 17 SDGs
1 Basic Resources: Water, Food, Energy	SDG 1, SDG 2, SDG 6, SDG 7, SDG 12, SDG 14
2 Shelter	SDG 11
3 Security and Peace	SDG 16
4 Health and Environment	SDG 3
5 Inequalities and Gender Social Inclusion	SDG 5, SDG 10
6 The Future of Work and Education	SDG 4, SDG 8
7 Productive Transformation and Sustainable Innovation	SDG 9
8 Integration and Strategic Alliances	SDG 17
9 Longevity Trends	SDG 3
10 Climate Change and Renewable Energies	SDG 13
11 Biodiversity: Natural and Social Capital	SDG 15
12 Resilience	SDG 11
13 Democracy and Social Networks	SDG 8, SDG 16
14 Decocracy and Social Networks	SDG 16
15 Well-Being and Quality of Life	SDG 2, SDG 3, SDG 4, SDG 16

And also to relate the RIBER 15 SDGs with the synthetic UN 5Ps

- P1. PEOPLE - End poverty and hunger in all forms and ensure dignity and equality.
- P2. PLANET - Protect our planet's natural resources and climate for future generations.
- P3. PROSPERITY - Ensure prosperous and fulfilling lives in harmony with nature.
- P4. PEACE – Foster peaceful, just and inclusive societies
- P5. PARTNERSHIP - Implement the agenda through a solid global partnership

As shown in the following Table 2

**Table 2 Relating the RIBER 15 SDGs to the UN 5 Ps**

RIBER 15 SDGs	UM 17 SDGs
1 Basic Resources: Water, Food, Energy	P1, P2
2 Shelter	P1, P2
3 Security and Peace	P1, P3, P4
4 Health and Environment	P1, P2, P5
5 Inequalities and Gender Social Inclusion	P1, P3, P4, P5
6 The Future of Work and Education	P1, P3
7 Productive Transformation and Sustainable Innovation	P2, P5
8 Integration and Strategic Alliances	P1, P5
9 Longevity Trends	P1
10 Climate Change and Renewable Energies	P1, P2
11 Biodiversity: Natural and Social Capital	P1, P2, P3
12 Resilience	P1
13 Democracy and Social Networks	P1, P3

<sup>41</sup> <https://www.pucsp.br/catedraignacysachs/oriber.html>

14 Decocracy and Social Networks	P1, P3, P4,P5
15 Well-Being and Quality of Life	P1, P2, P3

Using these ideas it was possible, using multivariate analysis based on information( hundreds of variables for 132 countries ) regarding the **RIBER 15SDGs** to build up a **Global SD Ranking** that allows in particular, to see how is The Iberoamerican Region – AIBER ( 21 Countries) doing when compared to a group of Advanced Economy Countries – AVECO ( 27 Countries) and Other Countries – OTHER ( 84 Countries ). The greatest difference among AVECO and the other two groups as may be seen in Fig. 3 clearly being regarding Partnership and in particular, Peace as it was to be expected and would need a special care.

A linear Model was built for each of the SDG 5Ps, by using Principal Component Analysis ( PCs ) and Stepwise Regression, to select a give weights to the variables involved ( Vars ) that give raise to New Indicators( Nis ), find levels of simliarity ( Fig. 1 ) and build up rankings as shown in thenext tables.

$$NI = \sum_{PC1}^{PCn} PCn * ((R-Sq * Var 1) + (R-Sq * Var 2) + \dots + (R-Sq * Var n))$$

NI = New Indicator

PC = Eigenvalue of principal component

R-SQ = Corresponding R<sup>2</sup> on the Variable on the Stepwise Regression

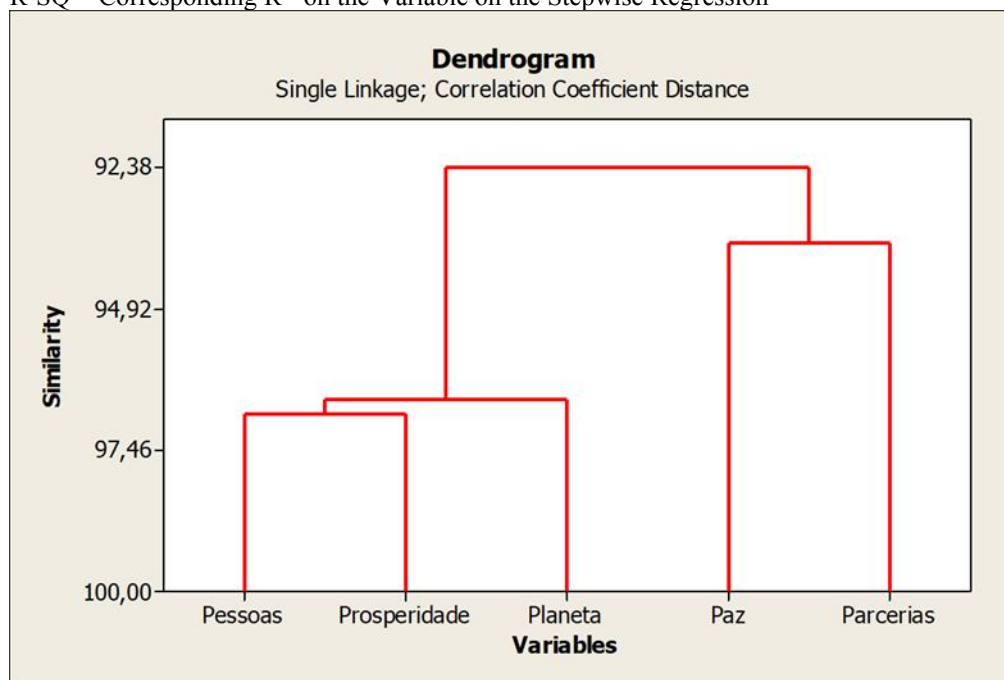


Figure 1 Relationships among the 5 Ps

Table 3 People Ranking

BEST 10			WORST 10		
Country	Ranking	Region	Coountry	Ranking	Region
New Zealand	100	AVECO	Iraq	19	OTHERS
Canada	99	AVECO	Pakistan	17	OTHERS
Iceland	97	AVECO	Nigéria	16	OTHERS
Norway	97	AVECO	Sudan	12	OTHERS
Denmark	96	AVECO	Burundi	12	OTHERS
Australia	96	AVECO	Guine	12	OTHERS
Switzerland	96	AVECO	Yemen	11	OTHERS
Netherlands	95	AVECO	Angola	11	OTHERS
Finland	94	AVECO	Centr.Afri.Rep.	6	OTHERS
Sweden	94	AVECO	Chad	0	OTHERS

Note. For Building the Model for People Ranking were used 5 Synthetic Indicators: Estimated GNI per capita Female, Estimated GNI per capita Male, IDH, GINI index e Social Progress Index; and other 23 other Variables: Maternal mortality rate, Stillbirth rate, Child mortality rate, Deaths from infectious diseases, Life expectancy, Non-communicable disease deaths between the ages of 30 and 70, Obesity rate, Suicide rate, Women treated with respect, Tolerance for immigrants, Tolerance for homosexuals, Discrimination and violence against minorities, Religious tolerance, Health expenditure, public, External resources for health, Gender Inequality Index Value, Share of seats in parliament, Life expectancy at birth Female, Life expectancy at birth Male, Mean years of schooling Female, Mean years of schooling Male, Expected years of schooling Female, Expected years of schooling Male.

**Table 4 Planet Ranking**

<b>BEST 10</b>			<b>WORST 10</b>		
<b>Country</b>	<b>Ranking</b>	<b>Region</b>	<b>Country</b>	<b>Ranking</b>	<b>Region</b>
Switzerland	89	AVECO	Mozambique	9	OTHERS
Norway	87	AVECO	Madagascar	8	OTHERS
France	87	AVECO	Niger	7	OTHERS
Australia	87	AVECO	Congo Rep.	7	OTHERS
Sweden	87	AVECO	Chad	6	OTHERS
Canada	86	AVECO	Benin	6	OTHERS
Germany	86	AVECO	Ghana	5	OTHERS
Japan	85	AVECO	Tanzania	1	OTHERS
Czech Rep.	85	AVECO	Togo	0	OTHERS

Note. For Building the Model for People Ranking were used 5 Synthetic Indicators: EV - Water Resources, EV – Agriculture, EV – Forests, EV – Fisheries, Ocean Health Index Score; and other 18 Variables: Access to piped water, Rural vs. urban access to improved water source, Access to improved sanitation facilities, Availability of affordable housing, Access to electricity, Quality of electricity supply, Indoor air pollution attributable deaths, Outdoor air pollution attributable deaths, Greenhouse gas emissions, Water withdrawals as a percent of resources, Biodiversity and habitat, Renewable internal freshwater resources per capita, Electric power consumption, Alternative and nuclear energy, Combustible renewables and waste, Fossil fuel energy consumption, Population growth, Population total.

**Table 5 Prosperity Ranking**

<b>BEST 10</b>			<b>WORST 10</b>		
<b>Country</b>	<b>Ranking</b>	<b>Region</b>	<b>Country</b>	<b>Ranking</b>	<b>Region</b>
Norway	100	AVECO	Laos	10	OTHERS
Sweden	99	AVECO	Tajikistan	10	OTHERS
Netherlands	98	AVECO	Rwand	10	OTHERS
Finland	97	AVECO	Sudan	9	OTHERS
New Zealand	95	AVECO	Guinea	8	OTHERS
Canada	93	AVECO	Mauritania	5	OTHERS
Iceland	93	AVECO	Pakistan	4	OTHERS
Switzerland	92	AVECO	Centr.Afr.Rep.	4	OTHERS
Denmark	92	AVECO	Iraq	4	OTHERS
South Korea	90	AVECO	Chad	0	OTHERS

Note. For Building the Model for Prosperity Ranking were used 6 Synthetic Indicators: Well-being, Political rights, Freedom of movement, Freedom of religion, Modern slavery human trafficking and child marriage, Inequality in the attainment of education; and other 16 variables: Adult literacy rate, Primary school enrollment, Lower secondary school enrollment, Upper secondary school enrollment, Mobile telephone subscriptions, Internet users, Press Freedom Index, Freedom of speech, Private property rights, Freedom over life choices, Satisfied demand for contraception, Years of tertiary schooling, Women's average years in school, Number of globally ranked universities, Unemployment total, Total Labor Force.

**Table 6 Peace Ranking**

<b>BEST 10</b>			<b>WORST 10</b>		
<b>Country</b>	<b>Ranking</b>	<b>Region</b>	<b>Country</b>	<b>Ranking</b>	<b>Region</b>
Denmark	100	AVECO	Nigeria	10	OTHERS
Finland	99	AVECO	Congo Rep.	10	OTHERS

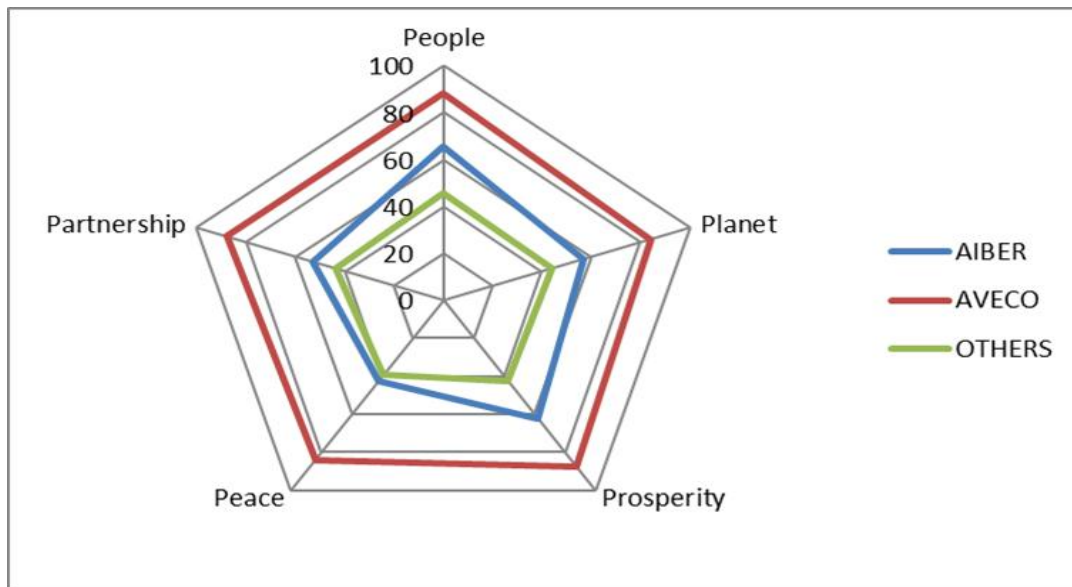
Sweden	98	AVECO	Tajikistan	10	OTHERS
New Zealand	97	AVECO	Venezuela	9	OTHERS
Norway	95	AVECO	Cambodia	8	OTHERS
Switzerland	93	AVECO	Uzbekistan	5	OTHERS
Canada	93	AVECO	Yemen	4	OTHERS
Netherlands	92	AVECO	Chad	4	OTHERS
Australia	92	AVECO	Iraq	4	OTHERS
Iceland	90	AVECO	Sudan	0	OTHERS

**Table 7 Alternative Peace Ranking using the Global Peace Index - GPI**

BEST 10			WORST 10		
Country	Ranking	Region	Country	Ranking	Region
Iceland	100	AVECO	Russia	18	OTHERS
New Zealand	96	AVECO	Central Afr.Rep.	15	OTHERS
Austria	93	AVECO	Dem.Rep.Congo	14	OTHERS
Portugal	91	AVECO	Libya	13	OTHERS
Denmark	90	AVECO	Yemen	12	OTHERS
Canada	89	AVECO	Somalia	9	OTHERS
Czech Rep.	89	AVECO	Iraq	7	OTHERS
Singapore	89	AVECO	South Sudan	4	OTHERS
Japan	88	AVECO	Afghanistan	1	OTHERS
Ireland	88	AVECO	Syria	0	OTHERS

**Table 8 Partnership Ranking**

BEST 10			WORST 10		
Country	Ranking	Region	Country	Ranking	Region
UK	100	AVECO	Uzbekistan	13	OTHERS
Switzerland	100	AVECO	Burundi	13	OTHERS
Sweden	99	AVECO	Mali	13	OTHERS
Canada	98	AVECO	Togo	12	OTHERS
U.S.	97	AVECO	Angola	11	OTHERS
Denmark	96	AVECO	Pakistan	9	OTHERS
Australia	94	AVECO	Yemen	7	OTHERS
Finland	93	AVECO	Venezuela	4	OTHERS
Norway	93	AVECO	Guinea	4	OTHERS
New Zealand	93	AVECO	Sudan	0	OTHERS



**Figure 2 Comparing the 5Ps Using ANOVAs for the 3 Regions**

As may be seen in Figure 2 the greatest differences among AVECO and the other two groups are

clearly Partnership and in particular Peace, as it was to be expected and would need a special care.

### 3 Conclusion

No doubt all 5Ps are basic but it may depend on the region as well as how critical is the timing regarding climate, that the UN Climate Action Summit 2019 that will be working in New York next September 23; as a matter of fact UN Secretary Antonio Guterres is pressing the countries representatives for realistic plans to reduce greenhouse gas emissions by 45% over the next decade, *by means of full transformation of economies in line with sustainable development goal since. uneven growth, rising debt levels, possible upticks in financial volatility, and heightened global trade tensions are hampering progress on reaching the Sustainable Development Goals* (UN,2019). This is reinforced by the Energy Transition Commission (ETC, 2018) very recent report **Mission Possible** declaring that full decarbonization is technically feasible with technologies that already exist and could cost less than 0.5% of Global GDP, but it could take longer due to uneven growth. So there is still some questions like to what extent will the poor countries benefits form the COP24 (BARAKAT, 2019).

The question is if the present geopolitical deglobalizing crisis that is going on, as well as the impacts on local unstable governments, will allow to actually develop and implement Strategic Foresight Planning focusing Sustainable Development, before is too late. This means changing Mind Sets of present day Governance, and perhaps moving into what it is now called Society 5.0, an idea that came from Japan that helps to develop human strengths and values as mentioned by Seiichi Matsuo (MATSUO, 2019), President of Nagoya University, and represents an Advanced Educational approach<sup>42</sup>. For this purpose, some projects like Teach the Future develop by the Futurist Peter Bishop<sup>43</sup> and Transforming the Future by Riel Miller (MILLER, 2018) as well as groups like the Resilience Alliance<sup>44</sup>, the Stockholm Environmental Institute (SEI), and the World Economic Forum (WEF)<sup>8</sup> may be of some help.

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<sup>42</sup> <https://www.globaljapan.world/article/japan-leads-world-in-education-for-society-5-0/>

<sup>6</sup> <http://www.teachthefuture.org>

<sup>7</sup> <http://www.resalliance.org>

<sup>8</sup> <https://www.weforum.org/whitepapers/from-funding-to-financing-transforming-sdg-finance-for-country-success>.

## A Ranking of Countries concerning Progress towards a Society 5.0

Arnoldo José de Hoyos Guevara, Daniela Mary Terra, Jerônimo Henrique Portes,  
José Luiz Alves da Silva, Kallita Ester Magalhães

Pontifical University Catholic of São Paulo, São Paulo, Brazil  
(E-mail:dehoyos@pucsp.br; daniela.terra@hotmail.com; jeronimo.portes@bol.com.br;  
jl.alves@uol.com.br; kallitaester@gmail.com)

**Abstract:** The Fourth Industrial Revolution has arrived, and we are trying to adapt to the innovations. It is changing the way we interact in society, how we consume, live and work. But this agile process already presents a new stage that takes place in conjunction with the new digital age, involving people, technology, sustainability, risks and opportunities: it is the 5.0 Society. This article seeks to understand the impact of ongoing changes and the needs around sustainability, analyzing key indicators that include both movements. With this, we hope to obtain data on the possibility of building the new Sustainable Technology Society, besides investigating the next steps to make this happen in Latin America. In this study, 35 variables were analyzed a sample of 57 countries, including management, business, sustainability, technology, education and Society 5.0 dimensions, among others. We present an analysis of the relationship between the variables and the creation of a synthetic indicator, called SSI (Society 5.0 Index), which allows us to show the position of each country in this ranking. This is the discussion we present here.

**Key words:** Society 5.0; Smart society; Fourth industrial revolution; Industry 4.0; Imagination society.

### 1 Introduction

Society 5.0 is a term used in the Fifth Science and Technology Basic Plan, reviewed by the Japanese Government's Council for Science, Technology and Innovation, and can be defined as a "Society of Intelligence", in which physical space and cyberspace are strongly integrated. Although focused on humanity, 5.0 refers to a new type of society where innovation in science and technology occupies a prominent place, with the aim of balancing social and societal issues that need to be solved, while ensuring economic development (Salgues, 2018).

Recently, Keidanren (Japan Business Federation) has defined Society 5.0 as the "Imagination Society", where digital transformation will be combined with creativity and values to develop a sustainable society. In the Fourth Industrial Revolution, as called by WEF - World Economic Forum (WEF, 2019), we are observing the fusion between distinct scientific worlds, where the discoveries are mixing and building new frontiers. The main subject is that "what makes the Fourth Industrial Revolution fundamentally different from the previous ones is the fusion of these technologies and the interaction between physical, digital and biological domains" (Schwab, 2016).

In this new brave world, we have to learn how to use correctly and fully the capacity of the new developments. It's necessary a correct direction, for example in the IoT, BigData and AI application, where "like other general-purpose technologies, their full effects won't be realized until waves of complementary innovations are developed and implemented" (Brynjolfsson, E.; Rock, D.; Syverson, C., 2017).

In Germany, there were discussions about Industry 4.0. This term was created in 2011 at the Hannover fair to describe how smart factories will be and how to revolutionize the organization of value chains. At MIT, we can observe this information and concerns about its application when it was mentioned that the effect of these digital technologies will manifest itself with full force through automation and unprecedented things (Brynjolfsson, McAfee, 2014).

We can see in the table 1 the main disruptive technologies regarding the Industry 4.0.



**Table 1 Main Disruptive Technologies of 4.0 Industrial Revolution**

	Features	Reference
Artificial Intelligence	Machine Learning, Advanced Algorithmics, Avatars, Chatbots and Automatic Decisions	Kaplan, 2016 Brynjolfsson et. al, 2017
Advanced Mobility Wide World	SmartPhones, 4G/5G, QRC, NFC, Autonomous Car	Deloitte, 2017 <sup>1</sup>
Internet of Things - IoT <sup>2</sup>	Monitoring of Digital and Physical information, Wireless Sensors, RFID, Beacons and BLE- Bluetooth Low Energy	Greengard, 2015 Kevin Ashton, 2009 <sup>2</sup>
Big Data	Data Science, Analytics, Structured and No Structured Data	Thomas Davenport, 2014
Blockchain	Cryptocurrency, Digital Ledger	Swan, 2015
Smart Environment (SmartCities and Houses)	Controlling and Decision, by machines or by human commands	Glasmeier et. Al., 2015
Ubiquitous Computing	Global Access and Storage	Schwab, 2016
Wearable Clouths and Devices	Human action measurement, Remote health monitoring, diagnostics and decisions, emergency notification systems	Greengard, 2015

Source: prepared by authors - adapted from references.

As a result, all industries have the potential to create new value through disruptive innovation and Advanced Mobility<sup>45</sup>, both in terms of creating innovative products and services and improving supply efficiency. The key features of core technologies such as IoT<sup>46</sup>, Big Data, and Artificial Intelligence are the common technology foundations in all industries, not only in the manufacturing process problem, but also in a wide range of industries across industry boundaries where most likely it will have an impact. As a result, there may be unforeseen rapid changes in the industrial structure and work structure itself, and new opportunities may be spread globally, but concerns about labor migration will be a concern. For this reason, in advance of this change, redesign of the entire economy and society including various legal systems has become essential to become more humane (Fukuyama, 2018).

Society 5.0 will be an Imagination Society, where digital transformation combines with the creativity of diverse people to bring about "problem solving" and "value creation" that lead us to sustainable development. It is a concept that can contribute to the achievement of the Sustainable Development Goals (SDGs, 2018) adopted by the United Nations (Nakanishi, 2019)<sup>47</sup>.

More broadly, it is defined that a Smart Society as one where digital technology, thoughtfully deployed by governments, can improve three broad outcomes: the well-being of citizens, the strength of the economy and the effectiveness of institutions (Chakravorti, 2017)<sup>48</sup>.

A bibliographic survey was carried out on the topic using the Web of Science database, and only 14 articles mention the theme of Society 5.0. Only a few of them actually work the core theme. This demonstrates the importance of addressing the issue, facing the challenge of achieving sustainable development around the world.

We have important issues that are appearing during this process, such as: what are the major components of society 5.0? Can we consider some countries as models for such societies? What kind of variables can we suggest monitoring and analyze this new model of society?

<sup>45</sup><https://www2.deloitte.com/br/pt/pages/manufacturing/articles/futuro-da-mobilidade.html>

<sup>46</sup><https://www.rfidjournal.com/articles/view?4986>

<sup>47</sup><https://www.weforum.org/agenda/2019/01/modern-society-has-reached-its-limits-society-5-0-will-liberate-us/>

<sup>48</sup><https://hbr.org/2017/10/the-smart-society-of-the-future-doesnt-look-like-science-fiction>

## 2 Theoretical Reference

The studies on society 5.0 involves the search for new models and solutions to the main global challenges of today's society on the context of the 4<sup>th</sup> Industrial Revolution - World Economic Forum, (WEF, 2019). Within these models we can highlight the Japanese model, presented at the last WEF, where he presents the transition from society 4.0 to society 5.0, through the following dimensions:

**Table 2 Transitions Dimensions from Society 4.0 to Society 5.0**

Dimension	Description
1 - Economies of scale	Problem solving & value creation: a society where value is created
2 - Uniformity	Diversity: a society where anyone can exercise diverse abilities
3 - Concentration	Decentralization: a society where anyone can get opportunities anytime, anywhere
4 - Vulnerability	Resilience: a society where people can live and pursue challenges
5 - High environmental impact Mass consumption of resources	Sustainability & environmental harmony: a society where humankind lives in harmony with nature

Source: prepared by authors - adapted from Nakanishi, 2019<sup>49</sup>.

Inside this model, we can find some indicators suggested by the authors, such as:

- **Problem Solving & Value Creation:** Wealth to growing populations, diversity, digital technologies, satisfying individual needs, solving problems, and creating value.
- **Diversity:** Diversity, discrimination by gender, race, nationality, etc.
- **Decentralization:** Concentration of wealth and information (or distribution), opportunities to study and work, population distribution, etc.;
- **Resilience:** Damage caused by earthquakes and floods, vulnerabilities, public security, growing social anxiety about terrorism and other crises, damage caused by cyber-attacks, resilience, unemployment and poverty, level of medical care, etc.
- **Sustainability & environmental harmony:** Energy efficiency, water supply and waste management, food wastage, etc.

In the study of smart society presented by Chakravorti and Chaturvedi (2017), other dimensions were also considered with other group of variables, such as: (1) Citizens/People: inclusivity, environment and quality of life, state of talent and the human condition, talent development. (2) Economy Components: global connectedness, economic robustness, entrepreneurial ecosystem, innovation capacity. (3) Institutions Components: freedoms offline and online, trust, safety and security, public services.

This article aims to compile, compare and suggest some important variables within the discussion of society 5.0, as a way to understand and make contribution in the development of the theme. Thus, we search for possible relations between variables related to the skills of the future (Coursera, 2019) and a set of variables linked to other dimensions of development of society that are aligned with the model proposed by the Japanese Keidanren. Below we can check the **34 Indicators** selected for this work:

- **Skills for the future:** Data Science, Data Management, Data Visualization, Machine Learning, Mathematics, Statistical Programming, Statistics, Business Global Ranking (BGR), Accounting, Communications, Finance, Management, Marketing, Sales, Technology, Computer Network, Databases, Human Capital Index (HCI), Operating Systems, Security Engineering, Software Engineering.
- **Society:** Global Innovation Index (GII), Global Innovation INPUT, Global Innovation OUTPUT, Control of Corruption, Environmental Performance Index (EPI), Well Being, Democracy, Vulnerability, Susceptibility, Peace, Governance, GINI Index.
- **Development Index:** Human Development Index (HDI), Social Progress Index (SPI).

## 3 Methodology

This is an exploratory study that seeks to contribute to the discussion of variables important to

<sup>49</sup><https://www.weforum.org/agenda/2019/01/modern-society-has-reached-its-limits-society-5-0-will-liberate-us/>

society. For this proposal, 57 countries were selected and divided into 3 regions: AIBER (Iberian American Region), AVECO (Advanced Economy Countries) and OTHERS (Other sample countries), as follows:

- **AIBER (12):** Argentine, Brazil, Chile, Colombia, Costa Rica, Dominican Republic, Ecuador, Guatemala, Mexico, Peru, Portugal, Spain;
- **AVECO (22):** Australia, Austria, Belgium, Canada, Czech Republic, Denmark, Finland, France, Germany, Greece, Ireland, Israel, Italy, Japan, Netherlands, New Zealand, Norway, Rep. of Korea, Sweden, Switzerland, United Kingdom, United States;
- **OTHERS (23):** Bangladesh, Belarus, China, Egypt, Hungary, India, Indonesia, Kenya, Malaysia, Nigeria, Pakistan, Philippines, Poland, Romania, Russian Federation, Saudi Arabia, Singapore, South Africa, Thailand, Turkey, Ukraine, United Arab Emirates, Vietnam.

Using Minitab as statistical analysis software and data collected by the ORIBER and Global Skills Index Report (Coursera, 2019), we examined the possible dimensions of Society 5.0. The selection considered 35 synthetic indicators that were normalized (0-100) and positivized (the higher the better), out of which 10 were selected for being more representative; moreover for Saudi Arabia, Singapore, Vietnam and the United Arab Emirates, regression was used to estimate some missing values in the Welfare and SPI variables.

In our final analysis, using PCA (Principal Component Analysis) and Stepwise Regression, a **Society 5.0 Index -S5I** was developed, to represent our final model integrating the variables, and defining a ranking of the countries (see table 4).

It is important to emphasize the limitations of our study. The countries were selected according to their similarities in each group and the availability of data on these countries, in the many variables selected by us. As an exploratory study, it is an initial step that will require further analysis and further research in the future. It is, therefore, a proposal for a new approach in our academic environment.

#### 4 Results and Discussion

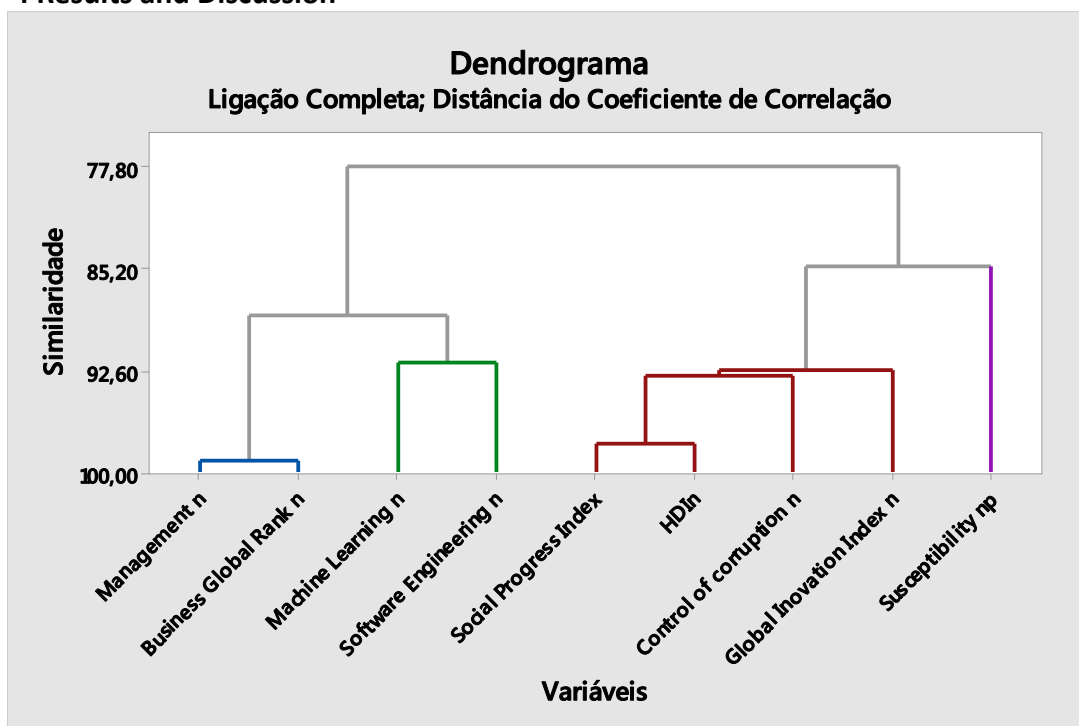


Figure 1 Dendrogram of the Level of Similarity of the 9 Indicators More Relevant

In the dendrogram it is possible to visualize some interesting relations. One may consider three main sectors of variables are present in the dendrogram: Skills for the future –Sector A (4 variables), Society – Sector B (4) and Development – Sector C (2).

On the left side, Sector A it is possible to notice that the Management and the BGH (Business Global Ranking) run closely together (99.14) as well as Software Engineering and Machine Learning do (92.03) being technical tools. Actually, both groups seem to be closely connected (88.60). This scenario indicates the importance of human actions in the decisions of how to use technological evolution.

Then we have also high similarity between HDI and SPI (97.89), that correspond to Sector B related to main indicators for human development, the final goal to the sustainable society.

It is very interesting to observe three other variables in sequence. Control of Corruption, with 92.90 of similarity with Sector B as well as 92.51 with GII (Global Innovation Index); all of these with 84.97 similarity with Susceptibility. This scenario may indicate the strong systemic dependence between human development, the use of technological solutions and the government actions. It is worth remembering that the GII means how to deliver Innovative Solutions and how to build Cooperation between countries around the world and the control of Susceptibility means resilience, the ability to react quickly to crises and unforeseen events. It is sector C.

It is possible to observe a similarity of 77.80 between subgroups A and B/C. We could verify the real needs of working for management and business using technology to achieve social and developmental outcomes in society. It is important to highlight that Management and HDI are the main variables in this study representing 70.2% of the results in our model.

There is an approximation between Democracy and subgroups A/B/C (69,03), what seems to indicate that it is necessary to have conditions of preservation of freedom, right of expression and security in the strengthening of an environment capable of sustaining a development of other variables.

It was observed that it is possible to relate the groups of variables that stood out most in the study with the Keidanren model, as described below:

- **Problem solving & value creation:** with the variables of *Management, Business, Machine Learning* and *Software Engineering*, which indicates the importance of a conscious management of business and technology in the generation of value to society, as is the case of HDI and SPI. Here, we show the dynamics of governance and transparency in organizations so that there is an alignment in the search for solutions to global challenges.

- **Resilience and Decentralization:** with the variables of *SPI, HDI, Control of Corruption, Global Innovation and Susceptibility*, that indicates that human development is important in the generation of skills and environments capable of generating a better response to crises, disasters and situations of risk. In this sense, *innovations* enter as a tool of collaboration in the process creating paths of greater connectivity and access to information. The idea is to create environments with greater opportunities for the people.

- **Diversity:** with the variables of *democracy, SPI and HDI*, that connects to environments of political stability, respect for diversity and freedom, economic stability and security, defending the freedom of individuals, strengthening the "being who they are" and being responsible for their choices.

The table 3, bellow, shows the comparison of the 3 regions for each one of the variables by using ANOVAs.

**Table 3 Summary of Data (ANOVAs)**

Region	Management	Business	Machine Learning	Software Engineer.	SPI	HDI	Control of Corruption	Global Innovation	Susceptibility	Democracy
AIBER	42,08	47,9 2 75,5	29,67	47,33	60,61	59,07	39,06	26,45	67,52	64,73
AVECO	77,09	5 28,1	76,32	68,14	93,90	91,62	86,27	71,42	88,00	83,15
OTHERS	29,83	3 27,6	36,91	36,52	42,00	50,04	39,35	30,33	63,53	38,67
F - value	28,86	5	24,19	7,93	48,18	33,95	28,87	40,04	10,80	46,66

Source: prepared by authors

The value of "F" represents the degree of approximation between the regions was added (the larger the F value the greater the difference). The most important difference between regions is SPI (48,18) and the one that makes less difference is Software Engineering (7,93).

We have the following outliers by indicators: Republic of Korea (Management and Business, may be because the country has had a quick development in the last decades), Israel (Susceptibility by the geographic region) and Singapore (Global Innovation, with superior indicator in OTHERS).

These approximations and deviations are best seen in the figure 2.

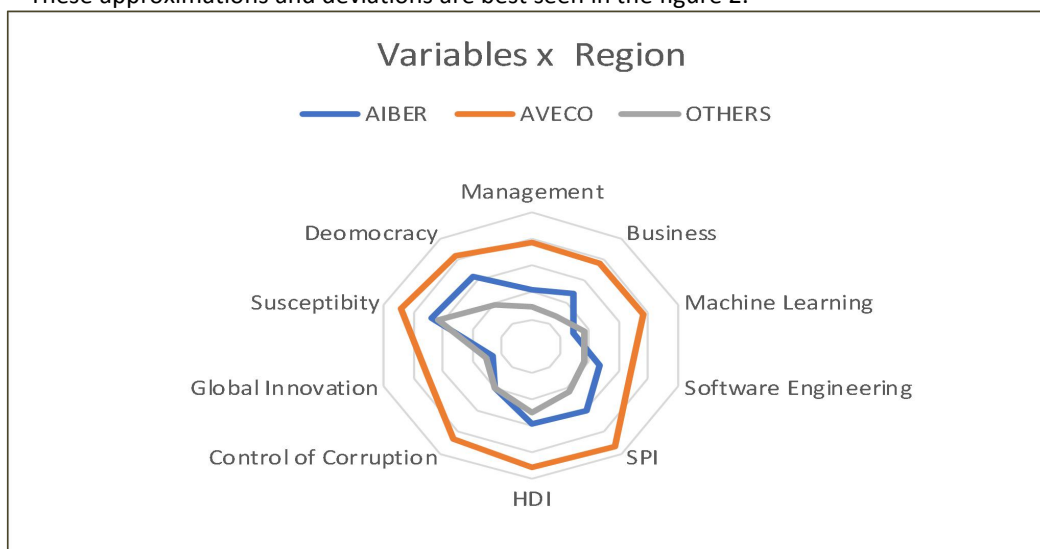


Figure 2 Variables by Regions

**Comments:**

✓ In the chart it is possible to notice that the **AVECO region** presents all the best Indicators of the studied set, distancing itself from the other groups of countries mainly in *innovation and human development (SPI and HDI)*, maybe in consequence of their management process.

✓ The second group with the best performance is the **AIBER region**: it emerges in the dimension of *democracy, medium indicator for SPI and HDI, software engineering and business* but presents the lowest score in the *Global innovation index and Machine Learning*. It is necessary pay attention because it is possible find out opportunities in this situation.

✓ In addition, AIBER approaches the **OTHERS region** in the issue of *susceptibility* which may indicate a greater need for investment under conditions of less exposure to risks and crises. The **OTHERS region** is the one with the lowest performance in the sample studied.

**Main differences observed:**

**Susceptibility:** This is the indicators where the **AIBER** and **OTHER** regions are very close, presenting as Outlier Israel (1) that is in the region AVECO. The highest indicator of the **AIBER** and **OTHER** regions was the susceptibility. This can be explained by the greater vulnerability of these countries to external influences. We need to reinforce that the low "F" factor (10,80) indicates that this susceptibility variable is the one of greater proximity and similarity between the three groups.

**Global Innovation:** Within the 10 variables, innovation was the dimension that presented one of the lowest performances and the greatest impact for the three regions, being the only dimension where the AIBER region was inferior to the OTHERS region. However, it is one of the indicators of lower adhesion in all regions surveyed with factor "F" 44.04. It may be that developing countries do not need more collaboration than they already have with other countries, and AIBER and OTHERS need more than they can get at this moment.

**Democracy and business:** For these indicators, it is clear that the AIBER region moves radically away from the OTHERS region in these two points.

**SPI and HDI:** These are the best indicators presented in the AVECO region. They present with the largest individual indicators of the study (93,90 and 91,62), where we can associate issues of health, education and income development.

**Software Engineering:** The lowest indicator of the AVECO region is related to technology (68,14). In the other hand, they are the countries where the advances are in the state of art with disruptive technologies. Is a point to research on future studies.

**Business:** This is the lowest indicator in the OTHERS region (28,13).

Finally using Principal Component Analysis and then selecting weights for the variables using Stepwise Regression it was possible to define what we are calling a Society 5.0 Index – SSI that lead us to define a Ranking as shown in Table 5, where one could observe that regarding the Society 5.0 Index. Spain is doing a little better than the United States as well as Brazil a little better than China... the two greatest powers today

**Table 4 Ranking of Countries for SSI – Society 5.0 Index**

Countries	Region	SSI - Index	Ranking	Countries	Region	SSI - Index	Ranking
Switzerland	AVECO	100	1	Romania	OTHERS	51,38	29
Austria	AVECO	94,71	2	Japan	AVECO	50,48	30
Finland	AVECO	94,46	3	Costa Rica	AIBER	47,76	31
Belgium	AVECO	92,3	4	Greece	AVECO	43,49	32
Sweden	AVECO	62,2	5	<b>Brazil</b>	<b>AIBER</b>	<b>43,27</b>	<b>33</b>
Germany	AVECO	91,13	6	China	OTHERS	40,22	34
Netherlands	AVECO	90,21	7	South Africa	OTHERS	39,36	35
Australia	AVECO	85,7	8	Ukraine	OTHERS	38,36	36
New Zealand	AVECO	84,1	9	Peru	AIBER	38,02	37
Czech Republic	AVECO	83,89	10	Malaysia	OTHERS	34,22	38
United Kingdom	AVECO	83,28	11	United Arab Emirates	OTHERS	33,47	39
Norway	AVECO	82,79	12	Colombia	AIBER	33,15	40
Canada	AVECO	81,35	13	Thailand	OTHERS	32,78	41
France	AVECO	80,93	14	Viet Nam	OTHERS	29,72	42
Israel	AVECO	80,71	15	México	AIBER	28,97	43
Denmark	AVECO	78,55	16	Rep. of Korea	AVECO	27,59	44
Singapore	OTHERS	76,03	17	Philippines	OTHERS	26,86	45
Poland	OTHERS	75,77	18	Ecuador	AIBER	24,14	46
<b>Spain</b>	<b>AIBER</b>	<b>75,04</b>	<b>19</b>	Guatemala	AIBER	22,65	47
United States	AVECO	74,92	20	India	OTHERS	22,58	48
Hungary	OTHERS	71,67	21	Dominican Republic	AIBER	22,14	49
Portugal	AIBER	66,42	22	Saudi Arabia	OTHERS	17,93	50
Ireland	AVECO	66,37	23	Turkey	OTHERS	17,58	51
Italy	AVECO	66,26	24	Indonesia	OTHERS	16,96	52
Argentina	AIBER	65,48	25	Kenya	OTHERS	15,73	53
Russian Federation	OTHERS	60,53	26	Egypt	OTHERS	8,28	54
Belarus	OTHERS	58,13	27	Nigeria	OTHERS	2,25	55
Chile	AIBER	57,18	28	Bangladesh	OTHERS	0,93	56
				Pakistan	OTHERS	0	57

Source: prepared by authors

The final average per region, for synthetic indicator SSI (Society 5.0 Index), is showing in the table number 5.

**Table 5 Average by Region**

SSI	Average
AIBER	43,68

AVECO	78,43
OTHERS	33,51

Source: prepared by authors

It is important to note that AVECO is almost twice the AIBER average (1,8) and 2.5 times the OTHERS average (2,3). This distance means a huge effort to develop new approaches and be close to the developed countries. This situation highlights the urgency of developing public and private policies for this purpose.

In the chart below (Figure 3) it is possible to visualize the pairs, within the sample surveyed, that stood out the most for these variables. The darker regions represent the places with the best performance. In general, the countries of the AVECO region (developed countries) presented the best results.

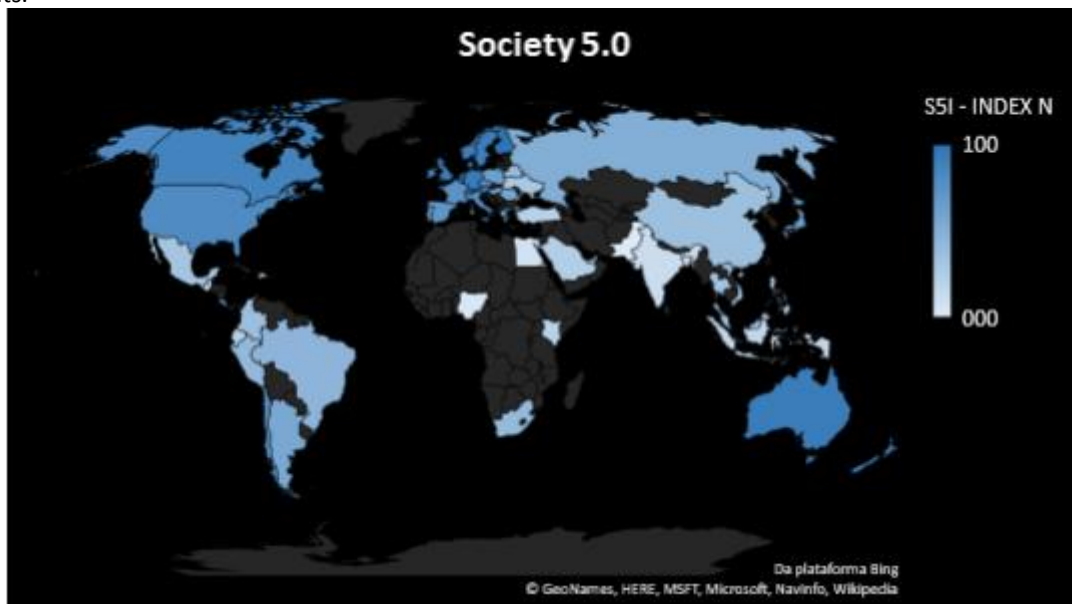


Figure 3 Dimensions that Favour the Development of Society 5.0 for the Countries of this Study

## 5 Conclusion

There are many directions in which society will advance through technological development. While technology can bring about improvements such as higher living standards and greater convenience, it can also have negative effects, such as employment impact, increasing disparity, and uneven distribution of wealth and information. It's up to all of us to choose which direction we should go. We should consider what kind of society we want to create rather than try to predict what kind of society it will be (Nakanishi, 2019).

The use of technology is directly responsible for the success of the business and management, as everyone knows, but we can highlight the connection between Management, BGH (Business Global Ranking), GII (Global Innovation Index) and Control of Corruption with HDI e SPI, Human Development indicators, as a signal to get our total attention, because it means results that have a direct impact on the whole society. The appropriation of disruptive technology and government actions are the way to achieve the necessary inclusion and prepare the new generation for the Digital Age, using the direction of the United Nations Development Goals (SDGs, 2018) for a sustainable society. What stands out is that the economic, social and environmental dimensions are revolving around the technological axis and that "the revolution now is to change our way of thinking and a way of living in greater harmony with nature" (Sange, 2008).

This theme is only at the beginning of its academic discussion and depends on concrete actions to be integrated to the society and to be part of the political agenda for sustainable growth, which is so much sought.

In other words, government rules and policies need to include specific studies to prepare each

state, culture, and society to figure out how to apply technology, where to apply the digital solution, and how to spend money. These indicators, studied here, show that there is a connection between management, technology and social outcomes.

On the other hand, the distance between the countries of AVECO and those of AIBER / OTHERS in Global Innovation in the figure 2 and the average in the table 5, is very worrying, given that the time to address and manage modern technologies is far from the latter countries. And, in our opinion, these are the last opportunities to approach the leaders of the technologically advanced world. Because, in some cases, we are talking about software application and Artificial Intelligence, solutions that do not require an industrial park to be developed, such as 4.0 Industry. But surely, it requires a better educational system and a strong leadership of nations and business leaders to watch out for these issues. A good example of this process is the Nagoya University in Japan, as mentioned recently by its President Seiichi Matsuo, regarding a new Educational Philosophy to help moving into a Society 5.0 Culture (Matsuo, 2019).

It will be almost impossible to deploy Society 5.0 in AIBER, at the same time with the rest of the developed world, if the ecosystem and the necessary positive conditions have not been prepared before.

We understand that society 5.0 is clearly linked to the SDGs (2018) in the most of dimensions. We suggest that new variables studies should be development with these directions also.

Our contribution is to use technology and data as a tool to identify the indicators that help define and build the new society. We can see, from this study that these variables have a strong relation among them, so that these indicators may be considered in future studies to monitor and create models for the Society 5.0.

### Acknowledgement

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# Effect of Environmental Regulation on Corporate Financial Performance: Mediating Role of Green Technological Innovation

Chen Xiaofang, Tong Xiaohong, Xia Wenlei, Chen Xin

School of Management, Wuhan University of Technology, Wuhan, P.R.China, 430070

(E-mail: cxf2010611@163.com, tongxh518@163.com, 290149@whut.edu.cn, cx910316@163.com)

**Abstract:** This paper adds new insights to the increasingly prominent contradiction between economic development and environmental protection in China by examining the effect of environmental regulations on corporate financial performance. As a novel attempt, based on the Porter Hypothesis and Schumpeter's Innovation theory, it argues that a company's efforts to bring green technological innovation plays a mediating role on the relationship between the environmental regulations and corporate financial performance. The sample of the study consists of 561 heavily polluted listed companies over the period from 2010 to 2017. The results reveal that government regulation pressure can effectively improve financial performance, of which the green technological innovation plays a mediating role.

**Key words:** Environmental regulation; Green technological innovation; Corporate financial performance; Intermediary effect method

## 1 Introduction

Environmental regulations put pressure on enterprises to conduct their operations in an environmentally friendly manner. As a result, the operations of the enterprises may be constrained, affecting their financial performance. The extant literature reveals two types of thoughts relating to the effect of environmental regulations on green technological innovation and corporate financial performance.

The early studies report that environmental regulations increase the burden of enterprises, which impairs not only their green technological innovation, but also financial performance. For example, environmental regulation led to increased costs and capital transfers, ultimately restraining the technological innovation (Walley and Whitehead, 1994). The invention of environmental protection technology patents lacks funds because of the pollution emission control (Chintrakarn, 2008). People find that the relationship between environmental regulation and green technology is not simply monotonous (Bréchet and Meunier, 2014), but U-shaped (Zhang Qian and Qu Shiyong, 2013). It is also uncovered that too strict environmental regulations are not conducive to green technological innovation of enterprises.

On the other hand, in line with the "Porter hypothesis", it can be argued that well-designed environmental regulations can stimulate technological innovations for improving productivity and resource utilization, and, thereby, increase the financial performance. Through an empirical test using statistics from more than 4200 factories in the European Union, it was found that under certain

conditions, environmental regulation would encourage technological innovation to reduce production costs of enterprises (Lanoie et al., 2008), and enterprises can reduce unnecessary costs through green technological innovation, and thereby, improve corporate profits (Marin, 2014). Studies also showed that green innovation has a positive effect on enterprise economic performance (Li Yina and Ye Fei, 2011), green innovation can improve economic efficiency and ecological efficiency when compared to the traditional technological innovation (Xiao Xianjing and Zhao Wei, 2006).

Accordingly, the current literature reveals contradictory evidence on the effect of environmental regulations on green technological innovation and financial performance of enterprises. Therefore, the objective of this study is to examine how the environmental regulations affect the enterprises' green innovation and financial performance. The results of the study can contribute the industry in the following manner. The findings promote the enterprises to continuously engage in green technological innovation to enhance their sustainable development. The environment regulatory authorities can also use the results to determine the effectiveness of the environmental regulations in promoting enterprises to engage in green technological innovation. Further, the findings are of great significance to policy makers when introducing new environmental regulations.

The remainder of the paper is organized as follows. Section 2 shows the formulation of research hypotheses. Section 3 explains the conceptual model, measurement of variables and hypothesis testing. The results are discussed in Section 4. Section 5 concludes the paper.

## **2 Research Hypothesis**

### **2.1 Environmental regulation and green technological innovation**

According to the system theory, when enterprises encounter pressure from government system, they tend to be obeyed the system to avoid punishments so that their survival legitimacy will be improved. The environmental regulations reflect the government's pressure to protect the environment. As a part of mandatory regulatory measures, the government compels enterprises to adopt environmental protection strategies to enhance their survival. Further, it brings external prestige pressure to enterprises through environmental information collection and disclosure. Therefore, it can be expected that enterprises attempt to take measures to comply with the environmental regulations in order to avoid pollution penalties and protect the corporate image, which eventually promote green technological innovation, as given by the hypothesis 1.

Hypothesis1 (H1): Environmental regulation is positively related to enterprise green technological innovation.

### **2.2 Green technological innovation and enterprise performance**

As discussed in Section1, the extant literature lacks a strong consensus on the impact of green innovation on corporate financial performance. The green technological innovation increases the development cost of enterprises. However, this increased cost could, to a certain extent, be offset or even outweigh by financial benefits arising from the efficient utilization of resources from the improved production processes. In addition, green innovation is beneficial for enterprises to produce low energy consumption and low pollution products, which can distinguish enterprises from competitors and help enterprises to expand new market segments. Based on these arguments, it can be expected that the Green technological innovation improves the financial performance of enterprises, as given by the hypothesis 2.

Hypothesis2 (H2): Green technological innovation is positively related to the financial performance.

### 2.3 Green technological innovation and enterprise performance

The policies and measures for environmental protection and regulation force enterprises to internalize the environmental concern into their business activities, which can lead to innovation and, thereby, improve their financial performance. Porter's Hypothesis emphasizes that the influence of the environmental regulations on the financial performance is indirect. Studies argued that external environmental policies can promote enterprise innovation activities, and the "technology compensation" brought by innovation activities can improve the financial performance (Wang Jianming et al., 2010). Hence, there exists a mediating role of green innovation activities on the relationship between environmental regulation and the financial performance of enterprises. The following two hypotheses are formulated to examine this mediating effect.

Hypothesis3 (H3): Environmental regulation has a positive effect on corporate financial performance.

Hypothesis4 (H4): Green technological innovation has a mediating effect on the relationship between environmental regulation and financial performance.

## 3 Data and Methodology

### 3.1 Conceptual model and hypothesis testing

Figure 1 depicts the conceptual model with the related hypotheses. This study employs asset-liability ratio, firm size, cash holdings and shareholding of the largest shareholder as the control variables of financial performance. Hence, the H2, H3 and H4 hypotheses are examined after controlling for the effects of these variables.

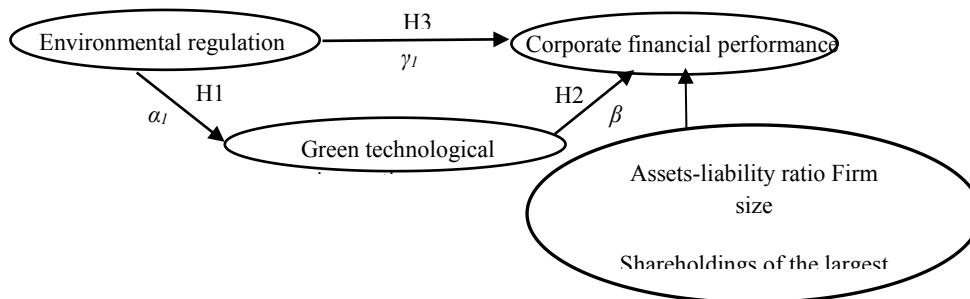


Figure 1 Conceptual Model of the Study

The examination of the direction and significance of coefficient  $\alpha_1$  in equation (1),  $\beta_1$  in equation (2) and  $\gamma_1$  in equation (3) provides evidence relating to the hypotheses H1, H2 and H3 respectively.  $\alpha_1 * \beta_1$  represents the mediating effect of green technological innovation on the relationship between environmental regulation and financial performance, as indicated by H4. The total effect of the environmental regulation on the financial performance is the sum of the direct effect ( $\gamma_1$ ) and the mediating effect ( $\alpha_1 * \beta_1$ ).

$$PA\_GR = \alpha_0 + \alpha_1 RE\_COGD + Controls + \varepsilon_1 \quad (1)$$

$$ROA = \beta_0 + \beta_1 PA\_GR + Controls + \varepsilon_2 \quad (2)$$

$$ROA = \gamma_0 + \gamma_1 RE\_COGD + Controls + \varepsilon_3 \quad (3)$$

$$ROA = \theta_0 + \theta_1 PA\_GR + \theta_2 RE\_COGD + Controls + \varepsilon_4 \quad (4)$$

### 3.2 Sample selection and measurement of variables

This study concerns on the heavy polluting companies listed in the A-share market from 2010 to 2017 as the research sample. The validity of the sample is improved by excluding the companies \* ST and ST that were specially processed and the companies that had major asset restructuring during the sample period. Further, the data with abnormal values are eliminated from the sample. Accordingly, the final data set includes the equilibrium panel data of 561 listed companies.

Table 1 shows the measurement of variables depicted in the conceptual model. The intensity of the environmental regulations is measured based on the cost of pollution control, which can be obtained from the Yearbook of Environmental Statistics. The number green environmental protection patents, as published in the 5ipatent.com website, is used to measure the green technological innovation. Studies argues that it is reasonable to measure the innovation level of enterprises by patents, because patents have certain potential market value (Shane, 2005). The CSMAR database of Guotaian is used to obtain the financial data of the selected companies to measure the financial performance and the control variables.

**Table 1 Variables and Their Measurement Units**

Variable type	Variable name	Symbol	Measurement
Response	Corporate Financial performance	<i>ROA</i>	Return on assets
Mediator	Green innovation patent	<i>PA_GR</i>	Ln(Applied green environmental protection patents +1)
Predictor	Environmental regulation	<i>RE_COGD</i>	(Cost of pollution control in provinces /GDP of provinces)×1000
Controls	Asset-liability ratio	<i>DEBT</i>	Total liabilities/total assets
	Firm size	<i>SIZE</i>	Natural logarithm of total assets
	Cash holding	<i>CASH</i>	Balance of cash and cash equivalents /Average total assets
	Largest shareholder	<i>FISH</i>	Shareholding ratio of the largest shareholder

## 4 Results and Discussion

### 4.1 Descriptive analysis

The descriptive statistics relating to the variables employed in this study are shown in Table 2. The average of ROA is 0.044, which indicates a lower performance level of the selected sample of

companies. The average of PA\_GR is 0.239, which is quite different from its median. It indicates that the companies' green technological innovation is at a very lower level.

**Table 2 Descriptive Statistics of the Study Variables**

Variable	Average	Median	Standard deviation	Minimum	Maximum
<i>ROA</i>	0.044	0.038	0.055	-0.506	0.482
<i>PA_GR</i>	0.239	0.000	0.498	0.000	3.136
<i>RE_COGD</i>	3.871	3.043	3.855	0.000	58.530
<i>DEBT</i>	0.422	0.427	0.212	0.007	1.345
<i>SIZE</i>	22.128	21.892	1.299	18.760	27.040
<i>CASH</i>	0.158	0.111	0.142	-0.165	0.931
<i>FISH</i>	37.317	36.200	15.329	3.620	95.950

#### 4.2 Correlation analysis

Table 3 reports the correlations between study variables. It shows that the correlation coefficients are no more than 0.4, indicating the fact that there is no serious collinearity between environmental regulation, green technological innovation and the control variables. The correlation coefficient between RE\_COGD and PA\_GR is 0.047, which preliminarily proves that environmental regulation can promote enterprise green technological innovation.

The correlation coefficient between PA\_GR and ROA is 0.021, which indicates a positive correlation between green technological innovation and financial performance of companies. The positive correlation between RE\_COGD and ROA (0.042) also provides preliminary support for the expected positive relationship between environmental regulation and financial performance of companies.

**Table 3 Correlation of Study Variables**

	<i>ROA</i>	<i>PA_GR</i>	<i>RE_COGD</i>	<i>DEBT</i>	<i>SIZE</i>	<i>CASH</i>	<i>FISH</i>
<i>ROA</i>	1						
<i>PA_GR</i>	0.021	1					
<i>RE_COGD</i>	0.042	0.047**	1				
<i>DEBT</i>	-0.447**	0.077**	-0.089	1			
<i>SIZE</i>	0.113**	0.161**	0.080**	0.552**	1		
<i>CASH</i>	0.315**	-0.052**	0.023	-0.057**	-0.362**	1	

*FISH*            -0.006            0.019\*\*            0.068\*\*            0.106\*\*            0.303\*\*            -0.001            1

\*\* indicates that the correlation is significant at the level of 0.01;

\* indicates that the correlation is significant at the level of 0.05

### 4.3 Regression analysis

In order to reveal the impact of environmental regulation on enterprise green technological innovation, this paper carries out panel regression analysis based on equation (1). The results show that the regression coefficient of RE\_COGD to PA\_GR is 0.001, which is significant at the level of 5%. This shows that government environmental regulation has a certain promoting effect on enterprise green technology output, which supports the view of Hypothesis 1 in this paper.

**Table 4 Regression Result among Variables and Mediating Effect**

	<i>PA_GR</i>		<i>ROA</i>	<i>ROA</i>	<i>ROA</i>
	(1)		(2)	(3)	(4)
<i>C</i>	0.483*** (109.543)	<i>C</i>	0.485*** (115.361)	-0.108*** (-6.850)	-0.111*** (-6.938)
—	—	<i>PA_GR</i>	0.001** (2.312)	—	0.002** (2.4335)
<i>RE_COGD</i>	0.001** (1.984)	<i>RE_COGD</i>	—	0.002** (2.031)	0.002** (2.318)
<i>DEBT</i>	0.138* (1.743)	<i>DEBT</i>	-0.054*** (-7.915)	-0.057*** (-8.301)	-0.057*** (-8.347)
<i>SIZE</i>	0.006*** (20674)	<i>SIZE</i>	0.002*** (8.257)	0.006*** (8.762)	0.006*** (9.044)
<i>CASH</i>	-0.172* (-1.874)	<i>CASH</i>	-0.027*** (-3.389)	-0.025*** (-3.126)	-0.027*** (-3.354)
<i>FISH</i>	-0.000** (-2.352)	<i>FISH</i>	0.000 (0.710)	-0.000 (-0.647)	-0.000 (-0.695)
<i>Adj-R<sup>2</sup></i>	0.398	<i>Adj-R<sup>2</sup></i>	0.572	0.668	0.781
<i>F</i>	4.838***	<i>F</i>	8.767***	254.685***	227.631***
<i>OBS</i>	3303	<i>OBS</i>	3304	3303	3304

\*\*\*、\*\* and \* respectively indicated that T-test was significant at 1%, 5% and 10% levels

In equation (2), the correlation coefficients of PA\_GR and ROA are 0.001, which is significant at the level of 5%, this proves that green technological innovation indeed improves enterprise performance significantly. That is, the more green technological innovation, the better financial performance. This conclusion confirms Hypothesis 2 of this paper.

As shown of equation (3) in the Table 4, it is the regression result of environmental regulation and enterprise performance, the coefficient of RE\_COGD and ROA is 0.002, which is significant at 5% level. This shows that environmental regulation has a positive impact on enterprise performance, and verifies Hypothesis 3 in this paper.

In order to test the mediation effect of green technological innovation, the test method to verify the mediation effect model was used to test the mediation effect model (Wen Zhonglin et al., 2004). As shown of the equation (4) in the Table 4, the total effect of environmental regulation on enterprise performance is 0.002, and has passed the significance test of 5% level respectively. In the mediation effect model, Table 4 shows that the direct effect of environmental regulation on green technological innovation is 0.01 and was significant at 5%. In table 4, the direct effect of green technological innovation on enterprise performance is 0.002 and was significant at 5%. The direct effect of environmental regulation on performance was 0.002, and passed the significance test. Therefore, green technological innovation plays a part of intermediary role between environmental regulation and enterprise performance. Hypothesis 4 holds.

## 5 Conclusion

### 5.1 The summary

Based on the data of 561 heavy polluting enterprises from 2010 to 2017, this paper draws the following main conclusions:

Environmental regulation promotes green technological innovation in enterprises. The policy of environmental regulation regulates the pricing mechanism of pollution discharge and reasonably estimates the cost of pollution discharge. It not only forms a compulsory pressure on the polluting enterprises, but also has a certain incentive effect on the resource and environmental protection enterprises.

Green technological innovation can improve enterprise performance. Green innovation activities can not only minimize production pollution, avoid environmental penalties, but also improve productivity, develop new market for environmental protection products, and win a good social reputation, thereby establishing environmental protection first-mover advantage and enhancing the market performance of enterprises.

Green technological innovation plays a part of intermediary role between environmental regulation and enterprise performance. Enterprises will take more green technological innovations to reduce environmental pollution and improve the legitimacy of the system, thereby enhancing the competitive advantage of enterprises and promoting the performance of enterprises.

## 5.2 The proposal

Strengthening green technological innovation and promoting enterprise performance. From the empirical analysis, we can see that green technological innovation and enterprise performance are significantly positively correlated, indicating that the implementation of green technological innovation is conducive to improving enterprise performance. As people pay more and more attention to the green environment, the global supply chain has begun to pay more attention to the green environment, so it is particularly important to strengthen the green technological innovation of enterprises.

Perfecting corporate governance and improve the efficiency of resource allocation. From the research results, we can see that the proportion of the largest shareholders is negatively correlated with the green technological innovation and performance of enterprises, which indicates that highly concentrated equity is not conducive to the development of enterprises. Studies pointed out that board governance plays a positive role in enterprise green technological innovation (Wang Fengzheng and Chen Fangyuan, 2018). Good corporate governance objectively helps enterprises to establish a long-term mechanism of independent innovation, which can improve the allocation of green technological innovation funds.

## 5.3 The expectation

Although this paper analyses the impact of government environmental regulation on enterprise green technological innovation, and also analyses the economic consequences of green technological innovation, due to the limitations of time, capacity and resources, there are still some shortcomings in this paper, such as single sample and incomplete selection of indicators, so future research can be carried out from the following points:

Expand the research samples. This paper chooses heavy pollution industry companies as samples. Although green technological innovation in heavy pollution industry is the most urgent, the current development of green economy requires green production in all industries, so the research object can be extended to other industries in the future.

In addition to considering the government's environmental regulation, we should consider the impact of stakeholders such as consumers, media, investors, community public on enterprise green technological innovation, especially the community public. As one of the most effective stakeholders around the enterprise, the environmental pressure of the community public can have the most direct impact on the enterprise. However, it is difficult to quantify and obtain data on the environmental attitude of the community public, which can be used as one of the directions for further in-depth research in the future.

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## Awareness of the Worth of Life Within/Without for Systemic Resilience under Climate Change Disasters: The Amazon Bioma and the Gender-Differentiated Vulnerability

Arnoldo José de Hoyos Guevera<sup>1</sup>, Daniela Gasperin<sup>2</sup>, Christine Syrgiannis<sup>3</sup>, Anastasia Zabaniotou<sup>4</sup>, Ivani Fazenda<sup>5</sup>

1 School of Management at Pontifical Catholic University, São Paulo, Brazil

2 Members of Group of Studies and Research on Futures at Pontifical Catholic University, São Paulo, Brazil

3 Group of Studies and Research on Interdisciplinarity, Futures and Spirituality at Pontifical Catholic University, São Paulo, Brazil

4 School of Engineering, Aristotle University, Thessaloniki, Greece and Network of Mediterranean Schools of Engineering and Management

5 Educational Program-Interdisciplinarity, Leader of the Group of Studies and Research on Interdisciplinarity – GEPI at Pontifical Catholic University, São Paulo, Brazil

(E-mails: arnoldodehoyos@yahoo.com.br, palestrante@daniellagasperin.com.br, chrissyrgiannis@yahoo.com.br, azampani@auth.gr, jfazenda@uol.com.br)

**Abstract:** Resilience is acknowledged both explicitly and implicitly in a range of the proposed SDGs targets. It is a core feature of target 13.1 in its aim to ‘strengthen resilience and adaptive capacity to climate-related hazards and natural disasters in all countries’. The scope of this paper is to discuss the extent of Resilience considering the expectation of adaptation of Human Beings to unfavorable and risky situations, concerning the Reference used. Taking Life as a reference, adaptation brings us out of suffering. That may be called Resilience in the Systemic View of Life, which understands that everything and everyone is interconnected. In order to better feel the Worth of Life, a Vision/Approach of Inner Processes of Creation is discussed, helping each one, who experiences it, to become conscious of Worth in him/herself, and therefore in others and Nature as a whole. The lack of such understanding has led to decisions of the use of human, material and financial resources exclusively for utilitarian purposes, bringing exhaustion to all of them. This is the case of the huge bioma of Amazon, which is under threat and needs urgent care and respect to stop disaster in chain. Women’s vulnerability is also connected with the concept of global resilience and discussed. The above can help decisions taken under the discussed perceptions to lead to constructive Creation.

**Key words:** Resilience; Worth of life; Systems view of life; Interdisciplinarity; Gender differentiated vulnerability; Amazon bio ma.

### 1 Introduction

The term resilience emerged in physics and engineering, being one of its forerunners the English scientist Thomas Young who according to Timoshenko (Timoshenko, 1953) already in 1807 introduced the concept of elasticity and resilience, describing his experiments on tension and compression related to the relationship between the applied force in a body and deformation that this force produces.

Yet, it is in Psychology that the term resilience is explored as a cognitive and behavioral effort. So much that the area takes ownership of the concept and considers it a landmark, from the book *Vulnerable but invincible: a longitudinal study of resilient children and youth* by Werner and Smith (Werner and Smith, 1989); and more recently a contribution to the concept of resilience on this area may be found in the work of Gasperin and Marca (Gasperin and Marca, 2019).

Reflecting on this concept, that leads us to an individual that needs to be tough without failing, an individual who is expected to overcome any adversity, we ask: “To what extent? Under which references?” Neurolinguistics considers there is no failure, just feedback; and the Systemic View of Life by Capra (Capra, 1995; 1997, and 2002) can show the extent of adaptation. Besides, there is the possibility to use what Capra (Capra, 1987) calls the Uncommon Wisdom, the knowledge from within, and experience the Inner Processes of Creation devised by Syrgiannis (Syrgiannis, 2019) that lead to the awareness of the own Worth<sup>50</sup>.

<sup>50</sup><https://www4.pucsp.br/icim/ingles/downloads/PROCEEDINGS-ICIM-2013-Brazil.pdf>

Today, the various challenges of climate change demand societies to become more flexible to crises, to become resilient in integrated, sustainable, multidimensional and inclusive ways. The United Nations Agenda 2030 for Sustainable Development<sup>51</sup> recognizes the importance of transforming societies through sustainable, resilient and inclusive paths, encompassed by the interlinked and universal Sustainable Development Goals (SDGs)<sup>52</sup>. Target 1.5 represents the core resilience target, as mentioned on the HLPF report: 'By 2030 build the resilience of the poor and those in vulnerable situations, and reduce their exposure and vulnerability to climate-related extreme events and other economic, social and environmental shocks and disasters'. In fact, there is already a Global Solutions Initiative that organizes a Global Policy Forum yearly and publishes a Global Solutions Journal<sup>53</sup>, and there is a Resilience Alliance that has been acting for 40 years now<sup>54</sup>.

The objective of the present study is to discuss how essential it is to recognize the Worth of others and Nature in decisions making. Life involves Power, Love and Wisdom, which may be felt Within to be recognized Without, with the perception of Rhythms. Decisions by professionals, authorities and by each single Human Being should be taken considering the Web of Life. Particularly, when these decisions relate to biomass and bio resources like the Amazon Forest, now living critical times which affects climate change. The study takes a theoretical, philosophical approach to resilience and discusses the vulnerabilities produced, particularly the gendered vulnerability during risks and disasters of climate change<sup>55</sup>.

## 2 Development of the Study

In order to approach the subject holistically, an interdisciplinary approach was used by the collaboration of authors who are professors in Management and Engineering Schools, members of a group of Studies and Research on Futures, and Leaders of the Group of Studies and Research on Interdisciplinarity, and Spirituality, from two regions of the planet: Brazil/Latin America and Greece/Mediterranean.

Firstly, a discourse contribution to the concept of resilience was developed, followed by reflections on the denial of the fragilities of the subject in the concept of Resilience, and on the mercy of being the ideal subject of the dominant ideology. This part of the study is based on discourse analysis (DA) which works with language in the world. It works with ways to give significance and considers the production of sense, as part of life.

Then, there was the presentation and discussion on how awareness of our Worth through the Inner Processes of Creation leads to decisions making for Life. This was followed by the Amazon Forest example of Climate Change and the gender differentiated vulnerability in Natural Disasters.

### 2.1 A discourse contribution to the concept of resilience

The main pillars of resilience proposed by Werner and Smith (Werner and Smith, 1989) are vulnerability and the ability to deal with situations of extreme adversity. Vulnerability refers to individual predisposition to the development of psychopathology or ineffective behavior in crises. However, the ability to deal with adversity needs to be described as the set of strategies used by individuals to adapt to adverse or stressful circumstances.

With this milestone, the concept of resilience is divided from the perspective of two generations, the first generation of studies defines resilience as "the adaptability of the individual, that is, the person who is able to handle and overcome an adversity". In parallel to the first generation of studies, positive Psychology emerges. One of the forerunners of the study in this field was Rutter (Rutter, 1993). The author mentions that invulnerability and the ability to adapt sustain the concept of resilience. The second generation adds the term "positive adjustment", as it favors the development of the potential of individuals and makes them stronger and more active.

We would like to consider the unconscious aspect of an individual who suffers in the process of adaptation. An individual who is not always capable of handling and overcoming adversity. The

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<sup>51</sup><https://www.un.org/sustainabledevelopment/development-agenda/>

<sup>52</sup><https://sustainabledevelopment.un.org/>

<sup>53</sup><https://www.thesolutionsjournal.com/>

<sup>54</sup><https://www.resalliance.org/>

<sup>55</sup><https://www.nationalgeographic.com/environment/2018/11/how-cutting-the-amazon-forest-could-affect-weather/>

individual who, according to Freud (Freud, 1923), had the sovereignty of the self of consciousness and reason affected with a new conception; and that from Lacan book 5 (Lacan, 1999) is structured in the field of language and was constituted as a subject willing for ideology.

Freud (Freud, 1990) went beyond the notion of the individual, as he describes the unconscious, and modified, successively, its records. At this point, the self emerges. It would be the part of the unconscious mind that changed by the proximity and influence of the external world and could serve as a mediator.

Lacan re-elaborated the constitution of the self by Freud, and emphasized that the self is the subject of language. The self as the subject of language is determined by the representations, the traces of memory and the signs of perception that are organized as a structure. In this perspective, the language reveals the contents of the unconscious.

So, the unconscious mind is represented by a signifier, i.e. an acoustic image. This signifier shows in speech through metaphor or metonym. The metaphor is when a word replaces another, and metonym is the substitution of one term for another, but it has some relation with the first.

## **2.2. Methodology used in the research of Resilience**

This study is based on discourse analysis (DA) which works with language in the world. It works with ways to give significance and considers the production of sense, as part of life.

Starting from the idea that the materiality of ideology is speech, and that the materiality of the speech is language, the relationship speech-language-ideology is worked. Thus, behind speech there is an ideology, that is, a set of ideas, thoughts, doctrines or world views of an individual or group, for their social and political actions.

According to Pêcheux (Pêcheux, 1988), there is no speech without a subject and there is no subject without ideology. That is the way the language makes sense. So the speech of an individual or group reveals their ideologies. The speech has regularity, functioning and cannot be analyzed as a closed structure in itself. It is understood that speech is determined by a social – historical process

As for Lacan (Lacan, 1999), he understands that the speech is from the Other; and that the subject is considered a subject, because he is subjected to the discourse of the Other. Therefore, the individual becomes a subject when he is subjected to the discourse of the Other.

We perceive in the discourse of resilience, that it proposes an individual immersed in the discourse of resistance, to overcome any limits, and supply any lack. Since the current social-economic paradigm has integrated resilience with capitalist production, it advocates the development of increasingly strong and productive individuals.

## **2.3 The denial of the fragilities of the subject in the concept of Resilience**

The conceptual definition of resilience involves the language and the significance that could be understood through the empty spaces, the effects of meaning that are inserted in it. Therefore, the subject depends on the functioning of a linguistic structure, that is, on the one hand he or she is found in a language arrangement, and on the other, he or she is constituted in historicity and memory.

Speaking about the self, we submit it to the structural functioning of language, which enables to use language and emptiness. To become a subject, it is necessary to inhabit a language system, that is, the discourse which reveals the unconscious.

For the existence of a subject, it is necessary to go through the signifiers that occupy the place of the Other and transmit the laws of the symbolic meaning. The process of Subjectivity crosses the meaning of the Other; in other words, when analyzing the materiality of resilience, we can reflect that the definition attests to the presence of an ideology, and stands before the question: what does that mean?

With regard to the subject assumed by this discursive construction, we can think that the materiality of resilience reveals the subject of Lacan's alienation and the ideological subjection of Althusser (Althusser, 1971).

The individual who is immersed in a discourse of adaptation without suffering, reveals a subject who is lost in the process of being subjected, when he is submitted to the discourse of overcoming and strengthening.

For Althusser (Althusser, 1971), the interpellation of the individual in the subject occurs by ideology. We can say that ideology is part, or rather, is the condition for the Constitution of the subject. The interpellation produces the subjection and this occurs at any historical time and in whatever

conditions of production. Therefore, the discourse of adaptation, coping, overcoming and strengthening presents representatives of an ideology.

It could be said that in the discourse of the concept of resilience, there is a denial of human fragilities, by proposing the development of qualities that help individuals to resist; forgetting that by resisting there is suffering. Therefore, it is shown not only an individual who adapts, but also an individual who adapts positively. An individual who moves by the desire of completeness. However, by denying his or her incompleteness, he or she becomes subjected to discourse, which is not by him; it is the discourse of the Other (Gasperin & Marca, 2019).

"The individual is expected to be capable of boundless freedom and unfailing submission. He or she is allowed to say everything, as long as he or she submits to the speech". This free subject, without limits, submissive and without flaws, is observed in the resilience that achieved social expectations or performance without signs of misfit.

This definition that the individual does not present signs of misfit, sacraments the process of fragmentation of the subject, through the subjection of the discourse of the Other. The discourse regulates the relationship between what was said and the unspoken. The non-said relates to the non-saying, that is, in the sense of being implicit. What is not verbalized, but is still there. The untold keeps secrets between the lines. For this reason, by dipping in the text to interpret it we must keep in mind the principle that each subject has his or her ideologies with a discursive memory.

It is what the materiality of adversity reveals, which is described as the set of strategies used by individuals to adapt to adverse or stressful circumstances, with cognitive and behavioral efforts to cope with demands of adverse situations. Such discourse makes us reflect and make some questions: If adversity is evaluated as an overload, how can this individual overcome this adversity? Why nothing is said about adversity? What is silenced expecting individuals to adapt to adversity? Does the untold of adversity reveal the ideal subject for the dominant ideology?

#### **2.4 Are we at the mercy of being the ideal subject of the dominant ideology?**

The ideal subject proposed by the concept of resilience reveals an individual who is able to cope, overcome and strengthen in a positive way against adversity. This proposition presents a resistant individual and subjected by the dominant ideology that aims to make it increasingly stronger and more productive. Thus, nothing is said about adversity, because the ideal subject is the one responsible for adapting, indiscriminately, to anything that is placed in the category of adversities. No matter what he or she has to adapt to, as long as he or she adapts (Gasperin & Marca, 2019).

The capitalist production transformed work into an activity linked to strength and productivity. Moreover, defines the object to be explained as the human history that includes the wills and consciousness of the historical agents, and does not mention the will and consciousness of the subject. Thus, we can consider that capitalist production does not consider the suffering of the individual. In fact, it is responsible for individuals to adapt to adversities (Dardot & Laval, 2016).

The productive subject constructed the industrial society. It was not just about increasing material production, it was necessary that the power would be redefined as productive and stimulating production, whose limits would be determined by the effects of his or her action on production.

This productive power is correlated to the productive subject, not only the worker, but the individual who produces well-being, pleasure and happiness. In this way, one can think that in the society in which we live the capital and the goods are at the center of economic activity, not life. Therefore it is a *si ne qua non* condition, to understand the subject who suffers in face of a discourse of overcoming.

It is essential to understand the anxieties of the subject who lives an adaptation process and who often suffers, because he cannot adapt, and does not even strengthen him or herself. The new imposition to the subjects assumes that the company is not a community or a place of Self Realization, but an instrument and a space of competition. It is presented ideally, above all, as the place of all innovations, permanent change, continuous adaptation to variations in market demand, pursuit of excellence, and zero failure.

Althusser (Althusser, 1971) suggests that ideology acts or works in such a way that it recruits subjects among individuals, if not all, or transforms individuals into subjects, if not all through the interpellation. For the author, the human subject transcends his true state of diffusion, and finds an image of himself.

In this sense, it can be stated that language enables and enhances the expression and

communication of the distance of the real that is originated in the relations of work. So it is evident that the ideal subject is determined by the productive powers. The understanding of this aspect reveals that the subject becomes an epiphenomenon of social relations, without any interference from his subjectivity, that is, adversities are taken as invariable.

It can be considered that the ideal subject of the dominant ideology is to manufacture useful men, docile to work and disposed to consumption. Since the law of effectiveness is to intensify efforts, it maximizes results and minimizes waste. Such ideology reaches the insane height of alienation by wishing to suppress any feeling of alienation: obeying our own desire or the Other who speaks in a low voice within us. In this sense, it is a Lacanian control: the desire of the subject is the desire of the Other.

### 3 Reflections for Discussion

#### 3.1 Becoming aware of our worth through the inner processes of creation leads to decisions for life.

Knowledge can be accessed both, from outside and inside. It is usually offered by outside. However, we have a very important Source which comes from inside, called by Capra (Capra, 1987), Uncommon Wisdom. The word Uncommon was used to show that it is often not used, but it is an extraordinary reservoir of power, Love and Wisdom. It makes conscious what we did not know we knew. It is related to the Inner Processes of Creation, which have been devised along many years of the use of language that emerges for proposals, to help professionals, scholars and citizens in general to take decisions on a variety of issues, particularly the ones related to Life and sustainability.

This Vision/Approach considers the individual from the perspective of Interdisciplinarity, Complexity and Transdisciplinarity, with the capacity of self organization as an Autopoietic Being. Interdisciplinarity is understood not only as a connection of fields of knowledge, but also the way to regard the individual as full of possibilities, according to Fazenda (Fazenda, 2002). The dialogics by Morin (Morin, 2008, 2012, 2014) considers what emerges even if it appears to be in opposition to something else. Transdisciplinarity by Nicolescu (2002, 2008, 2010<sup>56</sup>, 2014) considers Science as focussed on the Subject, not the object. The object emanates from the subject and both are immersed in a third hidden element of a ratio of infinite reach. Oneness is felt, then.

This process is described in detail on the article “Inner Processes of Creation towards awareness of own worth for sustainable proposals”, by Syrgiannis et al (Syrgiannis et al., 2019) at the Journal of Cleaner Production Volume 230, from Sept 1st, 2019 based on a workshop conducted at the Global Conference on *Cleaner Production and Sustainable Consumption*, in Barcelona, Spain, in November 2015<sup>57</sup>, with further perceptions on a presentation of the topic at ARTEM Conference on *Creativity and Sustainability*, in Nancy, France, in September 2017<sup>58</sup>.

The process is conducted regarding the Autopoietic ability of the individual, that is, the ability to get organized, in constant movement of autonomy and interdependence, which cannot be controlled by outside. Besides, the interdisciplinary view of the individual as full of possibilities, takes him/her out of conditioning, allowing the condition of author of the own speech, which emerges rhythmically from inside, the key words being the beat.

The inner Processes of Creation are composed of 4 movements: Creation, Unity, Way and Realization. The first movement, is the one which allows for words to emerge on a topic in an attitude of Will Power, in which one opens him/herself to register words in an atmosphere of trust and respect to the unique rhythm of each one. Once some words are registered, they can be correlated in an attitude of love and meaning is revealed. Therefore, wisdom is verbalized. What was unconscious coming to light.

This process could be shared in groups working on the same topic for further meaning. During this time, some apparent contradictions are seen as dialogics by Morin allowing for thoughts, feelings, words and actions to be aligned. In the second movement, Unity, the group selects some of the ideas to compose a proposal, reflecting the light of the Process, to be developed. The third movement allows for the group to make any adjustments to proceed with clarity and harmony in respect to life. Then, the proposal can be presented with keywords in the style chosen, when there is Self Realization.

<sup>56</sup>Nicolescu, 2010. Methodology of Transdisciplinarity – Levels of Reality, Logic of the Included Middle and Complexity, International Center of Transdisciplinary Research and Studies CIRET, France. Online at: <[http://basarab-nicolescu.fr/Docs\\_Notice/TJESNo\\_1\\_12\\_2010.pdf](http://basarab-nicolescu.fr/Docs_Notice/TJESNo_1_12_2010.pdf)>

<sup>57</sup><https://www.iiiee.lu.se/event/global-cleaner-production-sustainable-consumption-conference>

<sup>58</sup><https://www.icn-artem.com/en/article/2nd-artem-organizational-creativity-and-sustainability-international-conference>

It is to this Power, Love and Light that all of us can seek for resilience out of suffering to creative solutions for life. Decisions, then, will be according to the Systems View of Life, for they have emerged by the beings who are part of the System of Life, having become aware of their Worth.

### 3.2 Nature claims for a systemic view of life – The Amazon Forest as an example

The Amazon Forest is the biggest and most important in the world, corresponding to 53% of all tropical vegetation. It is located in the North of Brazil, a continental country, corresponding to 40% of all Brazilian territory, extending along the states of Pará, Amazon, Amapá, Acre, Rondônia, Roraima and some parts of the states of Maranhão, Tocantins and Mato Grosso. It also includes some land from countries near Brazil, like the Guianas, Suriname, Venezuela, Ecuador, Peru and Bolívia, being a very important bioma to be preserved.

Despite its biodiversity, the ground found in the area is poor on nutrients, meaning that, when the original vegetation is removed, there is no more chance for re-planting, because the ground cannot handle deforestation.

Preservation of the Amazon Forest depends on the Systemic View of Life and the economic reference cannot be the only one to guide decisions on how to use the region. Just as Sustainable Development took decades to introduce the triple bottom line, that is, adding the social and environmental aspects to the single bottom line which was economical, so the environment and people have to be taken into consideration for any economical improvements in the region.

An organization called SUDAM- *Supertendência de Desenvolvimento da Amazônia*<sup>59</sup> was created to attract financial incentives from national and international investors, one of the main activities being the vegetable exploitation, allowing big companies to remove invaluable raw materials to produce their products, at no controlled rate.

In 1995, the deforestation of the Amazon Forest had reached its peak, leading to a significant increase of heating of the weather worldwide. This effect is called global warming and, because of its size, the Amazon Forest has a direct impact on the weather and the humidity around the world.

Even with the problems presented, there is no improvement in any law to keep the integrity of the forest. Actually, based on a study by Kroner (Kroner, 2019), since 1961, Brazil has altered 66 times, for the worst, the laws supposed to protect the Amazon forest, affecting 11 million hectares of it.

All these mistreat is caused because companies lack the Systems View of Life, not being able to understand and respect the production of disaster in chain. When our Worth could be made aware within, we may finally recognize Worth in everyone and everything else, especially in Nature.

Sustainability has been regarded as an adversity to Industrial rise, so companies are not able to make a choice for sustainable development. Industries would have to consider the Worth of Nature, not only productivity. In the case of Amazon Forest, if Nature's Worth<sup>60</sup> was taken into consideration, not only the weather heating would be solved, but there would be a way of producing without harming and still having the economical profits.

### 3.3 Challenges to comprehensive humanized care

The recently released documentary *Amazon, The Awakening of Florestania and the Pan-Amazonian Synode* represent signs of a new civilizing moment, which allied with the call of the Pope's *Laudato Si*<sup>61</sup> on our commitment to take Care of our Own Home, are helping initiatives to strengthen our Planetary Consciousness and Responsibility, which can now benefit strategically with accelerated and converging advances of the 4<sup>th</sup> Industrial Revolution to implement Global Impact projects within the New Paradigm; already in the context of a Platform such as the SDSN-Amazon<sup>62</sup> can be leveraged by the Global Solutions Forum (ICSD)<sup>63</sup>. Avoiding disaster and climate change is our responsibility.

Even the Sweden teenager Greta Thunberg is engaged in going around the world to make people conscious of the threat of life in the planet. However, it is clear that we have to also develop the Inner Wisdom to implement the necessary measures, reflecting the correct perspective of Life care.

<sup>59</sup><https://www.sudam.gov.br/>

<sup>60</sup><https://www.aljazeera.com/programmes/countingthecost/2019/09/amazon-rainforest-worth-190907121817405.html>

<sup>61</sup>[https://w2.vatican.va/content/francesco/es/encyclicals/documents/papa-francesco\\_20150524\\_encyclica-laudato-si.html](https://w2.vatican.va/content/francesco/es/encyclicals/documents/papa-francesco_20150524_encyclica-laudato-si.html)

<sup>62</sup><https://networks.unsdsn.org/amazonia/>

<sup>63</sup><https://unsdsn.org/news/2019/04/18/amazon-solutions-forum/>

### 3.4 Gender differentiated vulnerability in Natural Disasters

Resilience to disasters and climate change of individuals, communities, organizations and countries refers to adaptation and recovering from hazards, and it starts with disaster risk reduction. It is gaining much attention in discussions on the theory and practice of adaptation to climate change. The concept is widely coupled with the social-ecological systems and their resistance to climate-change adversities (Mikulewicz, 2019). Approaches to resilience to climate change can be socially exclusionary if they do not acknowledge diverse risks or social-economic barriers to resilience (Forsyth, 2018).

Risk is defined as the probability of loss in terms of human lives, economic assets, environmental, cultural values and critical infrastructure due to an unexpected destructive event that can occur in a certain area in a certain period of time. Risk is a function of Exposure and Vulnerability:

$$Risk = Hazard * Exposure * Vulnerability.$$

Vulnerability to environmental degradation and natural hazards is connected with social, poverty, and gender lines. Vulnerability and exposure are dynamic and varies with time and spatial scales. It is economic, social, geographic, demographic, cultural, institutional, governance, and environmental dependent. Individuals and communities are differently exposed and vulnerable due to differences in wealth, education, race/ethnicity/religion, gender, age, class/caste, disability, and health status; as was already mentioned in 2012 at a Special Report on *Determinants of risk: Exposure and vulnerability of the Working Groups I and II of the Intergovernmental Panel on Climate Change (IPCC)*<sup>64</sup>.

Disaster risk is the possibility of adverse effects in the future. The adversities of climate change, such as natural hazards (wildfires, floods and hurricanes, and others) and more gradual degradation of the environment are already felt in many areas. These adversities are in relation with the ecosystems, water resources, human health, human settlements and migration patterns, energy, transport and women. Many regions in the world, have been undergoing profound transformations through forest degradation, land use changes and effects of global climate change. These transformations increase vulnerability of the region and also of the population because associated environmental risks are high.

Women are more affected, primarily, as they constitute the majority of the world population, the majority of the world's people in poverty. They are also more dependent on their livelihood on natural resources that are threatened by climate change and they face social, cultural, economic and political barriers that limit their coping capacity (UN Women, 2019)<sup>65</sup>.

Perception of the risks that come from climate change are important for local communities, for men and women for risk analysis and for subsequent societal decision making. Although women perceive a higher probability of a catastrophic event, men and female subjects do not make different investment decisions when faced with uncertainty and risk (Young et al., 2017).

Critical factors to climate change are mitigation, adaptation, technology transfer and financing. Mitigation involves a process of curbing greenhouse gas emissions from human activities, while adaptation involves a range of activities to reduce vulnerability and build resilience in key sectors, such as water, agriculture and human settlements (UN Women, 2019).

Building disaster resilient communities is the main objective for crisis management institutions across the globe, for suffering less and recovering more quickly when a community is faced with adversity. In order to assess a community's resilience, Norwegian researches propose to use vulnerability metrics that can be used to identify potential low-risk (high resilience, low vulnerability) and high-risk (low resilience, high vulnerability) (Scherzera et al., 2019).

Other researchers (Balaei et al., 2019) have used and tested indicators related to water supply at post-disaster period in Chile and New Zealand, countries that have experienced earthquakes in 2010 and 2011, respectively, concerning the issue of water supply. The proposed indicators were homicide rate, assault rate, inverse trust in army, inverse trust in police, mean years of school, and perception of crime to identify and explain the difference in water supply resilience between the two countries, while the vulnerability assessment of a community at the risk of a volcano in Indonesia, was performed by emphasizing the combination of physical, social, and economic characteristics (Hizbaron et al., 2018).

In many adversities, women are more vulnerable than the men. There is broad understanding that gender equality is a fundamental part of increased resilience to disasters (FAO, 2014).<sup>66</sup> However, most of the studies published in the international literature consider resilience as a function of social,

<sup>64</sup><https://www.sei.org/publications/determinants-of-risk-exposure-and-vulnerability/>

<sup>65</sup>UN Women Watch. Online at: <<https://www.un.org/womenwatch>>

<sup>66</sup><https://www.fao.org/3/a-i6618e.pdf>



economic, physical and hazard aspects, that surrounded the at-risk communities while the gendered-vulnerability is not considered.

Questions like how might men and women be differentially affected by long-run climate change and short-term climate risks, what are the characteristics and causes of gender differentials in vulnerability/resilience, what are the adaptation options, strategies, and approaches that are available to and preferred by men and women should be used by researchers, policy-makers and development practitioners to better understand the vulnerabilities of men and women to climate change, towards taking actions to reduce that vulnerability.

Gender-sensitive metrics are important in measuring the vulnerability and assessing the resilience or improving the resilience of a community, when coupled with unequal access to resources and to decision-making processes, and limited mobility that places women in rural areas in a position where they are disproportionately affected by climate change. It is commonly known that climate change has serious ramifications in food availability, food accessibility, food utilization and food systems stability (UN Women, 2019). Gender-sensitive indicators are necessary to track how different interventions affects the lives of different social-economic groups and assess whether progress is made towards gender equality and if corrective measures are taken (De la O Campos, A. P., Garner, E., FAO 2014).

It is also important to identify gender-sensitive strategies to respond to the environmental and humanitarian crises caused by climate change (UN Women, 2019). Work is required to identify and streamline the approaches and practices of gender-differentiated vulnerability in Natural Disasters differentiation approaches and practices, and to incorporate into guidelines for collaboration, women empowerment and resilience training, capacity building, planning, regulations and procedures and leadership in strategic development. Women and men can be proactive in adapting to the adverse consequences of climate change or mitigating climate change.

#### **4 Conclusion**

The study indicates that regarding resilience, the exclusion of the subject is observed in the discourse of the dominant ideology, with the predominance of an attitude, where his or her life is determined and treated as a mere object. Hence one should avoid to follow this predominant attitude but we must defend and protect our subjectivity, that is, our identity that is shaken and marked by its uniqueness, that lies in the untold of adversity and shaken by the discourse of adaptation out of suffering; particularly nowadays with the impacts of the Social Networks.

This may be fostered by increasing the awareness of our own Worth to share the Systemic View of Life, helping to take sustainable decisions in preventing chain disasters and avoiding additional suffering to everyone, particularly women, who are more affected. In the case of Amazon Forest, if Nature's Worth was taken into consideration, not only may help the weather heating problem and preserve biodiversity, but there would be a way of producing without harming the environment and still having social-economical profits.

In addition, women, need to be resilient in hazards and during the post-hazards periods because in disasters and extreme climate events linked with climate change is likely to affect women more than men. The gendered vulnerabilities may, however, be reduced by capacity building and social changes, by identifying gender-sensitive strategies to respond to the environmental and humanitarian crises caused by climate change.

Measures taken in the decision making with the Systems View of Life on the part of authorities can play a crucial role in preventing a huge number of risks to life in all its forms. That can be developed through the Inner Processes of Creation that brings awareness of own Worth, and therefore the Other and Nature.

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## Research on Evaluation of Industrial Sustainable Development Ability in China: Based on Dynamic Entropy Weight and DEA Model

Chen Mengxue<sup>1</sup>, Zou Wei<sup>2,3</sup>

1 School of Arts and Sciences, Jiangnan University, Wuhan, P.R.China, 430100

2 Business School, Jiangnan University, Wuhan, P.R.China, 430100

3 Research Center of Industry Development in Wuhan City Circle Wuhan, P.R.China, 430100

(E-mail: 184722704@qq.com, zou\_wei@126.com)

**Abstract:** This paper used dynamic entropy weight and data envelopment analysis method to study the industrial composition of industrial sustainable development in China's 29 provinces and cities, and constructed an industrial sustainable development capability evaluation index system for China. The sustainable development capabilities of 29 provinces and municipalities had been evaluated and proposed a series of recommended countermeasures to promote the sustainable development of China's industrial economy, comprehensive social progress, sustainable use of resources, continuous improvement of the environment and continuous innovation of technology.

**Key words:** Industrial sustainable development capability; Evaluation index system; Dynamic entropy weight method; DEA model

### 1 Introduction

In recent years, with the increasingly prominent problems of resources, environment and ecology, sustainable development has received more and more attention from people. Research on sustainable development at home and abroad has developed rapidly like springing up.

Sustainable development capability is "the probability that a particular system successfully limits its development, coordination, and sustainability to a sustainable development threshold", that is, "the ability of a particular system to successfully extend to sustainable development goals" (Wenyuan Niu, 1994). The ability to sustain industrial development is the ability of industries in specific regions to promote economic growth and development in accordance with the goals and requirements of sustainable development (Hongwei Li, 2010).

Foreign scholars' research on development evaluation indicators can be divided into four categories: (1) a more micro-level pressure-state-response indicator based on the ecological-environmental perspective (Costanza R, 1991) (China 21st Century Agenda Management Center, 2004); (2) Sustainability Index based on comprehensive value accounting (Daly HE, 1990); (3) Selecting population, resources, environment, economy, society and other indicators for systematic analysis; (4) Measuring sustainability by establishing unsustainable indicators (Jodha, N. S, 1993). The domestic

evaluation index system covers five aspects of economy, society, resources, environment and science and technology (HL Xie, 1999), (Li Zhao, 2009), (Cunzhi Guo et al., 2016). Some scholars first summarized it as “development degree”. Three dimensions of continuity, coordination (SG Chen, 2004). The Sustainable Development Research Group of the Chinese Academy of Sciences presented the China Sustainable Development Indicators System in the 1999 China Sustainable Development Strategy Report. The indicator system is divided into five levels, with a total of 45 indices covering 208 indicators (China) Institute of Sustainable Development of the Academy of Sciences.

The sustainable development ability evaluation methods mainly include analytic hierarchy process (Zhang JS, 2012), BP neural network evaluation method, entropy weight TOPSIS method (Guodong Xu, 2012), factor analysis method (SL Zhao, 2013), data envelopment analysis, ecology Footprint analysis, etc. Data Envelopment Analysis (DEA) is a common method for measuring sustainability. Compared with other methods, the DEA method has comparative advantages and strong objectivity in dealing with multi-input and multi-output problems, so it is widely used by scholars at home and abroad. The DEA model was used to evaluate the sustainable development ability of a large city in China from 1986 to 1996, and the evaluation results were briefly analyzed (ZX Zeng , 2000). Based on the DPSIR-DEA model, the sustainable development capacity of 31 provinces and cities in China from 2003 to 2015 was evaluated (JQ Zhang, 2017). The DE-Malmquist index method was used to calculate the green total factor productivity of the Yangtze River Economic Belt from 2004 to 2015 (Ming Yi, 2018).

## 2 Construction of Industrial Sustainable Development Ability Evaluation Index System and Selection of Evaluation Methods

### 2.1 Construction of industrial sustainable development capability evaluation index system

Based on the availability of data, the industrial sustainable development capability evaluation index system including five first-level indicators, 14 second-level indicators and 21 third-level indicators was designed from the input and output aspects (see Table 1).

**Table 1 Regional Evaluation Index System for Industrial Sustainable Development Capacity**

Type	Indicator			Unit	Attribute
	First level	Second level	Third level		
Input	Energy consumption $X_1$	Energy consumption $X_{11}$	Industrial enterprises above designated size Increased value of energy consumption $X_{111}$	tons of standard coal / 10,000 yuan	Reverse
		Electricity consumption $X_{12}$	Industrial enterprises above designated size added value of electricity consumption $X_{121}$	kWh / million yuan	Reverse

		Environmental Protection Investment $X_{21}$	Industrial pollution control investment accounts for the proportion of industrial added value $X_{211}$	%	Positive
				%	Positive
	Environment Pollution $X_2$		Comprehensive utilization rate of industrial solid waste $X_{221}$	10,000 tons	Reverse
		Industrial "three wastes" $X_{22}$	Industrial wastewater discharge $X_{222}$	10,000 tons	Reverse
			Industrial sulfur dioxide emissions $X_{223}$	10,000 tons	Reverse
			Industrial smoke dust emissions $X_{224}$	10,000 tons	Reverse
		technology staff input $X_{31}$	R&D personnel of industrial enterprises above designated size account for the proportion of industrial employees $X_{311}$	%	Positive
	Technology Innovation $X_3$	Science and technology funding $X_{32}$	R&D expenditure of industrial enterprises above designated size accounts for the proportion of main business income $X_{321}$	%	Positive
			New product development expenditures accounted for the proportion of main business income $X_{322}$	%	Positive
		R&D Emphasis $X_{33}$	The number of industrial enterprises with R&D activities accounts for the proportion of all industrial enterprises $X_{331}$	%	Positive
		Economic growth $Y_{11}$	Industrial added value growth rate $Y_{111}$	%	Positive
		Economic structure $Y_{12}$	High-tech industry (manufacturing) main business income accounting for the proportion of industrial main business income $Y_{122}$	%	Positive
			Total asset contribution rate $Y_{131}$	%	Positive
Output	Economic Development $Y_1$	Economic benefit $Y_{13}$	Labor productivity $Y_{132}$	%	Positive
			Cost and expense profit $Y_{133}$	%	Positive
		Industrial extroversion $Y_{14}$	Industrial export delivery value of industrial sales output value $Y_{141}$	%	Positive
		New product market competitiveness	New product sales revenue accounted for the proportion of main business income $Y_{151}$	%	Positive
			New product export sales revenue accounted for new product sales revenue $Y_{152}$	%	Positive

	$Y_{15}$			
society	Employment contribution $Y_{21}$	Employment contribution rate $Y_{211}$	%	Positive
development $Y_2$	Per capita labor remuneration $Y_{22}$	Per capita labor remuneration of manufacturing urban employees $Y_{221}$	%	Positive

## 2.2 Data source

The data was compiled from the China Statistical Yearbook, the China Industrial Statistical Yearbook, the China Science and Technology Statistical Yearbook, and the statistical yearbooks of the provinces (municipalities and autonomous regions). Among them, some data are directly taken from the statistical yearbook, and some data are calculated by the data on the statistical yearbook. Due to the lack of relevant data in Hainan and Tibet, only the industrial sustainable development capacity of 29 provinces and cities in China from 2011 to 2016 was evaluated.

## 2.3 Selection of evaluation methods for industrial sustainable development capability

Industrial sustainability assessment is a multi-input-multi-output evaluation study, so it is suitable to use data envelopment analysis; at the same time, in order to follow the Banker rule (the number of decision-making units must be more than twice the sum of input and output variables) In this paper, before using the data envelopment analysis method, the entropy weight method is used to determine the weight and calculate the comprehensive index, which not only reduces the number of indicators, but also ensures the completeness of the information of the indicators, thus conforming to the application conditions of the data envelopment analysis method. In addition, the dynamic entropy weighting method is adopted because the weights determined by the data are different each year.

## 3 Evaluation of China's Industrial Sustainable Development Capability

Applying the dynamic entropy weight method to determine the weight, and calculating the input and output comprehensive index values of industrial enterprises above designated size in China's 29 provinces and cities from 2011 to 2016, using DEAP 2.1 software to sustain industrial sustainability in 29 provinces and cities in China. Development capacity was measured (Table 2). The study found:

**Table 2 Evaluation Index of Industrial Sustainable Development Capacity of 29 Provinces and Cities in China from 2011 to 2016**

Area	2011	2012	2013	2014	2015	2016	Mean	Ranking
Beijing	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1
Tianjing	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1
Shanghai	1.000	1.000	0.887	1.000	0.978	1.000	0.978	3

Guangdong	1.000	0.983	0.801	0.659	0.897	1.000	0.890	4
Chongqing	1.000	1.000	0.874	0.678	1.000	0.616	0.861	5
Fujian	0.634	0.900	0.917	0.634	0.722	0.511	0.720	6
Zhejiang	0.502	0.524	0.561	0.480	0.671	1.000	0.623	7
Jiangsu	0.546	0.613	0.537	0.413	0.586	1.000	0.616	8
Guizhou	0.885	1.000	0.622	0.287	0.328	0.199	0.554	9
Shanxi	0.558	0.729	0.516	0.333	0.335	0.275	0.458	10
Ningxia	0.644	0.334	0.699	0.350	0.290	0.213	0.422	11
Jiangxi	0.447	0.385	0.496	0.359	0.403	0.317	0.401	12
Yunnan	0.416	0.806	0.346	0.195	0.413	0.194	0.395	13
Anhui	0.323	0.389	0.551	0.305	0.342	0.359	0.378	14
Hunan	0.321	0.405	0.384	0.319	0.378	0.322	0.355	15
Qinghai	0.495	0.375	0.335	0.343	0.468	0.113	0.355	15
<b>Hubei</b>	<b>0.282</b>	<b>0.345</b>	<b>0.356</b>	<b>0.394</b>	<b>0.308</b>	<b>0.310</b>	<b>0.333</b>	<b>17</b>
Neimenggu	0.460	0.339	0.399	0.245	0.339	0.181	0.327	18
Xinjiang	0.396	0.351	0.395	0.291	0.355	0.174	0.327	18
Guangxi	0.320	0.356	0.376	0.245	0.398	0.227	0.320	20
Shandong	0.288	0.367	0.334	0.217	0.263	0.357	0.304	21
Henan	0.267	0.291	0.389	0.235	0.326	0.307	0.303	22
Sichuan	0.366	0.380	0.354	0.249	0.232	0.233	0.302	23
Gansu	0.392	0.269	0.537	0.233	0.192	0.136	0.293	24
Jilin	0.327	0.341	0.313	0.262	0.240	0.220	0.284	25
Shanxi	0.276	0.404	0.346	0.090	0.180	0.166	0.244	26
Heilongjiang	0.353	0.301	0.218	0.135	0.198	0.136	0.224	27
Liaonign	0.233	0.222	0.275	0.174	0.171	0.187	0.210	28
Hebei	0.178	0.209	0.182	0.106	0.185	0.183	0.174	29
Mean	0.514	0.539	0.517	0.387	0.455	0.412	0.471	—

### **3.1 Industrial sustainable development capacity has important support for regional economy**

Areas with strong industrial sustainability are basically strong in overall economic strength, such as Beijing, Tianjin, Shanghai, and Guangdong. Reaffirming that industry is an important support for a region's economic strength.

### **3.2 The ability of sustainable development in different regions varies from year to year**

Except for the two municipalities directly under the central government of Beijing and Tianjin, the sustainable development capabilities of various provinces and cities in different years have fluctuated greatly. Moreover, it can be seen that the industrial sustainable development capability of most provinces and cities in China is weak and needs to be improved.

### **3.3 Industrial sustainability capacity is related to positive input and output**

Comparing Beijing with strong sustainable development ability and Qinghai Province with weak sustainable development ability, it can be seen from the comprehensive index value that provinces and cities with stronger sustainable development capacity generally have relatively less investment and relatively higher output. Large; the provinces and cities with weaker sustainable development capabilities are the opposite. From the perspective of the original indicators, provinces and cities with strong sustainable development capabilities generally have more positive inputs and positive outputs, and relatively less negative inputs and negative outputs; provinces and cities with weaker sustainable development capabilities in contrast.

## **4 Suggestions on Improving the Sustainable Development Capability of China's Industry**

In summary, this paper puts forward relevant suggestions from five aspects of resources, technology, economy, society and environment to enhance the sustainable development capability of China's industry.

### **4.1 Optimize resource allocation and improve resource allocation efficiency**

In general, the resources invested by industry mainly include manpower, material resources and financial resources. For human resources, through the establishment of a sound talent introduction mechanism, configuration and guarantee mechanism. For natural resources and energy, optimize energy structure and improve energy efficiency. For the capital element, shorten the payment period and increase the capital turnover rate.

### **4.2 Increase investment in innovation and promote the transformation of scientific and technological achievements**

For the government, it is especially important to formulate relevant policies and regulations to encourage innovation and optimize the innovation environment. For enterprises, according to production needs, increase R&D personnel and funding, and promote the transformation of scientific and technological achievements, and so on. For individuals, divergent thinking, stimulating imagination, and thinking about problems at the intersection of disciplines.



#### **4.3 Optimize industrial structure and transform economic development mode**

Accelerate the transformation and upgrading of traditional industries, increase the proportion of high-tech industries in the industry; vigorously develop new industries such as new energy automobile manufacturing, information technology industry, and green industries such as biomedicine, energy conservation and environmental protection equipment, and digital technology; The opportunity of structural reform will promote the deep integration and development of manufacturing, finance and service industries.

#### **4.4 Responding to local residents and improving people's quality of life**

First, establish a sound interest feedback system, increase investment in infrastructure such as schools, hospitals, parks, and road maintenance. Second, develop an ecological compensation system, and actively carry out ecological protection activities such as afforestation and land reclamation; once again, actively organize or participate. Public welfare donations, product sales and other activities give back to the community.

#### **4.5 Reduce pollution emissions and increase environmental management investment**

On the one hand, heavy chemical enterprises improve the comprehensive utilization rate of resources, reduce the generation and discharge of pollutants, ensure that pollutants meet the standards, and reduce pollution from the source. On the other hand, invest heavily in environmental protection projects, assist relevant departments in pollution control and ecological restoration.

### **5 Conclusion**

The research results showed that industrial development has a strong supporting role for the regional economy. The level of industrial sustainable development is related to the positive input and output of industries in various provinces and cities. In view of the research results, we have put forward targeted countermeasures from the five aspects of resources, science and technology, economy, society and environment to enhance the sustainable development capability of China's industry.

The future evaluation and research on industrial sustainable development capacity will also be an ongoing process. Industrial sustainability assessment needs to consider the resource endowments, geographic location, national policies, and other specific characteristics of each province, etc., but these qualitative factors are difficult to quantify in the research process and need to be broken in future research. The selection of relevant indicators will be a process of continuous development and improvement.

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## Corporate Social Responsibility: A Multiple Case Study of the Civil Construction Industry in the State of Bahia, Brazil

Paulo Melo<sup>1</sup>, Manoel Joaquim F. de Barros<sup>1</sup>, Arnaldo José de Hoyos Guevara<sup>2</sup>,

Edson Jorge M. De Sousa<sup>1</sup>

1 Universidade Salvador – UNIFACS, Salvador, Brazil

2 Pontifical Catholic University of São Paulo, Brazil

(E-mail: pmmelo@yahoo.com, manoeljfb@gmail.com,

arnoldodehoyos@yahoo.com.br, edsonjorgedemoraes@icloud.com)

**Abstract:** The main aim of this research is to verify the importance of corporate social responsibility (CSR) in the context of the civil construction industry in the State of Bahia. The CSR became relevant as business environment is increasingly more complex and competitive, and society has demanded from organizations concrete actions about issues such as sustainability and social development. Those actions are aligned with the ten principles suggested by the United Nations Global Compact. To carry out this research, a multiple case study strategy was used through interviews with key respondents from six construction companies based in the State of Bahia. The findings showed that CSR is a relevant issue as far as business strategies are concerned for 67% of companies surveyed. Despite the theme is not a consensus, this study showed that several actions have been developed informally related to CSR, especially those linked to the welfare of communities surrounding construction sites and the use of modern technologies that help reducing environmental impact, the management of construction waste (debris).

**Key words:** Corporate social responsibility; Sustainability; Strategy; Environment

### 1 Introduction

The increase of complexity in the business sector, together with the advances of latest information and communication technologies and consequent improvements of firm's productivity, have resulted in significant growth of competitiveness among organizations. This growth of competitiveness has caused significant changes inside companies, those focused on new differentiation strategies that include economic, social, organizational, and environmental dimensions. As far as different dimensions are concerned, social and environmental ones are becoming more relevant. Organizations which are social and environmentally responsible are in constant searching for answers for new challenges presented by contemporary management strategies. These strategies aim sustainable competitive advantages for companies in different markets and countries.

In response to these challenges, a new concept is appearing: the so called Corporate Social

Responsibility (CSR). According to the Commission of the European Communities (Commission of the European Communities, 2001), CSR is a concept whereby organizations decide voluntarily to contribute to a better society and a cleaner environment. Then, CSR aims to drive businesses to make companies an important partner of society and co-responsible for its development, not only economically but also social and environmentally.

To highlight the importance of CSR, the United Nation (UN) Secretary-General Kofi Annan in 1999, during his speech at the World Economic Forum launched the UN Global Compact focused to promote among companies worldwide, corporate policies based on sustainable social and environmental practices.

According to Voegtlin & Pless (Voegtlin & Pless, 2014), despite some limitations and challenges, this UN initiative has generated considerable attention and discussions among companies around the world and a new organizational infrastructure has emerged and changed the scope of social responsibility of those companies with benefits for the businesses and society as a whole.

Based on this concept, companies and governments are changing, affecting contemporary management strategies. One of the main changes is related to the understanding that organizational strategic decisions should not be driven by the accomplishment of shareholder's interests only, but also driven by other stakeholders' interests, such as employees, suppliers, public agents, competitors, local communities, environment, and society. This kind of debate is making a turn in another direction: while designing corporate strategies, firms should take into consideration not only the view that shareholders are the only and the main stakeholder. Firms should also consider the search for minimizing environmental and social potential negative impacts. It is a naive and a superficial feeling to believe that these actions would threaten the competitiveness of companies.

Companies have been accelerating and widely accepting this new organizational philosophy since the end of the 20th century with the growing concern for social and environmental impacts caused by some economic agents, such as firms in the oil, energy, and civil construction industries. In the construction industry, companies have caused impacts in the environment by changes in the local geography and treatment of residue, where construction works (building sites) are found at.

As a result, firms in this sector are adapting and adopting new strategies able to attend this new reality. Society pressure causes this new move to much more respect with the environment, which is more conscious, pushing companies to intensify actions to attend this new organizational profile of the social and environmental responsibility of firms.

In this context, the present study aims to understand how firms in the civil construction industry perceive the trend of the growing of CSR as an organizational strategy. The application of such strategy may help to improve firm's competitiveness and public image before society. Then, to carry out this research, the study surveyed firms in the State of Bahia's construction industry in 2017. The choice of the state of Bahia was due to the ease access to companies and the 2015 Brazilian Chamber of Construction Industry (CBIC) Report, which showed that Bahia held 1/4 of companies in the Northeastern region, with 8,833 registered firms (See Table 1).

In the civil construction industry, the importance of CSR is growing fast and has influenced how firms are dealing with new demands of society, including environmental and social aspects and the economic development of communities,

cities, and countries. In physically built environments, the construction of roads, bridges, sewer systems, tunnels and other infrastructure projects have significant impacts in the environment and the surrounding communities.

**Table 1 Civil Construction Firms in the Northeastern Region of Brazil by State in 2015**

<u>STATES</u>	<u>NR. OF FIRMS</u>	<u>%</u>
BAHIA	8.833	22,40
CEAR	7.291	18,49
PERNAMBUCO	5.470	13,87
RIO GRANDE DO NORTE	5.005	12,69
PARA BA	4.450	11,28
MARANH O	2.525	6,40
PIAU	2.390	6,06
ALAGOAS	1.884	4,77
SERGIPE	1.583	4,01
TOTAL.	39.431	100,0 0

Source: CBIC Report (2016)<sup>67</sup>

Then, the approach of CSR focused in the civil construction industry is justified by the clear impact this industry has caused in the environment, local communities and surrounding area of the construction sites as well as the relevant importance of this sector for the Brazilian economy, particularly, concerning new job generation. According to the 2017 report of Brazilian Institute of Geography and Statistics, this sector represented 6.2% of Brazilian GDP in 2016, employing around 3.5 million people in Brazil.

## **2 Corporate Social Responsibility, a Contemporary Theme in Organizations**

According to Bowen (Bowen, 1953), the field of study of CSR is very wide and has impact in all economic activities, thus with important repercussion in businesses, local communities, environment, and society. Even though it has been studied since the end of the Second World War, it was only in the beginning of the 21<sup>st</sup> Century that CSR appears as a new paradigm in the elaboration and designing of organizational strategies. This is due to the role of society in charging organizations with more responsible attitudes about the environment and society itself. According to O'Connor (O'Connor, 1999), these attitudes are related to the maintenance of the quality of the environment, the well-being of society and its long-term sustainability.

In this context, markets are becoming increasingly more competitive, with lower profit margins, combined with ever-increasing demands on quality and ethical posture. These factors are putting intense pressure on the way organizations are being managed and, particularly, on environmental management and social responsibility. Therefore,

<sup>67</sup>Câmara Brasileira da Indústria da Construção. Retrieved at: <<http://www.cbic.org.br>>. Access: 10/09/2016

CSR is a global phenomenon and not only a specific wave in developing countries. Traditional and mature markets have also been affected by this movement and pushing organizations to change dramatically.

New strategies focused on CSR have led companies to a distinctive look, searching for new attitudes towards the different stakeholders involved. According to Aaker (Aaker, 2007), CSR is not only a matter of organizational strategy, but is causally linked to the company's reputation and values, directly affecting the organization's image and brand *vis-à-vis* its target customers. Corporate social responsibility is an important part in the field of management study, influencing organization's goals, values, general strategies, and the concept of firms itself.

Recent studies (Capra, 1998; Reiser, 2010) in management field have emphasized significant changes in the business environment, relating them to the political, economic, and technological fluctuations that are occurring in the global arena. These changes concern business' nature and demand an original approach, fundamentally innovative, to understand and to deal with new realities, which directly involves social and environmental issues, creating a new benchmark for business management.

The 1987 Brundtland Report (a commission created by the United Nations to deal with environment and development) defined sustainability as a way of meeting the needs of the present without compromising future generation's needs (Wayne, 2012). Corporate interests must manage business as well as the interests of their stakeholders and the environment. This argument reflects the social and political role played by companies and their business purposes, because they go beyond profit maximization and compliance. According to Drucker (Drucker, 1993), any disregard for sustainability and CSR by organizations is not consonant with economic freedom and the liberalization of the economy.

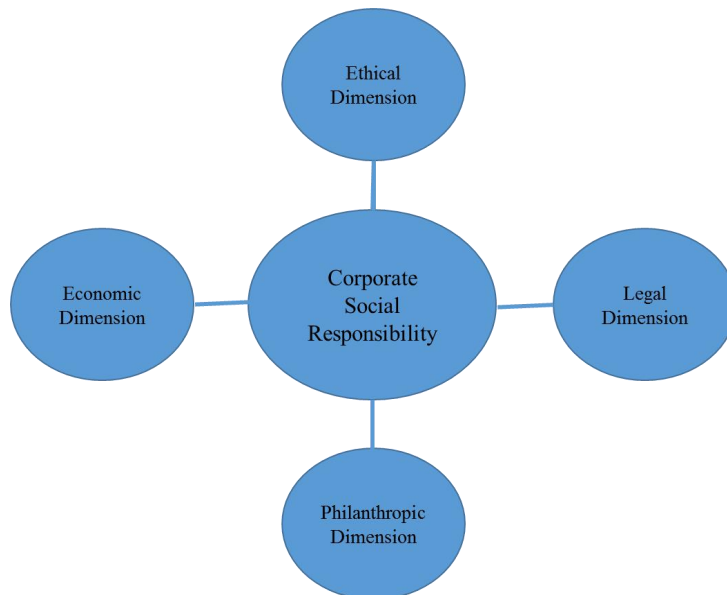
This new organizational paradigm brings the need for a socially responsible company that works in conditions that cause the least possible impact to the environment, through the production of ecologically cleaner products preserving environment, ensuring healthy ecosystems, social equality, and good organizational governance. For Hart e Milstein (Hart e Milstein, 2004), companies should be concerned with the balance between economy, society, and the environment, in an increasingly interdependent world.

In this new arena, issues such as social and environmental responsibilities are part of the agenda of large organizations, in recognition that their obligations go beyond profitability and compliance. It is increasingly strong the trend of a more responsible corporate social behavior in which companies seek the balance between the economically practical, the socially just and the environmentally sustainable. This paradigm is translated into the model proposed by Carroll (Carroll, 1979; 1991), when he considered that CSR should cover four (4) dimensions: economic, legal, ethical and philanthropic (See Figure 1).

Carroll (Carroll, 1979; 1991) suggests a model that attributes to business a series of responsibilities with society, far beyond the simple economic issue of generating profit for shareholders and obeying laws. According to this author, the company's role goes beyond economic and legal purposes *vis-à-vis* society. The traditional view is related to the economic performance, which involves a set of tools and methods that make it possible to diagnose the firm's financial situation to verify the stability and profitability of the business or project. According to Schuler and Cording (Schuler and Cording, 2006), these methods of measuring financial performance may be by profit, market value and growth, and in all cases, the results should be related to the contribution of companies to the development of society and the preservation of the environment.

Although the economic dimension, that involves the obligation of companies to be productive and profitable, is considered the most important of the activities; nowadays, Ursini & Bruno (Ursini & Bruno 2005), Campbell (Campbell 2007), Pelozo (Pelozo, 2009) and Pelozo, &Shang (Pelozo, &Shang, 2011) consider other dimensions also important and investigate the direct relationship between economic performance and CSR. This approach refers to the concept of the Triple Bottom Line for sustainability (Elkington, 1997), that suggests that companies must be measured by its responsibility with people, the planet and with profit as well. What determines the success of an enterprise is not the result of its profits alone, but also how companies act in relation to environmental and social issues.

From this point on, organizations should consider, in the elaboration of their institutional business planning, not only economic goals, but other issues, such as protection and conservation of the environment and the inclusion of communities. Both are part of the basic concept of CSR and sustainability.



**Figure1 Dimensions of the CSR Model (Carroll, 1979; 1991)**

The ability of companies to attend not only their interests, as well as the interests of society, must be in association with the organizational strategies. These strategies must be able to keep the level of

competitiveness, create value, supply financial results and a return to investors and to society. It is necessary to measure the financial and economic results to keep track of the evolution of production, costs, and profit, but also one must quantify sustainability measures to verify the firm's contribution to the society and the environment.

In Brazil, this relationship between economic performance and CSR is in maturation. Studies and researches developed by Moretti & Campanário (Moretti & Campanário, 2009) are showing that companies are getting satisfactory economic and financial results when applying the concepts of CSR and sustainability. Notably, those that started to integrate the New Market in the stock exchange are committed to the adoption of corporate governance standards, with CSR as one of its pillars (Prociány&Verdi, 2009).

### **3 Methodological Approach**

This research has the aim to understand how firms in the construction industry in the State of Bahia perceive the importance of CSR as an organizational strategy. The study selected six (6) companies preferentially based on the ease access to those with headquarters in the city of Salvador and availability of personal contact within their management staff.

Regarding the research approach, the present study is eminently qualitative, due to its subjective and less numerical nature in understanding the role of corporate social responsibility (CSR) in Bahia construction industry sector. As a research strategy, it used multiple case studies, because, according to Yin (Yin, 2005), the results are more exact and credible, and the researcher has greater security for the defense and presentation of the data.

As data collection strategy, this research used interviews with convenience access to key informants. For the choice of those key informants, the criterion adopted was according to the relevance of the position held within the companies and their ability to meet the goals of the research. The study conducted interviews between March and May 2017. For collecting data, a structured and semi-structured questionnaire was used, which allowed greater flexibility and freedom to address relevant issues that may appear during the interview. Other sources, such as websites of companies surveyed, were used to obtain relevant information that allowed the understanding about the companies, such as its history, mission, vision, organizational structure, and values.

The script construction of the questionnaire was based on the Ethos Institute method<sup>68</sup>. The Ethos Institute is a civil society organization of public interest, created in 1998, which ended up becoming a reference for the dissemination of the culture of sustainability and CSR in Brazil. The Ethos Institute developed a method with 47 thematic indicators, organized in four dimensions: social, governance and management, vision and strategy, and Environment. From the 47 indicators, this research named 23 that apply to the interests and aims of this study.

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<sup>68</sup> Instituto Ethos de Empresas e Responsabilidade Social. Retrieved at: <<http://www.ethos.org.br/>>. Access: 14/05/2016.



#### 4 Findings

Findings showed that four of the surveyed companies (67%) totally agree or agree that CSR is a relevant issue for their organizations (See Table 1); however, only two companies (33%) clearly showed that CSR is part of its business strategy. Those companies have even formally structured a specific department in the organization to deal with this issue inside the organization.

Other companies' issues, related to CSR, were translated informally into organizational actions, such as:

(i) Contacts with local community leaders, from surrounding construction sites, to carry out educational campaigns;

(ii) Agreements with organizations, such as Social Service of Industry (SESI), which used to carry out educational campaigns on occupational safety, health, and environment;

(iii) Company's construction projects, which, somehow, affected surveys of local community's needs. Some examples of such needs are paving streets and improvement of properties' general appearance by region around the construction site.

**Table 2 Is CSR considered a Relevant Issue in your Organization?**

Companies	Totally Agree	Agree	Indifferent	Disagree	Totally Disagree
01			X		
02					X
03	X				
04	X				
05	X				
06		X			

Source: Primary data

Moreover, even though companies state that they care about CSR mostly through non-institutionalized strategies; in fact, they have been working in a way that promotes social responsibility. Table 2 confirms this find, as it presents evidence that:

(i) although the questionnaire addressed twenty-three (23) items, based on the method of the Ethos Institute, twenty-two (22) were contemplated in the six (6) companies surveyed and;

(ii) fifteen (15), of the 23 items listed in the questionnaire, equivalent to 65%, are present in at least three (3) of the companies surveyed.

**Table 3 List of CSR Indicators Applied to Firms Surveyed Source: Primary Data**

ITEMS		Firm	Firm	Firm	Firm	Firm	Firm
		01	02	03	04	05	06
01	Publicly exposes its ethical commitments through institutional documents in the internet or other means to its stakeholders.				X		
02	The company is open to criticism from groups or stakeholders about the nature of its products, processes, or services.	X			X		X
03	Third parties audited piece of information on the economic and financial situation of the company's activities.				X	X	X
04	Supplies information that affects employees and unions in a prompt approach, facilitating them to position themselves	X		X	X	X	X
05	The company has incentive and recognition program concerning the employees' suggestions for improving internal processes.	X		X	X		
06	Has specific program for hiring apprentices	X	X	X	X	X	
07	The company's code of conduct and / or statement of values included the policy on promoting diversity and non-discrimination.				X		X
08	The policy on promoting equity and non-racial discrimination is formal and contained in the company's code of conduct and / or statement of values		X		X		X
09	The policy on promoting gender equity is formal and contained in the company's code of conduct and / or statement of values.		X		X		X
10	The company's job and salary plan are transparent and addressed in its code of conduct and / or its statement of values.	X			X		X
11	Supplies prevention and a treatment program for drug and alcohol addiction and HIV / AIDS	X		X			
12	Periodically analyzes the socioeconomic profile of employees to define strategies, benefits, education, and professional development programs						

ITEMS		Firm	Firm	Firm	Firm	Firm	Firm
		01	02	03	04	05	06
1 3	Offers supplementary pension plan to all employees.				X		
1 4	The environmental policy is formal, known to all employees and is included in company's code of conduct and / or statement of values.			X	X		X
1 5	Has environmental emergency plan, which lists all products, processes or services that involve risks. In addition, it supplies a training program to employees regularly facing danger situations.			X			
1 6	Promotes, in its strategic decisions, programs to reduce solid waste generation, as well as control and monitoring of production chain of inputs origin.			X	X		X
1 7	Customer and consumer policy and standards are set out in the company's code of conduct and / or statement of values.				X		X
1 8	Maintains a special program, focusing on consumer / customer health and products and services safety.	X	X		X		X
1 9	Recognizes the community, in which it is present, as an important stakeholder in its decision-making processes.	X	X	X	X	X	
2 0	Carries out surveys of local needs before designing projects in the community.	X		X	X		
2 1	Carries out, in the community, together with local organizations, educational campaigns of public interest.	X	X		X		
2 2	Take social actions and other stakeholders in account for the overall strategic planning process.				X		
2 3	Adopts or develops partnerships with public agencies, aiming at social goals, health, eradication of child labor, promotion of food security etc.	X	X	X	X		X

## 5 Conclusion

One of the main outcomes of this study is to verify that, in general, companies surveyed are concerned with CSR; however, this concern, in some of them, does not seem to be translated institutionally nor are formally adopted as business strategy. The belief of relevance of CSR issue, as part of business strategy agrees with Ashley et al. (Ashley et al., 2002), Soares (Soares, 2004), and

Bertoncello & Chang (Bertoncello & Chang, 2007), who emphasize the importance of this theme to organizations.

According to the findings, the CSR has been a critical issue, discussed among construction companies in the state of Bahia. Several strategies have been developed, especially those related to the welfare of communities surrounding construction sites and the use of innovative technologies that help reducing environmental impact, in particular management of construction waste (debris), which brings direct gains to the environment, the workers and society. Those strategies guarantee healthier ecosystems with less impact on environment and society.

Thus, to answer the research question, which deals with the importance of CSR within the context of the construction companies in the state of Bahia, this study showed that CSR, for most of the companies surveyed, is relevant, although, in some of them, are treated informally. In fact, most companies prove that, in some way, this theme is relevant, but not often translated into formal business strategies yet.

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# Study on the Driving of Energy Saving and Emission Reduction to the Transformation of Resource-based Cities

Chen Qiang, OuYang Xiao

School of Science, Wuhan University of Technology, Wuhan, P.R.China, 430070

(E-mail:52169530@qq.com, 1931114893@qq.com)

**Abstract:**From economic form, social form and natural form, this paper explores the driving effect of energy-saving and emission reduction on energy-consuming industries, high-tech industries and development of tourism industries of resource-based cities, based on the investigation of the current situation of resource-based urban development in China. By using statistical analysis methods such as correlation analysis and regression analysis, and multivariate regression model constructed, we find that there is a high degree of positive correlation between the transformation of resource-based cities and energy saving and emission reduction. Finally, we use the Markov prediction model is used to predict and analyze the industrial structure of a typical resource-based city, Pingdingshan City, in the next 10 years, in order to explain the driving effect of energy saving and emission reduction on the transformation of resource-based cities. The method presents good application value in the analysis of economic development, the prediction of industrial structure changing and urban development planning.

**Key words:** Energy saving and emission reduction; Resource-based city; Multivariate regression analysis; Markov prediction

## 1 Introduction

At present, environmental problems, population problems and resource problems have become one of the three major problems in the sustainable development of economic society (Zhu Xun, 2005). As the largest energy consumer and carbon emitter, China, while ensuring stable and sustainable economic development, must take the road of "energy saving and emission reduction" in line with the national conditions. The vigorous implementation of energy conservation and emission reduction policies has led to the gradual adjustment of the urban industrial structure and has had a driving effect on the transformation of resource-based cities (Liu Hongbin, 2010). Pingdingshan city in Henan Province is a mature and typical resource-based city with abundant mineral resources, but it needs to keep moving forward on the road of transformation.

## 2 Research Design

### 2.1 Purpose

Nowadays, facing the rapid development of society and economy, resource and environmental constraints, through energy conservation and emission reduction to promote the transformation and development of resource-based cities is imminent(Dou Bingci, Qin Yuanchun, 2016).In order to

understand the driving effect of energy saving and emission reduction on resource-based cities, this study takes Pingdingshan city of Henan province as an example to analyze. To ensure the validity and accuracy of the results, this survey first through pre-survey to determine the best sample volume, and then based on the best sample volume to determine the final survey volume, by using artificial auxiliary questionnaires and referring to government statistics. Because of the large sample size in the large-scale sample survey, the large sample theory is used to determine the interval estimation by using the limit distribution, while the theoretical basis of the finite total non-release sample is the Wald-Wolfowitz theorem (Sun Shanze, 2017), which can determine the optimum sample quantity according to the pre-survey data and then use the absolute precision.

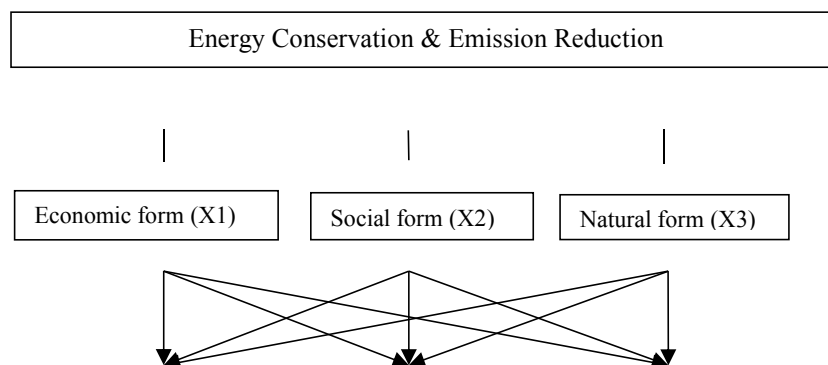
After screening and pretreatment, 774 effective questionnaires were obtained, the effective rate was 91.1%. This paper mainly analyzes the basic information of the interviewees, the basic situation of the Pingdingshan and the basic situation of energy saving and emission reduction, after that we carries on the correlation analysis and the regression analysis for the specific data, and then gets the driving effect of the energy saving and emission reduction on the resource-based city transformation. Finally predicts the future economic development trend of the Pingdingshan, thus validating the "Energy saving and emission reduction "driving effect on the development of resource-based cities.

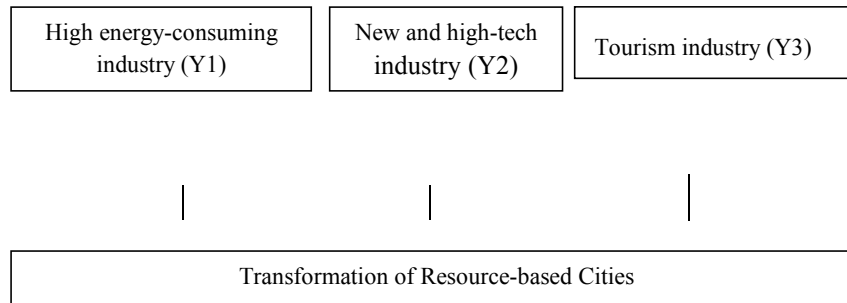
## 2.2 Research method

One of the key points of this paper is the setting of two variables-energy saving and emission reduction and resource-based urban transformation. Whether we can accurately grasp the setting of these two variable indexes is related to whether we can accurately reflect the driving effect of energy saving and emission reduction on the transformation of resource-based cities.

The core content of resource-based urban transformation is the transformation of its industrial structure (Yang Jianlin, Zhang Sifeng, Wang Jiajia, 2018).A large number of scholars at home and abroad do many academic researches from different disciplines. And there is a considerable amount of research in its evaluation. In this study, energy saving and emission reduction was set as an independent variable, and the transformation of resource-based cities was set as a variable. In the construction of the model, energy saving and emission reduction are mainly composed of its economic form, social form and natural form, while the transformation of resource-based cities is the adjustment of resource-based urban industrial structure, mainly for energy-consuming industries, high-tech industries and tourism.

Considering the need of research and the feasibility of operation, this paper simplifies the model to a certain extent. From the simplified model, we can see that the relationship between the two magnitude variable of energy saving and emission reduction and the two-magnitude variable of resource-based urban transformation is not a simple one-to-one correspondence effect, but a more complex correlation, which also shows that the driving effect of energy saving and emission reduction on the transformation of resource-based cities is not simply linear relationship, but has complexity and The specific model relationships are detailed in Figure 1:





**Figure 1 Driving Effect Model of Energy Saving and Emission Reduction on Resource-based City Transformation**

In the process of index setting, this paper fully investigates and references the literature published by other scholars, which mainly includes the reference to the evaluation system of industrial transformation ability (Wu Yayun, Gao shikui, 2015). The measurement indexes of energy saving and emission reduction economic form set in this paper include: Urban Development, Enterprise development, economic development and resource utilization, and the measurement indexes of social form include: Government attitude, policy cognition and residents ' attitude, while natural form includes residents ' living environment and urban environment construction.

### 3 Data Analysis

This paper mainly uses Excel software to input and organize the investigation data, and uses Spss19.5 software to carry out statistical analysis. In the process of discussing the driving effect of energy saving and emission reduction policy on the transformation of resource-based cities, this paper first uses Pearson correlation analysis (CD Jayaweera, N. Aziz, 2018) to discuss the correlation between variables, and then uses multivariate regression analysis to explore the specific influence degree of energy saving and emission reduction variables on dependent variables on the basis of greater correlation.

#### 3.1 Correlation analysis

In order to explore whether there is relevance and the extent of relevance, this paper analyzes and discusses the economic form, social form and natural form of energy saving and emission reduction.

Correlation analysis between the economic pattern index of energy saving and emission reduction and the industrial structure of Pingdingshan City is shown in Table 1 below:



**Table 1 Correlation Analysis of the Influence of Economic Form and Industrial Structure**

		Y1	Y2	Y3
X1	Pearson Correlation	.635**	.663**	.452**
	Sig.(2-tailed)	0.000	0.000	0.000

Note: \*\* is significantly correlated on 0.01 levels (bilateral)

From the data in the table, we can think that the economic form of energy saving and emission reduction is related to the high energy consumption industry, high-tech industry and tourism, and has a high positive correlation with the energy-consuming industry and high-tech industry, which shows that the economic form of energy saving and emission reduction has a great influence on these two industries. It can be argued that the deeper the policy of energy conservation and emission reduction, the greater its impact on energy-intensive industries and high-paying technology industries.

It is worth noting that there is a weaker correlation between the economic form of energy conservation and emission reduction and the tourism industry, which also shows that energy conservation and emission reduction have limited influence on tourism development in economy. The main reason is that tourism itself should on the basis of scenic natural environment and a long history and culture, which is why the correlation with the tourism industry is relatively low.

Correlation analysis of the influence of energy saving and emission reduction social form on Pingdingshan industrial structure the results shown in table 2 below can be obtained:

**Table 2 Correlation Analysis of the Influence of Social Form and Industrial Structure**

		Y1	Y2	Y3
X2	Pearson Correlation	.528**	.657**	.338**
	Sig.(2-tailed)	0.000	0.000	0.000

From the social form of energy saving and emission reduction and the correlation and significance of measuring the transformation of resource-based cities, the social form mainly has a strong correlation with high-tech industry. And high-tech industry is moderately correlated with the energy-consuming industry, and the correlation with tourism industry is relatively weak.

Correlation analysis of the influence of natural form of energy saving and emission reduction on Pingdingshan industrial structure the results shown in table 3 below can be obtained:

**Table 3 Correlation Analysis of the Influence of Natural Form and Industrial Structure**

		Y1	Y2	Y3
X3	Pearson Correlation	.678**	.568**	.535**
	Sig.(2-tailed)	0.000	0.000	0.000

Similarly, it can be seen from the table that the natural form of energy saving and emission reduction has a strong correlation with the energy-consuming industry, while the correlation with high-tech industry and tourism industry is in the medium range, and the correlation with the tourism industry is relatively weak.

By comparison, we can know that energy-saving emission reduction has a strong correlation with high energy consumption industry and high-tech industry, which means with the deepening of energy conservation and emission reduction work, the impact and fluctuation of these two industries will also be the largest. And the tourism industry is only more related to the natural form of energy saving and emission reduction, the main reason is that the natural environment focus on the development and maintenance of tourism has an important role in promoting, which naturally has a certain correlation.

2.3.2 Multiple Regression Analysis.

To explore whether the economic form further, social form and natural form of energy saving and emission reduction have an interdependent relationship with the transformation of resource-based cities. This study further adopts multivariate regression analysis on the basis of exploring correlation analysis (Zhou Rubiao, Lin Xiaoxia, Wang Yuhua, 2019). The results indicate that the three variables contained in energy conservation and emission reduction have a high degree of interpretation of resource-based urban transformation, which means the transformation of resource-based cities largely depends to energy conservation and emission reduction. The specific parameters of regression analysis are table 4 and table 5 below.

**Table 4 Model Summary Table**

Model	R	R <sup>2</sup>	Adjusted R Square	Std. Error of the Estimate
1	.652 <sup>a</sup>	.395	.472	.595

a. Predictors: (Constant), economic form, social formation, Natural form

**Table 5 Regression Coefficient Table**

Model	Unstandardized Coefficients		Standardized Coefficients	t	Sig.
	B	St. Error	Beta		
(Constant)	.087	.276		.216	.009
Economic form (x1)	.315	.073	.388	6.146	.000
Social formation(x2)	.470	.081	.206	3.154	.002
Natural form (x3)	.215	.072	.210	3.123	.002

The linear equations for the impact of energy conservation and emission reduction on Pingdingshan urban transformation, which are fitted by research data, are as follows:

$$Y = 0.087 + 0.315X_1 + 0.470X_2 + 0.215X_3$$

From the above results, we know that 65.2% of resource-based urban transformation can be determined by the three forms of energy conservation and emission reduction. Among the various elements, the social form of energy saving and emission reduction has the greatest contribution coefficient to the industrial structure of Pingdingshan, which shows that the government's policies, systems and residents' attitudes are very important to the transformation of resource-based cities. And the contribution rate of natural form is relatively small, which indicates that energy saving and emission reduction in environmental construction pressure is relatively small. From this, we can basically think that social form is the most driving effect on the transformation of resource-based cities.

In addition, on the basis of regression analysis, the variance analysis (Fu Yingying, Tian Zhenkun, Liyumei, 2019), the observation value of F test statistics is 67.573, the corresponding P value is approximately 0, so it is considered that the regression coefficients have obvious influence on the due variables in regression analysis, and a multivariate linear regression model can be established. Therefore, it can be concluded from the above analysis that the economic form, social form and natural form of energy saving and emission reduction have a direct positive effect on the transformation of Pingdingshan.

### 3.2 Prediction of industrial structure

#### 3.2.1 Build model

In order to verify the promotion of energy saving and emission reduction to the transformation of resource-based cities, this paper predicts with the help of Markov model (Shaanxi Statistical Bureau, 2018)<sup>69</sup>, the hypothesis includes: (1) The added value of three industries remains unchanged within one year, and its calculated by year; (2) Assuming that three industrial value added per year is only related to the proportion of industries in the previous year; (3) The acceptable range of errors is [-1.5%, 1.5%].

The basic model of Markov prediction is:  $X(k + 1) = X(k)P$ , where  $X(k)$  represents the state vector of the predicted object at  $t = k$  time;  $P$  represents a one-step transfer probability matrix;  $X(k + 1)$  represents the state vector of the Predictor object at  $t = k + 1$  time. The value added of the  $n$  industry in the  $T$  period as a share of GDP is  $Z_n(t)$  ( $n=1, 2, 3$ ). The Markov prediction model is:

$$\begin{pmatrix} z_1(1) & z_2(1) & z_3(1) \\ z_1(2) & z_2(2) & z_3(2) \\ \dots & \dots & \dots \\ z_1(t) & z_2(t) & z_3(t) \end{pmatrix} = \begin{pmatrix} z_1(0) & z_2(0) & z_3(0) \\ z_1(1) & z_2(1) & z_3(1) \\ \dots & \dots & \dots \\ z_1(t) & z_2(t) & z_3(t) \end{pmatrix} \begin{pmatrix} P_{11} & P_{12} & P_{13} \\ P_{21} & P_{22} & P_{23} \\ \dots & \dots & \dots \\ P_{31} & P_{32} & P_{33} \end{pmatrix}$$

The upper formula is  $Z_2 = Z_1P$ ,  $P = \begin{pmatrix} P_{11} & P_{12} & P_{13} \\ P_{21} & P_{22} & P_{23} \\ \dots & \dots & \dots \\ P_{31} & P_{32} & P_{33} \end{pmatrix}$  is the transfer probability matrix.

Then the optimal solution of the state transfer matrix in the above model can be obtained by using the least squares method. that is  $\hat{P} = (Z_1^T Z_1)^{-1} Z_1^T Z_2$ . The state transfer matrix can be obtained by bringing in the relevant data of Pingdingshan three industries.

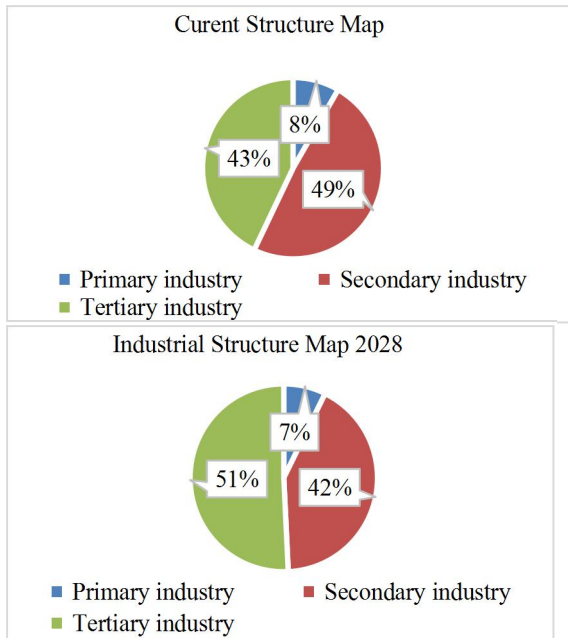
#### 3.2.2 Prediction results

In order to ensure the accuracy of the forecast, this study only predicts the changes of three industries after 10 years. According to the Statistical Yearbook data (Henan Statistical Bureau, 2019)<sup>70</sup>

<sup>69</sup><http://tjj.shaanxi.gov.cn/site/1/html/126/131/138/17204.htm>

<sup>70</sup> [http://www.ha.stats.gov.cn/sitesources/hntj/page\\_pc/index.html](http://www.ha.stats.gov.cn/sitesources/hntj/page_pc/index.html)

of Henan province, the proportion of three industries in 2018 was set as the initial state matrix, and the data of the next decade can be predicted by using the probability of State transfer. In order to make the comparison of the data results more obvious, this paper compares the predicted industrial structure diagram with the current industrial chart, and the results are shown in Figure 2 below.



**Figure 2 Comparison of Industrial Structure Chart of Pingdingshan**

By contrast, you can see intuitively: In the next 10 years, the proportion of the second industry will decline in Pingdingshan city, the tertiary sector will surpass secondary industry as the most important component of the industrial structure, which is also the inevitable result of the transformation of resource-based cities(Fu Xiaodong, 2015).

#### 4 Conclusion

This paper discusses and analyzes the driving effect of energy saving and emission reduction on the development of high energy consumption industry, high-tech industry and tourism in resource-based cities respectively, and the findings indicate the following: first, energy conservation and emission reduction have a significant positive impact on industrial optimization and economic development of resource-based cities; Second, the economic form, social form and natural form of energy saving and emission reduction have a high positive correlation with high energy consumption industry and hi-tech industry, and the transformation driving effect of resource-based city is obvious. Third, Pingdingshan can develop the tertiary industry and break through the limitation of resources and environment, insist on sustainable development and then realize the transformation of resource-based cities.

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# Research on the Relationship between R&D Coupling Coordination and Upgrading of Equipment Manufacturing Industry:

## An Empirical Study of Shandong Province

Li Xue, Hou Jie, Gao Pengbin

School of Economics and Management, Harbin Institute of Technology, Weihai, P.R. China, 264209

(E-mail: lixuehit@163.com, 2387764361@qq.com, gaopengbinhit@163.com)

**Abstract:** Based on the statistical data of Shandong equipment manufacturing industry from 2009 to 2016, this paper analyzed the mechanism between internal and external R&D coupling coordination and industrial upgrading. The coupling coordination model of physics was used to calculate the coupling degree of internal and external R&D, and the Malmquist index was used to measure industrial upgrading. The results showed that the R&D coupling coordination was at moderate level, which plays an important role in driving industrial upgrading. According to the results, some suggestions for R&D management were also proposed.

**Key words:** Internal R&D; External R&D; Industrial upgrading; Coupling coordination; Malmquist index

### 1 Introduction

The equipment manufacturing industry is the cornerstone of industrial development and the core component of the manufacturing industry, which provides production technology and equipment for the national economy and national defense construction. However, the deep-seated problems affecting the development of the equipment manufacturing industry have not yet been fully resolved, including unreasonable industrial structure and weak independent innovation capability, etc.

For the relationship between internal and external R&D and industrial upgrading, many scholars pay more attention to the following aspects. First, some scholars study the impact of internal R&D on industrial upgrading. Internal R&D capabilities contributed to the rise of the industrial value chain based on panel data of the Chinese manufacturing industry (Yu and Fan, 2014). Using the impulse response function method to study the internal R&D on high-tech industries, it is found medium-sized high-tech industries fluctuated greatly after the impact (Chu and Zhang, 2013). Second, some scholars focus on the impact of collaborative innovation on industrial upgrading. Combined collaborative innovation and industrial cluster theory, scholars show China's coal industry and found that synergistic innovation plays a positive role in regulating (Guo, 2014). Previous studies analyze the industry data of China's manufacturing industry from 2005 to 2014, the results showed that internal R&D, industry-university-research cooperation R&D are the best strategic choices in the transformation and upgrading of the manufacturing industry (Yuan and Sun, 2017). Third, some scholars analyze the impact of internal and external R&D collaboration on industrial upgrading. Based on electronic communication equipment manufacturing industrial transformation and upgrading of the Yangtze

River Delta, it is found that R&D innovation will promote its movement to the upstream of the value chain (Zhang, 2010). When scholars research the coupling between technological innovation and traditional industries, proposed the path of industrial upgrading, and promoted the transformation and upgrading of traditional industries through technological innovation, internal R&D and external R&D (Cheng and Wu, 2015).

Whether it can adhere to internal R&D as the leading factor and rely on external R&D has become the key of industrial upgrading. The synergistic relationship between internal and external R&D indicates that can have a more positive impact on industrial upgrading (John and Wang, 2012). In order to distinguish from previous research, this study uses the coupling coordination degree model and Malmquist index method to study the relationship between internal and external R&D coupling and industrial upgrading from the perspective of system. Finally, it provides corresponding countermeasures based on the research results. This paper will enrich and improve the theory of internal and external R&D and industrial upgrading and provide reference for future research. The suggestions are significant to solve the practical problems existing in the industrial development and to promote the industrial upgrading of the manufacturing industry and the development of the overall economy.

## **2 Method**

### **2.1 R&D coupling coordination model**

Coupling theory was initially mainly applied in the field of physics, and in recent years it has been gradually applied in the field of social science. Coupling refers to the interaction between two or more internal elements or modes of motion, which results in a coordinated and symbiotic dynamic association (Pile, David, 2012). The coupling of internal and external R&D refers to the interaction between internal R&D system and external R&D system, resulting in complementary advantages and further promoting the positive overall relationship. Coupling coordination can be carried out four levels: the low level ( $0 < H \leq 0.4$ ), the moderate level ( $0.4 < H \leq 0.6$ ), the high level ( $0.6 < H \leq 0.8$ ) and the extreme level ( $0.8 < H \leq 1$ ).

### **2.2 Malmquist index model**

The Malmquist index model describes the production changes of output and input through the distance function, which can measure total factor productivity, technological progress, etc. (Zhang and Jiang, 2014). Through the Malmquist index model, this paper studies the technological progress index to analyze equipment manufacturing industry, and explores the relevant content of industrial upgrading. The Malmquist index can be used to represent the input-based technological progress growth from  $t$  to  $t+1$  (Walheer, 2018). The Malmquist index value is greater than 1, indicating that the technological progress of the  $t+1$  is increased compared with the  $t$ ; the Malmquist index value is less than 1, indicating that the TFP has decreased; the Malmquist index value is equal to 1, indicating that the technological progress has not changed.

### **2.3 Data**

This study uses equipment manufacturing data from 2009 to 2016 collected by Shandong Statistical Yearbook. Seven sub-sectors are selected, including Metal Products Industry (M1), General

Equipment Manufacturing Industry (M2), Special equipment manufacturing Industry (M3), Transportation equipment manufacturing Industry (M4), Electrical machinery and equipment manufacturing Industry (M5), Computer, communications and other electronic equipment manufacturing Industry (M6) and instrumentation manufacturing Industry (M7).

## 2.4 Variable

R&D coupling. We use the coupling model to measure the coupling coordination degree of internal and external R&D. The internal R&D systems use internal R&D expenditure indicators, including government funds (I1), corporate funds (I2), offshore funds (I3) and others (I4). External R&D systems use external R&D expenditure indicators, including expenditures for domestic research institutions (E1), expenditures for domestic higher education (E2), and expenditures for overseas (E3) (Yu and Fang,2015).

Industrial upgrading. It is appropriate to use the technological progress index to evaluate. The total industrial output value, total assets and number of employees are selected to measure technology progress index in the seven sub-sectors. The above indicators are used to calculate the technological progress in the Malmquist index through Stata15., then analyze the industrial upgrading.

## 3 Result

### 3.1 R&D coupling coordination

Considering that only relying on the internal R&D and external R&D coupling degree will lead to misleading judgment and draw a pseudo conclusion that the degree of coordinated development is higher, this paper carries out the analysis of the coupling coordination degree of internal and external R&D in Table 1. Overall, internal and external R&D is in a moderate degree of coupling, there are relatively large industry differences from Figure 1.

**Table 1 Internal R&D and External R&D Coupling Coordination in Manufacturing Industry**

	2009	2010	2011	2012	2013	2014	2015	2016	M
I1	0.10	0.09	0.15	0.41	0.35	0.35	0.39	0.29	0.26
I2	0.51	0.50	0.53	0.70	0.65	0.48	0.58	0.48	0.55
I3	0.33	0.42	0.36	0.45	0.50	0.38	0.46	0.40	0.41
I4	0.68	0.74	0.94	0.73	0.75	0.82	0.80	0.87	0.79
I5	0.74	0.77	0.68	0.72	0.68	0.62	0.61	0.59	0.67
I6	0.52	0.55	0.59	0.43	0.47	0.53	0.60	0.58	0.53
I7	0.11	0.11	0.13	0.04	0.04	0.01	0.01	0.03	0.06
M	0.43	0.45	0.48	0.50	0.49	0.45	0.49	0.46	



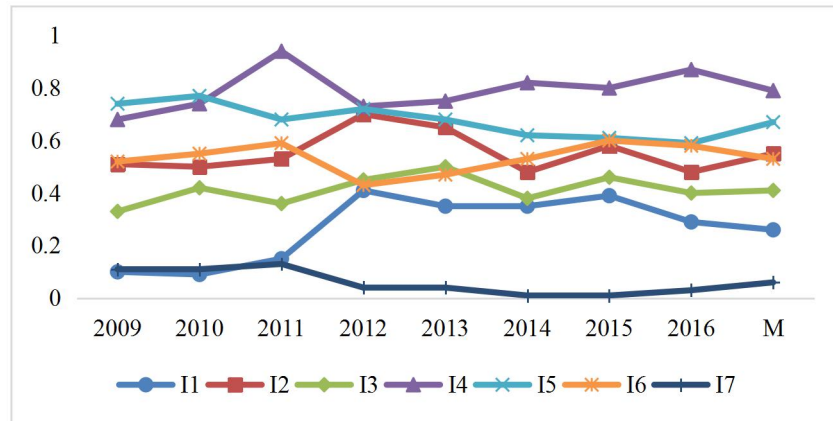


Figure 1 Internal R&D and External R&D Coupling Coordination in Manufacturing Industry

### 3.2 Industrial upgrading

The industrial upgrading of the equipment manufacturing industry in Shandong Province is quite ideal (Table 2), and the technological progress has performed well from Figure 2.

Table 2 Shandong Province Equipment Manufacturing Industry Technology Progress Index

Techch	I1	I2	I3	I4	I5	I6	I7	Mean
2009	0.96	0.96	0.96	1.11	1.08	0.99	0.96	1.00
2010	1.02	1.00	1.02	1.14	1.02	1.02	1.00	1.03
2011	1.11	1.11	1.13	1.06	1.12	1.12	1.10	1.11
2012	1.02	1.02	1.04	1.08	1.07	0.96	0.97	1.02
2013	1.04	1.04	1.05	1.09	1.06	1.03	1.03	1.05
2014	1.03	1.00	1.05	1.11	1.12	0.94	0.96	1.03
2015	1.03	1.04	1.02	0.99	0.99	1.04	1.05	1.02
2016	1.05	1.05	1.06	1.04	1.03	0.99	1.02	1.04
Mean	1.03	1.03	1.04	1.08	1.06	1.01	1.01	

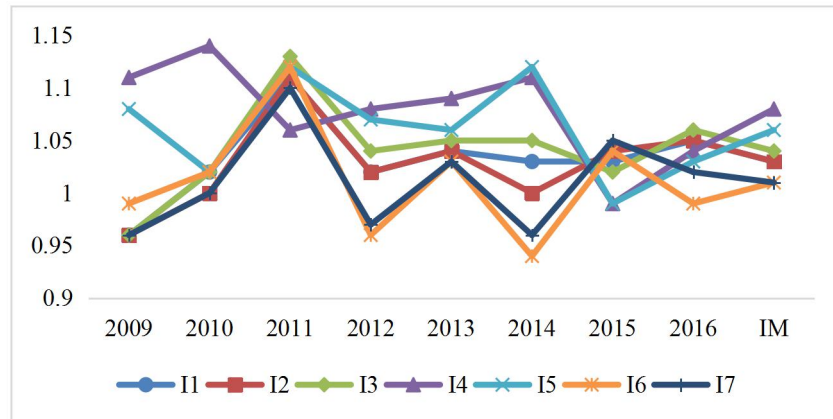


Figure 2 Shandong Province Equipment Manufacturing Technology Progress Index

### 3.3 R&D coupling coordination and industrial upgrading

In order to have a deeper understanding of the relationship between R&D coupling and industrial upgrading, we make unit root, panel data co-integration, granger causality analysis, and impulse response test using stata15. The relationship between internal and external R&D and industrial upgrading of equipment manufacturing industry is showed.

#### 3.3.1 Unit root test

The unit root test is performed on the internal and external R&D coupling coordination degree and the technology progress index to judge the stability of the corresponding panel data. The unit root test of the internal and external R&D coupling coordination degree and industrial upgrading are in compliance with the requirements at a significant level of 1%. Both of them have a long-term stable relationship, and can be co-integrated. analysis.

#### 3.3.2 Co-integration test

In order to test the relationship between internal and external R&D coupling coordination degree and industrial upgrading, co-integration test is performed. The result shows the R&D coupling has a co-integration relationship with industrial upgrading in the 5% Pedroni co-integration test( $P=0.003$ ), and also meets the conditions for long-term stable interaction. The further conformity of the co-integration relationship lays the foundation for the next Granger causality test.

#### 3.3.3 Granger causality test

The R&D coupling coordination degree is the Granger cause of the industrial upgrading( $P=0.00$ ), while the industrial upgrading is not the Granger reason for the R&D coupling coordination degree( $P=0.424$ ). On the whole, the test results confirm that the R&D coupling coordination degree is the Granger cause of the industrial upgrading.

### 3.3.4 Impulse response test

It can be seen from Figure 3 that when the coordination degree of R&D is accumulated to a certain extent, the growth rate and growth rate of the technological progress index are very rapid. The technological progress index has accumulated to a certain extent, and it also has a certain feedback effect on the coordination degree of research and development. This shows that the accumulation of internal and external R&D is to a certain extent, and when it reaches the point of explosion, it will greatly promote the technological progress and cause industrial upgrading.

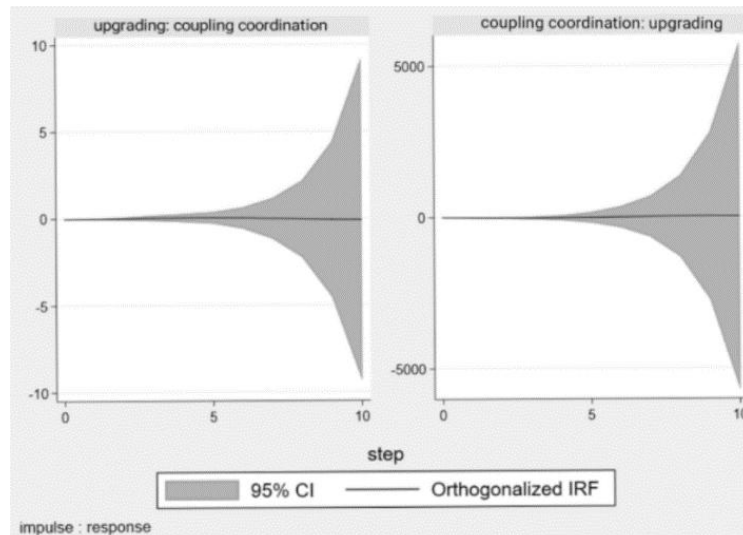


Figure 3 Impulse Response Function between R&D Coupling Coordination and Industrial Upgrade

## 4 Conclusion

The paper uses the physics coupling model to measure the internal and external R&D coupling. The research finds that the overall R&D coupling coordination degree is in the state of moderate coupling, and the industry distribution is uneven. The overall efficiency of the equipment manufacturing industry is good by using Malmquist analysis, but it also exists insufficient. The development of various sub-sectors in the equipment manufacturing industry is unbalanced, the coupling gap between R&D and the upgrade efficiency is also different, which indicates that there is still no optimal balance between R&D coupling and industrial upgrading. This paper verifies the role of internal and external R&D coupling in promoting industrial upgrading, thereby deepen the understanding of the relationship between internal and external R&D interactions and industrial upgrading, and fill the gaps in previous research.

The suggestions for the R&D of equipment manufacturing industry in combination with the development of Shandong Province are as follows. we must pay attention to balance the relationship between internal R&D and external R&D, and find a balance. In addition, we must pay attention to internal and external communication, maintain knowledge flow, information flow, capital flow, so that internal and external R&D coupling outputs can flow and drive upstream and downstream enterprises. Then, it can promote the upgrading of the overall industry.

However, there are some limitations in the research. Only the data of Shandong Province are used for verification. The best situation of the internal and external R&D coupling coordination degree is not further analyzed. In the future, we will continue to pay attention to the development of equipment manufacturing industry and make further research.

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# Employment Efficiency Evaluation of Innovation and Entrepreneurship Policy in China

Zhu Hua

School of Economic, Wuhan University of Technology, Wuhan, P.R. China, 430070

(E-mail: zmwhlg@163.com)

**Abstract:** The purpose of this article is to evaluate the regional employment efficiency of innovation and entrepreneurship policy (IEP) in China. We developed a set of indicators in relation to policy evaluation and employed super-efficiency dynamic slack-based model (DSBM) to calculate regional employment efficiency values. The article concludes that over 50% of the Chinese provinces have ineffective overall employment efficiency, and western region's performance is obviously superior to the central and eastern regions. Term efficiency scores of the three regions all show fluctuant trends over time, but there is regional inequality between eastern and other regions, implying that, in eastern provinces, policy resources bring about the least effect on creating employment opportunities.

**Key words:** *Innovation and entrepreneurship policy; Employment efficiency; Dynamic SBM model (DSBM); Factor efficiency index (FEI)*

## 1 Introduction

*In recent years, innovation and entrepreneurship have attracted governments' great attention due to its impact on economic growth and job creation (Audretsch, et al, 2014). Scholars proffer that innovation and entrepreneurship policy (IEP) contribute to risk reduction and market regulation for innovation and entrepreneurship (Edquist, 2011). However, in China, constantly increasing policy inputs has been employed with poor consideration of the performance of IEP. Meanwhile, annual growth in the number of college graduates and migrant worker forces China to confront unprecedented employment pressures in recent years. Therefore, employment creation has been regarded as one of the most crucial objectives of IEP. Although IEP deals with multiple issues such as economic growth, society development and environment protection, etc., a specialized investigation of employment performance of IEP not only leads to better investment and more even distribution of public resources, but also encourages greater responsibility for how those public resources are utilized.*

The following section presents relevant literature regarding performance assessment of IEP. Section 2 give a short review of the literature on the evaluation of innovation and entrepreneurship policy. In Section 3, we explore the framework logic of the relationship between IEP and job creation. Section 4 spells out super-efficiency DSBM to calculate the employment efficiency values of IEP. Section 5 is devoted to compute and analyze the regional employment efficiency values in China from 2007-2015. Also, a FEI analysis for calculated efficiency scores is presented in this section. The conclusion and recommendation are presented in section 6.

## 2 Literature Review

To examine the performance of IEP, past researchers normally evaluated the effect of public resource investment (inputs) on the outcome of IEP (outputs) (Wei, 2016). These researchers mainly concerned about economic objectives of IEP, resulting in output variables merely involving economic benefit indicators, such as production value of high technology industry and the number of patent applications, etc. (Zhou, 2017). Nonetheless, as an essential realistic goal, scholars have not yet attached

great importance to employment growth in policy evaluation, and few study selects employment growth as the output variable. Undoubtedly, different objectives of IEP should be balanced in evaluation. Otherwise, a biased assessment will lead to inconsistent attainment of different objectives.

Regarding the evaluation models of IEP, multivariate statistical methods are broadly used by many scholars. As a non-parametric method, DEA model attracts more scholars' attentions as it processes the inputs and outputs simultaneously (Apergis and Polemis, 2016). Performing efficiency values over a course of time is a new development in DEA model. Tone and Tsutsui (Tone and Tsutsui, 2010) developed dynamic slacks based measure (DSBM) in which the overall efficiency and term efficiency over a period of time is measured. However, at present, there is little literature adopts this method to assess the performance of IEP. Moreover, few studies combine the super-efficiency DEA and DSBM to rank effective units. Therefore, this paper applies super-efficiency DSBM model to evaluate the overall and term employment efficiency of IEP in China. Furthermore, some scholars argue that policy-makers depending heavily on increasing investment of policy resources rather than taking sufficient consideration of policy mix will lead to inefficiency of IEP (Atkeson and Brustein, 2011), yet few researchers conduct a quantitative analysis of the input excess or shortfall, which gives the specific references to policy-makers. Since factor efficiency index (FEI) is helpful in adequately measuring and analyzing the input excess or shortfall, it could be useful in understanding the direct reasons that cause the inefficiency (Bai et al., 2014).

On this basis, the objective of this paper is three-fold: firstly, this paper builds a more comprehensive measurement system that assesses employment efficiency of IEP. Second, super-efficiency DSBM is proposed to calculate and analyze provincial overall and term employment efficiency values in China. Finally, based on the term efficiency scores, FEI is employed to find main reasons that why employment efficiency fails to reach the optimal level.

### 3 Theoretical Framework

Since Schumpeter proffered that entrepreneurs were 'agents of creative destruction', entrepreneurship and innovation has been regarded as a single concept. Generally, on the one hand, by introducing creative products and processes into the market place, start-ups translate the investment of new knowledge into the competitiveness of economic growth (Audretsch and Keilbach, 2008). On the other hand, the entrants engage more in innovation than incumbents because producing new methods or new products is an approach to keep their core competence (Laguir et al., 2016). Therefore, the small but growing research emphasizes the association between innovation and entrepreneurship. Some scholars use the term 'facilitate one in the hope of getting more of the other' to represent the connection of innovation and entrepreneurship (Autio et al. 2014). We argue that innovation and entrepreneurship should be integrated into one system to provide a more realistic portrayal. Accordingly, public policy of innovation and entrepreneurship activities display complex interactions rather than two parallel processes, stemming from the complexity of innovation and entrepreneurship. Generally, according to the previous literature, innovation and entrepreneurship process includes three essential links, namely knowledge production, incubation activities and market promotion. Among them, knowledge production is the origin in the process; incubation activities transform the new knowledge into practical application; and market promotion commercializes new products.

Usually, innovation and entrepreneurship policy consist of three categories: supply-side policy, demand-side policy and environment policy. The supply-side policy is applied purposely to provide resources (funds, human resources, infrastructures, etc.). Supply-side policy can be subdivided into

provision for knowledge production and support for incubation activities. Demand-side policy focuses on creating demands for new products in commercialization and dissemination. Environment policy promotes optimal allocation by minimizing the uncertainties that might arise from the breakdown of converting public policy resources investment into the driving force to economic and social changes. Employment growth driven by innovation and entrepreneurship intrinsically links with the marketing in innovation and entrepreneurship process (Dachs and Peters, 2013). On the micro level, only when the large-scale production and application of innovations bringing about the expansion of emerging market and the reduction of production cost as well as motivating the enterprises to expand capacity and drive profits, firms are able to create substantially new positions. On the macro level, by demonstration effect and knowledge spill over, commercialized new products further add industrial values that may generate tremendous employment opportunities (Luan and Yang, 2016). Therefore, the higher market-based degree of innovation and entrepreneurship is, the more employment opportunities will be provided (Lawless, 2014). The relationship between IEP and employ mentis shown in Figure 1.

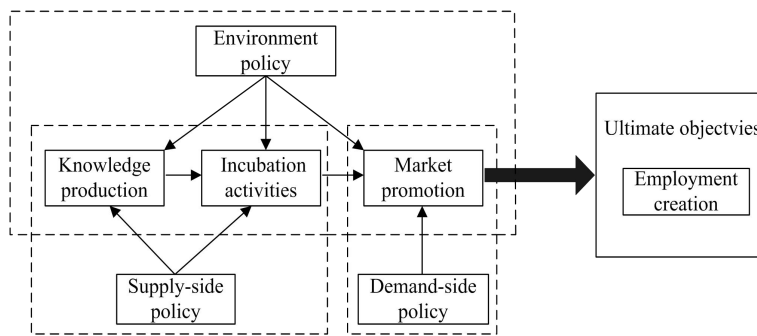


Figure 1 The Relationship between Innovation and Entrepreneurship Policy and Employment

#### 4 Efficiency Evaluation with Super-efficiency DSBM Model

Dynamic SBM model (DSBM) deriving from SBM proposed by Tone and Tsutsui is used to evaluate the DUMs in a consecutive period. Assume that there are  $t = 1, \dots, T$  periods and  $j = 1, \dots, n$  DUMs. Each DMU contains X input and Y output, and Z denotes the free link. To measure the accurate effective DUMs of the above DSBM, this paper combines the study of Tone on the base of super-SBM to rank the effective DMUs. The objective function the non-orientations DSBM model with free link under the constant returns-to-scale (CRS) is expressed as below:

$$\rho_0^* = \min \frac{\frac{1}{T} \sum_{t=1}^T w^t \left[ 1 - \frac{1}{m+1} \left( \sum_{i=1}^m \frac{W_i^- S_{iot}^-}{x_{iot}} + \sum_{i=1}^{nfree} \frac{S_{iot}^{free*-}}{z_{iot}^{free*-}} \right) \right]}{\frac{1}{T} \sum_{t=1}^T w^t \left[ 1 + \frac{1}{s+1} \left( \sum_{i=1}^s \frac{W_i^+ S_{iot}^+}{y_{iot}} + \sum_{i=1}^{nfree} \frac{S_{iot}^{free*+}}{z_{iot}^{free*+}} \right) \right]}$$

s.t.

$$x_{iot} = \sum_{j=1, \neq j_0}^n x_{ijt} \lambda_j^t + s_{it}^- (i=1, 2, \dots, m; t=1, 2, \dots, T); y_{iot} = \sum_{j=1, \neq j_0}^n y_{ijt} \lambda_j^t - s_{it}^+ (i=1, 2, \dots, s; t=1, 2, \dots, T);$$

$$z_{iot}^{free} = \sum_{j=1, \neq j_0}^n z_{ijt} \lambda_j^t + s_{it}^{free} (i=1, \dots, nfree; t=1, 2, \dots, T); \sum_{j=1, \neq j_0}^n z_{jt}^{free} \lambda_j^t = \sum_{j=1, \neq j_0}^n z_{jt}^{free} \lambda_j^{t+1} (\forall i; t=1, 2, \dots, T-1)$$

$$\lambda_t \geq 0, s_{it}^- \geq 0, s_{it}^+ \geq 0 \text{ and } s_{it}^{free} \geq 0, \sum_{t=1}^T w^t = T \sum_{i=1}^s w_i^+ = s \sum_{i=1}^m w_i^- = m \quad (1)$$

where  $x_{ijt}$  and  $y_{ijt}$  denote the input and output at term  $t$ , and  $z_{ijt}^{free}$  is free link;  $s_{it}^-$  and  $s_{it}^+$  are slack variables denoting input excess and output shortfall, separately;  $s_{iot}^{free*-}$  and  $s_{iot}^{free*+}$  indicate respectively excess and shortfall to  $z_{iot}^{free}$ ; and  $\lambda_t \in R^n (t = 1, \dots, T)$  is intensity vector in period  $t$ . This paper defines the  $\rho^*$  as efficiency value. Obviously, the smaller the value of  $\rho$  is, the less efficiency will be.

## 5 Employment Efficiency of Innovation and Entrepreneurship Policy in China

### 5.1 Indicator selection

As for supply-side policy, two types for knowledge generation and incubation activities are considered. For knowledge generation, R&D subsidy is employed as a common policy. Government funds in intramural expenditure on R&D are regarded as to be a good proxy indicator. For incubation activities, because regional governments encourage the application of new knowledge by building incubators for new firms or innovation agencies, the number of incubators is a similar indicator on behalf of government investment in financing incubation activities. As to demand-side policy, since public procurement as influences on expected profits of innovation agencies and new firms, the amount of provincial government procurement can be taken as the input of demand-side policy. In addition, we take it as the indicator of environment policy input because the government financial support broadly plays a part in optimizing the environment of innovation and entrepreneurship. Due to the hysteresis and continuity, government financial support is proper to be chosen as the free link variable in innovation and entrepreneurship process. For output indicator, since China's innovation and entrepreneurship activities are mainly concentrated in urban cities, the consequences generated by the activities tend to be found in urban cities. Then, employment in urban units at each year's end is considered to be a good proxy indicator.

### 5.2 Data sources

As a large country, unbalanced regional development remains a serious problem for China. Thus, regional employment efficiency scores tend to be significantly different. Therefore, we divided China into three regions, eastern, central and western. We take the panel data of mainland China's 28 provinces from 2007 to 2015 as a sample. Due to the significant missing data in Hainan, Tibet and Qinghai, these three provinces were not included in our research. The data comes from the China Statistical Yearbook, China Science and Technology Statistical Yearbook, China government procurement Statistical Yearbook and China Torch Statistical Yearbook. The basic statistical characteristics are shown in Table 1.

**Table 1 Descriptive statistical characteristics of input and output variables**

Type	Indicators	Variable	Mean	Median	Min	Max
Inputs	Input of supply-side policy(x1) (Knowledge production)	The amount of government expenditure in R&D	74.76	110.51	2.44	791.64



	Input of supply-side policy(x2) (Incubation activities)	The number of regional national incubators	30.19	59.99	1	505
	Input of demand-side policy(x3)	The amount of regional government procurement	377.31	357.16	29.2	2113.2
Free-link	government financial support(x4)	The amount of government financial support	70.41	78.95	4.33	569.55
Outputs	Employment figures(Y)	The number of employed people in urban	525.45	324.65	57.13	1973.3

### 5.3 The Result of empirical analysis and discussion

The overall efficiency and term employment efficiency are presented in Table 2.

**Table 2 Overall Efficiency and Term Efficiency**

Province	Overall efficiency	Term efficiency									
		2007	2008	2009	2010	2011	2012	2013	2014	2015	
Beijing	0.3325	0.4417	0.4934	0.5053	0.5879	0.4659	0.5627	0.4426	0.5219	0.3274	
Tianjin	0.2890	0.4806	0.5468	0.4457	0.4232	0.4653	0.5185	0.3716	0.4242	0.2561	
Hebei	0.5326	0.5205	0.7149	0.6590	0.6056	0.5535	0.7488	0.5049	0.6542	0.7635	
Liaoning	0.3867	0.5021	0.6099	0.5625	0.5143	0.4689	0.5192	0.5639	0.5462	0.4914	
Shanghai	0.2099	0.2739	0.3026	0.2913	0.2837	0.3663	0.4538	0.3528	0.4109	0.2442	
East China	Jiangsu	0.2437	0.3463	0.4409	0.3854	0.3462	0.3422	0.3382	0.4303	0.5443	0.4013
	Zhejiang	0.4928	0.5422	0.6437	0.6841	0.6839	0.6144	0.7048	0.6471	0.7555	0.5370
	Fujian	1.1023	0.9783	1.1145	1.1861	1.1554	1.0040	1.0561	0.8530	1.0049	1.0808
	Shandong	0.4701	0.6192	0.6927	0.6291	0.5971	0.5615	0.5655	0.5589	0.5899	0.5875
	Guangdong	0.4716	0.6270	0.6374	0.6046	0.6604	0.5754	0.5799	0.7407	0.6339	0.5838
	average value	0.4531	0.5332	0.6197	0.5953	0.5858	0.5417	0.6048	0.5466	0.6086	0.5273
	Shanxi	1.2218	1.2248	1.0335	1.0067	0.9529	1.0197	1.0402	1.3108	1.1144	1.2274
	Jilin	0.4523	0.4835	0.7350	0.6980	0.5498	0.5248	0.5907	0.5130	0.5596	0.5855
Central China	Heilongjiang	1.0101	1.0212	0.9452	0.9391	1.0845	0.9910	0.9617	0.8247	0.9177	1.1092
	Anhui	0.3065	0.3600	0.6102	0.5617	0.5211	0.4546	0.5216	0.3551	0.4490	0.3091

	Jiangxi	1.0396	0.7207	0.9229	0.9760	1.0134	0.9016	0.9882	1.0602	1.1508	1.0756
	Henan	1.0137	0.7679	0.9264	0.9187	0.9115	0.8895	0.8782	0.8596	0.8316	1.2391
	Hubei	0.4049	0.3441	0.5640	0.5324	0.5252	0.5695	0.5973	0.5363	0.7925	0.5193
	Hunan	1.0051	0.9702	1.0378	1.0396	1.0256	0.9778	0.9639	0.8438	1.0045	1.0596
	average value	0.8068	0.7366	0.8469	0.8340	0.8230	0.7911	0.8177	0.7879	0.8525	0.8906
	Inner Mongolia	0.6696	0.7199	0.9887	0.8579	0.7975	0.7686	0.6532	0.5895	0.6511	0.6909
	Guangxi	0.5191	0.5515	0.7281	0.5999	0.6358	0.5892	0.6728	0.6647	0.6621	0.5505
	Chongqing	1.0110	0.8961	1.0426	0.9875	0.9683	1.0050	0.9511	0.9310	0.8974	1.0953
	Sichuan	0.4765	0.3861	0.6221	0.5639	0.5854	0.5988	0.7088	0.5566	0.6987	0.6562
	Guizhou	1.1552	1.2595	1.1412	1.0367	1.1669	0.9878	1.0317	1.1973	1.1231	0.9996
West China	Yunnan	1.0044	0.9216	1.0565	1.0328	1.0021	1.0039	0.9749	0.8623	0.9900	1.0779
	Shanxi	1.0751	0.9443	1.0281	1.1221	1.1628	1.0562	1.0330	0.8944	1.1193	1.1690
	Gansu	1.1251	1.0374	1.1292	1.0496	0.9951	0.9575	1.1293	0.8999	1.1692	1.2395
	Ningxia	0.4551	0.4963	0.5536	0.5375	0.6600	0.6030	0.6278	0.5752	0.6915	0.5005
	Xinjiang	1.1938	1.2503	1.1948	1.2110	1.1127	1.1269	1.2694	1.1393	1.2636	1.1936
	average value	0.8323	0.8014	0.9211	0.8653	0.8860	0.8411	0.8647	0.7968	0.8892	0.8866
	National average	0.6974	0.6904	0.7959	0.7649	0.7649	0.7246	0.7624	0.7104	0.7834	0.7682

(1) The overall efficiency of national average from 2007-2015 has reached 69.74% of optimal level, indicating the overall employment efficiency of China is at an upper moderate level on the whole. Average over all efficiency values over the eastern, central and western regions are respectively 0.4531, 0.8068 and 0.8323, which imply that all regions are faced with tasks to improve efficiency. As shown in Table2, 12 provinces have attained the optimal efficiency, which are mainly from western region. Specially, Shanxi, Xinjiang, Guizhou, Gansu and Fujian are the 5 top provinces, while overall efficiency of Beijing, Tianjin, Shanghai, Jiangsu and Anhui show greater room for improvement. The results suggest that employment growth in some provinces, especially in most eastern provinces with greater development in terms of economies, has not yet been consistent with high public resources investment.

(2) The term efficiency scores are showed in Figure 2. At national level, term efficiency scores have fluctuated over time, and have a gradual increase with an 11.27% cumulative growth. Both central and western regions' term efficiency scores show a better performance than national average. Despite reaching the peak in 2008, term efficiency values of central and western regions decline gently to the lowest level in 2013 and bounce back from 2014. However, central region exhibits a relatively lower performance except in 2015. At the same time, the values of term efficiency in the east are consistently below national average significantly, which reach the peak in 2008, 2012 and 2014. It should be noted that differences in dynamic changes between eastern and other regions are getting larger in recent years,

indicating that, in eastern region, urgent and effective measures need to be taken to improve the employment performance.

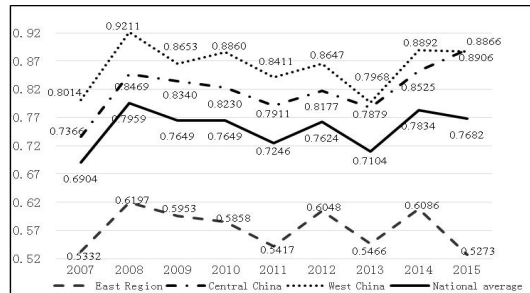


Figure 2 Dynamic Changes of Employment Efficiency

(3) The trends of provincial term efficiency values show that ending values in 16 provinces are higher than beginning values, but only Shanxi and Xinjiang invariably have effective performance. Eight provinces, with Hebei, Jilin, Jiangxi, Henan, Hubei, Chongqing, Sichuan and Shanxi, have cumulative growth rates over 20%, which suggests that employment efficiency scores are developing. The cumulative decline rates are more than 10% in five provinces, including Beijing, Tianjin, Shanghai, Anhui and Guizhou, implying that the driving effect from IEP to job creation are weakening. In the remaining provinces, efficiency values changeless in cumulative rates, which may be due to ineffective policy of innovation and entrepreneurship on employment.

5.4 Factor efficiency index analysis

Factor efficiency index (FEI) is used to measure the excess or shortfall of inputs and free-link. If FEI is zero, implying the input factor is regarded as efficient, while a positive or negative FEI indicates excess and shortfall, respectively. The same holds for free links. The calculation formula is  $FEI = \text{Actual data} / \text{projection} - 1$ . The average FEIs of different policy have been showed in Figure 3.

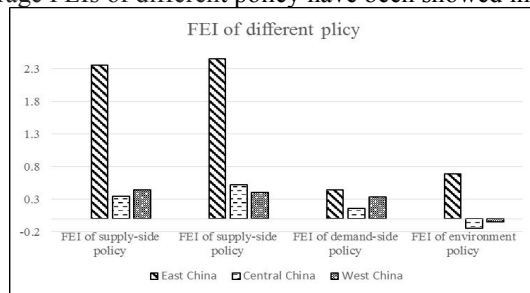


Figure 3 Average Factor Efficiency Index (FEI)

As for the FEIs of supply-side policy in knowledge production, three regions all have excess investment. Specially, the greatest potential for improvement are in eastern region. Meanwhile, from the FEIs of supply-side policy in incubation activities, we find that three regions have excess input, indicating that the employment growth are not accompanied with huge investments in incubation, at least to the same extent. The FEIs of demand-side policy hold the same situation. However, in eastern region, demand-side policy exhibits more effective impact on employment. As the free link, financial support can exert sustained long-term impact upon innovation and entrepreneurship process. In other words, the amount of financial support should be combined with other investment quantity of IEP. As

shown in Figure 3, all the provincial investment of financial support is unsatisfying. For improving the employment efficiency, financial support needs to be reduced in eastern region and increased in central and western regions overall.

## 6 Conclusion

With super-efficiency DSBM model, this paper measures the employment efficiency of IEP of China's 28 provinces during 2007 to 2015. The excess and shortfall of government investment on innovation and entrepreneurship are analyzed by FEI. The empirical results show that overall efficiency and term efficiency in most provinces are unsatisfying in the sample period, suggesting a rapid job growth are not accompanied with the swift growth of inputs on IEP. The employment efficiency of three regions undergo fluctuation over the period, and the provinces with high performance tend to be in western region, whereas the provinces with low performance are concentrated in eastern region.

1. Obviously, in eastern region, though the amounts of investment on innovation and entrepreneurship are larger, the public resources have not yet produced effective impact on employment. On the account of the public expenditure of innovation and entrepreneurship policy failing to promote employment growth effectively, the planning and management of IEP should be improved and undergo regular appraisal. A supervisory system for the IEP targeting at employment growth should be established.

2. According to FEI analysis, eastern region has the most excess input in three types of public policy, implying that all types of public resources fail to boost employment growth effectively. In the central and western regions, inputs of supply-side policy and demand-side policy are excess, while the environment policy should be added to guarantee its role of coordination. Based on the results, regional governments ought to adjust the investment structure of IEP. Specifically, the eastern provinces are supposed to appropriately reduce the investment of IEP, especially the investment of supply-side policy, and increasing the investment of environmental policy should be taken as priority by central and western provinces.

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## Study on the Evaluation of Industrial Innovation Capacity in Hubei Province

Song Weiwei, Zou Wei

Jiangnan University, Wuhan, P.R. China, 430056

(E-mail: 498695899@qq.com, 36937694@qq.com)

**Abstract:** In order to speed up the construction of innovation-oriented national construction, we must strive to improve our innovation capacity. As an important part of the national economy, the industry has long accounted for about 40% of China's gross domestic product, which plays an important role in the national economy. Industry as the principal part of innovation in the economic construction and social development of Hubei Province have played an important role. Hubei Province, as the key innovation base in China, is facing the dilemma of low efficiency in the integration of scientific and technological innovation resources. In view of this situation, this paper analyzes the current situation of industrial innovation ability in Hubei Province from the perspectives of input and output from 2009 to 2017. On this basis, using the method of data envelopment analysis, six indexes are designed from four aspects: human input, financial input, new product output and scientific and technological achievement output. This paper evaluates and analyzes the industrial innovation capacity of 31 regions in China from 2009 to 2016, finds out the position of Hubei, and explores the reasons for the low industrial innovation capacity of Hubei.

**Key words:** Innovation capacity; Industry of Hubei Province; Input-output; DEA

### 1 Introduction

In the report to the 19th CPC National Congress, General Secretary Xi Jinping stressed: "Innovation is the first driving force leading development and the strategic support for building a modern economic system." To speed up the construction of an innovative country, we must focus on improving the capacity of scientific and technological innovation. In recent years, various regions of our country have continuously increased their investment in scientific and technological resources, and remarkable achievements have been made in the development and reform of science and technology.

As for what is innovation, the scholar Fu Jiaji (Fu Jiaji,1998) holds that innovation refers to the technological revolution generated by enterprises in the continuous development process, breaking technological barriers, completing the entire production process, transforming technology into commodities, and finally achieving production goals. Katharine Wakelin (Katharine Wakelin,2001) used the Cobb-Douglas production function to analyze the data related to research intensity of 170 enterprises in the UK. The research shows that the longer the innovation activity lasts, the higher the research return rate.

At present, there are many researches on the evaluation of industrial innovation ability at home and abroad, mainly through the establishment of evaluation index system, the selection of mathematical modeling method to analyze the input-output efficiency of innovation ability in a region for a year or several years. Cao Hongjun (Cao Hongjun,2009) constructed five first-level indexes including innovation consciousness, innovation input capacity, innovation output capacity, innovation activity management mode and innovation mode, and expanded them into 27 second-level indicators to evaluate the independent innovation ability of enterprises by using Analytic Hierarchy Process. Jiang Xinghua (Jiang Xinghua,2012) constructed the evaluation system of regional scientific and technological innovation ability by using Analytic Hierarchy Process, and comprehensively evaluated the scientific and technological innovation ability of Foshan city by using the grey correlation degree evaluation theory.

Based on the data of listed industrial enterprises in Hubei Province during the three years from 2008 to 2010, Tu Hongxing (Tu Hongxing,2012) took R&D input capacity, R&D output capacity and transformation capacity of R&D input and output as first-level indicators to construct a comprehensive evaluation model of enterprise R&D capacity. Analyzed and evaluated the R&D ability of listed industrial enterprises by factor analysis. Su Yang (Su Yang,2017) selected factor analysis method to evaluate the independent innovation ability of industrial enterprises. Dong Dengzhen (Dong Dengzhen,2017) used the combination of dynamic factor analysis method and cluster analysis method to evaluate and compare the industrial innovation ability of 28 provinces and cities from 2009 to 2013. Based on this, it evaluates and analyzes the innovation ability of industrial subdivision in the region. Xu Ru (Xu Ru,2019) selected industrial enterprises in 30 provinces of China in 2014 as samples for evaluation by means of factor analysis and cluster analysis. The results showed that the independent innovation ability of China industrial enterprises is obviously different in region.

Hubei Province is abundant in scientific and technological innovation resources and scientific research talents, and many well-known institutions of higher learning, scientific research institutes, national and provincial scientific research bases gather here. However, the integration level of scientific and technological resources in Hubei Province is not in the leading position in our country. There is still a huge room for improvement in Hubei Province in making full use of the abundant scientific and technological resources and effectively transforming it into a strong industrial advantage in order to better serve the local economic and social development. If make better use of scientific and technological resources and improve the efficiency of the utilization of scientific and technological resources in Hubei Province, we can help the transformation and upgrading of Hubei's industrial industry and promote Hubei's economy and society. It is of great significance to promote the economic and social development of Hubei Province.

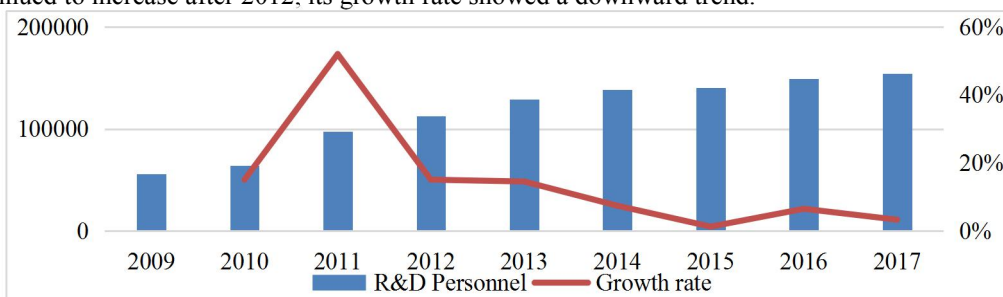
Based on the economic development of industrial enterprises in Hubei Province, this paper studies the current situation of innovation ability of industrial enterprises above designated size in Hubei Province from 2009 to 2017 from two aspects of input and output. On this basis, data envelopment analysis (DEA) method was used to conduct an empirical study on the innovation capability efficiency of industrial enterprises in various regions of China from 2009 to 2016, to find out the position of Hubei Province and compare it with other regions of China. Time span from 2009 to 2016, to avoid the choice one year of accident data, make the evaluation results more comprehensive and accurate.

## 2 Research on the Present Situation of Hubei's Industrial Innovation Ability

### 2.1 Research on the input status of industrial innovation ability in Hubei Province

#### 2.1.1 Number of R&D personnel in industrial enterprises above designated size in Hubei Province.

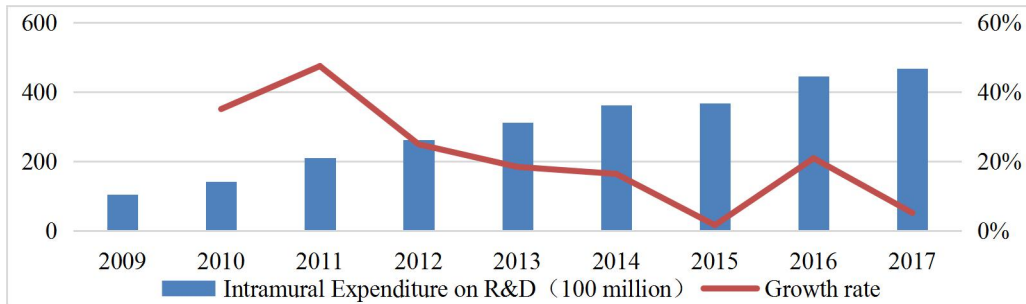
Figure 1 shows the number of R&D personnel in industrial enterprises above designated size in Hubei Province from 2009 to 2017. The number of personnel increased from 55,893 in 2009 to 154,580 in 2017, with an average annual growth rate of 13.56%. In terms of growth, the number of R&D personnel increased the most in 2011, 52.01 percent. Although the absolute number of R&D personnel continued to increase after 2012, its growth rate showed a downward trend.



**Figure 1 R&D Personnel in Industrial Enterprises above Designated Size in Hubei Province (2009-2017)**  
 Data source: Come up with China Statistical Yearbook on Science and Technology 2010-2018.

### 2.1.2 Internal expenditure on R&D funds of industrial enterprises above designated size in Hubei Province.

As shown in figure 2, the internal expenditure on R&D expenditure of industrial enterprises above designated size in Hubei Province increased from 10.577 billion yuan in 2009 to 46.894 billion yuan in 2017, with an average annual growth rate of 20.46 percent. In 2011, the increase peaked at 47.51 percent.

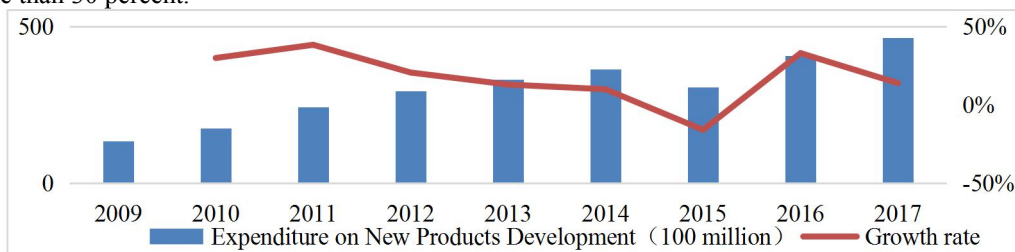


**Figure 2 Intramural Expenditure on R&D in Industrial Enterprises above Designated Size in Hubei Province(2009-2017)**

Data source: Come up with China Statistical Yearbook on Science and Technology 2010~2018.

### 2.1.3 Funds for the development of new products of industrial enterprises above designated size in Hubei Province.

Expenditure on new product development increased from 13.559 billion yuan in 2009 to 46.406 billion yuan in 2017, with an average annual growth rate of 16.63 percent. As can be seen from the figure 3, with the exception of a decline in 2015 (down 15.93 percent), inputs grew faster in the rest of the year than in the previous year, among which the increase in 2010, 2011 and 2016, both close to or more than 30 percent.



**Figure 3 New Products Development of Industrial Enterprise above Designated Size in Hubei Province (2009-2017)**

Data source: Come up with China Statistical Yearbook on Science and Technology 2010~2018.

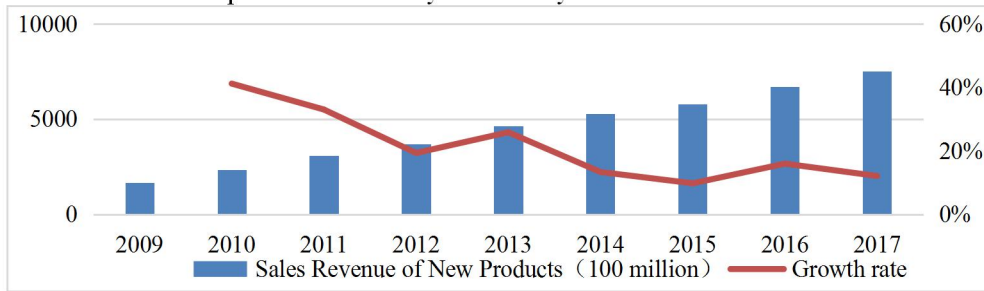
## 2.2 Research on the output status of industrial innovation ability in Hubei Province

### 2.2.1 New product sales revenue of industrial enterprises above Designated Size in Hubei Province.

As shown in figure 4, the new product sales revenue of industrial enterprises above designated size of Hubei Province has increased from 165.054 billion yuan in 2009 to 752.349 billion yuan in 2017, with an average annual growth rate of 20.88%. Among them, the highest growth rate is 41.18% in 2010, and the annual growth rate of new product sales revenue basically exceeded double digits, indicating



that the benefit of the new product is relatively satisfactory.

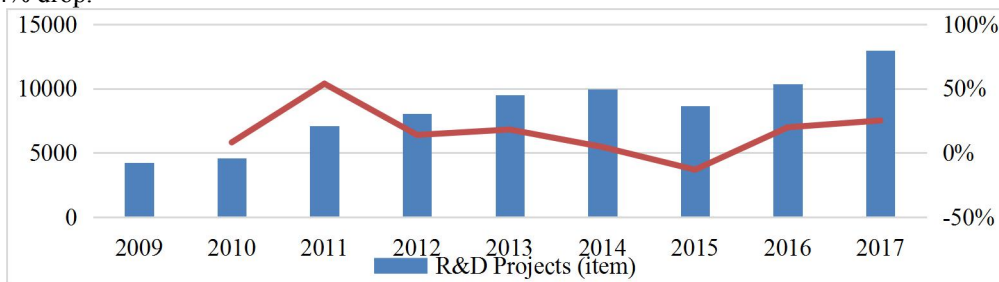


**Figure 4 New Products Sales of Industrial Enterprise above Designated Size in Hubei Province (2009-2017)**

Data source: Come up with China Statistical Yearbook on Science and Technology 2010~2018.

### 2.2.2 Number of R&D projects of industrial enterprises above designated size in Hubei Province.

The number of R&D projects of industrial enterprises above designated size in Hubei Province is shown in figure 5, increasing from 4,256 in 2009 to 12,968 in 2017, with an average annual growth rate of 14.94 percent. Among them, the largest increase in 2011, the growth rate of 53.78%, fell in 2015, a 13.14% drop.

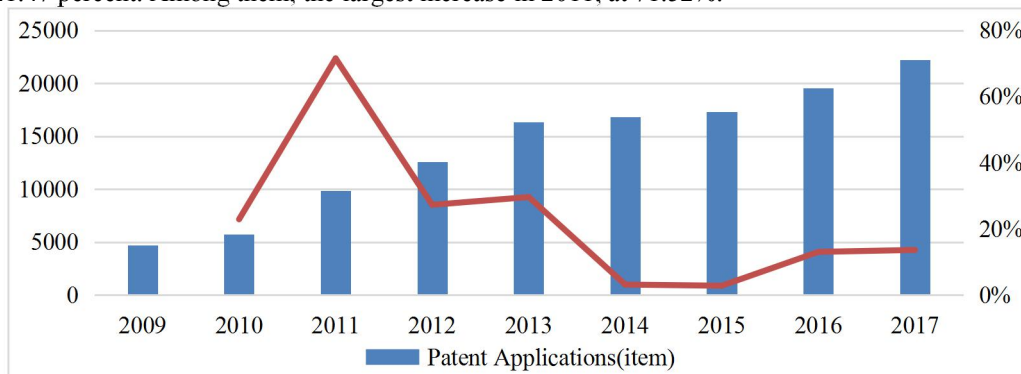


**Figure 5 R&D Projects of Industrial Enterprises above Designated Size in Hubei Province (2009-2017)**

Data source: Come up with China Statistical Yearbook on Science and Technology 2010~2018.

### 2.2.3 Number of patent applications by industrial enterprises above designated size in Hubei Province.

The number of patent applications for industrial enterprises above designated size in Hubei Province (figure 6) increased from 4,693 in 2009 to 22,244 in 2017, with an average annual growth rate of 21.47 percent. Among them, the largest increase in 2011, at 71.52%.



**Figure 6 Patent Application by Industrial Enterprises above Designated Size in Hubei Province (2009-2017)**

Data source: Come up with China Statistical Yearbook on Science and Technology 2010~2018.

### 3 Evaluation method selection and Index system Design of Innovation capacity of Industrial Enterprises

The evaluation of innovation capacity of industrial enterprises in Hubei Province is essentially an evaluation of input-output efficiency. In the evaluation, multiple input and output indicators should be taken into account, and most of them are difficult to set production functions and weights in advance. Therefore, DEA method is selected to evaluate the innovation capacity of industrial enterprises in Hubei Province.

According to the principles of scientific selection, consistency and comparability of index, and combining the development status of Hubei industry, this paper constructs the index of evaluation system of innovation capacity of Hubei industry from two aspects of input and output. The input of innovation capacity includes financial input, human resource input, material resource input, information resource input and other elements, among which financial input is an essential basic condition for enterprises to carry out innovation activities, while human resource is the core element of enterprises to carry out innovation. Based on the above principles, three innovative input indicators are selected from two aspects of human and financial input, namely total R&D personnel, internal expenditure of R&D expenditure, and new product development expenditure. New product development funds. The output of scientific and technological achievements, the transformation and industrialization of scientific and technological achievements are the key elements of enterprise innovation capacity, which have an important impact on the sustainable development of enterprises. Therefore, three output indicators of innovation capacity are selected from two aspects of new product output and scientific and technological achievements output: sales revenue of new products, number of R&D projects and number of patent applications (shown in Table 1).

**Table 1 Evaluation System of Hubei Industrial Enterprises Innovation Capacity**

	Category	Index
<b>Input of Innovation Capacity</b>	Input of Human	Total R&D Personnel
	Input of Financial	Internal Expenditure of R&D Expenditure
		New Product Development Expenditure
<b>Output of Innovation Capacity</b>	Output of New product	Sales Revenue of New Products
	Output of Scientific and Technological Achievements	Number of R&D Projects
		Number of Patent Applications

### 4 Evaluation and Analysis of Industrial Innovation ability

According to the evaluation index system of Hubei industrial innovation capacity in Table 1, 31 regions in China from 2009 to 2016 were selected as the research objects, and the analysis results as shown in Table 2 were obtained. The main results are as follows:

**4.1 The technical efficiency index of industrial innovation capacity is in a relatively backward position.**

Technical efficiency value (Comprehensive efficiency value) is reflected in the given input (or output), the extent to which DMU can obtain output (or reduce input), which can be used to reflect the effectiveness of the evaluated object as a whole. As shown in Table 2, the average industrial innovation technology efficiency index in 31 regions of the country is 0.746.

**Table 2 Evaluation Results of Industrial Innovation Ability in Hubei Province**

Region	crste	vrste	scale	Return to scale changes
Beijing	0.833	0.971	0.857	drs
Tianjin	1	1	1	—
Hebei	0.575	0.837	0.687	drs
Shanxi	0.401	0.506	0.791	drs
Inner Mongolia	0.522	0.556	0.94	drs
Liaoning	0.593	0.675	0.878	drs
Jilin	1	1	1	—
Heilongjiang	0.532	0.881	0.603	drs
Shanghai	0.97	1	0.97	drs
Jiangsu	0.58	1	0.58	drs
Zhejiang	0.85	1	0.85	drs
Anhui	0.664	0.786	0.845	drs
Fujian	0.637	0.719	0.886	drs
Jiangxi	0.577	0.918	0.629	drs
Shandong	0.656	1	0.656	drs
Henan	0.628	0.813	0.771	drs
<b>Hubei</b>	<b>0.57</b>	<b>0.679</b>	<b>0.839</b>	<b>drs</b>
Hunan	0.801	0.823	0.974	drs
Guangdong	1	1	1	—
Guangxi	0.99	1	0.99	drs
Hainan	1	1	1	—
Chongqing	1	1	1	—
Sichuan	0.794	1	0.794	drs
Guizhou	0.969	0.97	0.999	irs

Yunnan	0.632	0.723	0.873	drs
Tibet	1	1	1	—
Shaanxi	0.558	0.899	0.621	drs
Gansu	0.582	0.797	0.73	drs
Qinghai	0.549	0.556	0.987	drs
Ningxia	0.753	1	0.753	drs
Xinjiang	0.914	1	0.914	drs
<b>Mean</b>	<b>0.746</b>	<b>0.875</b>	<b>0.852</b>	

Data source: Come up with Statistical yearbook of Chinese science and technology 1909-2017, Hubei statistical yearbook 2009~2016.

The technical efficiency index of industrial innovation capacity in Tianjin, Jilin, Guangdong, Hainan, Chongqing and Tibet is 1, which is in the state of technical efficiency and best scale. The technical efficiency of other regions is not effective. Among them, the technical efficiency index of industrial innovation capacity in Guangxi, Shanghai, Guizhou, Xinjiang, Zhejiang, Beijing and Hunan is between 0.8-1, indicating high technical efficiency. The technical efficiency index of industrial innovation capacity was lower than 0.6 in Liaoning, Gansu, Jiangsu, Jiangxi, Hebei, Hubei, Shanxi, Qinghai, Heilongjiang, Inner Mongolia and Shaanxi, indicating that the industrial innovation ability of these regions was relatively low. Only 6 of the 31 regional industrial innovation technology efficiency indexes are in the technically effective state, indicating that most regional industries need to make input and output adjustment.

#### **4.2 The pure technical efficiency index of industrial innovation ability is in a relatively backward position**

Pure technical efficiency refers to whether the output has reached the maximum under the given input quantity, and whether the output can be increased by optimizing the structure of input factor or strengthening management. According to Table 2, the average pure technical efficiency of industrial innovation capacity in 31 regions is 0.875.

The pure technical efficiency index of industrial innovation capacity in 14 regions of Guangdong, Guangxi, Hainan, Jilin, Jiangsu, Ningxia, Shandong, Shanghai, Sichuan, Tianjin, Tibet, Xinjiang, Zhejiang and Chongqing is 1, which is in a state of pure technical efficiency. It shows that these areas are effective for the use of input resources. The pure technical efficiency index of Beijing, Guizhou, Jiangxi, Shaanxi, Heilongjiang, Hebei, Hunan and Henan is between 0.8 and 1, which is relatively high. The pure technical efficiency index of Hubei, Liaoning, Inner Mongolia, Qinghai and Shanxi is less than 0.7, which shows a certain gap with other regions.

#### **4.3 The scale of input and output of industrial innovation capacity is decreasing, and the input resources have not been fully utilized**

Scale efficiency reflects the relationship between the change of input quantity and output quantity. The closer the scale efficiency is to 1, the more appropriate the production scale and the higher the productivity. According to Table 2, there are three states of input and output of

innovation ability of industrial enterprises in 31 regions: Return of scale increases, return of scale remains unchanged and return of scale decreases.

Among them, Tianjin, Jilin, Guangdong, Hainan, Chongqing and Tibet six regions have no change in the scale of input and output of industrial innovation capacity. The increase of input-output scale income of Guizhou industrial innovation capacity shows that the input scale of industrial innovation resources is not enough. In other words, increasing investment in research and development will increase output more than input, thus improving industrial innovation capacity. Therefore, industrial enterprises in Guizhou should increase investment in this aspect.

There are 23 regions in Anhui, Beijing, Fujian, Gansu, Guangxi, Hebei, Henan, Heilongjiang, Hubei, Hunan, Jiangsu, Jiangxi, Liaoning, Inner Mongolia, Ningxia, Qinghai, Shandong, Shaanxi, Shanghai, Sichuan, Xinjiang, Yunnan, Zhejiang and Shanxi with decreasing returns on the scale of industrial innovation capacity. This shows that the reasons for the unsatisfactory industrial innovation capacity of the above regions are that the input resources are wasted to some extent.

## 5 Conclusion

The analysis of the innovation capacity of industrial enterprises in 31 regions from 2009-2016 shows that the technical efficiency index of Hubei (0.570) is lower than the average value of the national technical efficiency index (0.746). The pure technical efficiency of Hubei (0.679) was lower than the national average (0.875). There are increasing returns on scale (1 region), constant returns on scale (6 regions) and decreasing returns on scale (23 regions) in the input and output of innovation ability of industrial enterprises in China, Hubei Province is in a state of decreasing returns of scale. In view of the above phenomena, it is necessary to improve Hubei's industrial innovation ability from the following aspects: strengthening the input of independent innovation and diversified investment; optimizing the personnel allocation, perfecting the mechanism of introducing talents; promoting the transformation of scientific and technological achievements and speeding up the development of industrialization; Improve the ability of independent innovation and realize the sharing of resources among industries.

## Acknowledgement

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# **An Empirical Study on the Effect of Innovation on Employment from the Industry Level Perspective: A Case of China**

Allaberdiyev Guychmyrat, Wei Long

School of Economics, Wuhan University of Technology, Wuhan, P. R. China, 430070

(E-mail: 562502516@qq.com, longwei@whut.edu.cn)

**Abstract:** The paper studies theoretical and empirical scientific literature about the impact of innovation on employment. By using panel data from 30 China's industries from 2012 to 2016, examines the employment effect of innovation. New product sales revenue used as a proxy for product innovation, and R&D expenditures used as a proxy for product and process innovation. OLS with the fixed effect estimator method applied as an empirical model. Findings suggest a positive and significant relationship of new product sales revenue and R&D expenditures with employment throughout the corresponding industries, where the latter found to be better explaining the variations of employment.

**Key words:** Innovation; Employment; Product innovation; Process innovation

## **1 Introduction**

The impact of innovation on employment has long been a debated issue. While innovation is known to have a strong positive relationship with long term economic growth in general, the relationship between innovation and employment has not been clearly identified. This is because innovation has two distinctive effects on employment (Vivarelli, 2014; Harrison et al., 2008;). On the one hand, innovation has a displacement effect, which displaces workers by capital, and has a negative influence on jobs. On the other hand, innovation has a compensation effect, which increases the demand for workers in the production process. Thus, the overall employment effect of innovation cannot be

predetermined. Given that the economic theory does not ascribe an exact net effect of innovation, it has become a matter of empirical analyses. Empirical analysis has mostly been conducted at the firm-level, and typically categorizes innovations as process innovations and product innovations. Some studies (Harrison et al., 2014, 2008) argue that distinguishing the innovation type facilitates understanding the employment effect of innovations and that each type of innovation has a different purpose and can have different employment effects. Firms introduce process innovation for cost-saving but introduce product innovation for demand expansion. Thus, the former is expected to have a negative influence on jobs and the latter, a positive influence. While a large volume of literature verifies the above reasoning, they are mainly at the firm level, and ignore the fact that innovative firms increase in demand for labor may be due to the stealing business from their industry peers, thus, on the industry level, the effect of innovation on employment may end up differently comparing with firm-level data.

The research purpose is to attempt to fill the gap by using aggregate industrial data to test the innovation-employment relationship. Employment always was and will be in the center of policy discussion, and China's government is making great effort to change the Chinese economy to innovation-driven economy. Therefore, it is essential to understand the effect of innovation on employment in order to avoid the adverse effects of employment policies on innovation (Gavin et al., 2017).

In what follows, Section 2 discusses the literature, and Section 3 describes the data, and applied estimation method, Section 4 explains the empirical results, and Section 5 draws conclusion.

## **2 Employment Effect of Innovation**

### **2.1 Firm level**

Most studies contend that the ambiguous employment effect of innovation is closely related to the type of innovation, namely product and process innovation.

At the firm level, product innovation creates more employment by increasing product demand and labor input for its production. However, the effect depends on the substitution rate and productivity differences between old and new products (Lim and Lee, 2018). In other words, increased labor demand to produce new products might be offset by the layoff of workers in the old product production facilities. Moreover, the labor displacement effect might intensify if the new product requires less labor input.

By contrast, process innovation has a direct labor displacement effect, which is reasoned by the productivity increase through improving the production process. Productivity increase means less labor and/or capital for the given amount of product. On the other hand, productivity might be accompanied by a price reduction, thus, leading to higher demand for the product and labor for its production.

Several empirical studies conducted on this topic consistently found that the product



innovation positively associated with employment growth, while the process innovation appears to have a less clear-cut impact. (Luigi et al., 2019; Calvino, 2019; Hou et al., 2019; Mitra, 2016; Harrison et al., 2014).

## **2.1 Industry level**

At the industry level, when the new product is complementary to the existing one within the industry, it increases the demand for employment. However, when the new product is a substitute for the old one, the employment effect of product innovation becomes unclear. The product innovation in one firm would encourage employment, only if the demand increase for the new product does not happen at the expense of other firms demand reduction within the industry. If the demand increases at the expense of the other firms, then the employment level in the industry not only stays the same but might reduce as the business stealing can hinder the performance of other firms (Daniel et al., 2018). Harrison's study on France, Germany, Spain and UK firms documents the fact that one-third of the net employment created by product innovators is due to reallocation effect of the business stealing (Harrison et al., 2014).

The unclear impact of process innovation on employment might become significantly negative once the analysis takes industry context into account. For instance, in a monopolistic market structure, process innovation leads to more significant employment decline and product innovation does not create larger employment (Lim and Lee, 2018).

Buerger's study on the relation between innovativeness and employment argues that the co-evolution of innovation and employment growth rates tends to be sector-specific. In the transport equipment industry, patent growth does not show any significant relation to employment growth. However, in the chemical industry, a (weak) negative relationship is found (which suggests the presence of business stealing effects). Instead, in the electrics and medical instrument industries, their results point out a positive and significant correlation between the growth of patenting and employment growth. Finally, the study highlights that in chemicals and transport equipment industries, employment growth is associated with subsequent R&D growth (Buerger et al., 2012).

In summary, firm level empirical studies consistently draw similar conclusions, the results differ when industry context is introduced. Moreover, it is challenging to develop a hypothesis and predict possible results. A recent study on China's manufacturing industries over the period 2000–2006 finds a positive effect of innovation on employment (Mairesse and Wu, 2019). We contribute to the literature by conducting an empirical study on China's manufacturing industries over the period 2012-2016 by using industry level aggregated variables as a confirmation to the previous study results.

## **3 Data and Methodology**

### **3.1 Data source and description**

This research encompasses 30 manufacturing industries in China. Data covers the period

of 2012-2016 on a yearly basis, collected from Wind database. Observations are the aggregate value of every industry (data is not the firm level), which enables to capture the short-term effect of innovation on employment. Industries with missing values removed from the dataset in order to avoid any unwanted effects throughout the calculation. And the selected variables for empirical analysis are as follows (Table 1):

**Table 1 Variables, Measurement and Expected Effect on the Dependent Variable**

Variables	Measurement	Expected correlation with the dependent variable
Dependent variable: Employment	10000 persons	---
Independent variable: New product sales revenue	CNY 100 million	Positive correlation
R&D expenditure	CNY 100 million	Positive correlation

The dependent variable is employed personal of the corresponding industry, and the independent variable is the frequently used proxy for product innovation in the literature, new product sales revenue and R&D expenditure (for example, Lim and Lee, 2018). New product sales revenue used as a proxy for product innovation. R&D is a broader measure of innovation activity, as it includes both product and process innovation.

**Table 2 Industry List**

[1] Mining and Dressing of Ferrous Metal Ores	[2] Manufacture of Textile Apparel
[3] Mining and Dressing of Non-ferrous Metal Ores	[4] Manufacture of Leather, Furs, Down and Related Products and Footwear
[5] Smelting and Pressing of Ferrous Metals	[6] Manufacture of Paper and Paper Products
[7] Smelting and Pressing of Non-ferrous Metals	[8] Printing and Recorded Media Reproduction
[9] Manufacture of Metal Products	[10] Processing of Petroleum, Coking, Processing of Nuclear Fuel
[11] Processing of Food from Agricultural Products	[12] Manufacture of Raw Chemical Materials and Chemical Products
[13] Manufacture of Foods	[14] Manufacture of Chemical Fibres
[15] Manufacture of Liquor, Beverage and Refined Tea	[16] Manufacturing and Supplies of Electricity and Thermal Power

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[17] Manufacture of Tobacco	[18] Production and Supply of Gas
[19] Processing of Timbers, Manufacture of Wood, Bamboo, Rattan, Palm and Straw Products	[20] Production and Supply of Water
[21] Mining and Washing of Coal	[22] Manufacture of Furniture
[23] Extraction of Petroleum and Natural Gas	[24] Manufacture of General Purpose Machinery
[25] Mining and Dressing of Non-metal Minerals	[26] Manufacture of Special Purpose Machinery
[27] Manufacture of Non-metallic Mineral Products	[28] Manufacture of Automobile
[29] Manufacture of Textile	[30] Manufacture of Electrical Machinery and Equipment

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### 3.2 Empirical model

In panel data analyses, simple OLS estimation may lead to biased results in the presence of unobserved heterogeneity. As the empirical analysis is based on a panel data regression model, the fixed effect estimator method applied to solve the time-fixed unobserved cross-sectional heterogeneity problem, which is a common problem for panel data analysis. Thus, the fixed effect estimator applied to remove any time-fixed unobserved cross-sectional heterogeneity and calculated by removing the average value of the whole period from each corresponding year. In order to deal with time related trend effects of the corresponding data, dummy variables for three years included in the equation. The panel data regression model takes the form:

$$Empl_{i,t} = \alpha + \beta_i X_{i,t} + \mu_i + \varphi_t + \varepsilon_{i,t} \quad (1)$$

where:  $Empl_{i,t}$  is dependent (number of employees) variable;  $i$  and  $t$  stand for cross-sectional unite (industry) and time (year), respectively;  $\alpha$  is constant;  $X_{i,t}$  is the independent variable (two variables are tested, sales revenue of new products as a proxy for product innovation and R&D expenditure as a proxy for product and process innovation);  $\mu_i$  is time-fixed unobserved cross-sectional heterogeneity;  $\varphi_t$  time effects that are constant for all cross-sectional observations (for instance, trend);  $\beta$  is a parameter that shows the impact of right-hand side variable on the dependent variable and need to be estimated;  $\varepsilon_{i,t}$  is error that is normally distributed with constant variation and zero serial correlation.

## 4 Results and Discussion

### 4.1 Results

Product innovation of corresponding Chinese industries has positive and significant effect on employment. When sales revenue from new products increases by 100 million yuan,

employed personal increases by 80 new employees. R-squared of the estimation is 0.33, which means there is still a significant part of employment variation that cannot be explained by the independent variables in the equation. The Durbin-Watson stat is 2.2, close to two, indicates that there is no serial correlation in the error term. Even though R squared is not ideal, the equation is stable enough not to ignore it.

The empirical calculation also conducted by using R&D expenditures as a proxy for innovation. Compared with new product sales revenue, R&D expenditures not only proxies product innovation but also encompasses process innovation as well. Although many researchers agree on the positive effect of product innovation on employment, several studies suggest the negative effect of process innovation on employment. In order to test these effects of innovation on employment in China's industry, R&D expenditures included in the calculation.

**Table 2 OLS Results. Dependent Variable: Employment (unit: 10000; t-statistics in parentheses)**

Independent variables	(1)	(2)
New product sales revenue (100mln)	0.008 (6.59)	–
R&D expenditure (100mln)	–	0.14 (7.38)
Year 2013 (dummy variable)	21.6 (5.21)	21 (5.2)
Year 2014 (dummy variable)	17.4 (4.18)	15.9 (3.95)
Year 2015 (dummy variable)	9.8 (2.37)	7.5 (1.83)
C (intercept)	-0.54 (0.23)	-1.23 (0.54)
Observations	163	163
R-squared	0.32	0.36
Durbin-Watson stat	2.2	2.1

As table 2 illustrates, product and process innovation of corresponding Chinese industries has overall positive and significant effect on employment (data limitation does not allow to distinguish the product innovation effects and process innovation effects separately). When R&D expenditures increases by 100 million yuan, employed personal increases by 1412 new

employees. Not surprisingly, R&D expenditures contain more information that explains the variations in employment compared with new product sales revenue. R-squared of the estimation is 0.36, which means there is still a significant part of employment variation that cannot be explained by the independent variables in the equation.

The calculation results support the positive employment effect of innovation on employment. R&D have more explanatory power compared with new product sales revenue.

#### **4.2 Discussion**

Several studies related to the topic that has been conducted where the subject was China's industries found a positive relationship between innovation and employment (Mairesse and Wu, 2019; Hou et al., 2019; Wei and Huifang, 2017). Our results are consistent with these related studies. The magnitudes of the parameters may differ because the different time periods and estimation method applied, but the signs are consistent. It shows the dominance of the compensation mechanism of the innovation over its labor displacement effect. It can be argued that the pace of China's economic growth creates a favorable environment for market and demand expansion.

Product innovation increases employment as the creation of jobs in the manufacturing of the new products seems to be bigger than the displaced jobs because of the substitution of new products' sales for sales of old products. Moreover, the business stealing cannot fully mitigate the positive employment effect of innovation.

Also, the process innovation positively effects to wage increase through productivity increase, which further boosts domestic demand. Process innovations, such as in logistics, also facilitated access to international markets and increases demand for products. Thus, the R&D variable as a proxy found to be more robust in explaining the employment effect of innovation than the new product sales revenue.

Altogether, the results point to the fact that innovation does not reduce employment. The idea that innovation stimulates employment seems then well established at the industry level.

#### **5 Conclusion**

The paper investigated the relationship between innovation and employment, firstly, from a theoretical perspective, then from an empirical perspective by thoroughly reviewing related literature. According to theory, even though innovation has labor displacing effect, those effects are fully or partially neutralized through different channels of the compensation mechanism. On the other hand, several empirical studies have been conducted to test the effect of innovation on employment. However, they have mainly focused at the firm level, and a limited number of studies analyzed at industrial level.

The paper investigated innovation-employment relationship at the industry level by using panel data for 30 China's industries. OLS regression with fixed effect estimator method was used to test the relationship of the corresponding variables.

Findings show a positive and significant correlation between innovation and employment in both cases, where the independent variable is new product sales revenue as a proxy for product innovation as well as where the independent variable is R&D expenditure. The latter found to be the better estimator of the variations in employment compared with the former one.

Limitations of this study must be mentioned to shed lights to future research avenues. New product sales revenue and R&D expenditures are good proxies for innovation, but they cannot fully capture the overall effect of innovation on employment. Also, it is hard to distinguish the effect of process innovation and product innovation by using these variables. Comprehensively constructed innovation index would be better to capture innovation-related information from a different perspective. Moreover, it is important to isolate industries' growth that is not related to innovation, but due to other reasons, such as the coverage expansion, which raises demand for products and leads to the higher demand for the labor force.

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## **A Study on Environmental Uncertainty, Internal Control and Earnings Management**

Yang Yu

School of Management, Wuhan University of Technology, Wuhan, P.R. China, 430070  
(E-mail: 1104023241@qq.com)

**Abstract:** In this paper, all the listed companies of non-financial industries in Shanghai and Shenzhen stock exchanges from 2011 to 2015 were taken as samples to test the effect of environmental uncertainty on earnings management behavior of companies, and to analyze the impact of internal control on the relationship between environmental uncertainty and earnings management. It is found that higher environmental uncertainty induces accrual earnings management behavior of listed companies, and good internal control has significant inhibitory effect on earnings management induced by environmental uncertainty. The research conclusion of this paper supports that enterprises should strengthen internal control to deal with the risk that may be brought by the change of external environment when facing the uncertain environment.

**Key words:** Environmental uncertainty; Accrued earnings management; Real earnings management; Internal control.

### **1 Introduction**

Since the 21st century, there have been a large number of incidents of accounting fraud, financial data falsification and earnings management of listed companies at home and abroad, resulting in different degrees of impact on the global capital market. The earnings management behavior of the management of listed companies is the opportunistic motivation choice of the management, which will reduce the accounting quality of listed companies and damage the long-term interests of the company. Therefore, the study of earnings management incentives and governance means is of great significance. For China in the transition period, modern enterprises are faced with many problems such as the transformation of government functions, economic transformation and upgrading, and the uncertainty of the capital market, which makes enterprises face the volatility and unpredictability of the external environment, that is, environmental uncertainty. Companies with higher environmental uncertainty are more likely to have more frequent earnings fluctuations, greater management pressure on operations and performance, and more likely to take opportunistic actions. So, can environmental uncertainty be an important external factor that induces earnings management? However, as an important internal governance mechanism to alleviate information asymmetry and improve the quality of accounting information, it is still worth exploring whether internal control can play its due governance role when environmental uncertainty triggers earnings management.

Previous studies have mainly discussed the influencing factors and economic consequences of earnings management. Most scholars believe that the establishment and improvement of internal control system and corporate governance mechanism can effectively reduce the degree of management's manipulation of corporate earnings (Doyle,2007; Ye, 2014). Hemmen (Hemmen,2010) took Spanish enterprises as an example, and the research results showed that debt financing could reduce the positive accrual earnings management behavior of enterprises. Ahn and Choi (Ahn and Choi,2014) found that



Banks play an important role in restraining the earnings management of loan enterprises, and the earnings management level of enterprises declines with the enhancement of bank supervision. The research of Lu Taiping and Zhang Dongxu (Lu Taiping and Zhang Dongxu,2014) shows that enterprises with higher degree of financing constraint will have smaller scope of earnings management, which may be due to higher risk.

As for the economic consequences of environmental uncertainty, existing researches mainly focus on three aspects. (1) the impact of environmental uncertainty on investment efficiency. The study of Veronesi (2012) shows that when the external uncertainty increases, enterprises will respond to it by reducing investment in external projects, and their investment will become more cautious. Xu Qian (Xu Qian,2014) believes that environmental uncertainty will bring negative effects on the investment efficiency of enterprises. (2) on the impact of environmental uncertainty on audit opinions. Li Wei (2015) 's study shows that under the circumstance of uncertain environment, the decision-making process of audit opinions has obvious anchoring effect. Bu Jishuan (Bu Jishuan,2015) pointed out that various risks faced by auditors would increase with the increase of the uncertainty degree of enterprise environment. (3) on the impact of environmental uncertainty on the cost of capital, Sharma (Sharma,2002) show that environmental uncertainty will bring high financing costs to enterprises. Most existing literature on the study of earnings management environmental uncertainty and other external factors and internal factors such as internal control to separate research, few will related theory at the same analysis framework that comprehensive consideration, and in this paper, the dynamic relations between the tentative efforts, study environment is uncertain the management of internal control of accounting information quality.

## 2 Hypothesis Development

Because the environment uncertainty provides, the motivation and opportunity for the management to carry on the earnings management. First of all, there is uncertainty about the environment management have a strong incentive for earnings management: on the one hand, environmental uncertainty can lead to a surplus fluctuation of listed companies, the external stakeholders will judge company instability, investors may be out of the stock market, the creditors to remove investment, finally resulting in a decline in the value of the enterprise, unable to continue as a going concern, such as bad, these will stimulate management for earnings management. On the other hand, earnings information is directly related to the reputation and salary of the management. The management will pursue its own interests first, so earnings management will go against the interests of shareholders (Mantecon, t. and Beard, D, 2005). Secondly, environmental uncertainty leads to an increase in the degree of information asymmetry (Osma, 2008), which makes it more difficult to identify the behaviors of the management, and makes external supervision and review more complex and difficult. The management is more likely to hide its opportunistic behaviors, thus increasing the possibility of earnings management. Based on the above analysis, this paper proposes the following hypotheses:

H1: The degree of earnings management is positively correlated with the environmental uncertainty, that is, the higher the environmental uncertainty is, the higher the degree of earnings management of the company will be.

Internal control, as a corporate governance mechanism, can effectively find fraud and fluke behaviors in various links of listed companies and improve the quality of accounting information (Wang Xuejun, 2017). High environmental uncertainty will induce enterprise management to conduct earnings management activities (Osma, 2008). Good internal control can effectively inhibit the earnings management induced by environment uncertainty. specific inhibition of path is as follows: first of all,

the environment is uncertain, there is a strong information asymmetry, more of the external supervision of listed companies, while internal control activities can be objectively comprehensively from the program to monitor the activities of the internal personnel (Zhang Guoqing, 2008). Secondly, through risk assessment in internal control, listed companies can identify the risks brought to enterprises by the uncertain environment, and then formulate strategies to actively deal with the risks, so as to prevent the management from manipulating earnings because of these risks (Lin Zhonggao, Zheng Jun, Bu Jishuan, 2015). Based on the above analysis, this paper proposes the following hypotheses:

H2: internal control significantly weakens the positive correlation between environmental uncertainty and earnings management degree.

### **3 Data and Methodology**

#### **3.1 Sample selection and data sources**

This paper takes A-share listed companies in Shanghai and Shenzhen from 2011 to 2015 as the research object. In order to ensure the reliability of the regression results, the following data were screened: (1) all listed financial and insurance companies were excluded; (2) elimination ST company, \*ST and PT enterprise, the reason is the continuous loss of these three types of companies, the reason has a lot of particularity, will have a great impact on the results; (3) AH cross stocks and AB cross stocks are excluded, because cross stocks have different regulatory environments, which will affect the results; (4) companies with missing variable data during the study were excluded. Finally, 4711 observations were obtained. In addition, in order to avoid the influence of extreme values on regression results, winsorize 1% processing was performed on all continuous variables. The relevant financial data in this paper are all from the CSMAR database, and the internal control data are from the DIB internal control and risk management database.

#### **3.2 Variable measurement**

(1) explained variables. In this paper, discretionary accrual (DA) is used to express the degree of earnings management. Referring to the measurement of corresponding accrual earnings management (DA) by Dechow, the modified Jones model is adopted.

(2) explanatory variables. The explanatory variables in this paper are environmental uncertainty and internal control. Based on the practice of Shen huihui, Yu peng and Wu liansheng (2012) in considering environmental uncertainty from a dynamic perspective, this paper adopts the variation coefficient of abnormal sales revenue of an enterprise in the past five years to measure the environmental uncertainty (EU) faced by the company after industry adjustment.

At present, the internal control measurement method widely used in China is the DIB internal control index published by DIB enterprise risk management technology co., LTD. It is based on the five objectives defined in the basic norms of enterprise internal control, adopts the method of objective and subjective scientific judgment, selects the representative detailed indicators and revised indicators, and uses the subjective judgment to give weight, finally weighted to obtain the DIB internal control index. Therefore, this article uses the DIB internal control index to measure the internal control.

(3) control variables. In this paper, the company size, asset-liability ratio, return on total assets, equity concentration, audit opinions, accounting firms are selected as control variables, and the introduction of industry and annual two dummy variables.

Specific variables are explained in table 1.

**Table 1 Variable Definitions**

Variable	definition
DA	Accrual earnings management
EU	Environmental uncertainty
IC	Internal control
Size	Enterprise size =ln (total assets)
Lev	Asset-liability ratio = total liabilities/total assets
ROA	Rate of return on total assets = total ebbtide/total assets
H5	the sum of squares of shares held by the top 5 shareholders
Audit	Whether the accounting firm is one of the top four international accounting firms
Audittyp	Audit opinion dummy variable
Year	Annual dummy variable: if it is the current year, it takes 1; otherwise, it takes 0
Indcd	Industry dummy variable

### 3.3 Regression model

According to the hypothesis of the paper, the corresponding control variables are selected and the following model is designed:

In order to test the impact of enterprise environmental uncertainty on real earnings management and accrued earnings management (that is, to verify H1), the following model is designed:

$$Abs\_DA = \beta_0 + \beta_1 EU + \beta_2 size + \beta_3 lev + \beta_4 ROA + \beta_5 H5 + \beta_6 Audit + Year + Indcd + Audittyp + \varepsilon \quad (1)$$

In order to verify H2, the cross term of internal control and environmental uncertainty was added into the model to obtain the following model:

$$Abs_{DA} = \beta_0 + \beta_1 EU + \beta_2 IC + \beta_3 EU * IC + \beta_4 size + \beta_5 lev + \beta_6 ROA + \beta_7 H5 + \beta_8 Audit + Year + Indcd + Audittyp + \varepsilon \quad (2)$$

## 4 Results

### 4.1 Descriptive statistics

The descriptive statistical results of the main variables in this paper are shown in table 2. Can be seen from the table, be explained variable accrued earnings management absolute value (Abs\_DA) the maximum value of 4.5105, the minimum value is 0, that is accrued earnings management behavior of listed companies, and the difference is bigger, positive accrued earnings management of listed companies in 2993, accounted for 63.53%, show more inclined to use accrued earnings management of listed companies to increase profits. The maximum value of environmental uncertainty (EU) is 20.2039, and the minimum value is 0.0783, respectively. It can be seen that different enterprises are faced with great differences in environmental uncertainty. The maximum value of internal control (IC) is 9.7772,

and the minimum value is 0, indicating that there is a big gap between different enterprises' internal control construction, and the median and average values are 6.8429 and 6.6886, respectively, indicating that the internal control of listed companies in China is generally low. Among the control variables, the mean value of company Size (Size) is 22.2854, and the standard deviation is 1.1916, indicating a large difference in the Size of Chinese companies. The asset-liability ratio (Lev), equity concentration ratio (H5) and return on assets (ROA) are all significantly different among listed companies. The average Audit value of the Audit firm is 0.0401, which indicates that not many listed companies use the international big four for auditing, only 4.01%.

**Table 2 Descriptive Statistics**

Variable	N	Mean	Sd	P50	Min	Max
Abs_DA	4711	0.0769	0.1167	0.0525	0.0000	4.5105
DA	4711	0.0279	0.1370	0.0241	-4.5105	2.6292
+DA	2993	0.0825	0.1023	0.0600	0.0000	2.6292
-DA	1718	-0.0672	-0.1377	-0.0425	-4.5105	-0.0001
EU	4711	1.2948	1.8729	0.7510	0.0783	20.2039
IC	4711	6.6886	1.0557	6.8429	0.0000	9.7772
Size	4711	22.3963	1.1916	22.2854	19.3223	25.2678
Lev	4711	0.4841	0.2049	0.4917	0.0470	0.9478
H5	4711	0.1692	0.1227	0.1362	0.0128	0.5664
ROA	4711	0.0516	0.0459	0.0454	-0.1601	0.2011
Audit	4711	0.0401	0.1963	0.0000	0.0000	1.0000

#### 4.2 Regression analysis

(1) environmental uncertainty and earnings management. OLS multivariate regression was used to test the model (1), with the absolute value of the manipulable accruals (Abs\_DA) as the explained variable and the environmental uncertainty (EU) as the explained variable. Regression results shown in table 3, model (1) the test results show that the environmental uncertainty (EU) and accrued earnings management (Abs\_DA) significant positive correlation, shows that the listed company environmental uncertainty is higher, the reason of earnings management will strengthen management, to adopt various means of earnings management, to verify the H1. Among the control variables, the higher the asset-liability ratio (Lev), the higher the degree of accrued earnings management, indicating that the greater the financial risk, the listed company will choose various ways and means to conduct earnings management in order to obtain financing. The Size of a company is positively correlated with earnings management, indicating that the larger the company is, the more opportunities and means the management has to manipulate earnings without being discovered. Equity concentration ratio (H5) is positively correlated with accrued earnings management, indicating that higher equity concentration makes major shareholders pay more attention to the long-term development of the company and prefer accrued earnings management with less operational risk.

(2) environmental uncertainty, internal control and earnings management. OLS multivariate regression method was used to test model (2), and the absolute value of manipulable accruals (Abs\_DA) was taken as the explained variable to test the relationship between environmental uncertainty (EU), internal control (IC) and earnings management. The regression results are shown in table 3. The test results of model (2) show that environmental uncertainty (EU) has a significant positive correlation with accrual earnings management, and internal control (IC) has a negative correlation with accrual earnings management, which is consistent with the research conclusion of hypothesis 1, and the cross term (EU\*IC) has a significant negative correlation with accrual earnings management (Abs\_DA). The results of model (2) fully demonstrate that in the impact path of environmental uncertainty on earnings management, internal control can play a good regulatory role and effectively inhibit the opportunism motivated behavior of management caused by environmental uncertainty. H2 is verified. Among the control variables, Size is positively correlated with accrued earnings management, indicating that the larger the company is, the more ways and means listed companies choose earnings management. Debt to asset ratio (Lev) is positively correlated with accrued earnings management, indicating that when the debt to asset ratio is high, listed companies will obtain financing through earnings management. Audit by the big four accounting firms is negatively correlated with accrued earnings management, but it is not significant, indicating that when accounting firms are highly competent, listed companies will be more cautious and reduce their earnings management behaviors.

**Table 3 Environmental Uncertainty, Internal Control and Earnings Management**

Variable	Model (1)		Model (2)	
	coefficient	T	coefficient	T
EU	0.00797***	7.80	0.00789***	7.70
IC			-0.00612***	-11.54
EU*IC			-0.0110***	-4.82
Lev	0.0431***	3.84	0.0431***	3.84
Size	0.00118	0.58	0.00121	0.60
ROA	0.273***	6.75	0.284***	6.83
H5	0.0236	1.60	0.0202	1.35
Audit	-0.0123	-1.42	-0.00441	-0.35
Audittyp	control		control	
year	control		control	
indcd	control		control	
cons	9.395***	3.41	9.690***	3.49
N	4711		4711	
R <sup>2</sup>	0.272		0.173	

\*, \*\*, \*\*\* Indicate significance at 0.10, 0.05, and 0.01, respectively (two-tailed).

## 5 Conclusion

This paper analyzes the environmental uncertainty influence on earnings management, and internal control on the environment uncertainty induced by earnings management governance effect, the following conclusion: the higher environmental uncertainty will induce the earnings management behavior of listed companies, internal control and good for the environment uncertainty induced surplus management has significant inhibitory effect. Further research shows that the internal environment, risk assessment, information and communication among the five elements of internal control have significant governance effects on earnings management.

Based on the research conclusions of this paper, the following Suggestions are put forward :(1) listed companies should adopt various means to perfect and implement internal control, so as to facilitate the board of supervisors to timely supervise the behavior of managers and reduce the possibility of earnings management. (2) the management needs to enhance its strategic flexibility to help enterprises reduce the impact of environmental uncertainty on earnings, so as to optimize the quality of enterprise information and maximize enterprise value. (3) when the environment is uncertain, regulators should strengthen the inspection of internal control construction, regularly inspect the construction and implementation of internal control of listed companies, and strengthen supervision.(4) in the face of the uncertainty of the external environment, investors should enhance their own risk awareness, to prevent the listed company management defects caused by the company's financial operation risk, resulting in investment mistakes.

The research prospects of this paper :(1) in addition to internal control, whether there are other contract mechanisms with governance effect that will affect the relationship between environmental uncertainty and earnings management is a question worth exploring in the future. (2) internal control is composed of five elements, so whether the five elements have an obvious role in earnings management under uncertain circumstances, and what the mechanism is, are worth discussing, in-depth research can better understand the mechanism of internal control.

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# Research on the Effect of Inbound and Outbound Open Innovation on Firm Innovation Performance

Hou Jie, Li Xue, Gao Pengbin

School of Economics and Management, Harbin Institute of Technology, Weihai, P.R. China, 264209

(E-mail: 2387764361@qq.com, lixuehit@163.com, gaopengbinhit@163.com)

**Abstract:** In recent years, open innovation has received extensive attention from scholars and practitioners. This paper integrates inbound open innovation, outbound open innovation and their interaction into a theoretical model. Based on the survey data of 209 Chinese manufacturing firms, correlation analysis and hierarchical regression analysis are used to verify the hypothesis. The results show that both inbound and outbound open innovations have a positive impact on the firm innovation performance, and the two-way open innovation interaction also has a positive impact on firm innovation performance. According to the results, some suggestions are also proposed.

**Key words:** Inbound open innovation; Outbound open innovation; Innovation performance; Interaction effect

## 1 Introduction

In an era of knowledge explosion, firms have been unable to maintain competitiveness in the fierce market competition by generating new ideas and developing new products through internal technology research and development. This makes the open innovation model quickly attract attention around the world. More and more firms are beginning to break the organizational boundaries of traditional closed innovation, and cooperate extensively with external organizations to purposely integrate internal and external resources, so as to obtain competitive advantage and provide sustainable development for the firm.

The impact of open innovation on corporate innovation performance has been extensively studied by scholars, most of whom view open innovation as a whole. In general, scholars can still reach a certain consensus that open innovation can improve the innovation performance of firms. However, researchers face an important question: how can firms open up in order to get a return (Laursen, Salter, 2014)? The focus of this research is on the choice of the direction of knowledge flow: choose inbound open innovation or choose outbound open innovation (Chesbrough, Crowther, 2006). Compared with outbound open innovation, inbound open innovation has long been the focus of researchers. Therefore, outbound open innovation has not been fully studied and understood. In recent years, some scholars have incorporated two-way open innovation into a theoretical model. Rubera et al. Showed that the two open innovations have significant positive effects on product portfolio innovation and firm performance (Rubera, 2016). But it is rare to study the interaction between the two modes, especially the impact on innovation performance.

Based on the above discussion, this study focuses on the analysis of the impact of inbound open innovation, outbound open innovation and their interaction on the innovation performance of firm, so as



to study the impact of the two-way knowledge flow management mode at the organizational boundary on the innovation performance.

## **2 Theoretical Analysis and Research Hypotheses**

### **2.1 Inbound open innovation and innovation performance**

Inbound open innovation is a process in which enterprises use external knowledge or technology internally by scanning the external environment. This process allows enterprises to obtain technical knowledge from external knowledge resources such as universities, scientific research institutions, users, even competitive enterprises or non-competitive enterprises to enrich the enterprise knowledge base. Enterprises can choose profitable or non-profitable open practice to get external knowledge and technology. In the first case, enterprises develop more formal transactions by obtaining patents and increasing investment in innovation, such as joint research and development, strategic alliances, etc. In the second case, enterprises get free ideas and knowledge from customers, suppliers, competitors and consultants in an informal way (Scuotto, 2017).

Resource-based view holds that resources are an important factor affecting firm innovation, but the scarcity and finiteness of resources determine that firms must interact with external controllers to obtain the required critical resources. At present, firms rich knowledge mainly through interaction with stakeholders such as customers and suppliers, which can improve the innovation of firms. In the process of interaction with customers, firms can identify valuable and exploitable business opportunities in relevant information such as market demand and the existence of new markets, thereby reducing the risk and cost of innovation (Baldassarre, 2017). Unlike customer collaboration, working with suppliers is often associated with cost reduction and organizational process innovation. The cooperation with suppliers, companies can achieve high-level input of knowledge resources through strategic alliances, joint ventures, and outsourcing agreements. High-quality knowledge resources can not only directly improve organizational processes, but also reduce the cost of new product development and design. It is worth mentioning that the exchanges between enterprises and scientific research institutions, competitors and other external stakeholders are also deepening, and the scope of introducing resources has continued to expand. These resources further enrich the innovation resources of enterprises and lay a solid foundation for the subsequent innovation of enterprises. Based on the above discussion, the following hypotheses are proposed:

**H1: Inbound open innovation has significant positive impact on firm innovation performance.**

### **2.2 Outbound open innovation and innovation performance**

Outbound open innovation is the process by which firms transfer knowledge or technology to the external environment to obtain monetary or non-monetary benefits. This idea begins with free disclosure of technical details in open source software, and later in the information and its related industries has been widely applied, which leads to free disclosure as an important feature of outbound open innovation. For paid opening to the outside world, firms usually adopt joint ventures, sell products that meet market needs, participate in standardization, business incubation, and technology licensing (Chesbrough, 2014).

In the process of development, firms may generate a large number of resources that do not match the current development or are temporarily idle, and under-utilized intellectual property rights. At this time, they can be commercialized to improve the utilization rate of internal innovation resources and reduce the cost of internal maintenance and update. Firms can also improve performance when they sell

intellectual property or introduce ideas into the external environment. On the one hand, the external commercialization of resources such as knowledge no longer limits a firm to its own market, but also enables it to discover and develop new markets by relying on external partners. On the other hand, in the external commercialization process of innovation achievements, firms can not only gain a lot of economic benefits, but also gain a high reputation and a strong influence in the technology market. These non-economic interests are conducive to the establishment of industry standards based on firm technology and the improvement of firm brand influence. Relying on the power of technological discourse and brand advantage, firms can reduce the cost of new technology development and increase the sales of new products (Noh, 2015). Based on the above discussion, the following hypotheses are proposed:

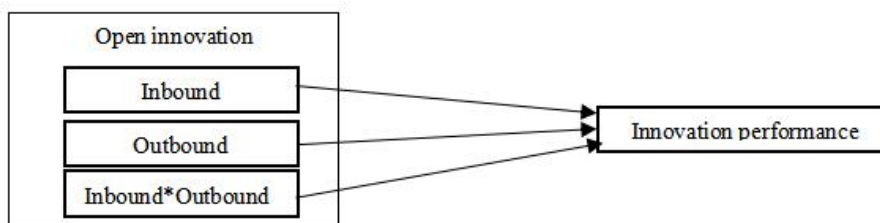
**H2: Outbound open innovation has significant positive impact on firm innovation performance.**

**2.3 Two-way open innovation interaction effect and innovation performance**

Inbound open innovation and outbound open innovation are not independent and closely related. Firms adopting inbound open innovation can obtain a large amount of external resources, including technology, knowledge, information, and manpower. By introducing these resources, firms can enrich existing resource systems, and externally rich resources are a true reflection of the market. Through the introduction of external resource, firm can also discover the current market demand, thereby promoting the firm to enhance its strength to carry out outbound open innovation. In other words, adopting inbound open innovation can promote enterprises to improve relevant knowledge and skills, stimulate enterprises to continuously innovate, and encourage enterprises to transform technological achievements, thus ensures the effective implementation of outbound open innovation. Outbound open innovation pays more attention to the ability of firms to commercialize. It is a means to externally transfer idle resources of firms. On the one hand, it solves the cost of maintenance and renewal of idle resources inside firms, so that firms have more funds to carry out internal innovation or purchase external resources. On the other hand, in the process of outbound open innovation, firms can have some understanding and control of the market environment, clarify the resources in the market, and formulate the firm's next development strategy, so as to carry out internal research and development or search for external resources and technology with more purpose. Based on the above discussion, the following hypotheses are proposed:

**H3: Two-way open innovation interaction effect has significant positive impact on firm innovation performance.**

In sum, based on the above hypotheses, we establish the conceptual model (Figure1).



**Figure 1 The Conceptual Model**

### 3 Date and Methods

#### 3.1 Sampling and data collection

This paper selects manufacturing firms as a research sample, because manufacturing firms have frequent exchanges and extensive cooperation, and obvious characteristics of open innovation compared with other industry firms. The questionnaire survey time of this study is from August to December 2018, and some firms are randomly selected from the manufacturing firms in key provinces and cities in China to issue a questionnaire on the spot. For the questionnaire, the respondent is required to be the middle and senior leaders of the firm or the relevant responsible persons of each department. A total of 300 questionnaires are distributed, and 240 are recovered. The recovery rate was 80%. Excluding the invalid questionnaire, 209 were obtained, and the recovery efficiency was 87.08%.

#### 3.2 Variable measurement

The measurement of the variables in this paper uses the Likert 5-point scoring method. The innovation performance measurement refers to Jugend's research and gets 5 items (Jugend, 2018). The measurement of open innovation refers to the research of Naqshbandi et al., in which the inbound open innovation gets 6 items and the outbound open innovation gets 4 items (Naqshbandi, 2016). The measurement of control variables refers to Randhawa's research, including firm year, firm capital, number of employees and industry (Randhawa, 2016).

### 4 Analysis and Results

#### 4.1 Validity and reliability

In this study, Cronbach's Alpha value of statistical software SPSS23.0 is used to test the reliability of the scale, and exploratory factor analysis is used to test the validity of the scale. According to table 1, the Cronbach's Alpha and CR coefficients of each variable are greater than 0.7, so the scale passes the reliability test. The KMO of each variable is greater than 0.8, indicating that it is suitable for exploratory factor analysis. The factor load factor of each variable exceeds 0.5, and all variables AVE are significantly greater than 0.5, so the scale has good convergence validity. According to Table 2, the square root (diagonal coefficient) of AVE of each variable is greater than the correlation coefficient of the row and column, indicating that the discriminant validity of the scale is good.

**Table 1 Reliability and Validity**

Variables	KMO	Item	Factor loading	CR	AVE	$\alpha$
Inbound open innovation	0.933	I1	0.890	0.958	0.792	0.947
		I2	0.876			
		I3	0.861			
		I4	0.919			
		I5	0.928			
		I6	0.863			

Outbound open innovation	0.818	O1	0.838	0.926	0.716	0.862
		O2	0.874			
		O3	0.814			
		O4	0.840			
Innovation performance	0.871	IP1	0.821	0.904	0.652	0.866
		IP2	0.806			
		IP3	0.802			
		IP4	0.793			
		IP5	0.816			

#### 4.2 Hypothesis tests

Table 2 shows the descriptive statistics for all the variables and their correlations. We adopt the regression equations via software SPSS 23.0 to test the effect of inbound open innovation, outbound open innovation and their interaction to firm innovation performance.

**Table 2 Means, Standard Deviations, AVEs, and Correlations for the Variables**

Variables	1	2	3	4	5	6	7
1 Year	1						
2 Capital	0.063	1					
3.Employee	-0.113	-0.087	1				
4 Industry	-0.133	-0.047	-0.107	1			
5 Inbound	0.081	0.002	-0.104	-0.004	0.889		
6 Outbound	0.074	0.047	0.045	-0.047	0.740**	0.846	
7 Innovation performance	0.080	0.003	-0.005	0.018	0.775**	0.666**	0.807
Mean	2.620	2.500	2.390	2.470	3.028	2.990	3.180
SD	0.078	0.075	0.075	0.077	0.078	0.067	0.482

Notes: n =209. \*p<0.01; \*\*p<0.00. Figures on the diagonal are the square root of the AVE.

Before constructing the interaction term, this paper centralizes the two-way open innovation to avoid severe multicollinearity problems in the model. Table 3 shows that the explanatory power of M2(relative to M1)is significantly improved ( $\Delta R^2=0.633$ ,  $p<0.001$ ). Inbound open innovation has a significant positive impact on innovation performance ( $\beta=0.644$ ,  $p<0.001$ ), supporting hypothesis H1. Outbound open innovation has a significant positive impact on innovation performance ( $\beta=0.185$ ,  $p<0.05$ ), supporting hypothesis H2. The interaction of two-way open innovation has a significant positive impact on innovation performance ( $\beta=0.097$ ,  $p<0.05$ ), supporting hypothesis H3.

**Table 3 Regression Result of Open Innovation and Innovation Performance**

Variable	M1	M2
Year	0.085	0.033
Capital	0.000	-0.003
Employee	0.008	0.071
Industry	0.031	0.037
Inbound		0.644***
Outbound		0.185*
Inbound*Outbound		0.097*
R <sup>2</sup>	0.007	0.633
Adjust R <sup>2</sup>	-0.012	0.620
△R <sup>2</sup>	0.007	0.626
F	0.378	49.538***

Notes: \*p<0.05; \*\*p<0.01; \*\*\*p<0.001. Explained variable: innovation performance.

## 5 Conclusion

Based on the survey data of 209 manufacturing firms in China, this study aims to provide information on how open innovation affects innovation performance. The research conclusion shows that inbound and outbound open innovation can promote innovation performance, which is consistent with the conclusions of most studies. Most importantly, this study confirms that the interaction of two-way open innovation has a significant impact on innovation performance, which not only enriches the research on the relationship between open innovation and innovation performance, but also provides a new theoretical contribution to the research on the relationship between two-way open innovation interaction effect and firm innovation performance.

This paper also has some important practical implications. In increasingly competitive market, firms should actively seek for external innovation elements, and then combine them with internal resources to strengthen their independent innovation capabilities. In addition, firms also need to actively "go global". In the process of "going global", they should pay attention to market information, predict market trend and create frontier products and services in line with market demand.

Besides, our research has some limitation. This study conducts empirical research on manufacturing firms in several representative regions of China in the form of questionnaires, but several regions are relatively independent, so the industries and firms surveyed have certain specialities and limitations, and it is possible to conduct targeted research on firms in a certain cluster area and propose more constructive proposals in the future.

## Acknowledgement

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# A Study on the Relationship between Servitization of Manufacturing Industry and Enterprise Performance: Based on the Perspective of Life Cycle

Zhu Zhangli, Fang Ming

School of Management, Wuhan University of Technology, Wuhan, P.R.China, 430070

(E-mail: 2404955401@qq.com; fxlasting@whut.edu.cn)

**Abstract:** Taking non-financial listed companies in China's A-share manufacturing industry from 2011 to 2016 as samples, this paper empirically examines the impact of servitization of manufacturing industry on enterprise performance from the perspective of enterprise life cycle. Research found that: (1) In the long run, servitization will bring about the improvement of enterprise performance. (2) There are also differences in the degree of "performance effect" of servitization in different life cycle stages. It reveals U-shape effect for enterprise at growth stage and mature stage, and it is more significant at maturity period, while in the recession stage, it is not obvious. (3) When there are differences in industry competition, the more competitive enterprises are, the more significant u-shaped relationship will be.

**Key words:** Servitization; Enterprise performance; Enterprise life cycle; Industry competition; Paradox of servitization

## 1 Introduction

With the rapid development of information technology and modern management technology, the global industrial structure is gradually shifting from industrial economy to service economy. Under the economic development status of our country, our government timely put forward national strategic planning: the "Made in China 2025", in order to speed up the coordinated development of manufacturing and services, and to promote production for the manufacture industry to transform to a service-oriented one. Service-oriented value-added has become a new engine and new power for the manufacturing industry to carry out profound reform and high-end transformation and upgrading (Kowalkowskiet al., 2017).

At present, scholars at domestic and abroad have carried out many researches around servitization. The provision of services in any organization is taking on greater strategic importance (Eloisaet al., 2018). The studies and disciplines that have the greatest impact on servitization among manufacturing firms have been identified to illustrate the intellectual structure of this discipline (Martín-Peña et al., 2017). The service-oriented transformation is an important source of the competitiveness of China's manufacturing industry, which can effectively expand the value-added space in the value chain (Wang Xiaoping et al., 2019). In order to realize servitization, the resources in the enterprise can be integrated by taking the elements of the business model as attributes. The original key resources and capabilities of manufacturing enterprises are the necessary basis for the transformation of enterprises (Li Jinghua et al, 2019). There are three different views on the relationship between servitization and enterprise performance. Firstly, servitization has a positive effect on enterprise performance. Servitized firms can havemore profits, more employees, and higher total sales than non-servitized firms (Crozet and Milet, 2017). Secondly, servitization has an inhibitory effect on enterprise performance. Advanced services positively affect firms' sales and profitability while basic services negatively affect firms' profitability (Sousa and Silveira, 2017). Furthermore, with the further development of the "service-performance"

empirical research, some experts suggest that service and enterprise performance may not be limited to linear relationships, including “U-shaped” (Szász et al., 2017), “saddle type” (Kastalli and Looy., 2013).

The above research on servitization and enterprise performance has remained at a static level, and has not yet penetrated the enterprise. So, in the different life cycle stages of manufacturing enterprises, how to have the enterprise performance effect brought by the implementation of servitization strategy is still an unsolved problem. In addition, considering the competition intensity of different industries, it is remained unknown that the differences in the performance of enterprises in implementing servitization.

## 2 Theoretical Analysis and Research Hypothesis

The manufacturing industry in China is generally based on processing and assembly, which is in the middle of the “smile curve” of the value chain. While processing and manufacturing are severely and easily manipulated and imitated due to low technical content and product homogeneity problems, resulting in an extremely low product added value. Due to the problem of China's manufacturing background, many manufacturing companies only focus on the expansion of production scale, neglecting intangible assets and human capital. At this point, the adoption of a service strategy will lead to a sharp rise in operating costs and management complexity, thereby curbing enterprise performance. However, with the continuous investment of intermediate elements and the deepening of service awareness, enterprises directly reduce production costs by outsourcing specialized production services. Enterprises outsource non-core links to service corporate and indirectly reduce manufacturing costs. In the organization of activities, not every link can produce value. Some activities create a higher proportion of the value of total value, which needs to focus on. By focusing resources on high-tech products, it is possible to achieve internal economies of scale and external economies of scale (Liu Bin et al., 2016), which can reduce the overall cost of the company, resulting in an increase in enterprise performance. Based on the above analysis, this paper proposes the following assumptions:

**H1: Servitization leads to long-term performance improvement and a certain degree of short-term performance sacrifice.**

Enterprise life cycle theory believes that enterprises with different life cycles reflect different characteristics in corporate governance, management, and finance. Therefore, enterprises need to choose the method and strategy to solve problems. There are big differences in the ability and conditions for companies to implement service strategies in different life cycles. For this reason, the economic consequences of servitization in manufacturing enterprises will be different.

Company at growth stage often do not form stable profitable methods. Their financial strength, technical support and other overall strengths are weak. The ability to develop new businesses is relatively limited, and they do not have competitive advantages. Enterprises have greater resistance to improve their performance through the implementation of service-oriented strategies. Adopting a service strategy in the growth period will reduce enterprise performance.

During the maturity period, the company has a sound organizational structure and rich management experience. The products produced have a large share in the market, it has strong competitive strength. As mentioned above, manufacturing enterprises are initially involved in the service sector, lacking awareness of the market, and there are problems such as information asymmetry and internal organizational changes. However, with the gradual deepening of the service strategy, adopting the “product and service” promotion model will win greater economic benefits for the enterprise.

In the recession period, the sales of enterprises declined, the market share and profit rate began to fall. The poor management within the enterprise hindered the implementation of the service strategy,



and it was easier to face the problem of service dilemma. Therefore, the relationship in the recession period is not obvious. Based on the above analysis, the hypothesis of this paper is proposed.

**H2: There are differences in the “performance effect” of manufacturing enterprises in different life cycle stages.**

There is a significant negative correlation between servitization and performance when enterprise in growth stage; the relationship is “U-type” when company at mature stage; while it is not obvious in recession period.

**3 Research Design**

**3.1 Sample selection and data sources**

In this paper, listed manufacturing companies in China from 2011 to 2016 were selected as the research samples. According to the information disclosed by the CSMAR database for the industry classification of listed companies, the following data were removed from the selected samples: (1) Enterprises established after 2014. (2) ST listed enterprises. (3) Enterprises with missing or incomplete data. In order to make the data more effective, this paper processed the extreme values of the sample data based on the degree of servitization, and finally obtained 1480 valid enterprise data. The financial data involved in this paper are mainly from the CSMAR database, and the missing data are supplemented and verified by combining the sample enterprise website and the annual report disclosed by the enterprise.

**3.2 Measurement of variables**

**3.2.1 Servitization**

According to the above analysis, this paper uses the proportion of service income to the total operating income as the representation of the degree of servitization. The larger the ratio is, the higher the degree of servitization. Since Chinese enterprises are not obliged to disclose service income, because service income is often regarded as a trade secret, which is difficult to obtain specific data. Therefore, this paper uses other operating income of enterprises to approximately replace service business income and calculate the degree of servitization. In addition, considering the possible of non-linear relationship between the degree of servitization and enterprise performance, the quadratic term of service income proportion is set.

**3.2.2 Enterprise life cycle**

Based on the cash flow grouping method proposed by Dickinson, this paper divides the life cycle of an enterprise into three stages: growth stage, maturity stage and decline stage.

**Table1 The Combination of Cash Flow Characteristics at Different Life Cycle Stages**

Cash flow	Growth period		Mature period	Decline period				
Operational cash flow	-	+	+	-	+	+	-	-
Investing cash flow	-	-	-	-	+	+	+	+
Financing cash flow	+	+	-	-	+	-	+	-

### 3.2.3 Industry competition

In this paper, the HHI index, which is the sum of squares of the sales revenue of enterprises in each industry, is used to measure the intensity of competition in the industry. HHI index can well reflect the distribution of the overall sales in the industry. When the number of enterprises in the industry is certain, the higher the HHI index is, the smaller the industry competition will be. In conclusion, if the value of the industry in which the sample is located is greater than the median, therefore the industry is highly competitive; otherwise, this industry is low competition industry.

### 3.2.4 Control variable

In this paper, asset-liability ratio, management ownership ratio, cash degree, enterprise size and enterprise age are selected as control variables.

**Table 2 Study Variable Definition Table**

Variable Type	Symbol	Variable Name	Calculation Formula
Dependent variable	<i>ROA</i>	Rate of return on total assets	$EBIT * 2 / (\text{total assets at the beginning of the year} + \text{total assets at the end of the year})$
Independent Variable	<i>SER</i>	Servitization	Extraordinary gains/ operating income
	<i>LIFE</i>	Enterprise life cycle	Cash flow composition
	<i>HHI</i>	Industry competition	The sum of the squares of the sales revenue of each industry
	<i>DEBT</i>	Asset-liability ratio	Total liabilities / total assets
	<i>SIZE</i>	Scale of the enterprise	$\ln (\text{The book value of the company's total assets})$
	<i>AGE</i>	Age of the enterprise	2016 minus the year the company was founded
	<i>GMS</i>	Managerial ownership ratio	Number of management shares/total shares
Control Variable	<i>FAR</i>	Assets specificity	Net fixed assets/total assets
	<i>CHR</i>	Cash degree	Net cash flow from operating activities/total ending assets

### 3.3 Model design

Referring to previous studies on the relationship between servitization and enterprise performance, this paper combines the above theoretical assumptions and selected variables to build the following specific model:

$$ROA_{i,t} = \beta_0 + \beta_1 Ser_{i,t} + \beta_2 Ser_{i,t}^2 + \sum_{i=1}^n \beta_i Controls_i + \varepsilon$$

## 4 Empirical Analysis

### 4.1 Descriptive statistical analysis and correlation analysis

The new statistical results based on the description of all the variables in the sample data are shown in table 3. According to the sample data, some enterprises have not yet implemented servitization, while some enterprise have as high as 45.42% of servitization degree. However, the average degree of servitization of the sample companies is only 4.85%, far lower than the average level of some developed countries such as the United States and Germany. Therefore, the servitization process of China's manufacturing industry is advancing. Compared with other sub-industries, equipment manufacturing industry has a higher degree of servitization. However, in general, the servitization level of China's manufacturing industry is still low, and its breadth and depth still need to be improved.

**Table 3 Descriptive Statistics**

	N	Min	Max	Mean	Standard Deviation
ROA	5220	-0.6683	1.3936	0.0441	0.0677
SER	5220	0	0.3152	0.042	0.0575
HHI	5220	0.0087	0.4192	0.025	0.0309
DEBT	5220	0	3.3055	0.3452	0.2113
SIZE	5220	3.6889	12.175	7.6788	1.0793
AGE	5220	1	36	14.51	3.729
GMS	5220	0	0.8973	0.178	0.2247
FAR	5220	0	0.8091	0.1589	0.1283
CHR	5220	-0.4726	0.5817	0.0368	0.0735

Besides, the correlation analysis shows that the correlation coefficient between most variables is less than 0.5, indicating that the correlation between explanatory variables and control variables is weak.

### 4.2 Regression analysis

The regression results of model (1) shows that, in the overall sample, the coefficient of the first term of servitization is significantly negative, while the coefficient of the second term of servitization is significantly positive, indicating that there is a u-shaped curve relationship between the degree of servitization (SER) and the net interest rate of total assets (ROA). The test results are consistent with H1.

**Table 4 The Impact of Different Life Cycle Servitization on Enterprise Performance**

	Total	Growth	Mature	Decline
SER	-0.311***	-0.246***	-0.277***	-0.135
	(-7.837)	(-4.793)	(-4.373)	(-0.855)

SER2	1.037*** (6.030)	0.677*** (3.042)	0.800*** (2.789)	0.557 (0.866)
HHI	0.046*** (5.471)	0.037*** (5.233)	0.042*** (4.381)	0.031** (2.492)
DEBT	-0.109*** (-24.105)	-0.104*** (-17.597)	-0.127*** (-17.705)	-0.139*** (-7.845)
SIZE	0.009*** (10.824)	0.006*** (5.080)	0.012*** (9.360)	0.018*** (5.464)
AGE	0.001*** (2.590)	0.000 (0.500)	0.001*** (3.003)	0.003** (2.149)
GMS	0.031*** (7.783)	0.036 (6.951)	0.036*** (5.915)	0.035 (0.866)
FAR	-0.043*** (-6.420)	-0.031*** (-3.359)	-0.027*** (-2.788)	-0.091*** (-3.453)
CASH	0.192*** (16.904)	0.199*** (12.516)	0.308*** (14.604)	0.222*** (4.619)
N	5220	2643	1850	727
R2	0.240	0.255	0.317	0.337

The results of different life cycle of regression are shown in table 4, growth period and mature period are significant negative coefficient of service, while quadratic coefficient is positive. Regardless of enterprise in the growth and maturation, the level of service and enterprise performance is a u-shaped curve relationship, but under 1% significance level, the relationship of mature enterprise is more significant. The first term coefficient and the second term is negative and positive respectively, but they are not significant at the level of 10%, indicating that the effect of the servitization strategy is not efficient. This test result is not completely consistent with H2 above. Although the comprehensive strength of enterprises in the growth stage is weak, its effect on enterprise performance is not always negative with the advancement of servitization. After reaching a certain critical point, servitization can also promote the improvement of enterprise performance in the growth stage.

## 5 Further Discussion and Robustness Analysis

### 5.1 The service effect of manufacturing enterprises under the different industry competition

In addition to enterprise life cycle, industry competition intensity is also an important factor

affecting enterprise performance. The HHI index is used to divide the entire sample into low-competitive industries and high-competitive industries for regression of model (1), and the results are shown in table 5.

**Table 5 The Regression Results under the Difference of Industry Competition**

	Total	Low-competitive industry	High-competitive industry
SER	-0.311*** (-7.837)	-0.264*** (-4.547)	-0.329*** (-6.068)
SER <sup>2</sup>	1.037*** (6.030)	0.899*** (3.606)	1.110*** (4.691)
HHI	0.046*** (5.471)	/	/
DEBT	-0.109*** (-24.105)	-0.130*** (-19.885)	-0.086*** (-13.760)
SIZE	0.009*** (10.824)	0.010*** (8.171)	0.008*** (6.538)
AGE	0.001*** (2.590)	0.001** (2.076)	0.001* (1.704)
GMS	0.031*** (7.783)	0.039*** (6.481)	0.026*** (4.775)
FAR	-0.043*** (-6.420)	-0.033*** (-3.563)	-0.061*** (-5.531)
CASH	0.192*** (16.904)	0.159*** (9.964)	0.233*** (14.425)
N	5220	2548	2672
R <sup>2</sup>	0.240	0.261	0.281

According to the results, the low and high competition industry competition is a significant negative coefficient of service industry, the secondary coefficient is positive. It shows that the strength of the companies in any industry competition, the relationship both show a u-shaped curve. Under 1% significance level, the quadratic term coefficient of highly competitive enterprise is significantly greater than that of low-competitive industries, which indicates that the more competitive the company, the more obvious the u-shaped curve.

## 5.2 Robustness analysis

Reappraisal of enterprise performance. It is too simple to use the net interest rate on total assets as the indicator of enterprise performance. This paper further uses ROE to represent enterprise performance, and then conducts regression on the overall sample data and sample data of different life cycles. The results show that the magnitude and direction of the key coefficient are basically the same, while the other control variables remain relatively stable. This result proves the reliability of the corresponding empirical results to a large extent. Due to the limitation of space, the regression results of control variables are not listed in this paper.

**Table 6 The Impact of Different Life Cycle Servitization on Enterprise Performance**

	Total	Growth	Mature	Decline
SER	-0.293*** (-3.089)	-0.207*** (-3.831)	-0.282*** (-4.465)	-0.148 (-0.927)
SER2	0.983*** (5.581)	0.552*** (2.866)	0.838*** (2.928)	0.625 (0.960)
N	5220	2643	1850	727
R2	0.236	0.220	0.301	0.318

## 6 Conclusion

Based on the theory of enterprise life cycle, through the regression of sample data, the research findings of this paper are as follows: (1) There is a u-shaped curve relationship between servitization and enterprise performance. The information asymmetry or the limitation of their own resources leads to the decline of short-term performance of enterprises. (2) The influence of manufacturing servitization on enterprise performance varies in different life cycle stages. (3) Further research finds that the more competitive the industry is, the more significant the impact of servitization on enterprise performance will be. The results show that enterprises need to be identified according to their life cycle stages when implementing the servitization strategy. It should be noted that it takes time for the "performance effect" of servitization to play its role. Therefore, a reasonable choice of servitization strategy in different life cycles can be an important means for enterprises to improve performance.

Many of the literature related to the derivative services of manufacturing companies emphasize that services play a significant role in the ability of manufacturing companies to enhance their competitiveness, but it is still unknown that how services play a role in this process. The ability status of different enterprises to transform into service-oriented manufacturing has certain differences. What kind of aspects (product technology, service capability, etc.) should be derived from services in order to achieve competitiveness improvement and transfer of enterprise capability status is worth studying.

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# The Innovation and Management of China's Urban Brand Image under Experience Service Economy

Li Huipeng<sup>1</sup>, Zhang Yazhou<sup>2</sup>

<sup>1</sup> Wuhan University of Technology, Wuhan, P.R. China, 430070

<sup>2</sup> Maoming Vocational and Technical College, Maoming, P.R. China, 525000

(E-mail: 411276362@qq.com, 360954128@qq.com)

**Abstract:** China's economic development has changed from high-speed growth to high-quality development. However, the domestic traditional economic development model is difficult to support the development of urban industrial clusters and the construction of urban brand image. The evolution of global economic development has brought innovation and management inspiration to the shaping of urban brand image. The construction and perception of city brand image mainly includes the shaping of five sense experience and the innovative thinking of urban brand image, which allows customer to pay attention to the point of the city brand friendly experience image, accurately and quickly spread the city brand image innovation value and disseminate management space. In this paper, an image innovation and management strategy is proposed by using field research and literature research methods for the experiential economic service in China. The construction strategy and innovative management mode are achieved through the combination of urban brand image innovation management and experience economic service under the experience economy service.

**Key words:** Experience service; Urban brand; Image building; Innovation and management

## 1 Introduction

### 1.1 Experience service economy

Experience service economy is a kind of service economy in which experience is emphasized when products or services are purchased. The younger generation consumers pay increasing attention to the "experience" during the procedure of purchasing products, especially in the area of urban. This kind of "Experience" is able to make customers fully feel the charm of the city brand to create the interaction and intimacy and a sense of belonging to the city brand. Experience service economy is the development of the consumer economy, emphasizing the material needs and feelings of customers, and paying attention to the psychological experience of the service economic behavior audience. It is a new type of economic development from passive consumption to active service to experience interaction. Different from the enterprise product economy and the service consumption economy, experience service economy pays more attention to the audience participation and self-experience. Through the experience-aware service, the audience identity and good expression can be enhanced so that the need and spiritual enjoyment of customers can be fully satisfied.



## 1.2 Urban brand image

The city brand image stands out in the era of experience service economy, providing a feasible idea for the formation of urban brand value competitiveness, and plays significant role in the competition between cities. The interpretation for “Brand” in the Oxford dictionary is “to prove ownership, as a sign of quality or other purposes”, mainly used to distinguish and display quality<sup>71</sup> (Li Cheng, 2010). With the long-term development and the emergence of new commodities, the brand’s connotation is also becoming mature and rich, mainly referring to the combination of elements such as words, symbols, patterns, etc., which have been known widely today.

The city brand is developed and studied combining brand and the image of city after the maturity of the corporate brand, and with the accumulation of design practice experience. As professor Keith Dinnie in the University of Duke said: “The power of urban branding is to let People understand and know a certain area and naturally associate a certain image and association with the existence of the city, let its spirit blend into every building in the city, and let competition and life coexist with the city.”(Keith Dinnie, 2014)

The urban brand image is the external image and visual modeling symbol of the city brand. It establishes its own image position and the core value through a long-term accumulation of the development of the city, and then integrates the development context of the city into the brand's visual image.

## 1.3 The relationship between experience economy and urban brand image

Experience economy meets the need of high-quality service of customers. The city brand image is the direct feeling of people during the experience procedure of city service and the human landscape of the city. The urban brand image carries out economic activities and the feelings through the urban experience service carrier, and at the same time affects the cognitive establishment of the city brand image in the audience psychology. It can be said that experience economy and urban brand image are interrelated and mutually compatible.

The intangible assets accumulated by the city brand image have a demonstration effect on improving the development of the service economy, and at the same time enhance the reputation and popularity of the city brand image. The city brand image is influenced by the economic development of the experience service, and it is counterproductive to the experience service economy. The goodness of the urban experience service economy plays a crucial role in brand image formation and management (Ping Yang, 2007).

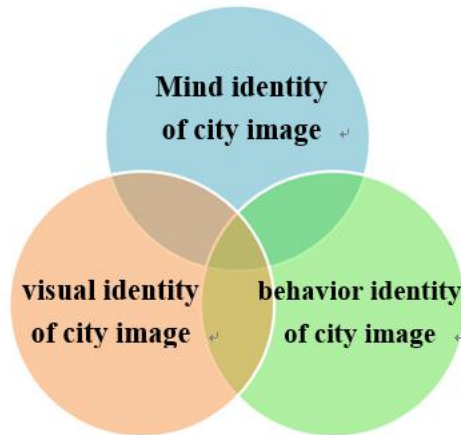
## 2 The Innovation Path of Urban Brand Image with Experience Economy

City brand image is a brand development strategy, which is mainly composed of three parts: urban concept recognition, city image visual recognition and city image behavior recognition, as shown in Figure 1(Xuqing Zhu, 2014). It shows the individualized characteristics and development vision of urban development. The identification is transmitted to people, which in turn allows people to identify

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<sup>71</sup> Li Cheng. Brand interpretation culture pursuit. 2010. <http://theory.people.com.cn/GB/12008739.html> (In Chinese)

with the image of the city. The city brand image is mainly used to display the charm of urban brands, increase the competitiveness of urban brands, and at the same time be the public image and external evaluation accumulated by the city in the long-term development(Shunshu Xie, 2013).



**Figure 1 The Components of Urban Brand Image**

### **2.1 Mind identity of city image**

Urban development depends on the economic vitality and creation of the city. Experience service economy is an important reference factor for creating an innovative city. Only by establishing the core concept of urban development can the construction and concrete implementation of the planned city brand image be guided. The recognition of city image concept reflects the core of urban value and has strong cultural cohesion. Beijing, as China's political, economic and cultural center, carries important functions of the capital (Juai Pang, 2016). Based on the actual development of the city, Beijing puts forward the development concept of building an international and innovative city. This is not only the cultural heritage of Beijing but also the positioning of Beijing itself. Mind recognition to spread a personalized experience image to the audience.

### **2.2 Visual identity of city image**

The urban visual image recognition system is the result of visual symbolization under the development of service economy, and the city concept is displayed through unique visual modeling. The city image visual recognition system can actively display the external quality and intuitive image of the city and create good opportunities for promoting economic development and audience service experience (Hongbo Wang, 2011). Visual recognition is to enrich the visual language of the city image by visualizing symbols. The visual language of intuition, refinement, fun and experience is directly displayed in the audience experience, so that the audience can achieve a sense of identity and achieve the purpose of visual recognition of the city brand image.

Melbourne is a coastal city in southern Australia. Melbourne, under the rapid economic development, realizes that the experience service economy brings great vitality to urban development, and the establishment of urban brand image is also imperative. Melbourne has designed the urban brand image as an important city brand asset accumulation, with the aim of demonstrating the city's image of openness, service and innovation, as shown on Figure 2. The updated city brand image is constructed and optimized with the first letter "M" of Melbourne as the creative point. The shape is full of three-dimensional composition and the characteristics of the times. The image color system boldly breaks

through the colorful charm of Melbourne's urban charm and highlights the vitality, innovation and openness of Melbourne's urban image.



Figure 2 The Upgraded City Image of Melbourne

### 2.3 Behavior identity of city image

The behavior recognition is a behavioral practice integrating concept recognition and visual recognition. It is the comprehensive support of the city brand image landing, mainly applied in the administrative management, cultural education, system reform and other aspects of urban economic development (Qing Guo, 2009). The purpose is to display the urban brand image concept and convey the visual image of the city brand. Hong Kong's urban brand image is a good implementation of urban development concept and visual image creativity in behavior recognition (Xiangming Shun, 2012). Hong Kong is one of the more dynamic cities in Asia's economic development. In recent years, Hong Kong has used the service economy as a carrier and the audience experience as an opportunity to conduct cities. Brand image optimization, and also the first innovative city to promote the city brand image with commercial economic thinking.

Through the positioning of urban development, it can be seen that Hong Kong hopes to innovate its image and maintain contacts that can attract public attention to Hong Kong's urban brand image so as to give people a good association with Hong Kong, an international metropolis, and deep the loyalty of the brand image. The "Hong Kong Brand", as shown on Figure 3, which was updated by Mr. Chen Youjian, retains the original design of the original dragon pattern, making the updated image more modern and aesthetic. The historical context of Hong Kong and the atmosphere of the service economy experience have been combined perfectly. The blue dragons are coming from afar. The green ribbons and blue sky and green areas show the development ideas and positioning of Hong Kong's cities. The blue sky and green trees create the city's sustainable development. The overall image represents the open, diversity and courage of Hong Kong city with a ribbon of ethereal and ethereal gestures.



Figure 3 The City Brand Image of Hongkong

The urban brand image innovation path under the modern experience service economy should focus on the progress of consumption to experience so that the audience can fully feel the intercommunication of the city service economy, and give a true and reliable sense of belonging. The image of the city brand in experience service economy reflects the strong commercial economic needs, and it is necessary to deeply grasp the great turning point and challenge brought by the city brand image of the “experience service economy” value team. At the same time, the history and culture of the city's own development is associated with the continuity and sustainability of experience service economy, paying attention to the timely development concept of the city brand image, and implementing the urban brand visual image design into the city's brand characteristics.

To build a city brand image is to create a city brand image with great experience in service economy. The city brand image is also an experience service carrier for urban economic development. It is necessary to be good at making the innovation of urban brand image as the differentiated point of personality development with other cities. Through the city brand image strategy, the development of experience service economy could be driven and explored fully by integrating and refining the city's service economic resources and experience context.

The main path to the construction of urban brand image:

First of all, the orientation of city development is established. The city's overall core competitiveness and cohesiveness focus on the urban brand equity, which can enhance the influence and added value of urban brand image.

Secondly, urban brand image is created by people experience to improve the quality of urban branding. Through improving the experience of urban service economic development, the city's brand is built more highly and deeply so as to promote the construction of urban brand image mechanism.

In return for the city brand image assets, it promotes the high-quality development of the city's service economy. The development of urban service economy should be based on the audience's experience of urban brand image. Continuously promoting urban brand assets can make the city products and services more brand-value premium, creating a more comfortable experience environment for the future sustainable development of the city.

### **3 The Management Mode of Urban Brand Image with Experience Economy**

Effective management of the city's brand image can promote its innovation under the experience service economy development, because the city brand image has a great impact on the development of the city's service economy (Lisha Cui, 2017). It is necessary to scientifically manage the city brand image in time to make it more effective (David A. Aaker, 2012). The promotion of urban brand development emphasizes the characteristics of urban brand image management differentiation and diversification under the experience service economy environment, and builds a management model suitable for urban brand image in the experience of service economy development, and promotes the sustainable development of urban brand image.

First of all, the core of the city's brand image needs to be highlighted. The risk management and effective response measures need to be increased from the perspective of experiencing the service economy. In the process of understanding the image of the city's brand, people mainly come from the service experience. In the environment of experience service economy, the audience has an understanding of the city brand image in a short period of time. Under the experience service economy environment, the core of the experience of the city brand image should be highlighted.

Secondly, accurate management is necessary to effectively cope with the crisis of urban brand image. In the management of urban brand image, the diversified cognitive changes and public opinion monitoring should be paid attention in the environment of experience service economy. The precise management is able to improve the influence of the city brand image so that the audience can feel the connotation and differentiated personality of the development of the city brand image in the new service experience, which can improve the quality of city brand image management.

Thirdly, service experience management is taken as the target to meet the differentiated needs of the audience in the cognitive city brand image. In the experience service economy environment, it is necessary to pay attention to the competitiveness of the city brand image in real time, and take the brand management as the path to highlight the differentiation of the city brand image.

#### **4 Conclusion**

The city brand image is a booster in the era of experiencing the development of service economy, and will play an irreplaceable role in the construction of innovative cities. It is necessary to construct the city brand image with the innovation path and exert its continuous promotion role in the development of urban economic construction. The management model is taken as the starting point to maintain the whole process of urban brand image as an important task, avoiding the negative influence of urban brand image from being generated by the audience. Therefore, it is necessary to pay attention to the innovation path and management monitoring of the city brand image in the experience service economy environment, and continue to establish the audience's recognition and loyalty to the city brand image.

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# House of Quality-Based Analysis of Green Supply Chain Management for the Sustainable Investment Decisions with Interval Type 2 Fuzzy Hybrid Model

Luis Martínez<sup>1</sup>, Hasan Dinçer<sup>2</sup>, Serhat Yüksel<sup>2</sup>

1 Universidad de Jaén, Spain,

2 İstanbul Medipol University, Turkey,

(E-mail: martin@ujaen.es, hdincer@medipol.edu.tr, serhatyukse@medipol.edu.tr)

**Abstract:** The aim of the study is to propose a set of criteria for the customer needs and technical requirements of green supply chain management in the sustainable investment decisions. For that, house of quality has a unique role to evaluate the customer and technical factors at the same time. Accordingly, house of quality-based analysis of green supply chain management for the sustainable investment decisions is applied for measuring the performance of technical requirements with respect to customer expectations. A hybrid decision making method is applied for ranking the technical factors of green supply chain management for the sustainable investment decisions. Interval type 2 fuzzy DEMATEL is used for weighting the criteria of customer expectations and then interval type 2 fuzzy TOPSIS is employed for ranking the factors of technical requirements for the green supply chain management. The findings show that reuse of product and services is the most significant criterion. It shows that companies should firstly focus on this issue to gain an opportunity to reduce costs. Another important conclusion is that waste management is the most important technical requirement for the green supply chain management. Therefore, it is recommended that companies should make technological investments in waste management. In this context, they should provide necessary comprehensive machines, materials and equipment in the context of innovative strategy, employ qualified personnel capable of using this equipment and give necessary training to the existing personnel.

**Key words:** Green supply chain management; House of quality; Investment; Interval type 2 fuzzy sets; DEMATEL; TOPSIS

## 1 Introduction

With globalization, there has been a significant increase in world trade. The main reason for this is the abolition of trade borders between countries. This increasing trade around the world has been effective in increasing both production and consumption. As a result, there has been a significant increase in the competition in the market. High competition has led companies to develop new strategies. Otherwise, they will not be able to continue their activities in this harsh competitive environment. Within this framework, companies have tried to produce innovative strategies in order to gain competitive advantage (Gabrielsson et al., 2016).

Logistics sector is one of the most important sectors affected by globalization. This increased trade has made the logistics sector more important worldwide. In order to maintain international trade in a healthy way, the products must be delivered to the other party completely. In this context, the concept of supply chain is the general name given to the movement of the product, service or money flow from the supplier to the customer and the activities within this process. This concept has emerged especially in order to meet the many needs arising from increasing international trade. In this period, a good logistics strategy was needed to adapt to the change in the production market and to manage more complex logistics networks (Ceniga and Sukalova, 2015).

The most important problem in the logistics sector is considered as carbon dioxide emission due to excessive energy consumption. This has become a serious problem for the ecological environment. However, sensitivity to environmental issues is increasing throughout the world. As a result, it has become necessary for logistics companies to take action against this problem (Paksoy et al., 2019). In this context, logistics companies have taken serious steps to find innovative solutions. For this purpose, the most prominent solution is the green supply chain implementation. It is a kind of supply chain management in which environmentally friendly product or service production strategies are combined (Zhu et al., 2017). It mainly aims to reduce environmental negative impacts of companies. In addition, it also increases efficiency and provides a major competitive advantage in innovation and processes. Green purchasing, green production and material management, green distribution and marketing and

reverse logistics are accepted main implementations of this issue (Shibin et al., 2016; Tachizawa et al., 2015).

In this study, it is aimed to evaluate the green supply chain management for the sustainable investment decisions. For this purpose, a set of criteria for the customer needs and technical requirements of green supply chain management is proposed. In the analysis process, interval type 2 fuzzy DEMATEL is used to weight the criteria of customer expectations. On the other side, technical requirement factors for the green supply chain management are ranked by using interval type 2 fuzzy TOPSIS approach. According to the analysis results, strategies can be developed to obtain the sustainable investment policies by selecting the criteria of green supply chain management.

This study includes many different novelties. Firstly, house of quality approach is implemented to evaluate the customer and technical factors at the same time. This situation provides us to understand the most significant technical requirement based on these expectations. In addition to this situation, interval type-2 fuzzy logic is firstly considered in this study to make analysis for logistic industry. Hence, this issue has an important contribution to the originality of this study. Finally, a weighted set of criteria is provided to understand the customer expectations regarding green supply chain management subject.

This study has mainly 5 different sections. In this section, general information related to the issues of logistic, supply chain management and green supply chain management are provided. In the second section, the studies regarding green supply chain management and investment decisions are analyzed. The third section includes the explanations about the methods used in this study. Furthermore, analysis results are shared in the fourth section. In the last section, necessary recommendations are discussed.

## 2 Literature Review

The green supply chain management subject was discussed in the literature very much. It is obvious that most of these studies are related to the performance analysis of this issue. Chin et al. focused on the green supply chain management performance in Malaysia (Chin et al., 2015). They concluded that companies should consider environmental factors to provide sustainability in supply chain management activities. Also this issue was identified in (Cousins et al., 2019). Vanalle et al. evaluated the performance of supply chain activities for Brazilian automotive industry (Vanalle et al., 2017). The similar result was also underlined according to the analysis results. Parallel to them, other studies emphasized the importance of this factor (Geng et al., 2017; Li et al., 2016; Govindan et al. 2015).

Additionally, it is seen that different methodologies were taken into consideration in these studies. (Dubey et al., 2015; Tachizawa et al., 2015; Kirchoff et al., 2016) conducted a survey analysis to measure the performance of the green supply chain in many different regions. In this process, they asked different questions to many people. According to their answers, they aimed to identify the important points. On the other side, (Uygun and Dede, 2016; Kusi-Sarpong et al., 2016) considered fuzzy multi-criteria decision making techniques to reach this objective. In the analysis process, firstly, they defined many different indicators. With the help of these methodologies, they tried to find the significances of these indicators.

Some studies defined that an important factor of green supply management is customer satisfaction. For instance, in (Laari et al., 2016) was stated that companies should consider customer expectations in green supply chain operations. Similarly, (Chavez et al., 2016; Teixeira et al., 2016; Zhu et al. 2017) conducted an analysis to improve the performance of the green supply chain activities. They reached the conclusion that customers should be satisfied for the success of the green supply chain management. Furthermore, (Zhu et al., 2017; Schmidt et al., 2017; Seles et al., 2016; Luthra et al., 2015) aimed to analyze this situation and identified that companies should understand and satisfy customer expectations to have higher performance in green supply chain management.

Moreover, risk assessment of the green supply chain management was made by many different researchers. They mainly aimed to identify the significant risk of the companies in this process. After that, they tried to identify which of these risks are more important for the companies. In the final stage, necessary actions were defined to manage these risks. For instance, (Mangla et al., 2015) determined 25 common risks of the green supply chain management by reviewing the similar studies in the literature for Indian companies. These risks are weighted by using fuzzy AHP approach. Also in (Paksoy et al., 2019) was made this analysis by using the same methodology. In addition, (Wang et al., 2016; Shibin et al., 2016; Tachizawa et al., 2015) are other studies which performed similar analysis.

On the other hand, investment decisions on green supply chain management were considered in many different studies. As an example, (Bai et al., 2016) conducted a study to manage investment in green supply management. In the analysis process, fuzzy clustering approach is considered. In (Yan et al., 2018) was also made similar analysis while implementing prisoner's dilemma on competing retailers' investment in green supply chain management. Additionally, (Sun et al., 2019) made a similar analysis and concluded that government subsidy mechanism plays a very significant role to make investment in green supply chain management, (Wu et al., 2019); Yang et al., 2019; Rostamzadeh et al., 2015) also focused on similar issues in their studies. As a result of the literature review, it is determined that a new study can be conducted to evaluate investment issues in green supply management with a new methodology, such as interval type-2 fuzzy logic.

### 3 Methodology

In this section, different methods used in this study are explained. In this framework, firstly, interval type-2 fuzzy sets are explained. After that, necessary information is given about interval type-2 fuzzy DEMATEL and interval type-2 fuzzy TOPSIS.

#### 3.1 IT2 fuzzy sets

$\tilde{A}$  refers to the type-2 fuzzy set. On the other side, the membership function is given as  $\mu_{\tilde{A}(x,u)}$ . It can get a value between 0 and 1. The details of these items are given on the equation (1) (Xu et al., 2019; Liu et al., 2019; Dinçer et al., 2019a).

$$\tilde{A} = \{(x,u), \mu_{\tilde{A}(x,u)} | \forall x \in X, \forall u \in J_x \subseteq [0,1]\} \text{ or } \tilde{A} = \int_{x \in X} \int_{u \in J_x} \mu_{\tilde{A}}(x,u) / (x,u) J_x \subseteq [0,1] \quad (1)$$

Moreover, this membership function can be replaced with  $\Sigma$  regarding the discrete universe. Equation (2) gives information about this process.

$$\tilde{A} = \int_{x \in X} \int_{u \in J_x} 1 / (x,u) J_x \subseteq [0,1] \quad (2)$$

$\tilde{A}_i^U$  and  $\tilde{A}_i^L$  explain the upper and lower trapezoidal membership functions detailed in the equation (3).

$$\tilde{A}_i = (\tilde{A}_i^U, \tilde{A}_i^L) = ((a_{i1}^U, a_{i2}^U, a_{i3}^U, a_{i4}^U; H_1(\tilde{A}_i^U), H_2(\tilde{A}_i^U)), (a_{i1}^L, a_{i2}^L, a_{i3}^L, a_{i4}^L; H_1(\tilde{A}_i^L), H_2(\tilde{A}_i^L))) \quad (3)$$

On the other side, the equations (4)-(8) give all details about the calculation process.

$$\begin{aligned} \tilde{A}_1 \oplus \tilde{A}_2 &= (\tilde{A}_1^U, \tilde{A}_1^L) \oplus (\tilde{A}_2^U, \tilde{A}_2^L) \\ &= \left( (a_{11}^U + a_{21}^U, a_{12}^U + a_{22}^U, a_{13}^U + a_{23}^U, a_{14}^U + a_{24}^U; \min(H_1(\tilde{A}_1^U), H_1(\tilde{A}_2^U)), \min(H_2(\tilde{A}_1^U), H_2(\tilde{A}_2^U))), \right. \\ &\quad \left. (a_{11}^L + a_{21}^L, a_{12}^L + a_{22}^L, a_{13}^L + a_{23}^L, a_{14}^L + a_{24}^L; \min(H_1(\tilde{A}_1^L), H_1(\tilde{A}_2^L)), \min(H_2(\tilde{A}_1^L), H_2(\tilde{A}_2^L))) \right) \quad (4) \end{aligned}$$

$$\begin{aligned} \tilde{A}_1 \ominus \tilde{A}_2 &= (\tilde{A}_1^U, \tilde{A}_1^L) \ominus (\tilde{A}_2^U, \tilde{A}_2^L) \\ &= \left( (a_{11}^U - a_{24}^U, a_{12}^U - a_{23}^U, a_{13}^U - a_{22}^U, a_{14}^U - a_{21}^U; \min(H_1(\tilde{A}_1^U), H_1(\tilde{A}_2^U)), \min(H_2(\tilde{A}_1^U), H_2(\tilde{A}_2^U))), \right. \\ &\quad \left. (a_{11}^L - a_{24}^L, a_{12}^L - a_{23}^L, a_{13}^L - a_{22}^L, a_{14}^L - a_{21}^L; \min(H_1(\tilde{A}_1^L), H_1(\tilde{A}_2^L)), \min(H_2(\tilde{A}_1^L), H_2(\tilde{A}_2^L))) \right) \quad (5) \end{aligned}$$

$$\begin{aligned} \tilde{A}_1 \otimes \tilde{A}_2 &= (\tilde{A}_1^U, \tilde{A}_1^L) \otimes (\tilde{A}_2^U, \tilde{A}_2^L) \\ &= \left( (a_{11}^U \times a_{21}^U, a_{12}^U \times a_{22}^U, a_{13}^U \times a_{23}^U, a_{14}^U \times a_{24}^U; \min(H_1(\tilde{A}_1^U), H_1(\tilde{A}_2^U)), \min(H_2(\tilde{A}_1^U), H_2(\tilde{A}_2^U))), \right. \\ &\quad \left. (a_{11}^L \times a_{21}^L, a_{12}^L \times a_{22}^L, a_{13}^L \times a_{23}^L, a_{14}^L \times a_{24}^L; \min(H_1(\tilde{A}_1^L), H_1(\tilde{A}_2^L)), \min(H_2(\tilde{A}_1^L), H_2(\tilde{A}_2^L))) \right) \quad (6) \end{aligned}$$

$$\begin{aligned} k\tilde{A}_1 &= (k \times a_{11}^U, k \times a_{12}^U, k \times a_{13}^U, k \times a_{14}^U; H_1(\tilde{A}_1^U), H_2(\tilde{A}_1^U)), \\ &\quad (k \times a_{11}^L, k \times a_{12}^L, k \times a_{13}^L, k \times a_{14}^L; H_1(\tilde{A}_1^L), H_2(\tilde{A}_1^L)) \quad (7) \end{aligned}$$

$$\begin{aligned} \frac{\tilde{A}_1}{k} &= \left( \frac{1}{k} \times a_{11}^U, \frac{1}{k} \times a_{12}^U, \frac{1}{k} \times a_{13}^U, \frac{1}{k} \times a_{14}^U; H_1(\tilde{A}_1^U), H_2(\tilde{A}_1^U) \right), \\ &\quad \left( \frac{1}{k} \times a_{11}^L, \frac{1}{k} \times a_{12}^L, \frac{1}{k} \times a_{13}^L, \frac{1}{k} \times a_{14}^L; H_1(\tilde{A}_1^L), H_2(\tilde{A}_1^L) \right) \quad (8) \end{aligned}$$

#### 3.2 IT2 fuzzy DEMATEL

DEMATEL approach is used to identify the importance of different criteria under the complex environment. In addition to this issue, the main advantage of DEMATEL approach is that it can be used to identify the impact relationship map among the criteria. Hence, it can be possible to understand the influencing and influenced criteria. This methodology can be considered with interval type-2 fuzzy logic. In the first step of the analysis process, expert opinions are converted to the interval type-2 fuzzy logic (Dinçer and Yüksel, 2019; Pandey et al., 2019; Dinçer et al., 2019b,c; Tang and Dinçer, 2019). Initial direct relation matrix is generated in the second step as in the equation (9) and (10).



$$\tilde{Z} = \begin{bmatrix} 0 & \tilde{z}_{12} & \dots & \dots & \tilde{z}_{1n} \\ \tilde{z}_{21} & 0 & \dots & \dots & \tilde{z}_{2n} \\ \vdots & \vdots & \ddots & \dots & \dots \\ \vdots & \vdots & \vdots & \ddots & \vdots \\ \tilde{z}_{n1} & \tilde{z}_{n2} & \dots & \dots & 0 \end{bmatrix} \quad (9)$$

$$\tilde{Z} = \frac{\tilde{Z}^1 + \tilde{Z}^2 + \tilde{Z}^3 + \dots + \tilde{Z}^n}{n} \quad (10)$$

Thirdly, this matrix is normalized with the help of the equations (11), (12) and (13).

$$\tilde{X} = \begin{bmatrix} \tilde{x}_{11} & \tilde{x}_{12} & \dots & \dots & \tilde{x}_{1n} \\ \tilde{x}_{21} & \tilde{x}_{22} & \dots & \dots & \tilde{x}_{2n} \\ \vdots & \vdots & \ddots & \dots & \dots \\ \vdots & \vdots & \vdots & \ddots & \vdots \\ \tilde{x}_{n1} & \tilde{x}_{n2} & \dots & \dots & \tilde{x}_{nn} \end{bmatrix} \quad (11)$$

$$\tilde{x}_{ij} = \frac{\tilde{z}_{ij}}{r} = \left( \frac{z_{a_{ij}}}{r}, \frac{z_{b_{ij}}}{r}, \frac{z_{c_{ij}}}{r}, \frac{z_{d_{ij}}}{r}; H_1(z_{ij}^U), H_2(z_{ij}^U) \right), \left( \frac{z_{e_{ij}}}{r}, \frac{z_{f_{ij}}}{r}, \frac{z_{g_{ij}}}{r}, \frac{z_{h_{ij}}}{r}; H_1(z_{ij}^L), H_2(z_{ij}^L) \right) \quad (12)$$

$$r = \max \left( \max_{1 \leq i \leq n} \sum_{j=1}^n z_{d_{ij}}, \max_{1 \leq i \leq n} \sum_{j=1}^n z_{d_{ij}} \right) \quad (13)$$

After that, in the next step, the total influence fuzzy matrix ( $\tilde{T}$ ) is created by using the equations (14)-(18).

$$X_{\tilde{a}} = \begin{bmatrix} 0 & a'_{12} & \dots & \dots & a'_{1n} \\ a'_{21} & 0 & \dots & \dots & a'_{2n} \\ \vdots & \vdots & \ddots & \dots & \dots \\ \vdots & \vdots & \vdots & \ddots & \vdots \\ a'_{n1} & a'_{n2} & \dots & \dots & 0 \end{bmatrix}, \dots, X_{\tilde{h}} = \begin{bmatrix} 0 & h'_{12} & \dots & \dots & h'_{1n} \\ h'_{21} & 0 & \dots & \dots & h'_{2n} \\ \vdots & \vdots & \ddots & \dots & \dots \\ \vdots & \vdots & \vdots & \ddots & \vdots \\ h'_{n1} & h'_{n2} & \dots & \dots & 0 \end{bmatrix} \quad (14)$$

$$\tilde{T} = \lim_{k \rightarrow \infty} \tilde{X} + \tilde{X}^2 + \dots + \tilde{X}^k \quad (15)$$

$$\tilde{T} = \begin{bmatrix} \tilde{t}_{11} & \tilde{t}_{12} & \dots & \dots & \tilde{t}_{1n} \\ \tilde{t}_{21} & \tilde{t}_{22} & \dots & \dots & \tilde{t}_{2n} \\ \vdots & \vdots & \ddots & \dots & \dots \\ \vdots & \vdots & \vdots & \ddots & \vdots \\ \tilde{t}_{n1} & \tilde{t}_{n2} & \dots & \dots & \tilde{t}_{nn} \end{bmatrix} \quad (16)$$

$$\tilde{t}_{ij} = (a''_{ij}, b''_{ij}, c''_{ij}, d''_{ij}; H_1(\tilde{t}_{ij}^U), H_2(\tilde{t}_{ij}^U)), (e''_{ij}, f''_{ij}, g''_{ij}, h''_{ij}; H_1(\tilde{t}_{ij}^L), H_2(\tilde{t}_{ij}^L)) \quad (17)$$

$$[a''_{ij}] = X_{\tilde{a}} \times (I - X_{\tilde{a}})^{-1}, \dots, [h''_{ij}] = X_{\tilde{h}} \times (I - X_{\tilde{h}})^{-1} \quad (18)$$

Finally, the influence degrees are calculated as in the equations (19) and (20).

$$\tilde{D}_i = \left[ \sum_{j=1}^n \tilde{t}_{ij} \right]_{n \times 1} \quad (19)$$

$$\tilde{R}_i = \left[ \sum_{i=1}^n \tilde{t}_{ij} \right]_{1 \times n} \quad (20)$$

The sum of all vector rows is represented by  $\tilde{D}_i$  whereas the sum of all vector columns is named as  $\tilde{R}_i$ . Hence,  $(\tilde{D}_i + \tilde{R}_i)$  demonstrates the total degree of the influence among criteria. Also, the defuzzification process is performed to calculate the weighting results of criteria as in the equations (21)-(24).

$$Def_T = \frac{\frac{(u_j - l_j) + (\beta_U \times m_{1U} - l_U) + (\alpha_U \times m_{2U} - l_U) + l_U}{4} + \frac{[(u_L - l_L) + (\beta_L \times m_{1L} - l_L) + (\alpha_L \times m_{2L} - l_L) + l_L]}{4}}{2} \quad (21)$$

$$Def_T = T = [t_{ij}]_{n \times n}, \quad i, j = 1, 2, \dots, n \quad (22)$$

$$\tilde{D}_i^{def} = r = \left[ \sum_{j=1}^n t_{ij} \right]_{n \times 1} = (r_i)_{n \times 1} = (r_1, \dots, r_i, \dots, r_n) \tag{23}$$

$$\tilde{R}_i^{def} = y = \left[ \sum_{i=1}^n t_{ij} \right]_{1 \times n} = (y_j)'_{1 \times n} = (y_1, \dots, y_i, \dots, y_n) \tag{24}$$

**3.3 Interval type 2 fuzzy TOPSIS**

TOPSIS approach is a type of multicriteria decision making models. The main aim of this methodology is to rank different alternatives (Opricovic and Tzeng, 2004). In this process, positive ( $A^+$ ) and negative ( $A^-$ ) ideal solutions are identified. They are demonstrated on the equation (25). In this equation, the term  $v_{ij}$  gives information about the weighted values (Yüksel et al., 2019).

$$A^+ = \max(v_1, v_2, v_3, \dots, v_n) \tag{25}$$

In addition to this process, the values of  $D^+$  and  $D^-$  are computed as in the equations (26) and (27) (Chen et al., 2019).

$$D_i^+ = \sqrt{\sum_{i=1}^m (v_i - A_i^+)^2} \tag{26}$$

$$D_i^- = \sqrt{\sum_{i=1}^m (v_i - A_i^-)^2} \tag{27}$$

Moreover, the closeness coefficient (CCi) is calculated in the final step. The details are shown in the equation (28) (Efe, 2019).

$$CC_i = \frac{D_i^-}{D_i^+ + D_i^-} \tag{28}$$

**4 Analysis**

In this study, it is aimed to analyze the house of quality-based factors of green supply chain management for the sustainable investment decisions. For this purpose, a hybrid model based on interval type 2 fuzzy sets is proposed. The steps of the analysis are detailed as follows.

Step 1. Define the problem of customer and technical factors of green supply chain management. For that, a set of criteria is defined with the supported literature as seen in Table 1 and 2 respectively.

**Table 1 Customer Expectations of Green Supply Chain Management**

Criteria	Literature
Reducing the pollution (Criterion 1)	(Franzoni, 2011; Khoshnava et. al., 2018; Sun et. al., 2017)
Clean energy sources (Criterion 2)	(Bhattacharya et. al., 2015; Tao et. al., 2016; Kucukvar et. al., 2016)
Reuse of product and services (Criterion 3)	(Kriwet et. al., 1995; Ferrer, 1997; Krikke et. al., 1999)
Varieties of distribution channels (Criterion 4)	(Onat et. al., 2015; Doll et. al. 2017)

**Table 2 Technical Requirements of Green Supply Chain Management**

Criteria	Literature
Waste management (Criterion 1)	(Deif, 2011; Islam et. al., 2017)
Energy efficiency (Criterion 2)	(Klassen and Whybark, 1999; Vachon, 2007; Baines et. al., 2012)
Recycling process (Criterion 3)	(Johnson and Wang, 1995; Mishra et. al., 2012; Misni and Lee, 2017)
Integrated transport systems (Criterion 4)	(Jensen et. al., 2001; Jensen, 2008; Martinsen and Björklund, 2012)

Step 2. Appoint the expert team to collect the linguistic evaluation for the criteria. Three decision makers are selected from the industry. They are experienced at least ten years in the field of clean technology and supply chain. The expert valuation results for the customer and technical criteria are given by using the linguistic scales in Table 3 and 4. And the results are illustrated in Table 5 and 6.

**Table 3 Evaluation Scales for the Criteria**

Criteria	IT2TrFNs
Absolutely Low (AL)	((0,0,0,0,0,0,0;1,0), (0,0,0,0,0,0,0;1,0))
Very Low (VL)	((0.0075, 0.0075, 0.015, 0.0525;0.8), (0,0,0,0,0.02,0.07;1,0))
Low (L)	((0.0875, 0.12, 0.16, 0.1825;0.8), (0.04,0.10,0.18,0.23;1,0))
Medium Low (ML)	((0.2325, 0.255, 0.325, 0.3575;0.8), (0.17,0.22,0.36,0.42;1,0))
Medium (M)	((0.4025, 0.4525, 0.5375, 0.5675;0.8), (0.32,0.41,0.58,0.65;1,0))
Medium High (MH)	((0.65, 0.6725, 0.7575, 0.79;0.8), (0.58,0.63,0.80,0.86;1,0))
High (H)	((0.7825, 0.815, 0.885, 0.9075;0.8), (0.72,0.78,0.92,0.97;1,0))
Very High (VH)	((0.9475, 0.985, 0.9925, 0.9925;0.8), (0.93,0.98,1,0,1,0;1,0))
Absolutely High (AH)	((1,0, 1,0, 1,0, 1,0; 1,0), (1,0, 1,0, 1,0, 1,0; 1,0))

**Table 4 Evaluation Scales for the Alternatives**

Alternatives	IT2TrFNs
Very Poor (VP)	((0,0,0,0,1;1,1), (0,0,0,0,0,0,0;0,9,0,9))
Poor (P)	((0,0,1,0,1,0,3;1,1), (0,05,0,1,0,1,0,2;0,9,0,9))
Medium Poor (MP)	((0,1,0,3,0,3,0,5;1,1), (0,2,0,3,0,3,0,4;0,9,0,9))
Fair (F)	((0,3,0,5,0,5,0,7;1,1), (0,4,0,5,0,5,0,6;0,9,0,9))
Good (G)	((0,5,0,7,0,7,0,9;1,1), (0,6,0,7,0,7,0,8;0,9,0,9))
Very Good (VG)	((0,7,0,9,0,9,1;1,1), (0,8,0,9,0,9,0,95;0,9,0,9))
Best (B)	((0,9,1,1,1,1;1,1), (0,95,1,1,1,1;0,9,0,9))

**Table 5 Linguistic Evaluations for the Criteria of Customer Expectation**

	C1			C2			C3			C4		
	DM1	DM2	DM3	DM1	DM2	DM3	DM1	DM2	DM3	DM1	DM2	DM3
<b>C1</b>	-	-	-	M	M	MH	M	M	MH	M	ML	M
<b>C2</b>	M	M	M	-	-	-	ML	M	MH	ML	M	M
<b>C3</b>	MH	MH	M	MH	MH	M	-	-	-	M	M	MH
<b>C4</b>	MH	MH	MH	MH	MH	M	M	M	MH	-	-	-

**Table 6 Linguistic Evaluations of Technical Requirements for the Decision Matrix**

Criteria/Alternatives	Waste management (Alternative 1)			Energy efficiency (Alternative 2)			Recycling process (Alternative 3)			Integrated transport systems (Alternative 4)		
	DM1	DM2	DM3	DM1	DM2	DM3	DM1	DM2	DM3	DM1	DM2	DM3
				1	2	3	1	2	3	1	2	3
Reducing the pollution (Criterion 1)	VG	B	B	G	F	F	G	VG	G	MP	F	F
Clean energy sources (Criterion 2)	B	B	VG	G	F	VG	G	VG	F	G	MP	MP
Reuse of product and services (Criterion 3)	G	G	G	G	F	F	B	B	VG	G	VG	F
Varieties of distribution channels (Criterion 4)	G	F	MP	F	F	F	G	F	F	B	B	B

Step 3. Weight the criteria of customer expectations. For this purpose, the computation procedures of interval type 2 fuzzy DEMATEL is applied and the results are given in Table 7.

**Table 7 Defuzzified Total Relation Matrix and the Weights for the Criteria**

	C1	C2	C3	C4	r	y	r+y	r-y	Weights
C1	3.43	3.59	3.33	3.03	13.37	14.83	28.21	-1.46	0.251
C2	3.36	3.25	3.14	2.87	12.61	14.89	27.50	-2.28	0.245
C3	3.97	3.99	3.54	3.38	14.88	13.78	28.66	1.10	0.255
C4	4.08	4.07	3.77	3.31	15.23	12.59	27.83	2.64	0.248

According to the results, Criterion 3 has the highest importance in the criteria of customer

expectations while criterion 2 is the weakest important factor among the criteria set.

Step 4. Rank the alternatives of technical requirements. The method of TOPSIS based on the interval type 2 fuzzy sets is applied for measuring the house of quality-based performance of green supply chain management for the sustainable investment decisions. The results are represented in Table 8.

**Table 8 Ranking Results for the Performance Measurement**

	D+	D-	Ci	Ranking
Waste management (Alternative 1)	0.853	1.141	0.572	1
Energy efficiency (Alternative 2)	1.206	0.438	0.266	4
Recycling process (Alternative 3)	0.819	0.886	0.520	2
Integrated transport systems (Alternative 4)	1.196	0.775	0.393	3

The ranking results demonstrate that waste management (alternative 1) has the best house of quality-based performance of technical requirement for the green supply chain management whereas energy efficiency (alternative 2) is ranked at last among the technical requirements.

## 5 Conclusion

This study aims to evaluate the green supply chain management for the sustainable investment decisions. For this purpose, the house of quality-based factors of green supply chain management for the sustainable investment decisions are determined. In this framework, 4 different criteria are defined related to the customer expectations of green supply chain management. On the other side, with respect to the technical requirements, different 4 factors are identified based on literature review. In the analysis process, the criteria of customer expectations are weighted by using interval type-2 fuzzy DEMATEL. Additionally, with the help of interval type-2 fuzzy TOPSIS method, the alternatives of technical requirements are ranked.

The results show that reuse of product and services (Criterion 3) has the highest weight. In addition, it is also determined that reducing the pollution (Criterion 1) is the second most important criterion. The issue of product reuse is the most prominent aspect in green supply chain management. The main reason for this is that thanks to re-used products, companies have the opportunity to reduce costs. This has a direct and significant impact on the profitability of these companies. In the literature, (Kriwet et. al., 1995; Ferrer, 1997; Krikke et. al., 1999) reached the similar conclusion.

In addition to them, the ranking results indicate that waste management (alternative 1) has the best house of quality-based performance of technical requirement for the green supply chain management. On the other side, energy efficiency (alternative 2) takes the second-best place among the technical requirements. As can be seen from these results, companies should make technological investments in waste management. The waste management process involves the use of many comprehensive machines, materials and equipment. In this framework, it is important that companies provide these tools and equipment in the context of innovative strategy. However, qualified personnel capable of using this equipment should also be employed. Existing personnel are also required to receive the necessary training. This will provide the necessary technical competencies for an efficient green supply chain investment. In the future studies, a different methodology can be considered to make a comparative analysis.

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## **Tourist Forecasting Model of Short Holiday Based on Network Data: A Case Study of Mount Emei Scenic Area**

Ma Zhaofeng, HuangPing, Guo Chuangle \*, Abdoulaye Boiro, Wen Zhili, Zhan Fei, Yin Zizhong

School of Management, Chengdu University of Information Technology, Chengdu, P.R. China, 610103

(E-mail: 1399558415@qq.com, hping@cuit.edu.cn, chuanglewh@cuit.edu.cn, 1323083611@qq.com, 759300645@qq.com, 982435449@qq.com, 522681381@qq.com)

**Abstract:** This paper takes Mount Emei Scenic Area as a case study, establishes a theoretical framework from the perspective of tourists' behavior and reveals the correlation between Internet search data and tourist volume. By searching the keyword data related to Mount Emei tourism and synthesizing the search index, a prediction model was established for the composite index of the network search data and the actual passenger flow of Mount Emei scenic spot during the Spring Festival holiday from 2015 to 2018. The prediction model can effectively forecast the tourist volume one or two days in advance during the Spring Festival holiday.

**Keywords:** Search engines; Baidu index; Synthetic indexes; Tourist amount forecasting

### **1 Introduction**

#### **1.1 Background**

The number of tourists in China has reached 5.5 billion, there is a great demand for tourism. In 2016, *the Government Report* proposed to “meet the rising or emerging era of mass tourism”. Within just three years, the number of domestic tourists has increased rapidly from 4.44 billion in 2016 to 5.54 billion in 2018, among which the self-drive trips with great mobility and strong randomness account for the absolute majority. In 2017, the number of self-drive is as high as 3.1 billion, which is 62% of the total domestic tourist of 5.01 billion in that year.

Chinese mainly travel on holidays, which is easy to cause congestion. *The China Leisure Development Annual Report 2017-2018* pointed out that from 2012 to 2017, the proportion of urban residents in China continued to increase, and the proportion of family leisure continued to decrease. The leisure activities of urban residents are shifting from “negative” to “positive”. In 2017, the proportion of urban residents in China choosing to travel on holidays has reached 42.2%, and family leisure has dropped to 24.8%. The proportion of physical fitness and tourism shopping of rural residents has increased, but leisure activities are still dominated by family leisure. Thousands of tourists wait to descend Mount Emei's high mountain area as of 9 PM on Dec 31, 2018 due to icy roads. On October 3, 2014, tourists stranded in Mount Emei scenic area also occurred, so it is particularly necessary to establish an intuitive tourist volume prediction model for the scenic area to optimize service and improve management efficiency.

#### **1.2 Literature review**

With the deepening of the research on social behavior based on network technology, the prediction of tourism behavior has gradually joined the ranks of the research. At present, the research of tourism



behavior prediction based on Internet search technology mainly focuses on the relationship between network attention and tourist flow.

Lu et al took Australian tourism websites as the research object, studied some problems of information flow guiding tourism flow in tourism websites, and confirmed the effect of virtual network information flow on real tourism flow (Lu et al.,2007). Ma et al analyzed the main factors and marginal effects affecting the spatial and temporal changes of urban passenger flow and tourist network attention by collecting data of urban passenger flow and tourist network attention, and constructed the spatio-temporal correlation model of domestic tourist volume and tourist network attention(Ma et al,2011).Taking the Forbidden City and Mount Tai as examples,Guo et al established the National Day holiday tourist prediction model of Mount Tai scenic area by using baidu search index and the actual daily passenger flow of the National Day holiday from 2008 to 2012(Guo et al,2012). Cui et al built the traffic forecast and forewarning model based on the Internet search behavior, made use of the Internet search volume provided by Google trend, and used regression analysis, grey theory to predict and forewarn the traffic of the World Expo (Cui et al,2013). Ren et al made an empirical study of the co-integration relationship between the search data of Beijing and the monthly tourist traffic by searching relevant keyword data and synthesizing the search index, and built a prediction model of tourist traffic in Beijing by combining the search index and historical data (Ren et al,2014). Wang et al introduced the Elman neural network of the dynamic characteristics of the reactive system to establish the Elman neural network dynamic prediction model for the inbound tourists in China (Wang et al,2013). Lu et al used the model based on BP and Elman neural network as the benchmark model respectively, and proposed to introduce the EMD method to improve the traditional BP prediction model to explore the new characteristics of tourists in the Internet era (Lu et al,2019).

Stephan Goslings pointed out that tourism relies heavily on climate and natural resources, and states that global environmental changes threaten the tourism industry. More and more scholars begin to analyze passenger flow and climate and socio-economic parameters. The relationship, the ultimate goal of developing a future tourism program is economic and environmental harmony, helping the tourism industry to plan and develop suitable future tourism solutions (Stephan Goslings,2006). Stephen F. Witt et al constructed the VAR model based on passenger traffic data of eight countries or regions during the period from 2003 to 2008. The prediction model indicates that Macao will face more and more tourism needs from mainland Chinese residents (Stephen F. Witt et al, 2006). Tolega Akturk used the ARDL model to research the factors affecting Turkish tourism from OECD countries based on the 1980-2004 Turkish entry data. The study not only analyzes the tourism and econometric models, but also discusses the results of economic research and gives the future direction of tourism in Turkey (Tolega Akturk,2006).

## 2 Theoretical Framework

By the end of 2018, the number of Chinese netizens reached 829 million, the number of mobile Internet users reached 817 million, the number of netizens using mobile Internet access reached 98.55%, and mobile network users ranked first in the world. More than 84% of Chinese tourists use mobile devices to search for information about destinations on the Internet during their travels. With the maturity of the Internet and big data analytics technology, it is possible to collect these massive data generated by tourists' search behaviors. Scenic spots or destinations can use these search data to predict the number of tourists in the future. To avoid the occurrence of holiday tourists and tourists, to bring a good tourist experience (Lv,2015).

This section establishes a theoretical framework based on the correlation between Internet search data and tourist volume, and analyzes the correlation between Internet search data and tourist traffic.

Nowadays, search engine has become the preferred way for tourists to obtain information related to the tourist destination when they travel. Tourists can search and find transportation, accommodation, catering, entertainment, shopping, travel strategy, weather and other information of the tourist destination through network searching. This forms a correlation between the search data and the number of visitors, which determines that the prediction method discussed later in this paper has a strong prediction function logically. Based on this logic, this paper established the theoretical framework model of the relationship between network search data and tourist volume, as shown in figure 1.

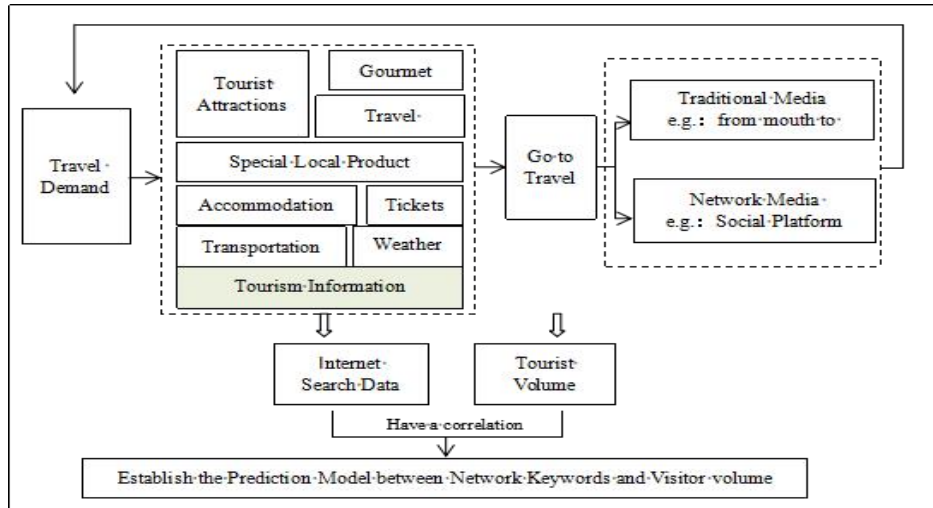


Figure 1 Network Search Data and Tourist Theory Framework

### 3 Empirical Analysis

#### 3.1 Tourism status of mount Emei

Located in the southwestern part of Sichuan Province, Emeishan City is a China Excellent Tourist City and National Garden City in China. Tourism is the pillar industry of Emeishan City. It has developed a series of tourism projects such as alpine skiing, hot spring vacation, and folk customs, which integrates ornamental and entertainment. Forming a complete reception system with food, lodging, travel, entertainment and shopping facilities. In recent years, the tourism economy of Emeishan City has continued to develop steadily, and the tourist’s volume and tourism income have increased substantially. In 2018, the number of ticket buyers in Mount Emei reached 3.295 million, an increase of 3.25% over the previous year. Ticket revenue was 473.8 million-yuan, accounting for 44.19% of operating revenue, up 3.49% from the previous year.

Table 1 Tourists Volume of Mount Emei from 2012 to 2018

year	2014	2015	2016	2017	2018
Number of visitors (thousand)	2870	3308.1	3298	3350	3295
Ticket income(million)	425	458	446	457.9	473.8

#### 3.2 Source of data

The tourist flow data of Mount Emei scenic spot adopted in this paper is derived from the real-time

visitor flow broadcast data released by WeChat official account of Mount Emei, covering the period from 2015 to 2018 Spring Festival holiday.

The search data used in this paper comes from the Baidu Index (<http://index.baidu.com>), and the time range is 15 days from the first five days to the last three days of the Spring Festival from 2015 to 2018. Based on the big data of Baidu web search and Baidu news search, Baidu Index calculates the value of user attention and media attention of each keyword.

### 3.3 Correlation analysis and keyword selection

#### 3.3.1 Correlation coefficient

First of all, this article manually selected "Traveling in Mount Emei, Guides to Mount Emei, Mount Emei Tourism Guide, Map of Mount Emei, Weather of Mount Emei, Accommodation Guide of Mount Emei, Hotel Reservation of Mount Emei, Tour Route of Mount Emei, Golden Summit of Mount Emei Tickets of Mount Emei, Tickets Price of Mount Emei, Pictures of Mount Emei, Monkey in Mount Emei ,Hot Springs in Mount Emei, A one-day tour of Mount Emei ,Mount Emei" were used as initial keywords. Then, EvIEWS software is used to calculate the correlation coefficient between each keyword and the daily tourist volume during the Spring Festival in Mount Emei, and the correlation between each keyword and the Mount Emei daily tourist volume is tested. Due to the lag between the network search data and the tourist volume, when calculating the correlation coefficient between the tourist volume and the keywords, the number of keywords searches for the first five days of the holiday, the holiday period, and the three days after the holiday is collected. Finally, 9 keywords with four-year correlation coefficients above 0.85 were selected (as shown in table 2).

**Table 2 The Correlation Coefficient between the Tourist Volume and the Number of Daily Searches for Primary Keywords During the Spring Festival Holiday**

keyword	Maximum correlation coefficient				Maximum Correlation Coefficient Date of Occurrence			
					(Number of Day in Advance)			
	2018	2017	2016	2015	2018	2017	2016	2015
Traveling in Mount Emei	0.88	0.95	0.91	0.84	1	1	1	1
Guides to Mount Emei	0.97	0.97	0.97	0.92	1	1	1	1
Mount Emei Tourism Guide	0.96	0.99	0.97	0.95	1	1	1	1
Map of Mount Emei	0.88	0.92	0.92	0.93	0	1	1	1
Weather of Mount Emei	0.97	0.98	0.97	0.97	1	1	1	1
Accommodation Guide of Mount Emei	0.89	0.94	0.91	0.94	1	0	1	1
Hotel Reservation of Mount Emei	-0.67	0.95	0.81	-0.70	2	1	4	3
Tour Route of Mount Emei	0.87	0.96	0.87	0.70	1	1	1	-1
Golden Summit of Mount Emei	0.92	0.92	0.95	0.78	1	-3	1	-1

Tickets of Mount Emei	0.98	0.98	0.97	0.93	1	1	1	1
Tickets Price of Mount Emei	0.87	0.88	0.82	0.89	1	1	1	1
Pictures of Mount Emei	0.84	0.92	0.98	0.83	-2	-2	1	1
Monkey in Mount Emei	0.96	0.62	-0.88	0.86	1	-1	-3	1
Hot Springs in Mount Emei	0.93	0.92	0.92	0.98	1	1	1	1
A one-day tour of Mount Emei	0.98	0.96	0.93	0.88	1	1	1	1
Mount Emei	0.94	0.92	0.95	0.94	1	1	1	1

3.3.2 Network search index synthesis

According to the correlation coefficient between the network search amount of the keywords selected in previous section and the actual tourist volume, the contribution rate of the network search volume of each keyword to the actual tourist amount can be determined, and accordingly, each keyword is given correspondingly. The weight value, and the keyword synthesis index during the Spring Festival holiday from 2015 to 2018 is determined according to the search volume value and weight value of each keyword. (In general, a keyword can only reflect the characteristics of a thing from one side. Therefore, it is necessary to have as comprehensive a network keyword as possible to reflect the overall trend to be measured. This paper synthesizes the selected keywords in a dimensionally reduced manner. The synthesized index is called the keyword synthesis index, and the trend analysis is carried out with the actual tourist amount of the Spring Festival holiday in the research year. It is found that the two variates have the characteristics of trend consistency (Figure 2), and the left vertical coordinate in the figure. P represents the tourist volume, the right vertical coordinate Q represents the keyword synthesis index, and the abscissa represents the seven-day holiday of the Spring Festival.

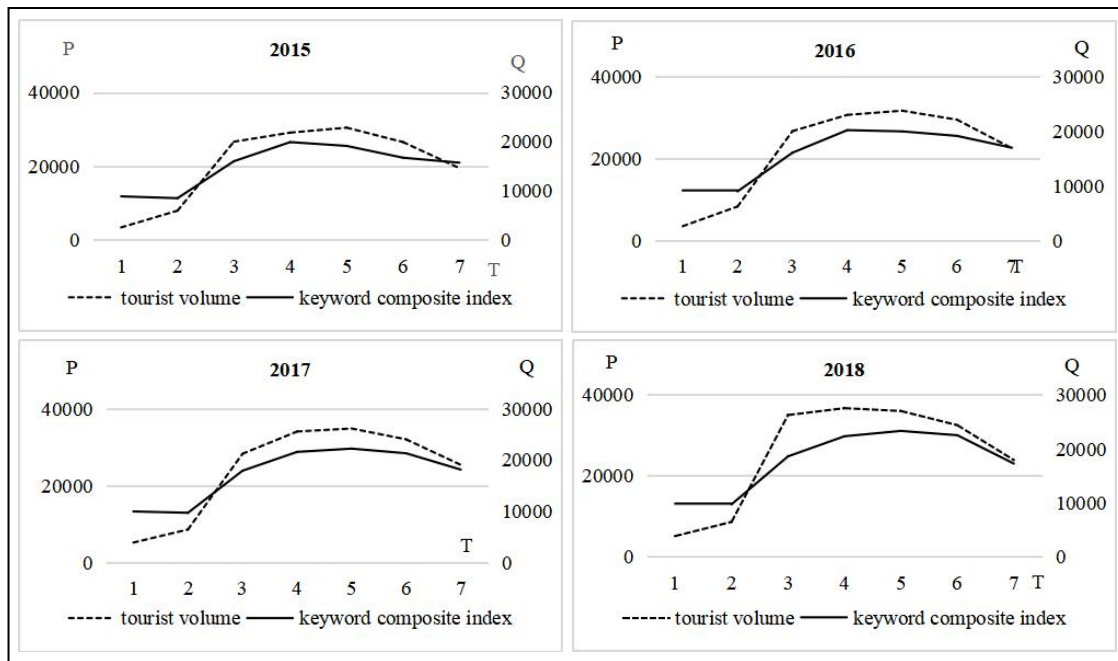


Figure 2 Tourist Volume and Keyword Composite Index Graph

During 2015 to 2018 Spring Festival Holiday

From the tourist volume of the Spring Festival holiday and the keyword synthesis index graph of the network search, it can be seen that there is a strong trend consistency feature between the keyword synthesis index and the actual tourist volume, and it is calculated that 2015 to 2018 The correlation coefficient between the actual number of visitors in the Spring Festival holiday and the keyword composite index of the online search was higher, 0.9599, 0.9899, 0.9752, 0.9651, respectively.

Therefore, using the above method, there is a strong correlation between the keyword synthesis index obtained by index synthesis and the actual number of visitors through the screening of keywords in the network.

### 3.3 Establishing a predictive model

According to the correlation between the above-mentioned network keyword synthesis index and the actual tourist volume, a regression prediction model for the number of tourists in the Mount Emei Scenic Area during the Spring Festival holiday is established.

$$y_i = c_i + \beta_i x_i$$

Among them,  $y_i$  represents the number of tourists on day  $i$  of the Spring Festival holiday of Mount Emei Scenic Area;  $x_i$  represents the selected keyword index;  $c_i$  is the constant term;  $\beta_i$  is the coefficient of the independent variable. Keyword index is based on the selected 9 keywords (Guides to Mount Emei, Mount Emei Tourism Guide, Map of Mount Emei, Weather of Mount Emei, Hotel Reservation of Mount Emei, Tickets of Mount Emer, Hot Springs in Mount Emei, A one-day tour of Mount Emei ,Mount Emei) with tourist volume correlation determine its weight, and in the process of prediction model is established, according to the size of the t-statistics and the Prob value, gradually picking variables did not pass inspection, final keyword index, for the following prediction results.

**Table 3 Variable Stationarity Test**

Constant	Coefficient	t-Statistic	Prob.	Variation Coefficient	Coefficient	t-Statistic	Prob.
$C_1$	-12902	-5.1535	0.0357	$\beta_1$	1.8197	6.8665	0.0206
$C_2$	3519	5.1391	0.0358	$\beta_2$	0.5232	7.0389	0.0196
$C_3$	-15833	-0.8432	0.4879	$\beta_3$	2.6258	2.399	0.1385
$C_4$	-29585	-7.0906	0.0193	$\beta_4$	2.9649	14.9196	0.0045
$C_5$	9146	8.413	0.0138	$\beta_5$	1.2227	22.2335	0.002
$C_6$	8915	4.524	0.0455	$\beta_6$	1.0647	10.8156	0.0084
$C_7$	-20089	-5.6532	0.0299	$\beta_7$	2.5231	12.0828	0.0068

When the model is subjected to regression test, the absolute value of t-statistic is greater than 2, indicating that this parameter contributes significantly to the model. At a 95% significant level, a Prob.

value of less than 0.05 indicates a significant effect on the model. According to the regression test, the models are 0.959, 0.96, 0.74, 0.99, 0.99, 0.98, and 0.98, respectively, and the other days have a good fitting effect except for the third day of the holiday. It can be concluded that the contribution rate of the keyword synthesis index to the model is significant, and the variables in the model have a relatively high degree of fit with the independent variables.

## 4 Conclusion

Based on theories of tourism behavior, network search technology and prediction model, this paper extensively reads the literature on tourist quantity prediction research, social behavior based on network information technology and tourism behavior research, and summarizes the research status at home and abroad. To explore and research of tourists' network behavior, explore the travel network behavior of tourists using Internet technology to obtain tourist information; study the attention and attention of tourists on online travel information, and understand the search engine of tourists who have online behavior through The Internet. The content and time of the travel information searched by the technology provide reference for the selection of network keywords. This paper mainly draws the following conclusions:

Firstly, visitors will check the information about the scenic spots before they travel. The online search volume of relevant keywords can reflect the number of future tourists in the scenic spot to a certain extent. The time for tourists to check the tourist information before traveling is concentrated in one to two days before the trip. Accommodation, transportation, weather conditions and travel routes are the information that visitors generally care about and inquire about.

Secondly, there is a strong correlation between the network keyword search volume data and the actual tourist volume data, and most of them appear to be positively correlated. This mainly depends on the travel network behavior before the tourists travel, that is, the search and Attention to relevant travel information.

On the overall, the final determination of the network keyword needs to be based on the correlation coefficient between the network search volume of the primary keyword and the historical data of the actual tourist volume. The keyword with a large correlation coefficient value can be obtained as a model Parameter. Predict the effect.

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## Influencing Mechanism of Business Mode Innovation Risk in Business Group

Mo Guoyong<sup>1</sup>, Liang Benbu<sup>2</sup>

1 Guangxi Geology & Mineral Huadi Industry and Trade group Co., Ltd., Liuzhou, P.R.China, 545000

2 School of Management, Wuhan University of Technology, Wuhan, P.R.China, 430070

(E-mail: 342895349@qq.com, 651783585@qq.com)

**Abstract:** Business mode innovation (BMI) is critical for building group' sustainable competitive advantage. This study focuses on influencing mechanism business mode innovation risks (BMIR). Specifically, based on the theories of risk management and strategic management, questionnaire survey data are collected from several national business groups. An influencing mechanism model is conducted by using the methods of structural equation modeling (SEM) and regression analysis. The results show that the organizational legitimacy (OL), environmental volatility (EV) and innovation ambidexterity (IA) have a significant positive correlation with BMIR, the IA plays a mediator role in the relationship between EV and BMIR, and the strategic experimentation (SE) plays positive moderating role between BMIR. The research, therefore, highlights the necessity of taking concrete and effective measures to avoid BMIR.

**Key words:** Business group; Business mode innovation risk; Influencing mechanism; SEM

### 1 Introduction

Although Business mode innovation (BMI) is critical for building a sustainable competitive advantage, market environment changes quickly and other firms may imitate the successful business modes and incorporate them into their own business (Casadesus Masanell R, Zhu F, 2013). Furthermore, business group typically consists of complex pyramidal structures, dividend policies and ambidexterity, which may lead to business mode innovation risks (BMIR). As a result, identifying the influencing mechanism and antecedents of BMIR represent a vital research topic.

In general, BMI means a new logic of a firm of creating, delivering and capturing value in a novel way by applying and deploying existing capabilities and resources (Haaker T, Bouwman H, Janssen W, et al., 2017). Tesch et al (Tesch J. F., Brillinger A., Bilgeri D., 2017) define BMIR as "all risks within the BM which can endanger the profitability and sustainability of the BM or even firm goals and value". Existing works mainly concentrate on the integration of risk management in the BMI process, offering BMI type-specific management methods, or establishing risk management frameworks and approaches. Hallikas and Varis (Hallikas J, Varis J, 2009) present an approach of risk management in value networks. Brillinger (Brillinger, 2018) created a methodology for identifying BMIR factors within the value network of a BM and unveils a set of general BMIR factors by applying the value network



analysis. Current literature mainly analyses effecting factors of BMIR by employing the approaches of risk management, focusing on the risk evaluation of BMI and studies of risk management methodology. This research presents how organizational legitimacy (OL), environmental volatility (EV), innovation ambidexterity (IA) and strategic experimentation (SE) effect BMIR from the dimensionality of external macro environment, industrial environment and enterprise internal environment.

## **2 Hypothesis Development**

### **2.1 OL and BMIR**

Prior researches of OL are mainly from the perspective of institutions and strategy, and the former focuses on how to integrate social norms into organizational cognition while the latter emphasizes that organizations should get social resources legitimately and carry out effective management. No matter from the system level or the strategic level, OL effects BMIR significantly which can not be ignored. First, interactive logic and norms from OL are provided to earn stakeholders' legitimacy and sustainability recognition. Second, High-quality resources are more readily available as OL help firms to integrate resources. Finally, OL can reduce the BMIR. So, the following hypothesis are made.

H1: OL has negative influence on BMIR.

### **2.2 EV, IA and BMIR**

EV increase the inaccuracy of management forecasts, which may lead to wrong investment decisions due to the lack of sufficient information (Goodman T. H., Neamtiu M., Shroff N., et al., 2013). Additionally, EV reflects uncertainty of market competition and stakeholders' preferences. As a result, BMI is likely to be challenged by potential competitors or deviate from customers' preferences, leading to failure of BMI. IA refers to exploitative competence and explorative competence of firms (O'Reilly III C. A., Tushman M. L., 2013), which can help enterprises to continuously allocate internal and external resources and re-establish new abilities. Hence, firms can quickly and accurately perceive environmental changes and better achieve BMI. However, excessive emphasis on exploitative and exploratory innovation will easily lead to enterprises' neglect of new market opportunities, increase the cost of enterprise innovation and increase the BMIR. Therefore, high EV can promote enterprises to establish IA. Based on the above researches, the following hypothesis are made.

H2: EV has positive influence on BMIR.

H3: IA has positive influence on BMIR.

H4: IA plays a mediating role between EV and BMIR.

### **2.3 EV, SE and BMIR**

SE can be conducted to solve the lack of experience and insight in the innovation progress. Feedback experience from SE can help enterprises to better understand the social norms and internal demand, and facilitate the experience and knowledge in strategy iteration to update quickly, which can encourage enterprises to fix BM. Thus, SE can reduce the BMIR and uncertainty in the volatile market environment, and help enterprises to establish efficient BM (Andries P., Debackere K., Van Looy B.,

2013). Thus, make the following hypothesis.

H5: SE plays positive moderating role between the EV and BMIR.

### **3 Study Design and Data**

Based on the existing mature scale and the actual characteristics of national group companies, the questionnaire is developed. (1) The BMIR is measured mainly according to opinions of Zott & Amit (Zott C, Amit R, 2007). (2) The measurement of the OL and ED mainly draws on the study of Fanghe & Zou. (3) According to Cao (Cao, Q, Gedajlovic E, Zhang H, 2009), mediating variable IA is subdivided. (4) Based on the study of Chandler et al (Chandler G N, DeTienne D R, McKelvie A, et al., 2011), the ED is divided into 2 dimensions including strategic adjustment and innovation. All variables are measured using Likert 5 scale settings. Before the formal questionnaire survey, pre-test questionnaires are issued, and 70 questionnaires were distributed to several national business groups. The reliability and validity of the original questionnaire were tested and after removing items OL1, OL4, BR1, BR6 and IA6, the overall coefficient of the scale is improved significantly. The main research objects of this study are staffs of national business groups. 150 questionnaires are made available at national business groups. 115 valid questionnaires were obtained after removing invalid ones, and the effective recovery rate is 76.67%.

### **4 Results and Analysis**

#### **4.1 Characteristics of the sample**

The characteristics of the sample indicate that there are, in terms of ownership, there are 55.7% State-Owned Enterprises, 20.9% Foreign-Invested Enterprises, 17.4% Private Enterprises, and 6.1% Collectively-Run Enterprises. There are 37.4% enterprises with more than 1000 employees, 20% with 500~1000 employees, and others with less than 500 employees. Among the 128 respondents, 5.2% were responsible for senior management, 34.8% are middle manager and 60% are entry level employee. Overall, the sample can reflect the current composition and characteristics of the business group.

#### **4.2 Preliminary analysis**

Reliability is usually judged by using Cronbach's  $\alpha$  and Combinational Reliability (CR). Structural validity is usually verified by exploratory factor analysis (EFA) and confirmatory factor analysis (CFA). Table 1 shows that all of the latent variables Cronbach's  $\alpha$  are all greater than 0.7, and the CR are all greater than 0.8, suggesting that a high internal reliability existed in the constructs. In addition, the average variance extracted (AVE) coefficients are all greater than 0.5, which suggests that the items are able to explain the variance in the constructs.

**Table 1 The Reliability Validity of the Sample**

Variable and Numbers	Number	Cronbach's $\alpha$	KMO	AVE	CR
OL	3	0.807	0.752	0.511	0.812
IA	6	0.868	0.873	0.587	0.913
ED	6	0.866	0.840	0.628	0.835
SE	3	0.698	0.662	0.535	0.868
BMIR	2	0.820	0.709	0.588	0.875

### 4.3 SEM analysis

Based on the influencing mechanism conceptual model of BMIR, the initial Structural Equation Model (SEM) is constructed including OL, ED, IA, and BMIR by employing AMOS 24.0. Fit indices of the SEM summarized in Table 2 indicate a reasonable fit of the model. In addition, the results of the parameter path show that the standardized path coefficient of OL→BMIR is negative (-0.302) while ED→BMIR, and IA→BMIR are positive (0.269, and 0.189, respectively) and significant ( $P<0.05$ ). H1, H2, and H3 are supported. This study, samples are repeated sampling 2000 times by using Bootstrap to obtain ab coefficient at 95% confidence intervals which can be divided into Bias-corrected percentile method (BC) and Percentile method (PC). The results show that whether the BC or PC 95% confidence interval, indirect effect between the ED and BMIR are significant. Thus, H4 is supported.

**Table 2 Fit Statistics of SEM**

Statistical test quantity	Normed fit index	Results
$\chi^2$	The smaller the better	269.198 acceptable
$\chi^2/df$	1~3	2.15 good
RMR	<0.05	0.047 good
RMSEA	<0.08	0.018 acceptable
GFI	>0.90	0.907 good
NFI	>0.90	0.873 acceptable
CFI	>0.90	0.853 acceptable
TLI	>0.90	0.827 acceptable
PNFI	>0.50	0.654 good
PGFI	>0.50	0.722 good

\*\*\* $P<0.001$

#### 4.4 Regression analysis

In order to verify the moderating effect in H5, multiple cross terms need to be conducted to examine by using hierarchical linear regression. In models 2 and 3, the tolerances for each dimension (Toli) ranged from 0.378 to 0.98, and the variance inflation factor (VIF) ranged from 0.817 to 2.578, which indicates that these models pass the multicollinearity test. Table 3 depicts the regression results, where, Model 1 is a regression model of independent variable ED for dependent variable BMIR, Model 2 adds SE independent variables to Model 1, Models 3 are main effect models including the independent variable, regulated variable. Model 2 shows that the ED has a positive while SE has a negative impact on BMIR. Thus, H2 is supported again. Models 3 indicates the coefficient of ED SE is positive and significant ( $\beta = 0.113$   $P < 0.001$ ). In addition, under the regulation of SE, the negative effect of ED on BM was obviously weakened ( $\beta = 0.34$  to  $0.250$ ), which indicates that SE have moderating effect between the relationship of ED and BMIR. H5 is supported.

**Table 3 The results of regression analysis**

Variable	BMIR		
	Model 1	Model 2	Model 3
ED	0.461***	0.132**	0.250**
SE		-0.181**	-0.480***
ED × SE			0.113**
F	32.392***	35.399***	38.391***
R <sup>2</sup>	0.213	0.604	0.494
Δ R <sup>2</sup>	0.206	0.587	0.481

\*\* $P < 0.01$ , \*\*\* $P < 0.001$

## 5 Conclusion

On the basis of a sample of 115 managers, developers and employees in the national business groups, this study has empirically explored the influencing mechanism of BMIR. The findings indicate that there are significant positive relationships between OL, ED and IA with BMIR. In addition, IA plays a mediator role in the relationship between ED and BMIR, and the SE plays positive moderating role between the ED and BMIR.

Based on the above analysis, policy recommendations and implications are given as follows:

(1) Business group should correctly respond to the turbulence in the macro environment caused by BMI. In the process of business mode innovation, the business group should fully understand the national policy orientation, do a good job in market environment research, understand the current market resource allocation and market structure and other important information, to reduce the

uncertainty caused by information asymmetry and environmental turbulence. Second, enterprises can't stop to strengthen organizational legitimacy, to keep continually response to the macro environment and stakeholder value appeal. Meanwhile, enterprises can develop strategic alliances, corporate social responsibility behavior, to improve its legitimacy and obtain the value identity of key stakeholders such as government, media and the public.

(2) Business group should actively integrate into the industrial environment ecology of BMI. Business group is required to fully understand the industry environment, correctly handle the relationship with stakeholders such as the value chain upstream and downstream. Relevant experience and innovation knowledge can be obtained by conducting a small amplitude, low cost of trial and error learning. Thus, business group could easily identify BMI opportunities, clear strategic positioning and BMI options.

(3) Business group should continuously build BMI internal environment advantages. The enterprise shall carefully sort out its internal organizational structure and institutions, and adopt administrative means such as removal and merger, reorganization and new establishment. An effective platform for technology complementarity and resource sharing among departments should be developed. Enterprise will vigorously foster a good corporate culture, establish strategic alliances with research institutes and research institutions, and properly share the risks brought by the dual capabilities of innovation.

However, the empirical results are derived from a sample of national business groups, hence the findings might be region-specific. Future studies could use samples of business group from other regions or countries to test and expand the generalizations of the findings.

### **Acknowledgement**

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## Dual Pre-Strategy Analysis of Clothing E-Commerce Reverse Logistics for Small and Medium-Sized Enterprises

Li Tianbiao, ShenJingye, Wei Qian, Zhang Yao, Dai Jinshan\*  
 School of logistics engineering, Wuhan University of Technology, Wuhan, China, 430063  
 (E-mail: litianbiao@whut.edu.cn, peonyshen.wh@foxmail.com,  
 867608756@qq.com,785370647@qq.com, jinshan.dai@whut.edu.cn)

**Abstract:** Based on the analysis of apparel e-commerce and existing professional third-party apparel logistics enterprises, this paper found their problems, and put forward the mode of dual pre-strategy of apparel reverse logistics. Combining the operational difficulties of professional third-party garment logistics enterprises with the needs of small and medium-sized garment e-commerce enterprises to improve customer satisfaction. Through pre-testing, shortening the return and exchange period, improving the quality of service; Through pre-processing, on the one hand, it can achieve the Scale Economies Effect of transportation and reduce the transportation cost of reverse logistics in the garment industry; on the other hand, it can classify the returned clothes to obtain the secondary value. Then, the feasibility of the model is illustrated from the perspectives of reducing the transportation cost and increasing the secondary benefits, indicating that the model can solve the problems for both e-commerce apparel enterprises and third-party logistics enterprises when the scale is big enough.

**Key word:** Reverse logistics; Professional garment 3PL; Model construction; Clothing e-commerce

### 1 Introduction

With the continuous development and advancement of Internet technology, the e-commerce industry relying on the Internet platform has also rises rapidly, which has greatly promoted the development process of the Internet era and transferred the consumption habits of most consumers from offline to online, forming a consumption boom of "online shopping for all".

After years of experience in the traditional sales mode, the garment industry has formed a relatively complete offline marketing system and a series of standardized market rules. Although the apparel e-commerce industry is emerging due to its low threshold, high exposure, wide source of customers, low operating costs and other characteristics, it also has many "growth defects" due to the virtual, regional, open and other characteristics of the network. The e-commerce boom has brought about a huge amount of garment commodities in circulation(He Zhenggang, 2018), but at the same time, the number of clothing return and exchange orders is also high, which is fundamentally related to the short popularity of garment, the great difference in consumers' personal preferences, and the lack of unified after-sales processing forms of e-commerce.



Figure 1 The Size of China's Clothing Online Trading Market From 2011 to 2016

At present, there is no systematic academic research on reverse logistics related to garment of returning and exchanging in clothing e-commerce industry, merchants are more relying on experience to handle relevant issues, under such background, because most of the small and medium-sized electric business enterprise lack post-sale experience and hardware facilities. At the same time, because of the high cost of repairing, businesses have to dispose this clothing in the form of waste. This approach not only imposes a certain economic burden on e-commerce enterprises, but also increases the pressure on the overall social logistics operation and causes great waste of social resources. Therefore, at present, the top priority of the e-commerce apparel industry is to build a new model to optimize the return and exchange process of e-commerce apparel, in order to reduce the cost of return and exchange clothing and improve the utilization rate of resources.

At the same time, with the rise of e-commerce apparel industry, some logistics enterprises have also transformed into professional third-party apparel logistics enterprises, providing a series of related logistics and value-added services for apparel e-commerce. However, due to the limited material flow of small and medium-sized garment e-commerce, the service costs are too high for these e-commerce enterprises, so they have to give up professional services. Therefore, professional garment logistics enterprises are faced with the problem of insufficient market development and fewer customers.

This article obtains from the clothing exchange areas of reverse logistics. We researched the existing traditional reverse logistics mode in the current market, finding that long return and exchange period and high cost are two serious problems. So, a new reverse logistics mode, double front of "logistics detecting point and processing center", for clothing e-commerce is put forward aiming at improving consumer satisfaction, and reducing the cost of clothing returning and exchanging and increasing the surplus value of returned and exchanged goods. Meanwhile, it puts forward a new development idea for professional third-party garment logistics enterprises and enhance the overall operation efficiency of China's logistics and improve the utilization rate of social resources.

## **2 Literature Review**

### **2.1 General overview of the development of apparel e-commerce**

Since 2005, as the e-commerce model to mature and apply, e-commerce apparel model has gradually become a way for people to buy clothes on a daily basis. In recent years, with the emergence of a series of e-commerce platforms such as taobao and jingdong, online clothing shopping has become the norm. On December 26, 2016, China e-commerce research center released "The 2015-2016 annual report on China's e-commerce apparel industry". It can be seen from the report that the development of clothing e-commerce has the following trends (Mo Qingqing, 2017):

(1) B2C apparel e-commerce enjoys a strong development momentum

B2C clothing e-commerce development has gradually shifted from PC to mobile, and major shopping apps have seized the mobile shopping market. Since 2015, the amount of mobile transactions has accounted for more than half of the industry's overall sales, and various apparel apps have flourished.

(2) More sophisticated and professional in market segmentation

The era of garment industry with large and complete characteristics has passed. Nowadays, clothing e-commerce has further segmented customer positioning, forming some clothing strategies for a specific customer group, just like personalized customization, single-category clothing stores and high-end brand clothing stores.

At the same time, the rise of major e-commerce platforms has led to the emergence of small and medium-sized garment e-commerce companies, and private and personal clothing e-commerce stores occupy most of the e-commerce interface.

### **2.2 The rise of clothing logistics enterprises**

Due to the different attributes of logistics enterprises serving storage and transportation of clothing, clothing logistics also presents different characteristics.

(1) The enterprise logistics, has great limitations and traditional flavor in the aspect of logistics due to the influence of the traditionality of the clothing industry. As a result, the business of enterprise logistics only includes warehousing and serving as a logistics center, then the mass trunk transportation and terminal distribution are outsourced.

(2) Third-party logistics enterprises can be divided into third-party logistics enterprises that



specialize in clothing logistics and comprehensive logistics enterprises. These enterprises provide standardized product services and professional warehousing business. At the same time, they have a high informatization degree of transportation and a perfect system of storage and distribution.

(3) E-commerce logistics is a logistics system based on e-commerce sales platform. The integration of warehousing and distribution is its outstanding feature. It accelerating the distribution of clothing relies on the rational layout of pre-storage and prediction of Big Data.

(4) Instant delivery is the latest mode to join the apparel logistics industry. It has the characteristics of high efficiency and single productization of distribution. It is an effective means to ameliorate the last-mile problem of garment logistics.

**Table 1 Classification of Clothing Logistics Enterprises**

Category	Characteristics
Immediate delivery	Stores in the front and warehouses in the back Deliver single piece The order failure rate is high
Internal logistics	Traditional attributes Separate trunk transportation and terminal distribution The transportation force is outsourced
Electrical business logistics	High efficiency Using big data to make predictions Integration of warehousing and distribution
3PL	Perfect network system Standardized product Stable transport power

Shanghai chunfeng as a professional third-party garment logistics enterprise which born in the traditional logistics industry, providing services such as distribution of warehouse to store, goods transfer between stores, reverse logistics of returned cloth and garment storage.

However, due to the seasonality, multi-SKU, non-standard, and large changes in the brand and business model of the apparel industry, the business flow itself is unstable. It is difficult for general clothing logistics enterprises to support the logistics solutions for many brands(Yang Chunyan., 2013). There are very few clothing logistics companies in the market that have the ability to handle the logistics operations for more than five brands. Those apparel logistics enterprises only have one-to-one or one-to-two services. Therefore, it is difficult for the clothing logistics market to develop such a professional giant enterprise(Tang Wen., 2018).

### 3 The Mode of Dual Pre-Strategy of Reverse Logistics

In view of the difficulties faced by small and medium-sized clothing e-commerce and third-party clothing logistics enterprises, we propose a “detection + processing” dual pre-mode that combines 3PL and small and medium-sized clothing e-commerce. we combined the business of professional third-party garment logistics enterprise and small and medium-sized clothing e-commerce, proposing a solution to solve the problems such as the long return period of clothing e-commerce, the serious depreciation of clothing, and the third-party clothing logistics enterprises cannot make an economics of scale, the difficulty to expand market.

For small and medium-sized clothing e-commerce, especially for personal online stores, there is only one clothing warehouse which send all the clothing to the country, and the returned clothes are directly returned to the warehouse from various logistics sites. In this case, the distance between customer and the e-commerce is far. After the customer make an application, they needs to negotiate with the after-sales personnel, obtain the return address, and send the clothing back. After the manufacturer checks and confirms and agrees to exchange or refund, they will send out the new clothes or refund. In this mode, it takes 3-6 days to solve the application of customer. Moreover, due to the lack of relevant processing equipment and the high construction cost, the cost of reprocessing a clothes is higher, so most of the clothes are recycled directly as waste fabrics, which greatly reduces the value of the clothes, bringing greater losses to e-commerce. The mode is shown in Figure 2.

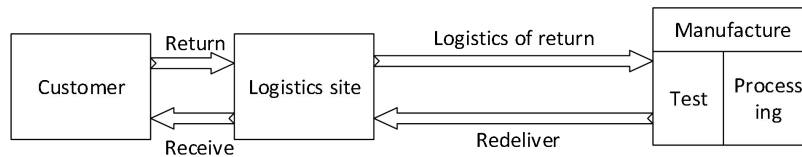


Figure 2 Return and Exchange Process in the Original Mode

### 3.1 The structure of the mode of dual pre-strategy

The logistics process involves information flow, material flow, and capital flow. For return and exchange logistic, it is directly related to information flow and material flow. The e-commerce send out new clothes only if they check the returned clothes and make sure that it has the problem which the customer said. The information flow must synchronize with the material flow.

“Dual pre-strategy” means shift the detecting and processing business which process at the warehouse to an earlier date, by this way ,it can save the time of the return and exchange process and realizing the economies of scale. This idea comes from the postponement strategy in industrial production.

The postponement strategy refers to a business strategy that is carried out to reduce the risk of the supply chain system and effectively meet the individual needs of the customer. The company delays part of the production process or logistics business until the customer places an order. The essence is to postpone the customer-oriented production business (all or part of the production process including design, procurement, manufacturing, assembly / assembly, etc.) or logistics operations (including customized packaging, transportation, distribution, distribution processing, etc.) to the time at which receive customer orders or clearly know the requirements. Specifically, postponement strategy can be implemented in the field of production or logistics, in two dimensions, time or space(Hu Jianbo., 2012).

Through the postponement strategy(Gong Bengang., 2002), the manufacture can obtain economies of scale. while in the field of garment reverse logistics, the enterprise is required to respond to the customer requirements as quickly as possible, so the advance strategy in time and space is significant. Through the detection and processing advancement, the reaction time of the reverse logistics chain can be shortened, and the value of the commodity can be improved.

### 3.2 The operation of the mode of dual pre-strategy

In the mode of dual pre-strategy, on the one hand, the inspection function which is set in the manufacturer's warehouse is advanced to the logistics point. When the customer returns the clothing at the logistics site, the clothing will be tested. Then the logistics site will send the test result to the manufacturer, and the cloth will be shipped directly after the result is confirmed by the manufacturer. At the same time, the reverse logistics process will begin and return clothes to the processing center. On the other hand, the function of the manufacturer's processing center will be moved to the regional processing center(Wang Ruiming., 2011), and the clothes will be returned to certain regional logistics points for classification processing. And the processed clothes are packaged and delivered. Through pre-detection, the manufacturer can directly send out the new cloth/refund without waiting for the clothes to return and the test is completed. which can shorten the return period. Through the processing center front, the returning clothes of a certain range of logistics points can be concentrated, which can reduce the transportation cost of a single piece of cloth, and realize the cost saving for the clothing e-commerce through the economies of scale of transportation. Dual-front mode is shown in Figure 3.

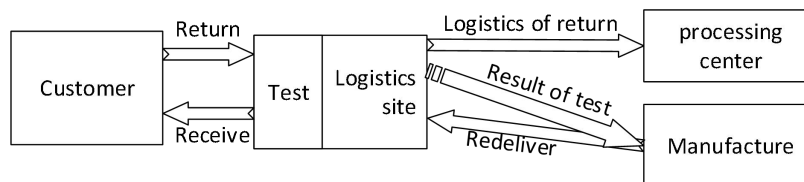


Figure 3 Operation Diagram of the Mode of Dual Pre-strategy

### 3.3 Preposition of logistics detection sites based on trust mechanism

In the form of pre-detection, the customer will send the returned clothing to the nearest delivery site, and the quality inspection personnel in the express delivery point will replace the e-commerce to exercise the detection right in advance. After the logistics point detection, the detection result will be given to the e-commerce company by the form of video, photo, etc. After obtaining the test result and confirming it, the e-commerce can carry out the delivery operation without waiting for the return of the returned clothing, which shortens the customer's waiting time, improves the customer satisfaction. This mode separates the information flow that was originally synchronized with the material flow, and sends the detection information to the manufacturer for confirmation in advance. It exerts the information flow's characteristics of fast and timely, advance the delivery and shorten the return time. This mode is shown in Figure 4.

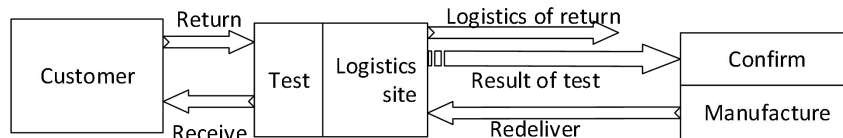


Figure 4 Preposition of Detection Sites

### 3.4 Preposition of clothing reverse logistics processing center based on value-added processing of returned clothing

Set up a regional processing center to concentrate the clothing that was sent back to the manufacturer through the logistics point in the original mode at that site, and classify the returned clothes here. The processing center can be directly constructed by the warehouse which belong to the third-party clothing logistics enterprise. As the intermediate connection point between consumers and clothing manufacturers, it can play the role of time transition and professional garment repair. The shortening of the distance and the improvement of the level of specialization can help to save the relevant returning clothing transportation costs due to returning to the clothing manufacturer, and to generate value for returning the clothes. At this point, the returned clothes are divided into three categories(Li Yaping, 2018): first category clothing is intact but the size and style are not suitable This type of clothing can be sold directly on the original price; the second category clothing needs to be repaired and it can be discounted(Qin Wei, 2014); the third category is a small amount of all the clothing which needn't repair cause it didn't have enough value. By subdividing the categories, the clothing e-commerce can obtain new profits and the "secondary utilization rate" of the clothes is increased(Zhao Xiaohui, 2016). This mode is shown in Figure 5.

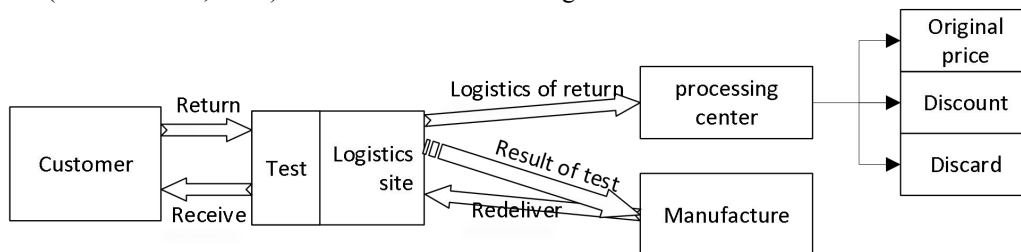


Figure 5 Preposition of Processing Center

## 4 Construct the Mode of Dual Pre-strategy

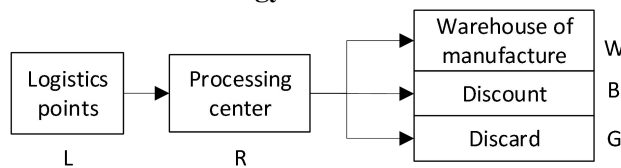


Figure 6 Schematic of the Mode of Dual Pre-Strategy

In order to assist the online retailers to provide return service, we built a mathematical model for the mode of dual pre-strategy.

#### 4.1 Conditions assumption

Considering the complexity of the problem, we abstract the actual situation and make the following assumptions:

- (1) Logistics points are transformed into inspection points by introducing equipment
- (2) The daily return amount of each logistics point is consistent with (0,10) evenly distributed
- (3) The logistics points are evenly distributed in a rectangular area which is centered around the processing center.
- (4) The nature of returned clothing at each logistics point is similar, and the transportation, handling and disposal costs are the same.
- (5) After the clothing is processed, they are transported in batches, 140 pieces per batch.

#### 4.2 Modeling

The subscripts and parameters in the model and their meanings are shown in Table 2 - Table 3

**Table 2 Subscripts And Its Collections**

Letter	Meaning
L	Logistics point
R	Processing center
W	Manufacturer shipping warehouse
B	Discount store
G	Abandoned point

**Table 3 Parameter Symbols And Meanings**

symbol	Meaning
$L_i$	The number of returned clothes at the logistics point
$F_1$	Fixed cost of processing center construction
G	Average cost of sorting each piece of clothing
C	Average repair cost per item
S	Service fee charged by third party for each piece of clothing
$D_{lr}$	Distance from logistics point to processing center
$D_{rw}$	Distance from the processing center to the manufacturer's shipping warehouse
U1	Single piece clothing transportation costs of short-distance transportation
U2	Single piece clothing transportation costs of long-distance transportation
a	The proportion of the first category of clothing selected by the processing center
b	The proportion of the second category of clothing selected by the processing center

Model function:

$$TC = TC_1 + TC_2 + TC_3$$

$$TC_1 = F_1$$

$$TC_2 = \sum L_i D_{lr} U + a \sum L_i D_{rw} U$$

$$TC_3 = \sum L_i G + b \sum L_i C + S \sum L_i$$

TC refers to the total cost of construction and operation of the dual-front mode.  $TC_1$  indicates the fixed cost of construction, and  $TC_2$  indicates the transportation cost of the clothing from the logistics point to the processing center and the processing center to the manufacturer's warehouse.  $TC_3$  indicates the operating costs of processing center.

## 5 Case Analysis

### 5.1 Cost analysis

The total cost of return and exchange in dual-front mode includes the transportation cost of clothing between nodes, the cost of processing center construction/rental, processing center's sorting equipment, processing center sorting clothing, and repairing of the second category of clothing. The specific cost values are shown in Figure 7.

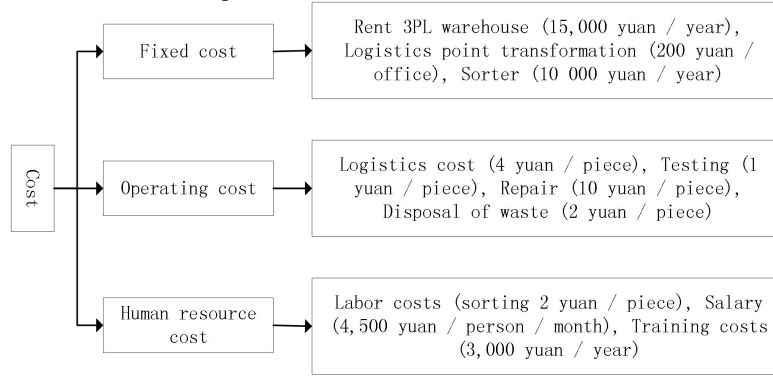


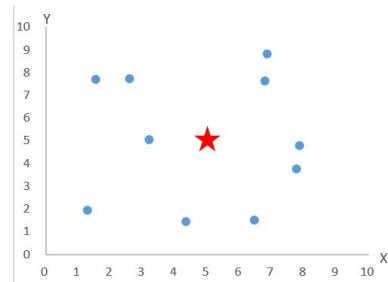
Figure 7 The Mode of Dual Pre-strategy Cost

It is assumed that there are 10 logistics points, and the clothes are returned to the processing center. 2% of all the clothes are not passed and will not be returned. After sorting by the processing center, we assume that there is 40% first category of clothing, 50% second category clothing, and 10% third category clothing. The first category of clothing is transported to the manufacturer's warehouse for sale, and the second and third categories are sold nearby. S takes 1.5 yuan / piece, U2 takes 10 yuan / piece in the original mode. Assume that each piece of clothing is 0.5KG, and each batch of clothing is 70KG. The fixed transportation cost of each batch is 30 yuan, variable cost is 2.6 yuan / KG, the total cost is 212 yuan per batch

We simulated the distribution of logistics points and the distance from the processing center through Excel as shown below. Unit: KM

Table 4 Simulation of Processing Center and Logistics Point Distribution

i	X	Y	X0-X	Y0-Y	X*X	Y*Y	D	X0=5	Y0=5
1	6.456	1.510	-1.456	3.490	2.119	12.180	3.781		
2	7.855	4.792	-2.855	0.208	8.153	0.043	2.863		
3	2.591	7.726	2.409	-2.726	5.085	7.429	3.638		
4	1.540	7.689	3.460	-2.689	11.974	7.231	4.382		
5	6.848	8.826	-1.848	-3.826	3.415	14.638	4.249		
6	4.335	1.429	0.665	3.571	0.443	12.749	3.632		
7	3.209	5.038	1.791	-0.038	3.207	0.001	1.791		
8	6.789	7.637	-1.789	-2.634	3.199	6.592	3.186		
9	7.771	3.749	-2.771	1.251	7.678	1.565	3.040		
10	1.281	1.940	3.719	3.060	13.828	9.364	4.816		



The daily return quantity of each logistics point is generated by random number, and the accumulated of 30 days is regarded as one month return quantity. The processing center processes the clothes, which make a cost. And the specific data is as follows:

Table 5 Operation Data of Logistics Point and Processing Center

i	X	Y	X0-X	Y0-Y	X*X	Y*Y	D	Li	$\sum_{i=1}^{30} L_i$	Pass the test
1	9.255	6.579	-4.255	-1.579	18.106	2.492	4.539	4	81	80
2	5.181	9.038	-0.181	-4.038	0.033	16.305	4.042	2	70	69
3	7.240	2.827	-2.240	2.173	5.016	4.722	3.121	3	67	66
4	3.908	0.145	1.092	4.855	1.192	23.574	4.977	3	85	83

5	5.795	3.840	-0.795	1.160	0.632	1.347	1.407	3	69	68
6	8.056	7.712	-3.056	-2.712	9.341	7.357	4.086	4	55	54
7	5.083	7.464	-0.083	-2.464	0.007	6.069	2.465	5	67	66
8	9.965	1.560	-4.956	3.440	24.646	11.830	6.040	3	70	69
9	9.533	6.632	-4.533	-1.632	20.544	2.663	4.817	0	60	59
10	0.863	8.630	4.137	-3.630	17.118	13.174	5.504	2	75	73
									SUM=700	SUM=686

According to the data, the processing center received 700 pieces of returned clothing in a month, and the logistics point detection cost was 700 yuan, of which 686 pieces were sent to the logistics point, and the cost of the logistics point to the testing center was  $686 \times 4 = 2,744$  yuan. The sorting cost in processing center is  $686 \times 2 = 1372$  yuan, the repair cost is  $686 \times 0.5 \times 10 = 3430$  yuan, and the service fee is  $686 \times 1.5 = 1029$  yuan.

In the dual-front mode, the total cost which include transportation and operating costs is  $700 + 2744 + 1372 + 1029 = 5845$  yuan, and the average cost of one piece of clothing is 8.35 yuan.

In the original mode, the same piece of return clothing is directly sent to the manufacturer's warehouse and the transportation costs of 7,000 yuan, and each piece of clothing costs 10 yuan.

At the same time, for repairing clothes, the resale price is greater than the processing cost, and a certain profit is obtained through low-priced sales.

### 5.2 Income analysis

By subdivision the returned clothing, the benefits for different part in this chain are as follows:

(1) Logistics service income: The logistics service fee charged by the third-party logistics enterprise for the transportation of the returned clothing, re-entry into the warehouse, etc.

(2) Service fee: The third-party logistics company provides venues and equipment for small and medium-sized online retailers, and charges a service fee for each piece of clothing.

(3) Re-sales revenue: For the online retailers, the second-class products that have been classified and processed can still recover the cost through price reduction.

(4) Government subsidies: Under the current policy environment, government departments can allocate certain funds to support reverse logistics enterprises.

For professional third-party clothing logistics enterprises, cause fixed costs such as warehouses, processing equipment, and sorting lines have been invested, the more services for small and medium-sized online retailers, the reverse logistics cost for each unit is lower. It can get a significant effect of the economies of scale and more logistics and service revenue.

## 6 Conclusion

This paper realizes the following highlights by constructing the mode of dual pre-strategy of "detection add logistics": First, the advance of detection will separate the logistics and information flow in the reverse logistics. By sending the information to the manufacturer in advance, it can shorten the return service cycle, and improve customer satisfaction. Secondly, through the establishment of processing points and move it forward, to achieve secondary sales of clothing, improve online retailer's profits and bring operating profits to professional third-party clothing logistics companies. Through the analysis of simulation, it is concluded that through the processing of professional third-party clothing logistics enterprises, when the total processing volume increases, the average processing cost of per piece of cloth will be reduced, and the surplus value of clothing will be effectively discovered, which bringing additional benefits to third-party apparel logistics enterprises and clothing online retailers. There are also some improvements in this paper. For example, it's difficult to ensure that the distribution of logistics points is evenly distributed around the testing center in real conditions. The construction cost of processing center may vary according to the real conditions. The quantity of clothing returned to the logistics point is related to the population and economy nearby. However, it can be expected that for professional third-party logistics companies, it is a development direction to form a service-oriented 4PL model by uniting small and medium-sized businesses.

### Acknowledgement

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## Research on Optimization and Collaboration of Cross-border E-commerce Logistics Supply Chain

Wang Aimin<sup>1</sup>, Ji Tingting<sup>1</sup>, Zhong Qianru<sup>2</sup>

1 School of Management, Wuhan University of Technology, Wuhan, P.R.China, 430070

2 School of Economics, Wuhan University of Technology, Wuhan, P.R.China, 430070

(E-mail: wangam@vip.163.com,838821378@qq.com,523391628@qq.com)

**Abstract:** In recent years, cross-border e-commerce is in a period of rapid development, and governments and related groups and enterprises of all countries attach great importance to it. At the same time, the development of cross-border e-commerce has also led to the development of a series of related industries. Among them, the impact of cross-border logistics supply chain is the most profound. As the influence of e-commerce in China continues to increase, it is very important to conduct a comprehensive system research, especially to analyze the synergy between cross-border e-commerce and logistics supply chain optimization. Based on the analysis of the mechanism of cross-border logistics coordination, the optimization of cross-border e-commerce logistics supply chain system, and the current situation and problems, this paper starts from multiple angles to ensure that there can be cross-border logistics and e-commerce. Better development, including improving the synergy and mutual trust mechanism, improving the government's service system, optimizing reverse logistics and the coordination of dry wells. At the same time, it points out the future research direction of cross-border e-commerce and logistics development, and provides reference for the research on synergy between cross-border logistics and e-commerce in the future.

**Keywords:** Cross-border e-commerce; Collaborative model; Supply chain; Cross-border logistics

### 1 Introduction

According to the big data of Alibaba Cloud in 2018, in 2016, China has reached an overall scale of 6.3 trillion e-commerce, an increase of 23.5% compared with last year, and has grown to 8.9 trillion yuan in 2018. With the rapid development of cross-border e-commerce, cross-border logistics has also developed rapidly, and the high efficiency of cross-border logistics has become one of the most powerful guarantees for cross-border e-commerce. The relationship between the two is dynamic. (Zhang Baoming, Zhou Peifeng, Meng Ling, 2014) It is complicated. With the development of cross-border e-commerce industry, there are also national policies that are constantly demanding, and the difficulties encountered in the actual negotiation between cross-border logistics and e-commerce, which make cross-border logistics and electricity the synergistic development between the two has become the main development trend in the future. (Liu Yousheng, Chen Yibin, 2016) By optimizing and selecting the logistics supply chain system in cross-border e-commerce, the synergy between the two can maximize the logistics structure and minimize the operating costs to improve the core competitiveness of the company.

Compared with the existing domestic e-commerce, cross-border e-commerce is characterized by a



long supply chain, and logistics plays a very important role in its development process. They constantly interact with each other and promote each other's development. (Zhang Xiaoheng, Guo Hailing, 2016) Based on the theory of supply chain, this article analyzes the development status of cross-border e-commerce and cross-border logistics, and discusses the dilemma of cross-border logistics and cross-border e-commerce collaborative development, aiming to further research and Cross-border e-commerce development and coordinated cross-border logistics service chain development issues.

## **2 Research Status of Cross-Border Logistics Development**

As far as cross-border logistics is concerned, because cross-border logistics crosses borders in the process of transportation, it will not only involve the links of commodity inspection and customs clearance, but also the level of infrastructure, logistics resources and logistics level of cross-border countries. (Wang Chunzhi, Gao Qiang, Heiko Gebauer, 2015) The legal policies and so on have a lot to do with it. In the face of different language cultures, legal systems and various technologies, the unmanageable and complex nature of cross-border logistics has increased. Due to the influence of network information, law, technology and other differences among cross-border countries, for the time being, cross-border logistics still cannot complete the entire process to be queried and traceable, which leads to a very poor user experience. From the chain of goods circulation analysis, in many complex links, the most critical links for cross-border logistics are collection, warehousing, commodity inspection and customs clearance, international delivery, and final delivery.

Looking at the world, the development between countries and countries is not the same. As far as Russia is concerned, its domestic rail standards are different from those of other countries. Cross-border logistics requires the transfer of goods at the border during the operation of Russia, which leads to low efficiency and increased costs. Australia's location in the Pacific Ocean, which is not directly bordered by other countries, has led to certain restrictions on the development of cross-border logistics. International multimodal transport is more frequent, and the probability of damage to goods will rise linearly. (Ji Fang, Zhang Xiaoheng, 2015)

Another unavoidable problem in the development of cross-border e-commerce is reverse logistics. Negative logistics occurs because of errors in the distribution, problems with the quality of the goods, and returns from the logistics itself. (Yao Yu, 2015) The emergence of such a situation is often accompanied by huge losses and risks, especially when the goods need to return to the exporting country, in which case the cost of logistics has far exceeded the value of the commodity itself.

In recent years, China has experienced rapid development in cross-border logistics, but for those engaged in related work, this is still a new and unfamiliar field, and there are many problems that need to be solved.

- (1) National policies do not support cross-border e-commerce logistics sufficiently;
- (2) backward logistics infrastructure;
- (3) Low cross-border logistics distribution capacity;
- (4) Lack and imperfection of the third-party logistics system.

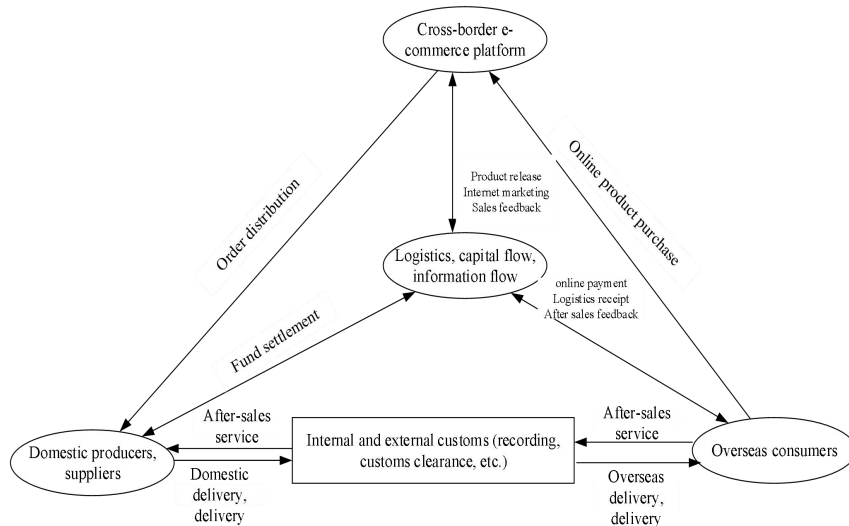


Figure 1 Cross-Border E-Commerce Flow Chart

### 3 Analysis of the Synergy Dilemma of Cross-Border E-Commerce Supply Chain

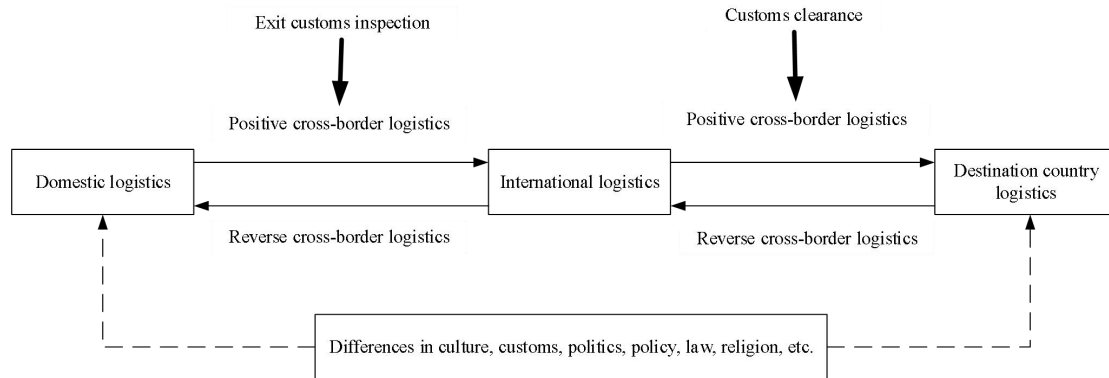
The development of cross-border e-commerce in China has experienced three major stages, namely, the budding period from 1999 to 2007, the development period from 2008 to 2013, and the outbreak period from 2014 to the present. At present, there are more than 5,000 cross-border platform enterprises in China. More than 200,000 foreign trade enterprises have been adopted through the platform, and 11 free trade zones have been built. Cross-border e-commerce has been set up in 12 cities including Tianjin. Comprehensive test area. At present, most of the enterprises engaged in cross-border e-commerce and logistics in China are mainly based on a dedicated line or special business. (Qian Huimin, He Jiang, 2016) They cannot achieve a comprehensive and efficient service system, resulting in the inefficient use of resources in all aspects, including Information, logistics, and funding, etc. In reality, there are many difficulties in achieving synergy between cross-border logistics and cross-border e-commerce. Here are a few key aspects:

(1) The lack of synergy between cross-border logistics and cross-border e-commerce. In recent years, the development of cross-border logistics is in a very backward situation compared with cross-border e-commerce. The two are not perfectly coordinated in terms of the size of the scale of development, the level of informatization, the state of infrastructure, and the service standards in the industry.

(2) Lack of mutual trust and cooperation mechanism. On the one hand, cross-border logistics companies cannot obtain the latest data of cross-border e-commerce in a timely manner, resulting in no scientific basis for the design of overseas warehousing systems and the scale of their scale, nor can they be targeted at the user base of cross-border e-commerce. (Fan Jing, Yuan Bin, 2018) The targeted construction of the logistics system is a serious waste of a lot of resources. On the other hand, cross-border e-commerce parties do not know the size of cross-border logistics and the maximum extent it can withstand, and cannot obtain accurate information and content of relevant distribution networks. Without understanding the human and material resources of the enterprise and the service scope of the outlets, the distribution capacity will be very low, and the consumer experience and service sense of the logistics service will be reduced.

(3) The system of cross-border logistics networks lacks synergy. The network system of cross-border logistics includes three large blocks, namely domestic logistics, destination country logistics and

international logistics. (Liu Xiaojun, Zhang Bin, 2017) The cross-border logistics system not only needs to coordinate the domestic system and the overseas system, but also the quality supervision department and customs of the cross-border countries. In addition, it needs to deal with issues such as long process, many links and large space span. As shown in Figure 2, from the perspective of the service network level of cross-border logistics, there are many links in the cross-border logistics network system, and there is often a serious lack of coordination between each link.



**Figure 2 Cross-Border Logistics Flow Chart**

#### **4 Cross-Border E-Commerce and Cross-Border Logistics Synergy Strategy**

##### **(1) Improve the government support service system**

The government plays a very important role in supporting and guiding the collaboration between cross-border logistics and cross-border e-commerce. (Lu Guohong, 2016) It can mainly promote cross-border logistics through the following four aspects. First, improve government resources and policy support system. Relevant departments of the Chinese government have issued a number of regulations to promote the coordinated development of cross-border logistics and e-commerce. However, cross-border e-commerce industry is still in its infancy in China, and further improvement will ensure better coordinated development of cross-border logistics and e-commerce. (Li Xudong, Wang Yaoqiu, 2018) Second, strengthen infrastructure construction. Support the development and innovation of Internet, broadband and other information technologies, and put them into practice in cross-border e-commerce industry, so as to promote the same level of information between cross-border logistics and e-commerce and ensure the synchronization of real-time information in all links. Third, vigorously promote the development of cross-border e-commerce industrial park. China established the first cross-border e-commerce industrial pilot park in Hangzhou in 2013, and the industrial park model entered a new stage. Cross-border e-commerce is very beneficial to the integration of traditional foreign trade, so as to form the scale and clustering of the industry and promote the more efficient coordination between cross-border logistics and e-commerce. Fourth, establish a comprehensive cross-border logistics service platform. Further consolidation by cross-border logistics system, and based on big data, Internet and artificial intelligence and other advanced technology to build a comprehensive service platform, together will be tactical, strategic layer and business layer to strengthen synergies, while promoting cross-border logistics network system of vertical and horizontal synergies, ensure better platform process and business integration and innovation, thus further realize express delivery, freight and other logistics and cross-border business integration between electricity, will eventually cross-border logistics and electronic business in each country and the process of synergy ascension.

##### **(2) We will improve the mechanism for mutual trust and coordination of interests**

Mutual trust between cross-border logistics and e-commerce mainly involves benefits, cooperation and capital turnover. Reasonable profit distribution mechanism is the fundamental guarantee for good cooperation and coordination. (Placzek E, 2010) The distribution scheme of benefits and cooperation can be completed and formulated under the guidance of the government and relevant departments, and the established institutions can be complete and achieve win-win goals. What is built must be a solid system with government guarantee. In terms of the distribution of benefits and the turnover of funds, in order to avoid unfair distribution, a third party can be appropriately introduced as an intermediary to maintain and manage funds through its platform, so as to further promote the rationality, fairness and transparency of the distribution of benefits. (Power T, Jerjian G, 2001) At the same time, the government and relevant departments should put forward more preferential policies, and the corresponding laws and regulations should also be improved and issued. This can give the two parties the maximum degree of mutual trust to ensure the sharing of information and resources.

Cross-border e-commerce can take supply chain synergy. Through revenue sharing in the contract, the supplier is given the benefit at the appropriate ratio in exchange for raw materials with lower price. In purchasing, lower price can get more market share and increase the benefits of cross-border e-commerce. At the same time, the economic benefits brought by the substantial increase of sales volume can enable suppliers to get more profits and returns. The strategy of supply chain synergy can also help reduce the price in the market, which is very beneficial to the development and competition of cross-border e-commerce in the market.

### (3) Optimize the collaboration between cross-border e-commerce and reverse logistics

Reverse logistics can be divided into two types, namely, reverse logistics of waste and recycling and reverse logistics of return of goods. In this paper, the logistics process caused by consumers of cross-border e-commerce returning goods to the origin of products, as opposed to forward logistics, is mainly targeted at. The rapid development of cross-border e-commerce has not only brought great development space to the logistics market, but also improved the efficiency of reverse logistics and reduced its costs, and put forward higher requirements for the development of logistics. (Quinn F J, 1997) Meanwhile, efficient and reasonable reverse logistics also ensures cross-border e-commerce can develop at a higher speed, further shorten the time of returning goods between consumers and sellers, further improve the mechanism of inventory management, and improve the quality of relevant management. If we want to solve the difficulties in the collaborative development of reverse logistics and cross-border e-commerce, from the perspective of cross-border e-commerce, we can further reduce the return rate by optimizing the cost performance and quality of goods at the front end of the supply chain. From the point of view of logistics, the mechanism of return insurance should be introduced to further minimize the loss.

### (4) Promote synergy between cross-border e-commerce and traditional foreign trade

To promote coordinated development between the traditional foreign trade and cross-border electricity, must constantly innovate new sales model, the whole channel sales model to build, in order to further promote the development of the cross-border electricity, electricity and the traditional foreign trade both offline and online are able to do better together, will eventually cross-border electricity to the new and changeable, direct the development of the road and continuously. (Sanders N R, 2007) Is analyzed from the Angle of macroscopic, need to the relevant laws and regulations to further improve and strengthen the regulation, and to the construction of infrastructure to further strengthen, constantly optimize the credit system of logistics and service system, and constantly trying new ways of the traditional collaborative development between foreign trade and cross-border electricity one step closer to optimization. Is analyzed from the Angle of microcosmic, cross-border electricity producers should

constantly will strengthen its core competitiveness in the market, constantly on technical innovation, ensure the quality of logistics service innovation and system, and further strengthen the social cooperation and division of labor, the enterprise to establish and perfect the core team, only in this way can make the traditional trade and cross-border electricity have better coordination between development.

(5) Facilitate the coordination of subsystems and multiple bodies

Only multi-dimensional cooperation can ensure the normal development of cross-border e-commerce. On the one hand, the functions of each subsystem must be fully stimulated to make them cooperate and develop together; On the other hand, national policies and departments are also needed for in-depth cooperation and collaboration. In the aspect of talent cultivation, not only the government and universities should be promoted to increase the contact, but also major enterprises should cooperate with universities to cultivate professional talents with diversified knowledge. (Simatupang T M, Sridharan R, 2005) In the market, we need to maximize the role of resource allocation.

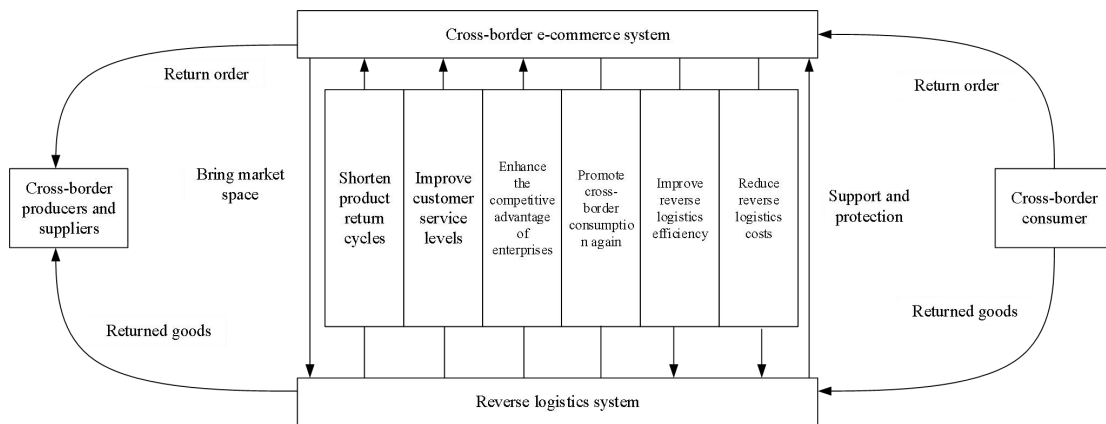


Figure 3 Synergy Diagram of Cross-Border E-Commerce and Reverse Logistics Supply Chain

5 Conclusion

At present, the world has been moving towards economic integration, so cross-border e-commerce slowly wake up from a sleepy state, and is rapidly developing. At present, cross-border e-commerce is still in the infancy stage of development. Although it is highly concerned by various fields, there are relatively few researches on it and reliable results, and some of the research results are not mature and systematic enough. In a word, cross-border logistics and cross-border agents are closely related to each other. Both sides influence each other and continuously promote each other's development. This article through the contrast analysis, for the present the problems put forward the corresponding measures, the research content is to promote the coordinated development of both B2B and B2C mode, with the help of the third party logistics to ensure efficient supply chain resources integration, to further promote the development of the localization of cross-border logistics and electronic business, promote operation, logistics and distribution patterns of innovation, and ultimately to the collaborative strategy is perfect.

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# Regional Difference Analysis of Logistics Industry Service Innovation Capability in Hubei Province of China: Based on Porter's "Diamond Model"

Lv Yuejiao, Liu Mingfei

School of Management, Wuhan University of Technology, Wuhan, P.R.China, 430070

(E-mail: lvwhut@126.com, Liumingfei5223@163.com)

**Abstract:** Based on the understanding of service innovation as an important way to enhance the core competitiveness of modern logistics industry, the evaluation index system of service innovation ability in Hubei Province of China is constructed by using the theory of service innovation and the theory of Porter diamond model and combining the development status of the service ability of logistics industry in Hubei Province of China. At the same time, Principal Component Analysis and Cluster Analysis were used to evaluate the regional differences in service innovation capabilities of the 17 cities and states in Hubei Province of China in 2017, and accordingly, relevant countermeasures were proposed for the service innovation capability of logistics industry in Hubei Province of China.

**Key words:** Regional logistics; Service innovation; Diamond model; Regional difference

## 1 Introduction

Hubei Province of China pays attention to the development of the logistics industry and continuously promotes the modernization of the logistics industry. In the process of logistics modernization in Hubei Province of China, service innovation plays an important role as the key path. Logistics service innovation refers to the innovative behaviors and activities that logistics enterprises invest capital and personnel to develop new products, new technologies and new services to increase service content, improve service quality and service efficiency, and create value (Bin Hu, 2013). The improvement of logistics service innovation ability is conducive to the formation of differentiation advantage, breaking through the existing development bottleneck, so as to reduce logistics costs, enhance the core competitiveness of enterprises, and realize the sustainable development of logistics industry and the transformation to "modern logistics".

At present, the research results of domestic and foreign scholars on the evaluation index system of logistics industry service innovation ability mainly involve two levels: logistics industry and logistics enterprises (Zhang Minjie, 2018). The two levels contain multiple angles. (1) Input and output angle: (Shen Jing, Zhai Ruili, Chen Zhonghua, 2016) constructs the evaluation index system of China's logistics industry service innovation capability from the three criteria of innovation investment, innovation output and innovation environment. (2) The ability to integrate Angle: (Pimden Hertog, Wietzevander Aa, Mark W.d eJong, 2010) focus on the service ability of product innovation, service innovation capability into six dimensions, determine the dynamic capability of a set of service innovation, including customer demand insight and the choice of technology, service conceptualization ability, ability to service

composition and split and common production and arrangement ability, service scope expansion and extension of ability, ability to learn and adapt. (3) Innovation motivation: (Yang liyun,2018) made an in-depth analysis of the impact on the performance of logistics enterprises from the internal and external environment of logistics enterprises. (4) Innovation process perspective: from the perspective of service innovation process, (Tao Yan, Zhou Dan,2014) constructed an enterprise service innovation ability evaluation system including four dimensions of service development capability, service production capability, service marketing capability and organizational support capability. (5) The knowledge outlook enterprise perspective: (Gallouj,2009) has the ability to form a “knowledge base” and the ability to form an “experience base” as two types of service enterprises.

Based on the service innovation as an important way to improve the core competitiveness of modern logistics industry, this paper uses the service innovation theory, Porter diamond model theory, combined with the development status of Hubei logistics industry service capability, and builds the evaluation index system of service innovation ability of Hubei Province of China.

## **2 Theoretical Basis and Research Hypothesis**

### **2.1 Model construction**

Compared with the traditional logistics industry, modern logistics service innovation has the following characteristics: (1) Open innovation. In an open innovation environment, it emphasizes breaking the boundary of the industry (Wang Kun,LuoWenping,2015) and integrating innovation resources, and a single static resource is integrated to achieve its dynamic. (2) Technological knowledge innovation ability. At present, the logistics industry is in a transitional period, and it is making a transition from traditional logistics to modern logistics with the help of service innovation capability. The ability of technological knowledge innovation plays a more important role (Liu Mingfei, Zhou Wei,2008). (3) Regional differences. Different regions have different resources, and resources are scarce. When developing the modern logistics industry, the government should effectively identify, distinguish the levels of each region, allocate resources effectively, and equip them with the capabilities and facilities (Wang Jian, Liu He,2014).

Porter (1990) introduced the diamond model to test the industrial competitiveness of a country. According to porter's diamond, the four attributes of a country fundamentally determine the competitiveness of a country or an industry at the microeconomic level. The diamond model is composed of four factors of production, including market demand, related industries and enterprise strategy, while opportunity and government are two major variables of the diamond model. Based on the diamond model and the characteristics of logistics industry service innovation, this paper constructs a new diamond model of logistics industry service innovation capability. Compared with the influence of corporate strategy on the service innovation ability of logistics industry, the role of technological knowledge innovation ability is more obvious. At the same time, this paper mainly analyzes from the industrial level, pays more attention to the practical significance of the government perspective. Therefore, the technological knowledge innovation ability is replaced by the enterprise strategy in the diamond model.



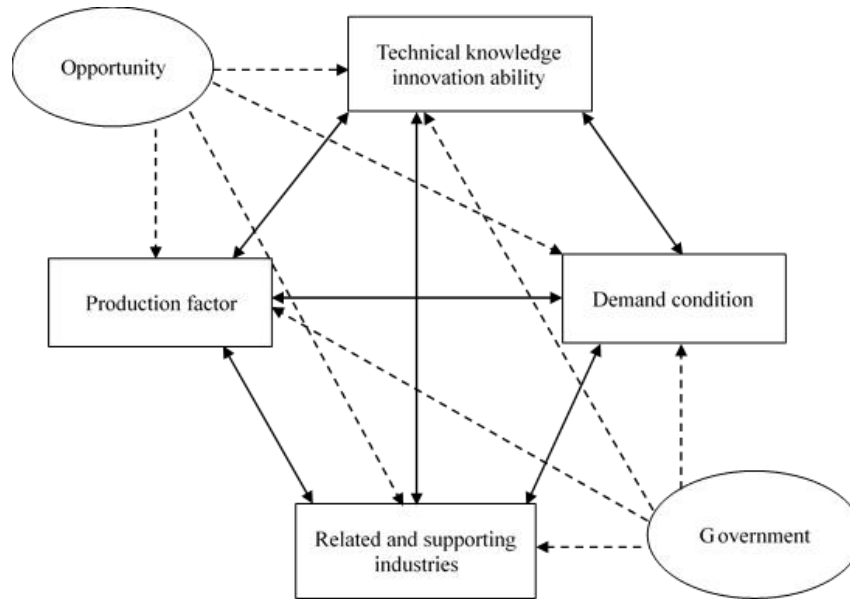


Figure 1 Improved Diamond Model

2.2 Establishment of the evaluation index system

In order to scientifically and reasonably analyze the regional differences in the service innovation capability of logistics industry in Hubei Province of China, the diamond model has been improved according to the characteristics of logistics service innovation capability. Based on the improved diamond model and service innovation theory, the evaluation index system of logistics industry service innovation ability is constructed.

Table 1 Evaluation Index System of Logistics Industry Service Innovation Capability

Primary indicator	Secondary indicators	Three-level indicators	Indicator measurement method	
<b>X1</b> <b>Innovative resource integration capability</b>	Innovation investment	Logistics infrastructure resources investment	Transportation warehousing and postal industry fixed assets investment	
		Logistics information resource investment	Fixed assets investment in information transmission, software and information technology services	
		Logistics human resources investment	Number of people employed in transportation, warehousing and postal services	
	Innovative output	Logistics infrastructure resource output		Number of logistics parks Cargo transportation volume Cargo turnover
			Logistics information resource output	Number of Internet access households

		Logistics human resource output	Average annual salary of employees in transportation, warehousing and postal services
<b>X2</b>	Innovation investment	Logistics R&D investment	R&D expenditure internal expenditure
			Total number of R&D personnel
	Innovation environment	The situation of regional logistics education	Ordinary institutions of higher learning
			Educational expenditure
			High-tech industry added value
			Number of high-tech enterprises
	Innovative output	Patent, scientific and technological achievement	Number of patent applications
			Number of patent licenses
<b>X3</b>	Environment system	Policy Support	The government issued corresponding policies
	Market environment	Supply environment	Transportation warehousing and financial investment in the postal industry
			Highway mileage
			Total post and telecommunications business
	Demand environment		The total retail sales of social consumer goods
			Total foreign trade import and export
			Industrial output
			GDP

The indicator system includes three first-level indicators: innovation resource integration capability, technological knowledge innovation capability, and innovation environment coordination capability. The ability to integrate innovative resources should not only reflect the investment of innovative resources, but also the output of using innovative resources, emphasizing the efficiency of service innovation capability. For this reason, two levels of innovation input and innovation output are selected for measurement; technical knowledge innovation the ability selects three secondary indicators of innovation input, innovation environment and innovation output for measurement; the innovation environment coordination ability selects two secondary indicators of institutional environment (macro) and market environment (micro) for measurement.

### 3 Date and Methodology

#### 3.1 Data collection

This paper takes the specific situation of logistics industry development in 17 cities of Hubei Province of China as the data source. The “Statistical Yearbook” of each city, as well as the government report and the China Economic and Trade Network statistical database are the main data acquisition channels.

#### 3.2 Data analysis

##### (1) Reliability and validity test

In order to reduce the impact of the original data dimension inconsistency on subsequent analysis, the sample data is dimensionless before the factor analysis. The validity of the original data is then checked by KMO test and Bartlett sphere, ensuring that the data can be factored and the results of Table 2 are obtained.

**Table 2 Tests by KMO and Bartlett**

<b>KMO VALUE</b>		<b>0.838</b>
<b>BARTLETT SPHERICITY TEST</b>	approximate chi square	167.06
	Df	28
	p value	0

##### (2) Evaluation of Logistics Industry Service Innovation Capability in Hubei Province of China

**Table 3 Variance Interpretation Rate**

Numbering	Characteristic root	Variance interpretation rate%	Cumulative %	Characteristic root	Variance interpretation rate%	accumulation%
1	5.991	74.885	74.885	5.991	74.885	74.885
2	1.068	13.35	88.236	1.068	13.35	88.236
3	0.579	7.244	95.479	-	-	-
4	0.165	2.063	97.543	-	-	-
5	0.085	1.068	98.611	-	-	-
6	0.066	0.827	99.437	-	-	-
7	0.03	0.372	99.81	-	-	-
8	0.015	0.19	100	-	-	-

It can be seen from Table 3 that after comparing the eigenvalues of the factors, the cumulative contribution rate of the first two principal components is found to be 88.236%, so the main factors are  $F_1$  and  $F_2$ . By calculating the coefficients of each of the two principal components, the formula for calculating the scores of the principal components is obtained:

$$F_1=0.156X_1+0.157X_2+0.161X_3+0.079X_4+0.159X_5+0.164X_6+0.162X_7+0.087X_8$$

$$F_2=0.159X_1-0.219X_2+0.046X_3+0.659X_4+0.075X_5-0.009X_6-0.026X_7-0.648X_8$$

According to the weighting weight of each principal component's variance contribution rate calculated by the contribution rate of all principal component variances, the evaluation formula of logistics industry service innovation input index of 17 cities in Hubei Province of China can be obtained:  $A_1=0.849F_1+0.151F_2$ , using the same the method calculates the technical knowledge innovation ability index and the innovation environment coordination ability index evaluation formula:  $A_2=F_3$ ,  $A_3=0.828F_4+0.172F_5$

#### 4 Results

According to the scores of the three dimensions of logistics service innovation ability of Hubei Province of China, the comprehensive score of Hubei Province of China's logistics industry service innovation ability is calculated by a certain weight (Table 4).

**Table 4 Regional Difference Factor Score, Comprehensive Ranking and Cluster Results of Logistics Industry Service Innovation Capability in Hubei Province of China**

Area	A1	A2	A3	Total score	Total ranking	Clustering
Wuhan	3.026	3.704	3.098	3.312	1	1
Fuyang	0.429	0.505	0.381	0.450	2	2
Yichang	0.505	0.426	0.385	0.450	3	2
Yellowstone	0.221	-0.127	-0.005	0.036	4	3
Jingzhou	0.200	-0.112	-0.091	0.017	5	2
Huanggang	0.203	-0.252	-0.110	-0.042	6	2
Jingmen	-0.278	-0.138	-0.232	-0.213	7	3
Shiyan	-0.258	-0.290	-0.049	-0.229	8	2
Xiaogan	-0.348	-0.177	-0.232	-0.256	9	3
Xianning	-0.258	-0.330	-0.275	-0.290	10	3
Enshi	-0.302	-0.368	-0.183	-0.305	11	3
Suizhou	-0.485	-0.402	-0.146	-0.384	12	3
Ezhou	-0.302	-0.439	-0.478	-0.392	13	3
Qianjiang	-0.465	-0.396	-0.500	-0.444	14	3

Tianmen	-0.578	-0.503	-0.509	-0.534	15	3
Xiantao	-0.564	-0.535	-0.502	-0.540	16	3
Shennongjia Forest Area	-0.743	-0.566	-0.551	-0.634	17	4

It can be seen from Table 4 that the service innovation ability of logistics industry in 17 cities and counties in Hubei Province of China is from high to low: Wuhan, Fuyang, Yichang, Huangshi, Jingzhou, Huanggang, Jingmen, Shiyan, Xiaogan, Xianning, Enshi, Suizhou, Ezhou, Qiang Jiang, Tianmen, Xiantao, Shennongjia Forest Area.

### 5 Conclusion

By comparing the results of the above factor analysis and cluster analysis, it is found that the ranking of factor analysis scores of the overall city and state has a good consistency with the ranking of cluster analysis results. Only the ordering of Huangshi City and Shiyan City has a certain way out, indicating the above analysis. Effectiveness. According to the above factor analysis and cluster analysis results, we divide the logistics industry service innovation ability of 17 cities and counties in Hubei Province of China into the following four levels: (1) The first level of service innovation ability is strong and belongs to the leading area; (2) The second level of service innovation ability is general, belonging to the follow-up area; (3) the third level of service innovation ability is weak, belonging to the enhanced area; (4) the fourth level of service innovation ability is very weak, belonging to the help-oriented area. The results of hierarchical division are shown in Table 5.

**Table 5 Hierarchical Clustering Results of Service Innovation Capability of Logistics Industry in Hubei Province of China**

Ability	Clustering	Quantity	Inclusion area
Strong	I	1	Wuhan
General	II	5	Xiangyang, Yichang, Jingzhou, Huanggang, Shiyan
Weak	III	10	Huangshi, Jingmen, Xiaogan, Xianning, Enshi, Suizhou, Ezhou, Qianjiang, Tianmen, Xiantao
Very weak	IV	1	Shennongjia Forest Area

(1) Category I area: The logistics industry has the strongest ability to innovate in the category I area. Wuhan leads the other cities with a score of 3.312. As a provincial capital, Wuhan is leading the way in service innovation investment, output and support. Wuhan should play the radiation role of the city circle and drive the development of logistics service innovation in surrounding cities.

(2) Category II area: The logistics industry has a strong ability to innovate in logistics services in the category II region, with a strong catch-up situation. While maintaining the scale effect, the service innovation ability of the logistics industry should be continuously strengthened from the aspects of technology, talent and management to improve the technical efficiency.

(3) Category III area: The logistics service capacity of the category III area is weak. The overall advantages of the 10 cities in the region are insufficient, but the advantages in some aspects are very obvious, and further development can be achieved through further strengths and weaknesses. Due to problems such as backward economic development, low technical level and lack of professional talents in the region, relevant input should be strengthened.

(4) Category IV area: The logistics service capacity of the category IV area is very weak. The Shennongjia forest area is subject to restrictions such as low level of economic development and shortage of resources, and its service innovation capability is weak. The government should correctly evaluate the advantages and disadvantages of its logistics industry as well as the changes in the external environment to accurately help its development.

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# Research on the Innovation Operation Mode of Science and Technology Business Incubator and its Influence on Innovation Economy

Han Wensi<sup>1,2</sup>, Xie Jialong<sup>3</sup>

1 School of Management, Wuhan University of Technology, Wuhan, P.R.China, 430070

2 School of Innovation and Entrepreneurship, South-central University for Nationalities, Wuhan, P.R.China, 430074

3 School of Management, South-central University for Nationalities, Wuhan, P.R.China, 430074

(E-mail: danisxxx@163.com, xiejialong1234@126.com)

**Abstract:** The incubator's promotion of entrepreneurial development and the help of N.E. growth make its research have a strong practical significance. At the same time, concern for the sustainability of incubator development, the core of the problem lies in the ability to configure their incubator resources, that is, the level of incubating-efficiency. By DEA, In-depth interviews to discuss the situation in Beijing sci-tech business incubator, as well as four generations and five functional influencing factors on incubating-efficiency and the improving path of the sample derived from the incubator in China, which proposed a new hierarchical model and incubation Strategies for improving of incubating-efficiency.

**Key words:** Sci-tech business; Incubator; Innovation economy; DEA; Incubating-efficiency

## 1 Introduction

In today's world, with the continuous development of information, network, globalization, high-tech industry promoting sustained and rapid economic growth has become the trend of global development. Under such a trend, how to realize the fast innovation of sci-tech achievements commercialization industrialization, how to support high-tech new ventures effectively, has become a major problem in countries in the formulation of sci-tech progress plan and high technology industry development needs to platform (Duanyang Ren, 2015).

Business incubator is a specialized system which designs and operates the new support to sci-tech business. This concept was originally produced in the United States in the fifty's of last century. In our country, sci-tech business incubator is also known as the high-tech business service center (D. Patten, Danny P., 2009, 2011). Since the birth of the first sci-tech business incubator in Wuhan, China's sci-tech business incubator has achieved a healthy and rapid development (Beverland, 2013). According to statistics, as of the end of the year, China's sci-tech business incubators have been to 1000. China has become a big country of incubator. At the same time, due to various reasons, the current in the sci-tech business incubator of the relevant theoretical research or practical operation, there are many shortcomings and deficiencies, and the advanced level of foreign countries and a certain gap (Sean M., 2014).

In the concept of sci-tech enterprise incubator, the researchers have made many theoretical and practical aspects of the research in the decades (Diane A., 2013). At present, the domestic scholars have carried on the comparatively deep research to the sci-tech business incubator and its management, the

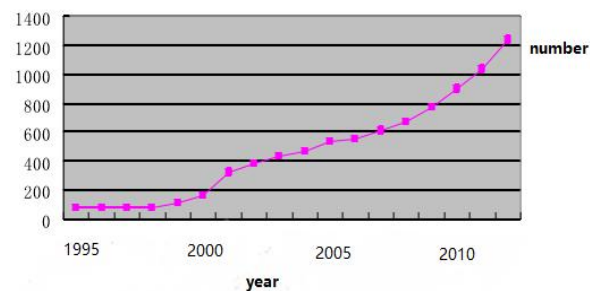
government function, the performance evaluation research and the operating mechanism, but in the sci-tech business incubator's business operation pattern, the network system construction and the management pattern, the incubation power promotion researches and so on, also lacks of system research, waits for the innovation (T. K. Gibson, 2013).

The development and the rise of sci-tech enterprise incubator is the inevitable requirement for the development of new sci-tech revolution. By providing research and development, production, management of the site, communication, network and office facilities, the system of training and consulting, policy, financing, legal and marketing and other aspects of support, sci-tech enterprise incubator can effectively reduce the venture and venture capital, improve the survival rate and success rate (Aberg, 2013). The experience of sci-tech business incubator in China has more than 20 years' experience. As a bridge between knowledge innovation and sci-tech enterprise, it can realize the industrialization of sci-tech achievements and promote the development of sci-tech enterprises, especially in small and medium sized enterprises.

At the same time, due to the late start of the sci-tech enterprise incubator, the relevant research is not perfect, and the vast majority of sci-tech enterprise incubator has a quasi-government background, many sci-tech enterprise incubator is not reasonable, the strategic positioning is fuzzy, the incubation efficiency level is not high, the related value-added services is limited, and other aspects of the problem (Beelitz, 2012). Through sci-tech enterprise incubator operation innovation research, it can effectively solve the problems in development, and promote the healthy and sustainable development of sci-tech business incubator in china.

## 2 Efficiency Measurement and Morphological Clustering Analysis of Science and Technology Business Incubator

With the rapid expansion of the number and scale of the sci-tech enterprise incubators in China, it has caused more and more attention. There are a lot of researches on the performance evaluation of the business incubators in China, but they are not combined with the incubator. The so-called efficiency, that is, to achieve a predetermined target. If the target of a business incubator is not clear, how to measure its efficiency? However, because of the special circumstances of the business incubator, the target of each incubator is different. A business incubator has multiple targets (Beverland, 2013). Therefore, this paper measures the incubating-efficiency of five of the most common incubating targets (functional dimension), and to explore the actual incubating behavior and morphology. Figure 1 Is



national incubator number growth curve chart from 1995 to 2012.

ve chart

**Figure 1 National Incubator Number Growth Curve Chart from 1995 to 2012**

Investors want to know whether the input is effective or not, policy makers would like to know how the technology business incubator has a real impact on the transformation of sci-tech achievements,



the development of sci-tech industry and the development of regional economy and society; Small and medium sized enterprise more need to know whether the light of technology enterprise can really promote its growth, the alternative of the technology enterprise's performance how to get drunk, what function is better. Nonetheless, there is still no convincing evidence that the Chinese tech business incubator has a good performance. Therefore, based on the different functional dimensions, it has very important practical significance for the Chinese sci-tech enterprise incubator to carry on a more detailed efficiency measure.

## 2.1 Model construction

The most common five functional dimensions of sci-tech enterprise incubator, including business incubator, technology, innovation, incubator, regional employment and regional economic dimension (Wen-Bo Wang , 2013). Specifically, the dimensions of corporate entrepreneurship is sci-tech business incubators new ventures to enhance the survival and development, and the cultivation of innovative entrepreneurs, which is enterprise of sci-tech incubator the most basic function. Technology transfer and innovation dimension is the function of incubator in technological innovation. This is one of the most important functions of the technology business incubator, including technology transfer and commercialization. Incubators profitability dimension refers to whether the sci-tech business incubator can achieve self-supporting profit, shows that the business incubator can be normal, continuous operation. The dimension of regional employment is the social function of the business incubator, which is mainly reflected in the increase of social employment and so on. Regional economic dimension is the function of the local government in particular emphasis. As an important policy tool for the government, a lot of business incubators in the establishment of the original intention is used to increase the local financial revenue, the revitalization of the regional economy (Zhenfeng Ge, 2018).

## 2.2 Research method

Efficiency is a relative concept, which is different between the actual and potential of the unit. The gap is small, that is closer to the maximum output, the higher technical efficiency, otherwise efficiency is low. The curve of the maximum output is called the production possibility. The distance between production possibility and boundary is closer, then the efficiency is high, otherwise the efficiency value is low. In this paper, the national sci-tech business incubator is considered as a decision-making unit. These resources and the utilization ratio of the business incubator determines the maximum output of the business incubator. If the actual output of the business incubator is equal to the maximum output, it is considered that the activity of the incubator is efficient, and vice versa.

At present, there are two main methods to measure the efficiency: parametric method and non-parametric method (Keying Chen, 2019). No parametric method is represented by data envelopment analysis method. The method has no need to set the function form, thus avoiding the influence of the subjective factors, and has obvious advantages in dealing with the efficiency of multi input and multi output. But this method is sensitive to outliers, which can easily lead to low efficiency, and neglect the effect of measurement error in the measurement. Parametric method is the most widely used in the stochastic frontier analysis method. It needs to estimate the model in advance, based on a more solid theoretical foundation, and can describe the production process, so as to test the efficiency of the estimation. In addition, in the measure of the efficiency value of the decision unit, we can further analyze the influence factors of the efficiency. Sci-tech enterprise incubator efficiency measure and influence factors analysis is an important research content of this paper. Therefore, the application of analysis method can just solve the problem. The general form of the model is as follows:

$$X = 2\pi k + \pi - \alpha_1 - \pi M \sin Y \quad (1)$$

It represents the actual output of the technology business incubator  $i$  in the period  $t$ .  $X$  represents a set of input elements.  $Y$  is the largest output that can be obtained in a set of inputs, i.e., at the frontier of production possibility frontier.  $\epsilon$  is the effect of random perturbation;  $\eta$  said the technology inefficiency and obey the normal distribution of non-negative tail.

The technical efficiency can be expressed as the ratio of the actual output of the decision unit to the potential output ratio, i.e. (Wenqing Wu, 2017), the following formula:

$$u_{p1}(X, Y) = \begin{cases} 0 & X \begin{cases} < 2\pi k + \pi - \alpha_1 - \pi M \sin Y \\ \geq 2\pi k + \pi - \alpha_1 + \pi M \sin Y \end{cases} \\ E/6 & X \begin{cases} < 2\pi k + \pi - \alpha_1 + \pi M \sin Y \\ \geq 2\pi k + \pi - \alpha_1 - \pi M \sin Y \end{cases} \end{cases} \quad (2)$$

It represents the technical efficiency. The decision making unit is below, where the efficiency of decision making units; When  $X$ , the decision unit is located on the front face, where the efficiency of decision making units, showing that the technology is effective.

In order to find out the factors that affect the efficiency of the technology, the following formula is needed.

$$u_{p1}(X, Y) = \frac{A_{00}}{2} + \sum_{n=1}^{\infty} (A_{on} \cos nX + B_{on} \sin nY) + \sum_{n=1}^{\infty} (A_{mo} \cos mX + B_{mo} \sin mY) + \sum_{m=1}^{\infty} \sum_{\pm 1}^{\pm \infty} [A_{mn} \cos(mX + nY) + B_{mn} \sin(mX + nY)] \quad (3)$$

$A_{mn}$  is the important factor that causes the technology to be inefficient;  $B_{mn}$  is coefficient vector for influence factors. When the value is positive, indicating that the efficiency has a negative impact; when it is negative, the impact factor has a positive effect on the efficiency value.  $\epsilon$  is random error term.

SAF needs to select the production function before the efficiency measure. At present, there are two kinds of common function forms of the production function of Douglas, and the function of the transcendental logarithmic production function. In this paper, we use the first function form.

The evaluation index system of sci-tech enterprise incubator is 100 points. The total score is the score of each index. Calculation formula for each index is:

$$A_{mn} + jB_{mn} = \frac{2}{(2\pi)^2} \int_{-\pi}^{\pi} \int_{-\pi}^{\pi} u_{p1}(X, Y) e^{j(mX+nY)} dXdY \quad (4)$$

$S_i$  is the score of index  $i$ ;  $O_i$  is observation value of index  $I$  (The observation value is the correlation index system data value of sci-tech enterprise incubator);  $S_I$  is the standard value of index  $I$  (It is the relevant index system should meet the standards) is the weight of index  $i$ .

The total score (incubator evaluation index total score: TTS) is as the following:

$$\frac{1}{\pi} \int_0^{\pi} e^{jmM\pi \sin Y} e^{jnY} dY = J_n(mM\pi) \frac{e^{jn\pi} - 1}{2}$$

(5)

Finally, the evaluation of the ability of the sci-tech enterprise incubator can be calculated by the formula (5). The higher the score, the higher the network operator of the sci-tech enterprise incubator, the weaker, otherwise weaker.

### 3 Empirical Analysis

#### 3.1 Evaluation value of incubation capacity index system of technology enterprise incubator

The evaluation model is constructed based on the index system and the formula above. First of all, the evaluation index system, weight and expected value are cited above; Secondly, the numerical value of the Beijing sci-tech business incubator is extracted, and thirdly the corresponding values are compared with the international standard; Finally, the score of each level index and the final score of the whole model are calculated by using the formula and weight above. The established evaluation model is shown in the Table 1.

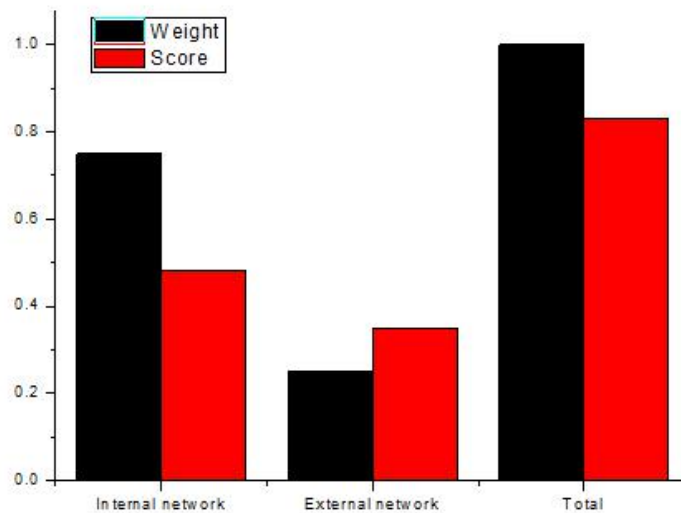
#### 3.2 Incubation capacity evaluation

According to the Beijing sci-tech business incubation force of the score, you can compare the internal network, the external network and the international standards of the gap, as shown in Figure 2.

**Table 1 The Expectation Value of the Evaluation Index System of Incubator**

irst level indicator	Second level indicator	Third level indicator	Unit	Expectation	
Internal network	incubation enterprise	Infrastructure construction investment	Million yuan	20	
		Hatching success rate	%	60	
	Financial institution	Financing ratio	%	25	
		Information network construction	%	80	
		Agency	Bachelor degree number / total number	%	90
	Number of intermediaries		number	15	
	Research Institute	Patent number	number	30	
		Conversion rate of scientific and technological achievements	%	80	
	External network	The government	Preferential policies for science and technology	number	25
			Number of special funds	number	15

policy			
	Preferential tax policy	number	12
Support system	Risk investment institutions	number	20
	Government involvement in investment	Yes or not	yes
University, scientific research institute	Introduction of talent	number	150
	Cooperative project number	number	120
	Provide facilities	number	80
Incubator	Contact number	number	500



**Figure 2 Comparison between Hatching Ability and Expected Value**

According to the above, the black column indicates the standard that should be reached, and the red column indicates the actual value. While the difference between black and red column indicates the gap between the Beijing sci-tech business incubator and the international standard. From the Figure 2, the Beijing sci-tech business incubator's internal network level is significantly stronger than the external network level. Although the internal network level still needs to be improved, but the lack of external network has seriously affected the overall level of Beijing sci-tech business incubator. The internal network is made up of incubators and enterprises, financial institutions, intermediary organizations, research institutions and other internal organs. The external network consists of incubators and government, venture capital institutions, universities, research institutes, and other vessels. Smooth, tightness, safety, internal conditions and factors such as network size determine the level of enterprise of sci-tech incubator. As mentioned earlier, the credit mechanism is not perfect, between enterprises lack a sense of trust, enterprise network cooperation exists potential problems, the application of information technology is not sufficient, these corresponding have bad influence on the network close, smooth and safe existence, resulting in the incubation level of Beijing sci-tech business incubators is far from the

international level, just to meet the standard. This gap is particularly reflected in the external network is not perfect.

### 3.3 Analysis of hatching efficiency based on functional dimension

Figure 3 is the average efficiency of five functional dimensions of Chinese national sci-tech business incubators. Consistent with the results in the above table, in promote high new technology enterprise growth and regional employment growth in two aspects, the efficiency values of National Sci-tech business were significantly higher than efficiency values of the other dimensions. For obtain employment promoting the growth of high-tech enterprises, the efficiency of the national sci-tech business incubator value increased year by year. At the same time, the national sci-tech business incubators in the efficiency of acquiring profitability also showed an upward trend, showing that more and more private incubators join into the ranks of the national level, and more and more technology business incubators began to focus on profitability. Although the technology business incubators in the promotion of the efficiency of the regional employment has been rising, but the overall trend is upward. National Sci-tech business incubator in promoting regional economic development efficiency instead in decline, which may incubator with the rapid expansion of the scale. Finally, in the promotion of technology transfer and technological innovation, the efficiency of the business incubator is a rising trend. This is related to the increase in the number of intellectual property rights of the national sci-tech business incubators in recent years.

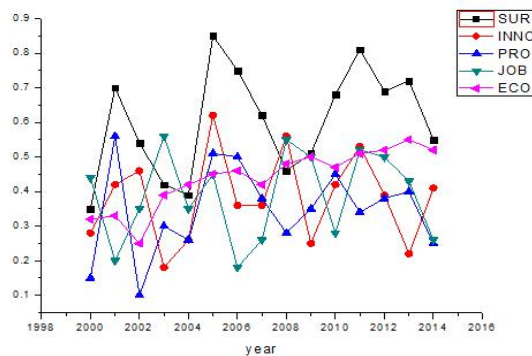


Figure 3 Efficiency Values of Five Functional Dimensions

### 3.4 Morphological clustering analysis based on efficiency

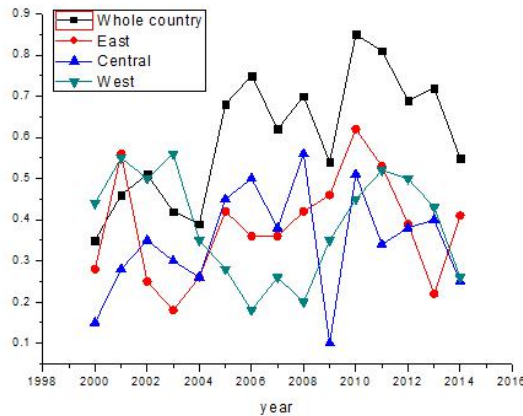
In order to further study the efficiency of the sci-tech enterprise incubator in each dimension, that's the actual incubation behavior, this paper analyzes the average efficiency value of every national sci-tech enterprise incubator in every dimension in five years. Below the average efficiency value of five functional dimensions as a variable, conduct the value cluster analysis (the paper also carried out the hierarchical clustering analysis, the results show that the more reasonable). The final cluster center table of the fast clustering method is shown in Table 2 below.

**Table 2 Clustering Analysis Results of Different Clustering Centers**

Model	Cluster number					
	3	4	5	6	7	8
INNO	0.25	0.31	0.17	0.62	0.47	0.22
JOB	0.45	0.48	0.25	0.31	0.75	0.36
PRO	0.25	0.65	0.74	0.34	0.46	0.18
SUR	0.81	0.64	0.12	0.18	0.26	0.38
ECO	0.40	0.23	0.14	0.35	0.24	0.19

**3.5 The influence of scientific and technological business incubator on convergence of economic**

In the study of the influence of the sci-tech enterprise incubator on the economic convergence of the city, the convergence of the regional economy should be measured. The use of  $\partial$  convergence method can see the level of economic development gap between the capital cities of Chinese clearly, shown in Figure 4. From the point of view of the country, the level of economic development between the urban existence obvious convergence, especially after 2008 ( $\partial$  values showed a clear downward trend). According to the traditional Eastern, middle and western regions, the capital city of the west capital city has some obvious convergence. The urban economy in the eastern part of the city has a certain convergence, and the economy of the capital city in the central part of the city has a certain divergence.



**Figure 4  $\partial$  Testing of Economic Convergence of Cities**

In order to separate the influence of the technology business incubator on the local economy and the convergence, the influence factor of the technology enterprise is added to the formula (4). Model 3, model 5 and model 4 use the least square method, the random effect method and the fixed effect method to estimation results. After comparison and analysis, the results refused the random effects of the original hypothesis, so the fixed effect model is better than the random effect model. As can be seen from the table, the fixed effect model is ideal for estimating the results of measurement. After adjusting the fitting degree has a substantial increase than before, and through the F test.

## 4 Conclusion

In this paper, the evolution of Chinese sci-tech enterprise incubator is divided into four generations, and the corresponding theory is used to explain the theory of the business incubator. Secondly, on the basis of summing up the five most common functional dimensions of business incubator, the efficiency value of the Chinese sci-tech enterprise incubator in each functional dimension is calculated, and the incubator is divided into six forms by using clustering analysis method. In the analysis of the factors affecting the incubating efficiency, this paper analyzes the area of business and the macro level from the micro level to the micro level, which is based on the theory and the externality theory. Finally, based on the new economic growth theory and endogenous economic growth theory, the influence of technology business incubator on the regional economic level and regional innovation level is studied. The main conclusions are as follows:

Overall, the efficiency of Chinese technology enterprises is low. And in promoting the transformation of sci-tech achievements, increasing the efficiency of regional employment and access to profitability is low.

According to the results of cluster analysis, the Chinese sci-tech business incubator can be divided into six forms: the entrepreneurial orientation, the economic orientation, the innovation oriented, the profit oriented, the general efficiency and the general low efficiency. And only two incubators are generally efficient, and most are still generally inefficient. This also confirms that the overall efficiency of Chinese sci-tech business incubators is low.

The ability of the business enterprise in the process of dealing with the product harm crisis is stronger than the external enterprise. This kind of enterprises have a stronger ability to survive, will have a greater positive impact on the performance of the incubator.

## Acknowledgement

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## Management and Operation of Trace Evidence Laboratory under the CNAS Review System

Lv Caihong<sup>1</sup>, Liu Guomin<sup>1,2</sup>, Fang De<sup>3</sup>

1 Jun An Forensic Center of Hubei, Wuhan, P.R. China, 430065

2 Criminal Justice School, Zhongnan University of Economics and Law, Wuhan, P.R.China, 430073

3 Center for Materials Research and Analysis, Wuhan University of Technology, Wuhan, P.R.China, 430070

(E-mail: lvchwhu@163.com, 370992420@qq.com, fangde94@163.com)

**Abstract:** The current status and problems of the accreditation work for the forensic science laboratories are analyzed in the paper. Meanwhile, the management and operation methods of the trace evidence laboratory under the CNAS (China National Accreditation Service for Conformity Assessment) review system are introduced. It proposes that the management of the trace evidence laboratory needs to consider factors such as personnel, equipment, samples, environment, methods and quality. Furthermore, the corresponding management procedures should be formulated to ensure the orderly operation of each link. Finally, the author shows the next research direction and prospects in the future.

**Keywords:** Trace Evidence Laboratory; CNAS; Management; Operation

### 1 Introduction

In many investigations of litigation case and accidents, it is required to identify or compare certain substances related to the case or accident. The types of these substances are very large and the amount available for identification or comparison might be extremely small. The common substances (such as paint, glass, fiber, paper, ink, rubber, grease, cosmetics, adhesives, metals, wood, soil, explosives, mineral oil or combustion aid, plastics, etc.) are collectively called as trace evidence in the field of forensic science (Yan Chunlei, 2011).

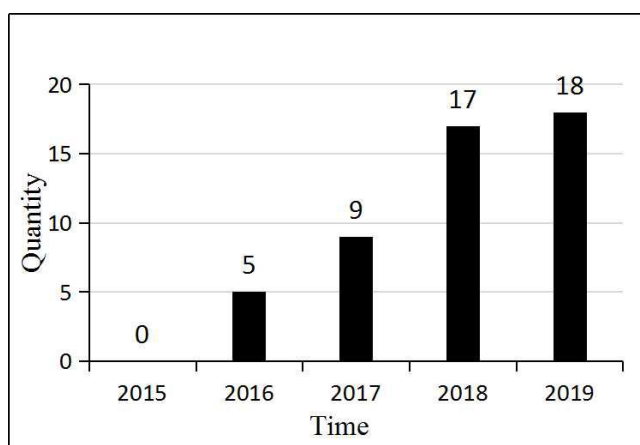
The trace evidence laboratory is a place used for trace evidence identification. It has the following distinct characteristics that are different from the ordinary laboratory. In the process of testing, it is required to keep the confidentiality of the case and preservation of material evidence. And, higher requirements have been proposed for equipment management. Some devices are specially developed for trace evidence test and lack relevant verification or calibration standards. In addition, trace evidence tests are different from ordinary tests. The examination objects are divided into known comparison samples and unknown materials, which need to be identified their type and characteristics to determine their source. They are usually taken away from the scene or left in the case site by criminals, and they both must be effectively isolated. Furthermore, standard substances required for the appraisal of trace evidence may not be available from the existing reference material supply department and need to be self-made (Quan Yangke, 2007). However, these characteristics have brought enormous challenges to the management and operation of trace evidence laboratory under the CNAS (China National Accreditation Service for Conformity Assessment) review system. In order to solve these difficulties, many scholars have researched and explored (Malkoc Ekrem, 2006, Liu Shuo, 2013). Hua Feng deeply

analyzed the present situation and existing problems in the recognition of forensic science laboratories. He thought accreditation work should be slower and the focus should be transferred to the basic work such as unifying inspection methods, training high-level and professional reviewers, organizing multidisciplinary proficiency testing, etc (Hua Feng, 2006, Hua Feng, 2009). Pan Xi proposed three measures to improve the utilization of personnel, equipment and management resources, the internal management level and the identification quality of the appraisal institution. Firstly, integrating the platform and sharing equipment. Secondly, strengthening management and standardizing the process. Thirdly, raising the threshold and building a profession (Pan Xi, 2013). Tao Qiangsong studied in forensic laboratory accreditation from the perspective of the Public Security Organs. Current status of laboratory accreditation in judicial appraisal institutions and the contradictions encountered in the reform were analyzed, and many good suggestions were put forward (Tao Qiangsong, 2013). Teng Jing also analyzed the realistic difficulties and breakthrough of forensic laboratory accreditation (Teng Jing, 2016).

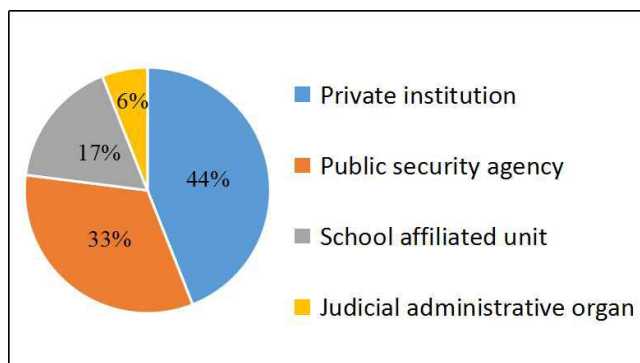
Based on these studies, some suggestions for management and operation of trace evidence laboratory under the CNAS review system are put forward based on the personnel, equipment, samples, environment, methods and quality in this paper. Meanwhile, the next research directions and prospects for the development of the future trace evidence laboratory are also discussed.

## 2 Management and Operation Methods

More and more trace evidence laboratories are approved by CNAS from 2015 to the present (as shown in Figure 1). According to the quantitative statistics, it grows the fastest in 2018. Up to now, there are only 18 trace evidence laboratories in total approved by CNAS in China. It indicates that laboratory accreditation is getting more and more popular, but there are few laboratories are approved by CNAS. It is probably because that the management and operation mode of many trace evidence laboratories could not meet the requirements of CNAS. Based on the institution nature of the trace evidence laboratories at present, 44% of laboratories are private institutions and 33% laboratories are public security agencies, while the percentage of judicial administrative organ is the least (as shown in Figure 2). It indicates that the private institutions attach great importance to the management of laboratories and take a major role in the judicial identification. Then, some methods of management and operation of trace evidence laboratory under the CNAS review system are discussed in the following contents.



**Figure 1 Quantitative Statistics of Trace Evidence Laboratory  
Approved by CNAS from 2015 to the Present**



**Figure 2 Percentage Statistics of the Institution Nature of the Trace Evidence Laboratories Approved by CNAS from 2015 to the Present**

### 2.1 Personnel management

Personnel Training and Assessment Procedures and Management Function FL location tables (as shown in Table 1) which specify staffing, training, authorization, and file management requirements to ensure adequate and qualified human resources should be drawn up. The trace evidence laboratory requires at least three licensed appraisers, one of which at least has a deputy senior title or has been engaged in the related work for more than 5 years after obtaining intermediate title. In order to ensure that the on-the-job personnel have the required professional knowledge and ability, the appraisers need to receive continuing education training, supervision and assessment every year, including relevant laws, regulations, professional skills, cross-examination skills in court, etc. The training time is not less than 40 hours per year.

**Table 1 Management Function Allocation**

System Element Department	Positive (deputy) Director	Quality Director	Technical Director	Administrative Director	Related laboratory
Fairness	▲	▲	▲	○	▲
Confidentiality	▲	▲	▲	△	▲
Independence	▲	▲	▲	○	▲
Organization	▲	△	△	△	○
Management System	▲	▲	△	△	○
Document Control	△	▲	○	▲	△
Entrusted Acceptance	△	○	▲	△	▲
Subcontract	△	△	▲	△	▲

Service and Supply Procurement	▲	○	△	▲	△
Customer Service	▲	○	△	▲	○
Complaint	▲	▲	△	▲	△
Non-conformance Term Control	△	▲	▲	○	△
Improvement	▲	▲	△	△	△
Corrective Action	▲	▲	△	△	△
Precaution	▲	▲	△	△	△
Record Control	△	▲	▲	▲	△
Internal Review	▲	▲	▲	△	△
Management Review	▲	△	△	△	△
Profile	△	△	▲	△	△
Personnel	▲	△	▲	▲	○
Facilities and Environment	▲	△	△	▲	○
Identification Method	△	○	▲	○	△
Equipment	△	○	△	○	▲
Quantitative Traceability	△	△	▲	△	△
Sampling	△	○	▲	○	▲
Sample Disposal	△	△	▲	○	▲
Quality Assurance	△	△	▲	○	△
Identification Document	△	△	▲	▲	▲

▲ Main function    △ Related function    ○ Related Department

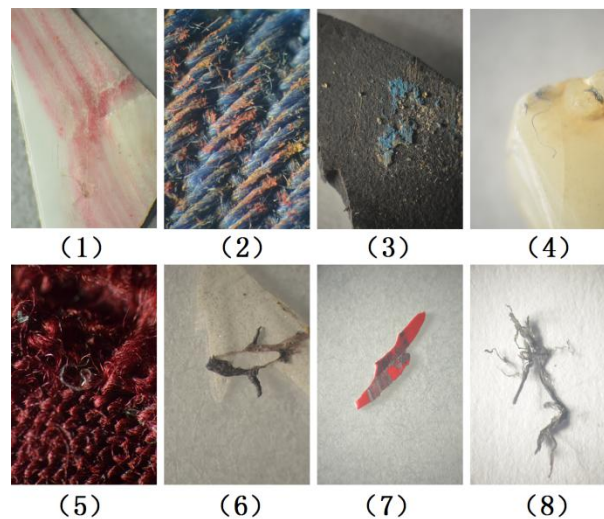
## 2.2 Equipment management

Equipment Management Procedure which stipulates the purchase, acceptance, identification, calibration, use, maintenance, verification, repair, and scrapping of the identification equipment (including hardware and software) should be formulated to ensure that the equipment is in good working condition and the identification result is accurate and reliable. The trace evidence laboratory should be equipped with the corresponding devices according to the instrument configuration requirements of forensic unit's accreditation. All analytical equipment and measuring instruments should be calibrated and verified periodically. For particular instruments and equipment specially developed for trace

evidence identification and without legal verification or calibration procedures, functional verification should be carried out. Subsequently, it should be confirmed whether the instruments and equipment could meet the requirements for identification and related standard specifications. The equipment should be labeled, indicating the equipment name, equipment number, equipment owner, equipment status, etc. In addition, operators of large-scale equipment must be trained, assessed and authorized. The use of the equipment should be recorded to ensure its traceability, including information such as time, user name, inspection content, instrument status and so on. Furthermore, each identification instrument or software should be uniquely identified. The key equipment that have significant impact on the identification results, such as energy disperse spectroscopy, spectrometers, etc., should be regularly maintained and build independent equipment archives. The equipment archive contains at least the following contents: name of the device and its software, unique identification, verification record, location, instruction manual, verification or calibration certificate, equipment acceptance record, equipment usage record, equipment maintenance record, etc.

### 2.3 Identification sample management

Develop Identification Sample Management Program that specifies methods for extracting, receiving, disposing and storing identification samples to ensure their integrity, confidentiality and traceability. When extracting a small amount of sample, both the carrier and sample should be photographed and fixed (as shown in Figure 3). When receiving the identification sample, its authenticity and integrity should be examined firstly. Then, its name, type, quantity, shape, storage status and time of receipt should be registered. Finally, it should be uniquely identified and status identified. If the sample needs to be damaged or destroyed during the identification process, the client must be informed and provide their written consent. Additionally, there should be a special preservation facility to store the identification samples and check them regularly.



**Figure 3 Micrograph of Common Trace Evidence under High Power Microscope**

( Notes: Figure (1)-(3) are paints respectively attached to paint, fiber, and rubber carriers, figure (4)-(5) are fibers respectively attached to plastic and fiber carriers, figure (6)-(7) are plastics attached to paint carriers and figure (8) is rubber)

### 2.4 Environmental control

Prepare Environmental Management Procedure to control the configuration and condition of facilities and the environment to ensure that they meet the requirements for identification work.

Environmental control factor includes space, dust, temperature, humidity and vibration. The non-inspectors should be restricted from entering areas in the trace evidence laboratory that may cause sample contamination. The trace evidence laboratory should be equipped with appropriate safety protection facilities, such as personal protective equipment, smoke alarms, eyewash devices, emergency sprinklers, fire extinguishers, etc. It should be ensured that the facilities and environment of the trace evidence laboratory do not affect the identification results. And, it should have corresponding conditions to ensure special requirements of some equipment. For examples, scanning electron microscopy requires no interference from magnetic fields and mechanical vibrations around, and infrared spectrometer requires constant temperature and humidity.

### **2.5 Method management**

Establish Identification Method Selection and Use Procedure to ensure that the identification methods used are accurate and effective. International standards, national standards, industry standards or technical specifications approved by the judicial administrative authorities should be preferentially used. In the absence of above standards, the approved method recommended by the Ministry of Justice or its authorized department should be preferentially used. Self-developed non-standard methods must be confirmed by the organization designated by the judicial administrative authority at or above the provincial level. Non-destructive testing methods should be used as much as possible. When it is necessary to test the same sample in a variety of ways and the amount of the sample is very little, the non-destructive testing methods should be used first, followed by the destructive testing methods.

### **2.6 Quality control**

Establish Quality Control Procedure to monitor the effectiveness of the identification results to ensure the quality of the identification (Swagman, 2000). The methods of quality control are as follows: One, use the certified standard substance or the secondary standard substance to check the result in the routine inspection and analysis process. Two, repeat the inspection of the retained sample by the same operator. Three, repeat the inspection of the retained sample by more than two person. Four, use the different analytical methods to test the same sample. Five, participate in proficiency testing (National association of testing authorities, 2012) or other inter-laboratory comparison activities. Six, results of all internal quality control plans should be recorded in detail and evaluated.

## **3 Conclusion**

This paper introduces the management and operation method of trace evidence laboratory under the CNAS review system, including factors such as personnel, equipment, samples, environment, methods and quality. It proposes perfect personnel training and assessment procedures, equipment management procedures, identification sample management procedures, environmental management procedures, identification method selection and use procedures, quality control procedures, etc., to ensure the orderly operation of all links. At present, there are few trace evidence laboratories in China passed the CNAS review system because of its high requirements, high standards and immature application in the trace evidence area. However, there are still more and more trace evidence laboratories are applying for passing the CNAS review system to improve their management system and enhance their international popularity. Therefore, the management and operation mode of the trace evidence laboratory urgently needs to be improved. Verification or calibration standards of particular instruments and equipment specially developed for trace evidence identification are imperative to be formulated. In terms of personnel, there are many appraisers who have not been engaged in the trace evidence certification field or non-related professions but have the certificates for trace evidence identification. Relevant

departments should strengthen personnel review, strictly control admittance and regularly assess. The author believes that these problems will be solved soon and the operation of the trace evidence laboratory will be better and better in the future.

### **Acknowledgement**

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## Study on Simulation and Optimization of Container Truck Path in Multi-quayside Crane Cooperation Mode

Ye Yani<sup>1</sup>, Ding Tao<sup>1</sup>, Xiang Shengbin<sup>2</sup>

<sup>1</sup> School of Transportation, Wuhan University of Technology, Wuhan, P.R.China, 430061

<sup>2</sup> Hubei Branch, China Southern Airlines Co., Ltd., Wuhan, P.R.China, 430061

(E-mail:yyn271934699@whut.edu.cn, 869983550@qq.com, 1471701290@qq.com)

**Abstract:** At present, the “work line mode” is commonly used in container terminal operations in China. There are limitations including that the workload of each line is not balanced, the utilization of quayside cranes and trucks is not high, and the terminals are quite crowded. The “multi-quayside crane cooperation mode” is proposed here on the combining of “working surface mode”, “synchronous loading and unloading mode” and “cross hybrid loading and unloading mode”. By using genetic algorithm and the simulation software, Flexterm, the study of searching optimal truck path and configuration in L port is conducted under the new mode. The result is that it shortens ship’s port time, saves energy and extends the service life of the trucks. In some degree, the study has practical reference for the operation scheduling of container terminals.

**Key words:** Container trucks; Routing optimization; Multi-quayside crane cooperation mode; Genetic algorithm; Simulation

### 1 Introduction

Container terminal is a complex system composed of multiple links, which coordinate and restrict each other. Optimizing the internal logistics of the container terminal is an important way to improve the overall management level of the container terminal. It has always been hot issues about how to make full use of limited resources under existing equipment and conditions, how to make the complex system of container terminal operate efficiently and how to reduce related costs.

There are mainly two aspects of researches about container trucks for improving terminal efficiency. One is about studying new shift modes. Yang (Yang, 2006), Wei and Zhu (Wei and Zhu, 2012), Wang and Xu (Wang and Xu, 2011) paid attention to the path optimization problem of the trucks in the “working surface” mode. Chen and Feng (Chen and Feng, 2011), Sun (Sun, 2013) studied the truck scheduling in the hybrid cross-operation mode.

The other is about optimizing container truck path under existing modes. Bish et al. (Bish et al., 2005), Byun et al. (Byun et al., 2000), Nishimura et al. (Nishimura et al., 2001), Ng et al. (Ng et al., 2007) study the optimal path of container trucks with the task of minimizing the total time of operation through greedy algorithms, genetic algorithms, etc. Koo et al. (Koo et al., 2006), Bish et al. (Bish et al., 2001) investigated the optimal configuration of container trucks.

In addition to the research results in China and other countries, there are two points that could be further studied. First, in the existing research, there is not much optimization for the “working surface”, and even if the “working surface” mode is adopted, it still actually sets the optimization object to single import or export container ship berthed at the same time whereas the loading and unloading areas are



still separate. Thus, there is still a large distance from the true multi-ship cross-mixing loading and unloading operation. Second, most of the researches have introduced optimization algorithms in which a lot of simplifications and assumptions have been made on the actual situation of the ports to solve the problems. Though the theory is strong, the actual application ability is poor, and there are still relatively few simulation cases to simulate the port production.

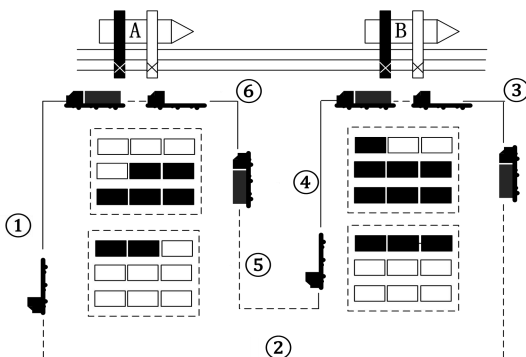
In this paper, a new container terminal operation mode is proposed. Besides, an actual case is tested through genetic algorithm modeling and system simulation. By re-planning the dispatch path and the loading and unloading mode of the trucks, a better working path is obtained. Through simulation, the optimal configuration is selected.

## 2 Methodology

### 2.1 Multi-quayside crane cooperation mode

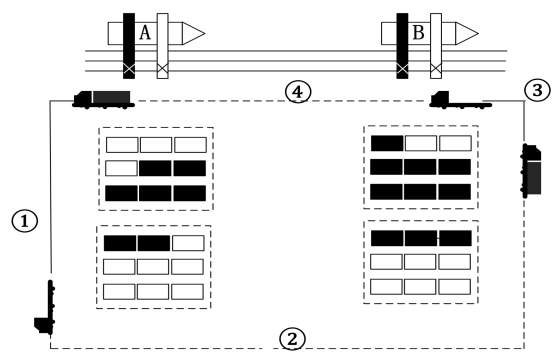
Compared with the traditional “production line mode” and “single ship mixed loading and unloading mode”, the “cross-mixing operation mode” can more effectively utilize the capacity of the trucks to dynamically balance the workload of each quayside crane. However, as can be seen from Fig. 1, under the current “cross-mixing operation mode”, for one of the two ships A and B, the loading and unloading operations are still separated, that is, Ship A can only be loaded but not unloaded, Ship B can only be unloaded but not loaded (or vice versa). Based on this situation, a new operation mode which called “multi-quayside crane cooperation mode” is proposed. The operation process of “multi-quayside crane cooperation mode” can be seen in Fig.2. The specific steps follow:

- 1) The truck is departed from the Ship A, receives an import container from Ship A and sends it to the import yard behind the Ship A.
- 2) The truck is no-load and goes to the exit yard behind the Ship B.
- 3) The truck takes out an export container and sends it to the Ship B, which is loaded onto the ship by the quayside crane.
- 4) The truck receives an import container and sends it to the import yard behind the Ship B.
- 5) The no-load truck goes to the exit yard behind the Ship A.



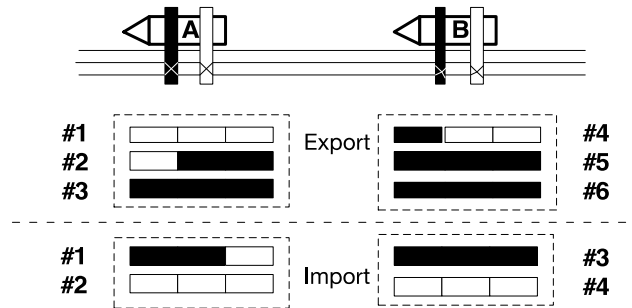
6)The truck takes out an export container and sends it to the Ship A, which is loaded onto the ship by the quayside crane to complete the circuit.

**Figure 1 Cross-mix Loading and Unloading Operation Mode**



**Figure 2 Truck Running Process in Multi-quayside crane Collaboration Mode**

This study takes two container ships MSKT (Ship A) and AHUT (Ship B) that arrived at the L port in the same time and parked at two adjacent berths #3 and #4 as actual examples. In fact, most of the containers are transported by liner. The arrival time of container ships and the amount of packing and unloading can be easily predicted. The berth configuration and stowage plan can be done before the ship



arrives (Zhang et al.,2003). The schematic diagram of the berth is shown in Figure 3.

**Figure 3 Berth and Yard Layout**

The details of ships and container areas are shown in following tables.

1.The ship docking information is shown in Table 1.

**Table 1 Ship Information**

Ship name	Docking berth	Distribution of quayside crane	Loading amount	Unloading amount	Berthing time
MSKT	#3	3 (C20-C22)	1517	974	21h10min
AHUT	#4	3 (C17-C19)	591	815	14h29min

2.The quayside cranes information is shown in Table 2.

**Table 2 Quayside Cranes Assignment Information**

Quayside crane	Starting time	End time	Downtime (h)	Net efficiency (TEU/h)
C17	2017-2-21 14:37	2017-2-22 5:01	0.49	27.66
C18	2017-2-21 13:18	2017-2-22 10:28	3.47	17.63
C19	2017-2-21 14:03	2017-2-22 9:55	0.90	27.56
C20	2017-2-21 13:22	2017-2-22 9:59	1.87	20
C21	2017-2-21 13:33	2017-2-22 7:36	1.73	22.06
C22	2017-2-21 15:23	2017-2-22 10:14	0.00	22.86

3. The capacity/task information of the import and export container area is shown in Table 3.

**Table 3 Import/Export Container Areas Capacity/task (Unit: TEU)**

Import container area code	#1	#2	#3	#4
Ship A	405	525	625	745
Ship B	635	755	415	535

4. The distances between the ship and the import container area, the ship and the export container area, the import container area and the export container area are shown in Table 4, Table 5 and Table 6.

**Table 4 Distance between Ships and Import Container Areas (Unit: meter)**

export container area code	#1	#2	#3	#4	#5	#6
Ship A	205	275	330	425	495	550
Ship B	435	505	560	215	285	340

**Table 5 Distance between Ships and Export Container Areas (Unit: meter)**

container area code	#1	#2	#3	#4	#5	#6
Import container area capacity	172	325	651	647	—	—
exported container area capacity	280	274	336	135	351	413

**Table 6 Distance between Import and Export Container Area (Unit: meter)**

container area code	#1	#2	#3	#4	#5	#6
#1	400	330	275	640	570	515
#2	520	450	395	760	690	635
#3	220	150	95	420	350	295
#4	340	270	215	540	470	415

The loading amount and unloading amount of the Ship A are 1517 TEU and 974 TEU, respectively; the loading amount and unloading amount of the Ship B are 591 TEU and 815 TEU, respectively. The total loading amount is  $1517+591=2108$  and the total unloading amount is  $974+815=1789$ , that is, the total loading amount is 319 TEU more than the total unloading amount.

In this paper, the part that can loading and unloading match is selected as the research object, that is, the extra 319 TEU are separately loaded and unloaded by the “production line mode”, and the remaining containers which are paired are loaded and unloaded by “multi-quayside crane cooperation mode”. Here only the paired ones are discussed.

## 2.2 Truck path optimization

The shortest path of the truck under the practical case was found through genetic algorithm in this study. The problem can be demonstrated as follows:

Object:

$$\text{Min}\left\{\sum_{i=1}^K \sum_{j=1}^K d_{ij}X_{ij} + d_{aijb}Y_{aijb} + d_{bijb}Y_{bijb} + d_{aija}Z_{aija} + d_{bijb}Z_{bijb}\right\}$$

Decision variables:

$$X_{ij}, Y_{aijb}, Y_{bijb}, Z_{aija}, Z_{bijb} \in \{0, 1\}$$

Subject to:

$$\sum_{i=1}^K X_{ai}q_i + Y_{aijb}q_i + Z_{aija}q_i = U_a$$

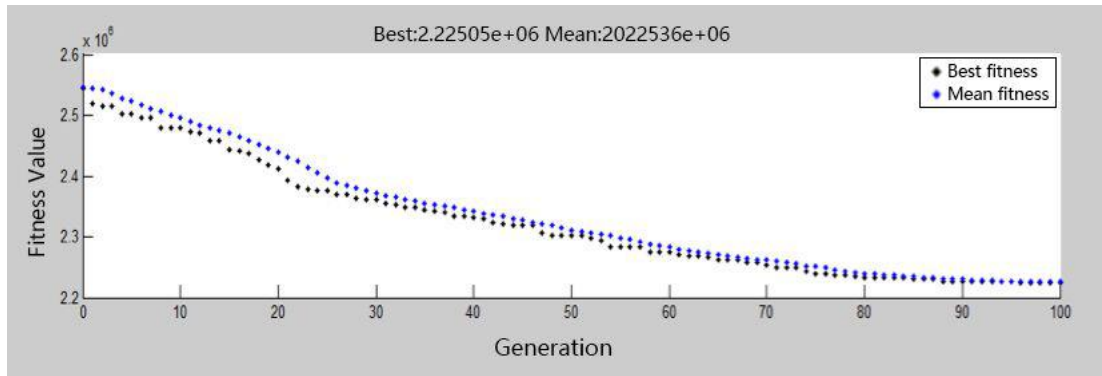
$$\sum_{j=1}^K X_{ja}q_j + Y_{bijb}q_j + Z_{aija}q_j = L_a$$

$$\sum_{i=1}^K X_{bi}q_i + Y_{bijb}q_i + Z_{bijb}q_i = U_b$$

$$\sum_{j=1}^K X_{jb}q_j + Y_{aijb}q_j + Z_{bijb}q_j = L_b$$

where  $X_{ij}$  is a binary choice of the route from  $i$  to  $j$ ;  $Y_{aijb}$  is a binary choice of the route from ship A to ship B which includes an import and an export;  $Z_{aija}$  is a binary choice of the route from ship A to ship A which includes an import and an export;  $Z_{bijb}$  is a binary choice of the route from ship B to ship B which includes an import and an export;  $d$  is the distance from one position to another position;  $q$  is the number of the container every truck takes;  $a$  is ship A;  $b$  is ship B;  $U_a$  is the number of unloading containers of ship A;  $U_b$  is the number of unloading containers of ship B;  $L_a$  is the number of loading containers of ship A;  $L_b$  is the number of loading containers of ship B.

The 2013b version of MATLAB was used to solve the problem. After 100 times iterations, the model reached convergence. The result is shown in Figure 4.



**Figure 4 Genetic Algorithm Convergence**

Since the genetic algorithm is a random search algorithm, the results obtained by each operation are slightly different. So, after running ten times, take the average as the final result.

- 1) Min  $f = 2224.25\text{Km}$ , wherein the no-load stroke is  $690.67\text{Km}$ ;
- 2) Non-zero optimal decision variables are shown in Table 7, Table 8, and Table 9.

**Table 7 Optimal Decision Variable in Loop I (Non-zero)**

$X_{a2}$	$X_{a4}$	$X_{b3}$	$X_{1a}$	$X_{2a}$	$X_{6a}$	$X_{4b}$	$X_{5b}$	$X_{6b}$	$X_{22}$	$X_{35}$	$X_{36}$	$X_{41}$	$X_{44}$
274	317	591	280	274	37	37	178	376	274	178	413	280	37

**Table 8 Optimal Decision Variables in Loop II (Non-zero)**

$Y_{a35b}$	$Y_{a44b}$	$Y_{a45b}$
60	98	66

$Z_{a13a}$	$Z_{a23a}$	$Z_{a43a}$	$Z_{a45a}$
172	51	113	47

**Table 9 Optimal Decision Variables in Loop III (Non-zero)**

According results above, there are 12 routes finally selected to be the optimal choices.

Line 1: Ship A - #4 import container area - #4 export container area - Ship B - #3 import container area - #6 export container area - Ship A, 37 times;

Line 2: Ship A - #3 import container area - #5 export container area - Ship B - Ship A, 60 times;

- Line 3: Ship A - #4 import container area - #4 export container area - Ship B - Ship A, 98 times;
- Line 4: Ship A - #4 import container area - #5 export container area - Ship B - Ship A, 66 times;
- Line 5: Ship A - #1 import container area - #3 export container area - Ship A, 172 times;
- Line 6: Ship A - #2 import container area - #2 export container area - Ship A, 274 times;
- Line 7: Ship A - #2 import container area - #3 export container area - Ship A, 51 times;
- Line 8: Ship A - #4 import container area - #1 export container area - Ship A, 280 times;
- Line 9: Ship A - #4 import container area - #3 export container area - Ship A, 113 times;
- Line 10: Ship A - #4 import container area - #5 export container area - Ship A, 47 times;
- Line 11: Ship B - #3 import container area - #5 export container area - Ship B, 178 times;
- Line 12: Ship B - #3 import container area - #6 export container area - Ship B, 376 times;

### 2.3 Truck configuration

After truck path optimization, the suitable truck configuration is considered. Since the configuration in the proposed new mode is a discrete event dynamic system (DEDS), it's relatively hard to solve the problem by mathematical methods. In this situation, system simulation provides a more effective solution.

The task routes of the truck in this model are the 12 ones obtained through the genetic algorithm, and the task sequence function in FlexTerm is used to ensure that the truck travels according to the shortest route. Except the one-way driving on the road passing through the quayside cranes to the yard, the other roads can travel in both directions, but the rear trucks are not allowed to overtake the preceding trucks on any road section. The maximum speed limit of the road is 50Km/h. The initial state of the model is that the trucks are waiting for the container ships to berth at the place where the trucks are stored. Based on the *FlexTerm2.0.0* simulation platform, the simulation model of #3, #4 berth loading and unloading operation system of L Port Container Terminal is established, as shown in Figure 5.

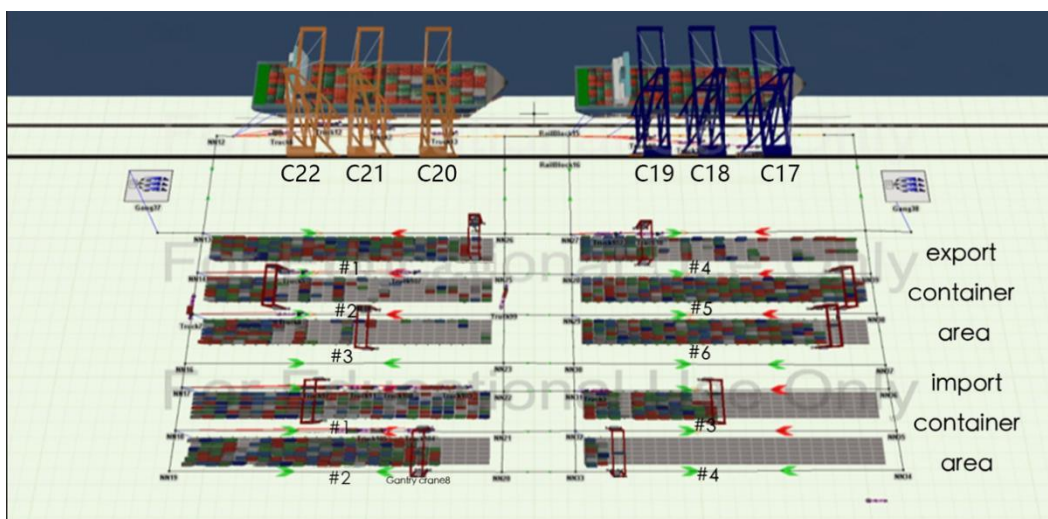


Figure 5 #3, #4 Berth Loading and Unloading Operation System Simulation Model

According to the current truck configuration strategy adopted by the terminal, each quayside crane is equipped with 5 trucks, the two ships' loading and unloading operations use 6 quayside cranes and a total of 30 trucks. Therefore, in the range of [20,35], the number of truck configuration is input to the FlexTerm model in turn, and the waiting time of each quayside crane and the blocking time of each truck are obtained by the statistic system, *Statistics*. Since the container bays are randomly generated, there is a little difference in the result of each run. Thus, the average of them is finally taken. According to this method, the average waiting time of the quayside cranes and waiting time of the trucks in different truck configurations are obtained in sequence as shown in Figure 6.

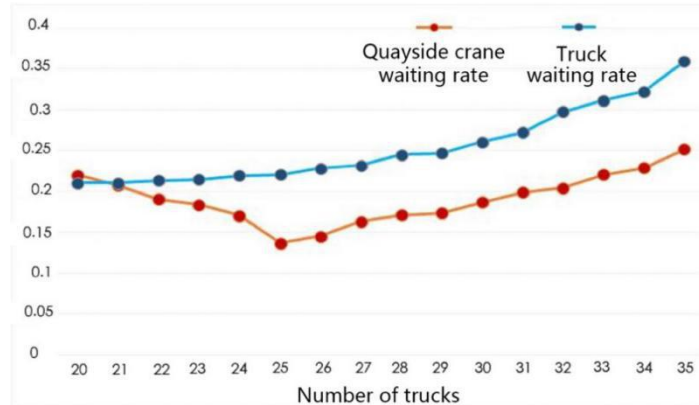


Figure 6 Waiting Rate of Quayside Cranes and Trucks in Different Truck Configurations

### 3 Result and Discussion

According to the optimal path, the total travel distance of the truck is 2224.25 Km, of which the no-load stroke is 690.67Km. With other conditions equal, in working line mode, the total travel distance of the truck is 3883.43 Km, of which the no-load stroke is 2391.47Km. The detail of results in the two modes are shown in Table 10.

Table 10 Comparison of Mode Effects

truck operation mode	Total trip (Km)	saving (Km)	Saving rate	Overload (Km)	No-load (Km)	No-load rate	Reduction
Multi-quayside crane cooperation mode	2224.25	1659.18	42.72%	1533.585	690.67	31.05%	30.53%
Working line mode	3883.43			1491.965	2391.47	61.58%	

It can be seen that with the multi-quayside crane cooperation mode, compared with the traditional "working line mode", on the one hand, the total mileage of the truck is reduced by 42.72%, which means that in the new mode, the truck can complete the loading and unloading tasks as soon as possible with a shorter path, reducing the berthing time and speeding up the truck-ship turnover. At the same time, it also means the reduction of truck loss and extension of the truck life. On the other hand, the

idling rate of the truck is greatly reduced from 61.58% to 31.05%, which greatly improves the utilization rate of the truck. This means that the same number of trucks can be used to complete more loading and unloading tasks, reflecting the concept of deepening the potential of port equipment resources and achieving fine management of terminals.

The simulation results show that when the truck configuration is small (less than 25 trucks), the quayside crane waiting rate decreases significantly with the increase in the number of trucks. When the number of trucks reached 25, the waiting rate of quayside cranes is reduced to a minimum. As the number of trucks further increases (more than 25 trucks), the waiting rate of quayside cranes gradually increases. This shows that the "25 trucks" is a critical value. When the number of trucks reaches 25, the quayside crane waiting rate is the lowest and the increase in the truck blocking rate is not obvious. Since then, as the number of trucks has increased, road congestion has become increasingly serious and the truck waiting time has become longer. In this situation, the quayside crane cannot be able to get timely service due to the blockage of the trucks on the road, and the waiting time becomes longer. The phenomenon of "effectiveness and counter-attack" reaches the maximum. It can be seen that the number of 25 trucks is the best-integrated point, so 25 trucks are determined to be the best truck configuration for this model.

In the terminal practice, it can be adjusted according to the actual situation to ensure the smoothness and efficiency of the loading and unloading operations.

## 4 Conclusion

In view of the many bottlenecks and shortcomings of the current container terminal operation modes, combining the "same-position synchronous loading and unloading operation mode", "working surface mode" and "cross-mixing loading and unloading operation mode", this paper proposed a "multi-quayside crane cooperation mode" that can be applied in the situation of "two ships simultaneously arriving at the port and synchronous loading and unloading". The genetic algorithm is used to find the optimal routes and the running times of the trucks on each route. The results show that the multi-quayside crane cooperation mode can effectively reduce the total distance traveled by the trucks compared with the traditional mode, and reduce the waste of the truck capacity. It proves that the "multi-quayside crane cooperation mode" has great advantages over traditional modes in improving the efficiency of container terminals and reducing operating costs. Using FlexTerm, the changes of the quayside crane waiting time and the truck waiting time of different truck configurations are tested. Finally, through the comprehensive analysis, the optimal configuration of the truck in the scenario is determined, the resource allocation of the L Port Container Terminal is further optimized, and good results are obtained.

There are still many shortcomings in the study. First of all, the container terminal operating system is a complex whole. What needs to be optimized is not only the transportation path problem of the trucks, it is not enough to optimize the partial part. Secondly, although the genetic algorithm has been widely applied on engineering practice due to its good robustness and adaptability and has achieved good results, the genetic algorithm is easy to fall into the local optimum. To avoid it, the genetic algorithm should be improved or the combination of different intelligent algorithms should be considered. Finally, computer system simulation is an important direction in related research. FlexTerm used in this study is just one of them. Innovations in simulation tools and modeling ideas can be future research directions.



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# Simulation Research of AGV Configuration Optimization in Automated Container Terminal

Chen Ning, Tao Hui

School of Transportation, Wuhan University of Technology, Wuhan, P.R.China, 430063

(E-mail: chenning5@126.com, taohui142857@163.com)

**Abstract:** To study the optimal AGV configuration of automated container terminal, this paper takes the domestic Q automated container terminal as an example and summarizes the production and operation situation of the terminal as well as loading and unloading process, and then analyzes the composition and operation process of AGV horizontal transportation system. To achieve the goal, this article constructs the three-dimensional visual simulation model of AGV horizontal transportation system, and then carries out simulation experiments, and finally obtains the optimal ratio of AGV horizontal transportation system under different conditions. The conclusion can provide reference for production and operation of automated container terminal.

**Key words:** Automated container terminal; AGV; Configuration optimization; Flex Term simulation

## 1 Introduction

With the rapid development and overflight of global automated container terminals, China's major coastal container ports, like Qingdao port and Shanghai port, have built fully automated container terminals. Increasing attention has been paid to research of the handling efficiency of automated container terminals and the optimization of operating machinery resources allocation. Foreign scholars mainly studied and discussed the horizontal transport operation machinery of semi-automated or fully automated container terminals, and most of these researches focused on the AGV dispatching system. Gopal SL et al. constructed a simulation model with the AGV number as objective function, then found the optimal configuration of AGV under the condition of constant workload (Gopal SL et al., 1991). QIU et al. analyzed and discussed the AGV scheduling problem of automated container terminal, and selected the heuristic algorithm to solve the constructed model (QIU et al., 2002).

However, domestic research on AGV horizontal transportation system of automated container terminal was relatively less. Ma Yuehui et al. established a mixed integer programming model with the goal of minimizing the end time of last task (Ma Yuehui et al., 2016). Kang Zhimin constructed a scheduling optimization model based on the principle of minimum invalid waiting time for vehicles, and solved the model by using genetic algorithm (Kang Zhimin, 2011). Chen Hongxian et al. constructed the trucks path optimization model by using mathematical modeling and Flex Term simulation (Chen Hongxian et al., 2017). Qiu Yuelong used SPN theory to model the AGV dispatching system and established the AGV route transportation model through Witness software (Qiu Yuelong, 2005). This paper mainly studies the loading and unloading efficiency of Q automated container

terminal in China as the research object, and analyzes the resource allocation problem of AGV by establishing a three-dimensional simulation model.

## 2 Status Analysis of Automated Container Terminal

### 2.1 Basic overview of terminal production

Q automated container terminal is one of the first fully automated container terminals to be built and put into operation in China. There are six berths in the dock. The total length of coastline is 2088m. At present, there are 7 single-lift double-car quay cranes at wharf apron and 38 fully automatic high-speed rail cranes in the yard. And 38 pure electric automatic guided vehicles(AGV) are responsible for horizontal handling tasks of containers.

### 2.2 Loading and unloading operation of terminal

The loading and unloading process of Q-terminal adopts the mode of "double-trolley container loading and unloading crane + AGV + automated rail gantry crane". In this mode, the double-trolley container crane is responsible for loading and unloading tasks of container ships; AGV is responsible for horizontal transportation between apron and storage yard; and the rail gantry crane takes stacking and picking up operations tasks in the yard. The terminal loading and unloading system mainly consists of wharf apron loading and unloading system module, storage yard loading and unloading system module, AGV horizontal transportation system module and gate collection and distribution system module. The loading and unloading operation process is shown in Figure 1.

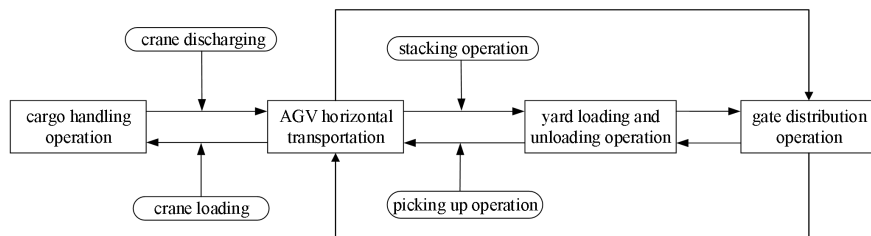


Figure 1 Terminal Loading and Unloading Operation Procedure

### 2.3 AGV horizontal transportation system of terminal

AGV is a kind of automated handling vehicle equipped with non-contact guiding device that requires no human driving, and it is hydraulically driven or electrically driven(Zhang Haiqing,2008). Q-terminal is equipped with 38 pure electric AGVs, which are responsible for horizontal handling of import and export containers. The AGV horizontal transportation system of container terminal is mainly composed of the following three parts: the connection between quay cranes and AGVs, the connection between rail cranes and AGVs, and AGV horizontal handling between yard and shoreline.

The AGVs of Q-terminal work as follows: the AGV starts working status firstly, and the Production Control System of the central control room issues a start operation command to run the AGV to a fixed parking space. When dispatching command is issued, the AGV runs according to the

instruction to the position below the designated quay crane. The sensor senses the actual position of AGV and then transmits the position information to the Production Control System. The control system then issues a parking command to the AGV to ensure that it stays in the target position accurately. The Production Control System also commands the horizontal transportation operations of AGV, including AGV fixed-point parking, travel path optimization, and container handling task management, to complete tasks of automated transport containers from the front of terminal to the yard(Wen Zhimin et al.,2009; Zhang Yuanchun et al.,2011).

The horizontal transportation operation of AGV changes through dynamic change of state of container crane. After loading a container from apron, AGV sails to the appointed box area, enters the gantry crane waiting queue, and accepts the task. Then it drives back to quayside and waits for next round of work. It repeats like that until all tasks are completed. The operation process of AGV horizontal transportation system is shown in Figure 2.

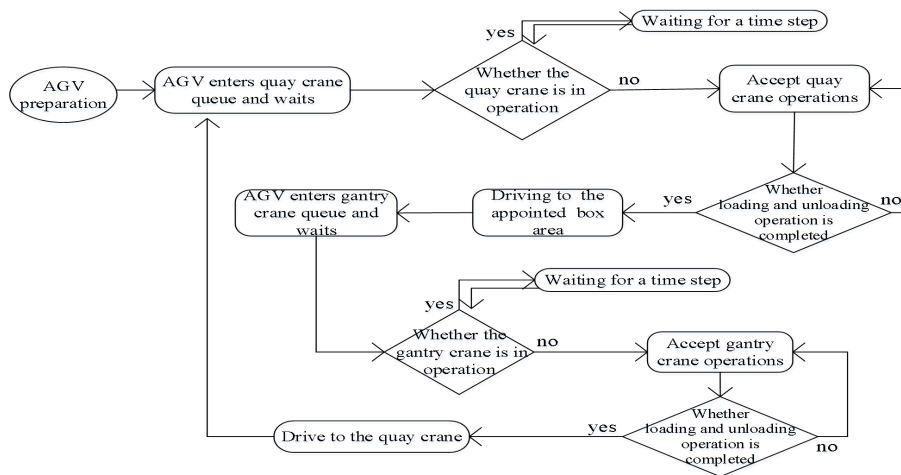


Figure 2 The Operation Process of AGV System

### 3 Simulation Modeling of AGV Horizontal Transportation System by Flex Term

#### 3.1 Flex Term simulation modeling steps

As a simulation software specifically for container terminal simulation, the Container Terminal physical library in Flex Term contains most of actual facilities and equipment in container terminals, such as berths, ships, container loading and unloading cranes, gantry cranes, AGV modules, gates and other terminal infrastructure and handling equipment. Flex Term simulation includes five basic steps(Tong Pengxiang,2018): setting up entities, parameters setting, entities connection, running model and simulation results analysis.

Step1 setting up entities: According to the characteristics of the system, drag and drop the required entity from Container Terminal entity library to corresponding appropriate position in the operation interface.

Step2 parameters setting: Set parameters of the entities according to the requirements of experimental specific data and logical characteristics described by each entity.

Step3 entities connection: According to the logical connections between model entities,

different connections are used to connect the corresponding ports of the corresponding entities one by one to form a visual simulation model.

Step4 running model: Set the simulation termination time according to actual requirements, then reset the model and run the model;

Step5 simulation results analysis: After the model simulation is terminated, the entity running effect is viewed through entity property window, and the simulation results are output and analyzed.

### 3.2 Simulation modeling of AGV horizontal transportation system

The simulation model of the terminal AGV horizontal transportation system was constructed by using Flex Term simulation platform. The 6# berth of Q-terminal was selected for this simulation. The berth is 300m in length and berth level is 70000 tons, and it is equipped with two double-trolley bridge cranes. The berth is planned to achieve weekly throughput of 1800TEU and annual throughput of 93000TEU. The following assumptions had been made to simplify model before establishment of simulation model:

- (1) Only containers of same type can be stacked in one container area during simulation time;
- (2) Container type was uniformly set as 20ft general container, regardless of special container and dangerous cargo container;
- (3) The number of containers stored in the yard at various stages during planning period was known;
- (4) Quay cranes adopted operation sequence of "loading first and then unloading" in the simulation process.

In Flex Term software, the related settings of Berth Planner and Yard Planner have been completed in turn, the arrival time distribution table of container ships and loading and unloading plans have been formulated, and the principles of containers stacking have been stipulated. Then two truck gangs and several network nodes were added to establish connections with quay cranes and yards respectively, and AGV queues were connected to the path through a certain node. Different connection methods were used to link corresponding ports of each entity. The visual simulation model is shown in Figure 3.

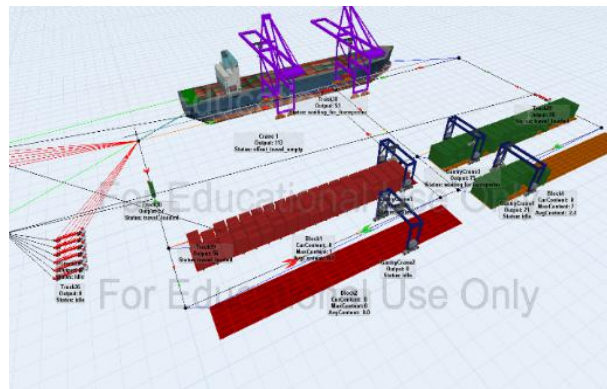


Figure 3 Flex Term Simulation Model

## 4 Simulation Experiments and Results Analysis

### 4.1 Simulation experiments

After construction of AGV horizontal transportation system simulation model, the optimal configurations of AGVs with different number of gantry cranes have been considered, under the condition that quay cranes operation remained unchanged. In the case of one gantry crane in each yard, one gantry crane was added to each yard one by one, and then two gantry cranes performed stacking and picking operations simultaneously; on this basis, the ratio of quay cranes to AGVs was increased one by one. The initial ratio of quay cranes to AGVs was 1:1, and the number of AGVs serving quay cranes was sequentially set from 1 to 10 by modifying property settings of truck gangs.

Considering that quay crane is not only the most important bottleneck restricting operating efficiency of whole terminal, but the most expensive and essential loading and unloading machinery of automated container terminal, the average loading and unloading efficiency of quay cranes and the percentage of waiting time of quay cranes were adopted as evaluation indicators to measure effectiveness of experiment scheme. The simulation running time of model was set to 10080min (one week), and related attributes of truck gangs were modified in each experiment. Finally the model was reset for simulation experiment and simulation data has been collected.

### 4.2 Simulation results analysis

During the process of model running, the real-time data of simulation operation was viewed and output through Dashboards and Statistics options, and the collected data results have been sorted after simulation experiments. The output is shown in Tables 1 and 2, Figures 4 and 5, where RTG represents gantry crane.

**Table 1 The average efficiency of quay cranes TEU/h**

Crane: AGV	1:1	1:2	1:3	1:4	1:5	1:6	1:7	1:8	1:9	1:10	
Number s of gantry cranes	4	38.75	42.70	42.05	42.20	43.40	43.50	43.35	44.20	44.15	44.30
	5	38.95	41.60	43.35	44.35	45.65	45.90	45.90	45.60	46.60	46.65
	6	39.30	43.10	42.90	43.55	44.40	44.65	45.05	45.95	45.95	46.20
	7	39.60	42.20	44.25	43.65	44.50	45.25	45.40	45.55	46.50	46.80
8	40.25	43.35	44.50	45.70	46.95	47.40	47.70	48.10	48.00	48.15	

**Table 2 The percentage of waiting time of quay cranes %**

Crane: AGV	1:1	1:2	1:3	1:4	1:5	1:6	1:7	1:8	1:9	1:10	
Number s of gantry	4	32.75	19.80	20.90	20.50	17.20	17.25	17.40	15.35	15.30	14.50
	5	32.05	23.25	18.35	16.95	12.05	11.80	11.55	11.25	9.70	9.50

cranes	6	31.10	19.50	19.55	17.40	14.80	15.20	13.25	12.25	12.05	9.40
	7	31.00	21.70	16.40	17.55	15.15	13.15	12.35	12.30	10.20	10.05
	8	29.45	18.90	15.35	12.45	9.85	8.50	8.00	7.65	7.45	6.30

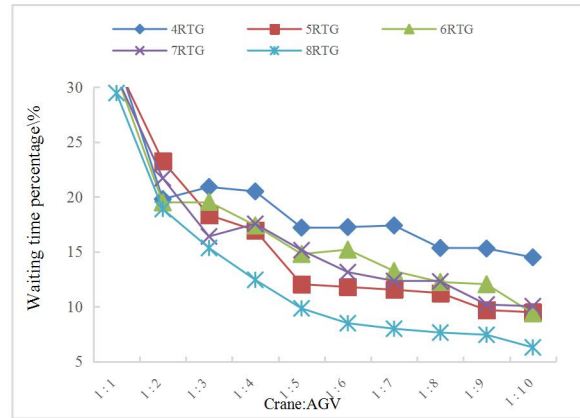
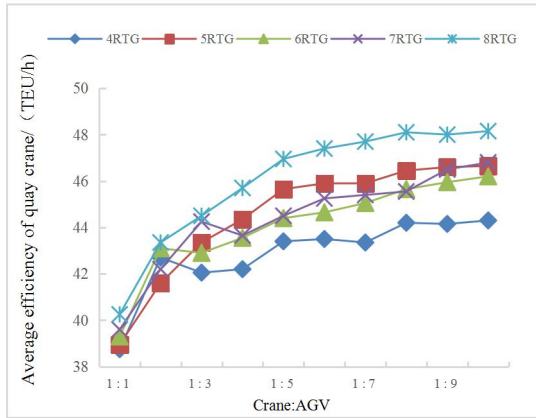


Figure 4 Simulation Results of Average Efficiency

Figure 5 Simulation Results of Waiting Time

Taking the case of 4 gantry cranes in the yard as an example, when the ratio of quay cranes to AGVs increases from 1:1 to 1:2, the actual loading and unloading efficiency of quay cranes and the percentage of waiting time change significantly. The average loading and unloading efficiency increases from 38.75TEU/h to 42.70TEU/h, and the percentage of waiting time decreases from 32.75% to 19.80%. And then when the ratio increases to 1:8, the average loading and unloading efficiency gradually increases to 44.20TEU/h, while the waiting time percentage of quay cranes gradually decreases to 15.35%. After that, although the actual loading and unloading efficiency of quay cranes and the percentage of waiting time change slightly, it is not obvious. Therefore, the quantity ratio of 1:8 is the optimal configuration scheme when there are 4 gantry cranes in the yard. Similarly, in the case where different number of gantry cranes are configured in the yard, AGV configuration scheme has been selected in turn and the results have been shown in Table 3.

Table 3 Optimal AGV Configuration Scheme under Different Conditions

AGV configuration scheme		Evaluation indicators	
Number of gantry cranes	quay crane : AGV	Average efficiency of quay cranes / (TEU/h)	Waiting time percentage/ %
4	1 : 8	44.20	15.35
5	1 : 8	45.60	11.25
6	1 : 8	45.95	12.25
7	1 : 9	46.50	10.20
8	1 : 9	48.00	7.45

It can be seen from above charts that average loading and unloading efficiency of quay cranes increases gradually while waiting time for AGV decreases gradually, as gantry crane has been added to yard one by one. When the entire yard is equipped with 8 gantry cranes, that is, each yard is equipped with 2 gantry cranes, the average loading and unloading efficiency and waiting time percentage of quay cranes have changed significantly. Under the optimal AGV configuration scheme, the average loading and unloading efficiency of quay cranes increases from 44.20TEU/h to 48.00TEU/h, and the percentage of waiting time decreases from 15.35% to 7.45%.

Therefore, the AGV configuration optimization scheme has been specifically selected as follows: When there are 4, 5 or 6 gantry cranes in the yard for stacking and picking up operations, the optimal AGV configuration scheme is 1:8 for the ratio of quay cranes to AGVs, while the optimal AGV configuration scheme is 1:9 when there are 7 or 8 gantry cranes for loading and unloading operations.

## 5 Conclusion

In this paper, after understanding current situation of production and operation in Q automated container terminal, the composition and operation process of AGV horizontal transportation system were analyzed. The professional simulation software Flex Term was used to construct a three-dimensional simulation model of AGV horizontal transportation system, and a series of AGV configuration scheme and simulation experiments were carried out. Finally, the simulation results were analyzed to obtain the optimal ratio of AGV horizontal transportation system under different conditions, which would be useful for planning of automated container ports.

The optimal configuration of terminal AGV resources involves not only quantity configuration problem, but also some other problems like path optimization design and scheduling strategy, which need further study.

## Acknowledgment

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# Supplier Relationship Quality and Supply Chain Performance in Engineering Enterprises: The Regulating Role of Cooperation Vision

Yin Long, Liu Mingfei

School of Management, Wuhan University of Technology, Wuhan, P.R.China, 430070

(E-mail: 962763327@qq.com, liumingfei5223@163.com)

**Abstract:** Many researches have shown that the quality of supply chain relations has an important impact on supply chain performance, but there are relatively few studies on overseas engineering and construction industry, especially based on the characteristics of engineering and construction industry and the supply chain research of cross-cultural scenarios of overseas engineering. Based on the characteristics of the engineering supply chain, this paper believes that engineering companies pay more attention to supplier quality than customer relationship quality. Based on the theory of resource dependence and social exchange, from the perspective of engineering supply chain, the concept model is constructed, and the quality of supplier relationship is divided into communication quality, cooperation quality and commitment quality, respectively, and its impact on supply chain performance is discussed. The role of cooperation in the cross-cultural context of overseas engineering. The research results show that the communication quality, cooperation quality and commitment quality with suppliers have a positive impact on supply chain performance, and the cooperative vision plays a regulatory role in the relationship between supplier relationship quality and supply chain performance.

**Key words:** Construction supply chain; Supplier relationship quality; Cooperation vision

## 1 Introduction

With the development of the country entering the "new normal", the engineering construction industry is also pursuing a low-cost and high-efficiency management mode in the increasingly fierce competition. The general contracting mode of engineering is gradually favored in the engineering construction market and has been effectively popularized and applied due to its characteristics of less resource occupation, low management cost, easy handling of industrial relations, optimization of organizational structure, easy control of cost and improvement of performance capability. Under the general contracting mode, the competition in the construction industry has gradually changed from a single enterprise to a supply chain with the general contracting enterprise as the core and formed with many suppliers.

Through the relationship management among the members of the supply chain, the establishment of trust, communication, commitment and cooperation among the members has become the key to ensure the normal operation of the engineering supply chain and improve the performance of the engineering supply chain. In the research of supply chain relationship quality, cooperative vision is becoming an important direction. Especially for some engineering and construction enterprises with overseas business, due to cross-cultural communication, there are differences in cultural background, management methods and management concepts. In this context, the construction of a good cooperative vision plays an important role in the normal development of the project. The cost of improving supply

chain performance with cooperative vision lies in the fact that the degree of improvement of cooperative vision is affected by the quality of relationships among suppliers, enterprises and customers.

It can be found that the relationship quality caused by the particularity of engineering supply chain is different from that of traditional supply chain. What is the role of cooperative vision between supply chain relationship quality and performance management? These are all problems to be solved.

## **2 Research Background and Literature Review**

### **2.1 Research background**

#### **2.1.1 Social exchange theory**

The theory of social exchange was first put forward by humans, who advocated studying the theory of social behavior from the perspective of the relationship between input and output in economics. The social exchange theory holds that the behavior activities between people are driven by "self-interest", which tends to seek benefits and avoid disadvantages in activities and gradually expand self-interest in actions. The theory of social exchange advocates avoiding people's competition in conflicts of interest as much as possible and obtaining win-win or multi-win through mutual social exchange.

In the related research of supply chain, relevant scholars believe that the existence of cooperation vision can effectively reduce supply chain conflicts and frictions and promote supply chain members to work towards common goals from the perspective of social exchange to reduce conflicts of interest and win win-win results, thus contributing to the formation of the relationship between supply chain partners and further having a positive impact on supply chain performance. Therefore, based on the social exchange theory, this paper proposes the influence of supply chain relationship quality with cooperation vision as the intermediary variable on supply chain performance.

#### **2.1.2 Resource dependence theory**

The paper on resource dependence points out that if an organization wants to survive for a long time, it must continuously reduce its dependence on external key resources and constantly find ways to stably master key resources. The resource dependence theory puts forward four important hypotheses: the most important thing for an organization is to care about survival; In order to survive, the organization needs resources, which the organization itself cannot normally produce. The organization must interact with the factors in the environment on which it depends, which usually include other organizations; The survival of an organization is based on its ability to control its relationship with other organizations. The core assumption of the resource dependence theory is that organizations need to obtain resources in the environment to maintain their survival. No organization is self-sufficient, and all organizations need to exchange with the environment.

Based on the theory of resource dependence, relevant scholars believe that the formation of a good supply chain relationship is conducive to the interaction between enterprises and other members of the supply chain, that is, the environment, so that it is easier to obtain and master key resources. The establishment of the cooperative vision is conducive to the supply chain enterprises to conduct business on the basis of mastering the key resources and organizational relationships. Therefore, based on the theory of resource dependence, this paper proposes the influence of supply chain relationship quality with cooperation vision as intermediary variable on supply chain performance.

### **2.2 Engineering supply chain**

With the wide application and development of supply chain management in traditional

manufacturing industry, many experts and scholars began to apply the supply chain management to the field of engineering construction. However, due to the characteristics of single production, centralization and decentralization, temporariness and complexity of engineering projects (Li, 2012), the engineering supply chain is also different from the common manufacturing supply chain. Xue believes that the engineering supply chain refers to the process that materials and information are transmitted between the owner, the design unit (Xue, et al., 2005), the construction contractor and the supplier during the whole process of engineering construction from design, construction, acceptance to recycling. From the perspective of resource management, Li Zhen believes that the engineering supply chain is actually a process of obtaining and allocating resources in many stages of engineering construction (Li, et al., 2017), including feasibility analysis, design, bidding, construction, etc. In addition, some scholars also look at the engineering supply chain from the perspective of engineering delivery. They think that the engineering supply chain is the process in which subcontractors deliver work to contractors, and contractors contact suppliers to build and finally deliver completed facilities to owners. But this definition is general.

Different from the traditional manufacturing supply chain, the engineering supply chain has the following characteristics: first, single-piece production, there is little demand for mass production in the general manufacturing industry in engineering projects, and it is often built for single or several complete sets of large buildings, which also means that the production and construction process is more complex, the construction site is more centralized, and the requirements for production site management are higher; Second, it is temporary, often the original project department will be dissolved immediately after the completion of the project, and a new project department will be set up to take charge of the new project, which also leads to the short timeliness of the project supply chain, unstable supply chain relations and difficult supply chain management. Thirdly, it is forward-oriented. Since the delivery standard has been determined before the implementation of the project, the project supply chain pays more attention to the link from the front-end supplier to the contractor.

### **2.3 Supply chain relationship quality**

The concept of supply chain relationship quality was first put forward by foreign scholars Crosby. It is believed that supply chain relationship quality refers to the dependence of supply chain partners on future behavior choices based on past trade cooperation (Crosby, 1990). Xu Ke believes that the quality of supply chain relationship refers to the evaluation of cognition and feelings by members of supply chain organizations in the course of their behaviors, thus forming an interactive environment and generating potential dependence on future behavior choices (Xu, et al., 2015).

In the measurement of supply chain relationship quality, Fynes believes that the quality of supply chain relationship can be studied from six aspects: trust, communication, commitment, dependence, adaptation and cooperation (Fynes, 2005). Domestic scholars have also added diversity of cooperation, complementarity of business structures, and high-level attention to measure the quality of supply chain relationships (Jiang, 2013). Qin pointed out in their research that the quality of the relationship cannot be limited to the relevant process of the relationship, nor can it be measured only by the behavioral factors of the relationship, such as communication, trust and cooperation, but should also involve environmental and contingency factors in the economy or society (Qin, et al., 2008). When measuring the dimension of supply chain relationship quality, scholars Xu believes that interactive environment is also one of the factors that need attention (Xu, et al., 2015). Its dimensions cover two aspects: the behavioral process of relationship occurrence, including communication, trust, cooperation and conflict coordination, etc. Interactive environment of relationship interaction, including adaptability and relationship atmosphere.

Based on the research on the quality of supply chain relations by scholars and the characteristics of

engineering supply chains, this paper holds that the characteristics of single-piece production of engineering projects make the quality of communication and cooperation in supply chain relations very important. The temporary nature of engineering projects makes the promised quality of supply chain relationship quality very important. This paper analyzes communication quality, cooperation quality and commitment quality as three dimensions of relationship quality in engineering supply chain.

#### **2.4 Supply chain performance**

SCOR and BSC models are commonly used to evaluate supply chain performance. For the evaluation of supply chain performance, most scholars use the above two models to construct evaluation indexes. In the performance research of the engineering supply chain, scholars Qiu Guofang has made a detailed review of the performance research of the domestic construction supply chain (Qiu, 2015). They believe that the performance evaluation of the construction supply chain can be based on the above two existing models, but also considered from the strategic objectives, including agility, finance, customers, internal operation ability, learning and innovation, supply chain closeness and so on. On the selection of performance evaluation indexes for engineering supply chain, the existing research mostly evaluates from three aspects of supply chain operation, project objectives and member relationships. On this basis, scholar Ke Hong proposed that the selection of performance evaluation indexes for engineering supply chain should not only refer to the manufacturing supply chain, but also consider the characteristics of the supply chain itself (Ke Hong, 2015). Based on ROF method and the characteristics of engineering supply chain, six performance evaluation indexes for engineering supply chain including progress, quality, cost, flexibility, core enterprise satisfaction and close degree of partners were selected. Project supply chain performance also belongs to the category of project performance. In the research on supply chain performance evaluation for large complex product manufacturing clusters, scholar Yang Jin combined with the performance characteristics of large projects such as infrastructure and evaluated them from five dimensions of synergy, reliability, flexibility, quality management and cost control (Yang Jin, 2013); He Qinghua and other scholars believe that whether rework occurs is an important factor affecting the performance of major engineering projects (He Qinghua, 2017).

Based on the perspective of external integration, this paper studies the influence of the relationship quality between enterprises and suppliers in engineering supply chain on the performance of enterprise supply chain. In the selection of evaluation indexes for supply chain performance, attention should be paid to the quality of supplier relations under the external integration strategy, and the characteristics of engineering supply chain and project management should be reflected at the same time. Compared with customer relationship quality, engineering projects pay more attention to supplier relationship quality, which requires many suppliers to supply raw materials efficiently and closely on site at the same time, while following the original plan in terms of cost. This paper measures the performance of engineering supply chain from three aspects: synergy, project progress and quality, and flexibility.

#### **2.5 Vision for cooperation**

With the deepening of research, the common vision between organizations has been frequently mentioned in the research of supply chain relationship quality. In an empirical study of Australia's road freight industry, scholar Ferrer regards cooperative vision as an important related factor to explain the quality of supply chain relationships (Ferrer, 2010). Yang believes that a common vision between organizations can strengthen constructive cooperation in the entire supply chain, and discuss the impact of the quality of supply chain relationships in the supply chain on the performance of enterprises with obvious supply chain embeddedness under the shared vision (Yang, 2018). Huang also mentioned a similar point of view in his research on the impact of supply chain relationship quality and embeddedness on the performance of manufacturers (Huang, 2015). The one-piece production and temporary characteristics of engineering projects make it possible that there is no long-term cooperation

between suppliers and enterprises in engineering projects. The cooperation vision reflects the possibility and willingness of both suppliers and enterprises to carry out project cooperation again even after the completion of the project. At the same time, in some transnational engineering projects, the long-term cooperation vision established under the background of policy support can effectively change the differences between the two sides in management methods and management concepts. Therefore, this paper believes that the cooperative vision plays an important role in the engineering supply chain management.

### **3 Research Assumptions**

#### **3.1 Supplier relationship quality and supply chain performance**

From the perspective of external integration, supply chain relationship quality can be divided into supplier relationship quality and customer relationship quality. Scholars such as Liu have proposed that supplier relationship quality has a greater impact on enterprise quality performance than customer relationship quality, and attributed it to the fundamental role of raw materials provided by suppliers in enterprise product quality (Liu, 2018). Therefore, it is necessary to study the influence degree of different relationship quality between enterprises and suppliers on supply chain performance. As for the relationship between relationship quality and supply chain performance, communication, cooperation and commitment will all affect supply chain performance, therefore, this paper puts forward assumptions.

H1: Communication quality has a positive impact on supply chain performance.

H2: Cooperation Quality Has Positive Impact on Supply Chain Performance.

H3: Commitment Quality Has Positive Impact on Supply Chain Performance.

#### **3.2 Moderating role of cooperative vision**

The characteristics of engineering supply chain make the relationship between enterprises and suppliers may be different when cooperating with suppliers. Especially for some overseas projects, the project will establish relationships with many unfamiliar suppliers. The relationships established in this situation may be more fragile and unstable than before, and the impact of relationship quality on supply chain performance may be weakened. The existence of a common vision makes the upstream and downstream partners of the supply chain have common development goals and share resources, which is expected to develop into long-term and close constructive cooperation (Yang, 2018), thus promoting the improvement of enterprise supply chain performance. Therefore, this paper puts forward assumptions.

H4a: Cooperative Vision has a positive moderating effect on communication quality and supply chain performance.

H4b: Cooperation Vision has a positive moderating effect on the effect of cooperation quality and supply chain performance.

H4c: Cooperative Vision has a positive moderating effect on the effect of commitment quality and supply chain performance.

Based on the above assumptions, this paper attempts to propose a multi-factor conceptual model to analyze the impact of supplier relationship quality on supply chain performance under the regulation of cooperative vision, as shown in Figure 1.

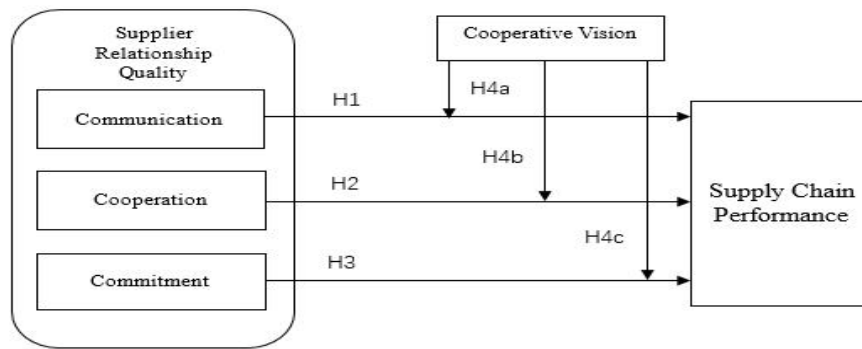


Figure 1 Conceptual Model

## 4 Research and Design

### 4.1 Sample and data collection

In engineering construction projects involving overseas businesses, the supply chain relationship is more susceptible to the influence of the cooperative vision. For example, for engineering construction projects under the Belt and Road Strategy, local suppliers are more likely to believe the reliability of the implementation of China's national strategy, believe that China's Belt and Road Strategic Initiative will greatly promote the development of all aspects of the local area, thus making it easier to share the same vision with Chinese construction enterprises. Therefore, this paper selects the engineering supply chain of overseas enterprises as the research target, and the survey object is mainly the overseas work and management personnel of Chinese construction enterprises. The topics and contents involved in the questionnaire all come from the mature scales at home and abroad, and are partially revised according to the characteristics of overseas construction supply chains. The Likert Five Scale was used to ask questions and answer the questionnaire. Respondents were required to fill in the questionnaire according to their own and actual working conditions.

### 4.2 Reliability and validity analysis

Firstly, this paper standardized the questionnaire, and tested the internal consistency of the questionnaire results with SPSS 23.0 software and clonal Bach coefficient. Generally speaking, when Cronbach coefficient is greater than 0.7, the reliability of the questionnaire is higher. The test found that the overall clonal Bach coefficient of the questionnaire was 0.941, and the clonal Bach coefficients of communication quality, cooperation quality, commitment quality, cooperation vision and supply chain performance were 0.932, 0.873, 0.823, 0.758, 0.918, respectively. The reliability of variable measurement was good, and the questionnaire had high reliability.

The validity measurement of the questionnaire mainly includes content validity measurement and structure validity measurement. The scales of communication quality, cooperation quality, commitment quality, cooperation vision and supply chain performance in this paper are all formed by using the existing mature scales for reference and revising them according to the characteristics of engineering supply chain. Therefore, they have good content validity. Therefore, this paper focuses on measuring the structural validity of the questionnaire through KMO test and Bartlett spherical test. Generally speaking, when the significant level of Bartlett spherical test is less than 0.001 and KMO value is greater than 0.5, the structural validity of the scale is relatively good.

SPSS 23.0 is used to analyze the structural validity of the questionnaire. The KMO values of the supplier relationship quality, cooperation vision and supply chain performance scale are 0.871, 0.659

and 0.754, with significance levels less than 0.001, which is very suitable for factor analysis. Therefore, exploratory factor analysis shows that the above scale has good structural validity and reasonable design. The reliability and validity of supplier relationship, cooperation vision and supply chain performance scale are shown in Table 1.

**Table 1 Reliability and validity analysis table**

Variable	KMO	Cronbach's Alpha
Communication		0.932
Cooperation	0.871	0.873
Commitment		0.823
Cooperative Vision	0.659	0.758
Supply Chain Performance	0.754	0.918

### 4.3 Hypothesis testing

#### 4.3.1 Model main effect test

H1, H2 and H3 propose the direct effects of communication quality, cooperation quality and commitment quality on supply chain performance under supplier relationship quality. H1( $B=0.331$ ,  $SE=0.077$ ,  $p < 0.01$ ), H2( $B=0.228$ ,  $SE=0.107$ ,  $p < 0.01$ ) and H3( $B=0.337$ ,  $SE=0.148$ ,  $p < 0.01$ ) have all been verified, indicating that communication quality, cooperation quality and commitment quality have positive effects on supply chain performance.

#### 4.3.2 Regulatory effect test of cooperative vision

In this paper, the adjustment effect of the cooperative vision is tested. The SPSS 23.0 is used for hierarchical regression analysis. The variable mean is centralized to construct the product interaction term, so as to verify the adjustment effect. That is, we first measure the three variables (i.e., communication quality, cooperation quality and commitment quality) under the quality of supplier relationship and the main effect of the cooperative vision on supply chain performance, and then the quality of the supplier relationship after standardization. The regression analysis is performed on the product interaction between the variable and the cooperative vision. If the P value is significant, it can be proved that the cooperative vision has a regulating effect.

H4a, H4b, and H4c propose a cooperative vision between the three variables of supplier relationship quality and supply chain performance. The interaction quality of communication quality and cooperation vision (COM\*CV) has a significant positive impact on supply chain performance ( $B=0.376$ ,  $SE=0.358$ ,  $P<0.05$ ); the interaction quality of cooperation quality and cooperation vision (COO\*CV) has a significant positive impact on supply chain performance ( $B=0.357$ ,  $SE=0.403$ ,  $P<0.05$ ); The commitment to quality and cooperation vision (CMT\*SI) has a significant positive impact on supply chain performance ( $B=0.116$ ,  $SE=0.453$ ,  $P<0.05$ ). The test results are shown in Table 2.



**Table 2 Main Effect and Regulatory Effect**

Dependent variable: SCP				
Variable	Main Effect		Regulatory Effect	
	B	SE	B	SE
COM	0.331**	0.077	0.360*	0.278
CV			0.013*	0.173
COM*CV			0.376**	0.358
COO	0.228**	0.107	0.345*	0.314
CV			0.039*	0.195
COO*CV			0.357*	0.403
CMT	0.337**	0.148	0.529*	0.320
CV			0.071**	0.231
CMT*CV			0.116*	0.453

Table 2 shows that the cooperative vision has a regulatory effect on the relationship between communication quality and supply chain performance, cooperation quality and supply chain performance, commitment quality and supply chain performance. H4a, H4b and H4c are established.

## 5 Conclusion

The research results show that communication quality, cooperation quality and commitment quality in the quality of supplier relationship have a positive impact on supply chain performance. Due to the forward-looking characteristics of the engineering industry, engineering companies pay more attention to the quality of relationships with suppliers compared to user relationships. In the process of establishing and maintaining supplier relationships, companies should pay more attention to communication, ensure cooperation and abide by commitments, which is crucial for the performance of the company's own supply chain.

In addition, with the implementation of China's "Belt and Road" strategy, more and more engineering and construction companies are going abroad to actively carry out overseas business. In this scenario, the establishment of a cooperative vision based on interest considerations is critical. Due to the differences in culture and values, it is difficult for construction companies and overseas suppliers to establish partnerships. The two sides have cross-cultural problems in establishing mutual trust and mutual assistance. The above research results show that the establishment of the cooperative vision has a significant adjustment effect on the relationship between the quality and performance of overseas engineering companies. Enterprises can improve supply chain performance by sharing resources with overseas suppliers, building strategies, and seeking common development, and actively establishing strategic partnerships and implementing strategic procurement.

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## Business Mode Innovation Based on Iceberg Theory

Yu Xiaoyu<sup>1</sup>, Zheng Zhan<sup>2</sup>

1 School of Management, Wuhan University of Technology, Wuhan, P.R.China, 430070

2 Media and Communication School, Wuhan Textile University, Wuhan, P.R.China, 430073

(E-mail: 632975612@qq.com, 22792466@qq.com)

**Abstract:** With the rapid development of emerging technologies such as the Internet, business mode innovation has received widespread attention from all walks of life in the past decade or so. This paper proposes an integrated analysis framework of business mode innovation by combining with the iceberg theory of business mode on the basis of dividing the elements of business mode into value proposition, key resources and capabilities, key business and profit model. The paper then applies the analysis framework to analyze the business mode innovation of Guangxi Geology & Mineral Huadi Industry and Trade Group Co., Ltd., and give some management enlightenment of business mode innovation for enterprises. The new analytical framework proposed in the paper can provide reference for scholars' research and enterprises' practice.

**Key words:** Iceberg theory; Business mode innovation; Innovation path; Case study research

### 1 Introduction

Academic research on the business mode(BM) first appeared in the 1960s. With the rapid development of emerging technologies such as the Internet, the scope of innovation is no longer limited to products and services. Business mode innovation(BMI) has received widespread attention from all walks of life in the past decade or so. Successful innovation of BMs can help companies build new capabilities that enable them to gain advantages in business competition (Martins L. L., Rindova V. P., Greenbaum B. E., 2015).

With BMI research moving forward, more and more studies on BMI for different industries has emerged. However, in the context of globalization, the external environment faced by enterprises is becoming increasingly complex. The existing analysis frameworks of BMI mostly lack the analysis of the influence of external environmental factors on BMI. Therefore, on the basis of dividing the elements of a BM into value proposition, key resources and capabilities, key business and profit model, and combining with the iceberg theory of BM, this paper puts forward an integrated analysis framework of BMI, with a view to providing reference for theoretical researchers and practitioners.

### 2 Literature Review

#### 2.1 Business mode theory

Even though academic research on BMs has been around for a long time, there is still no unified definition. The main reason is that scholars in different fields often discuss BMs from different points of view. Although definitions differ across studies, most current definitions are close to or consistent

with the definition of BM proposed by Teece, which is the design and architecture of value creation, delivery, and capture mechanisms of a firm (Teece D. J., 2009).

Scholars have proposed a number of BM research frameworks. This paper divides the existing BM research frameworks into two categories. One is the study of the components of BMs. The researchers list the elements that they think the BM should cover and explain them in detail. Osterwalder et al. clarified the nine components of the BM, and described the basic logic of value creation, delivery, and capture (Osterwalder A., Pigneur Y., Tucci C. L., 2005). Wei et al. presented a six-element business mode including business system, positioning, profit model, key resources and capabilities, cash flow structure and enterprise value (Wei Wei, Zhu Wuxiang, Lin Guiping, 2012).

The other is the study of the BM architecture. The researchers not only pointed out the components of the BM, but also explained the relationship between the various components. Yuan Lei established the "3-4-8" BM system, which links four unit structures through three interfaces to describe the composition of the BM (Yuan Lei, 2007).

## **2.2 Business mode innovation theory**

Literature review shows scholars have different opinions on the definition of BMI. The paper agrees with the definition of BMI proposed by Foss et al., which is "designed, novel, and nontrivial changes to the key elements of a firm's BM or the architecture linking these elements" (Foss N. J., Saebi T., 2016).

The research on paths to BMI has important guiding significance for enterprise practice, so it has attracted much attention. Through literature review, the studies on innovation paths mainly focus on the following three categories:

The first is based on the perspective of components of a BM. Osterwalder et al. proposed a BM canvas, which describes nine elements of a business mode and their interrelationships, and pointed out that BMI can start from these elements (Osterwalder A, Pigneur Y, 2010). Taking elements as the starting point of BMI has strong practical significance and operability for enterprises, but this perspective neglected that BMI is a dynamic process.

The second is based on the perspective of the value chain. Timmers argues that BMI can be achieved by extending, integrating and rebuilding the value chain (Timmers P., 1998). By reorganizing and improving key links and activities in the value chain, BMI can be greatly promoted. But most of the existing research is carried out in a specific industry context, and there is no universal paradigm.

The third is based on the process perspective. Teece pointed out that in order to achieve a sustainable BM, four stages are needed: market segmentation, creating the value proposition, capturing value and establishing isolation mechanism (Teece D. J., 2009). The BMI based on process perspective has dynamic characteristics, but the existing research on the innovation process is not thorough, and further research is needed in terms of progress control and resource integration.

## **2.3 Iceberg theory of business mode**

The iceberg theory is derived from psychology. Sigmund et al. defined personality as an iceberg in his book *The Ego and the Id*. In his opinion, the self-consciousness level and the unconscious level are the ice part and the underwater part respectively. And the underwater unconscious level is the

determining power of individual development and behavioral performance (Sigmund Freud, James Strachey, Peter Gay, 1962).

Based on the ideas of knowledge management and system engineering, Wang Shouyang et al. put forward the iceberg theory of BM (Wang Shouyang, AoJingning, Qiao Hao, et al, 2015). He considered the BM as a complex system, which is consist of explicit knowledge and tacit knowledge. Generally, tacit knowledge which is harder than explicit knowledge to analyze, includes factors such as external environment of organization, industry category, enterprise culture, technological development, etc. In summary, the iceberg theory of BM emphasize that environmental factors have an important influence on the formation and change of BMs.

### 3 Research Methods and Design

#### 3.1 Research methods and design

This paper adopts the single case study method, strictly following the case study process proposed by Yin: literature review → research framework design → data collection → case analysis (Yin R K, 2010). By reviewing the related research on BMs, the paper divides the elements of a BM into value proposition, key resources and capabilities, key business and profit model. Combining with the iceberg theory of BM, an integrated BMI analysis framework is put forward, as shown in Figure 1.

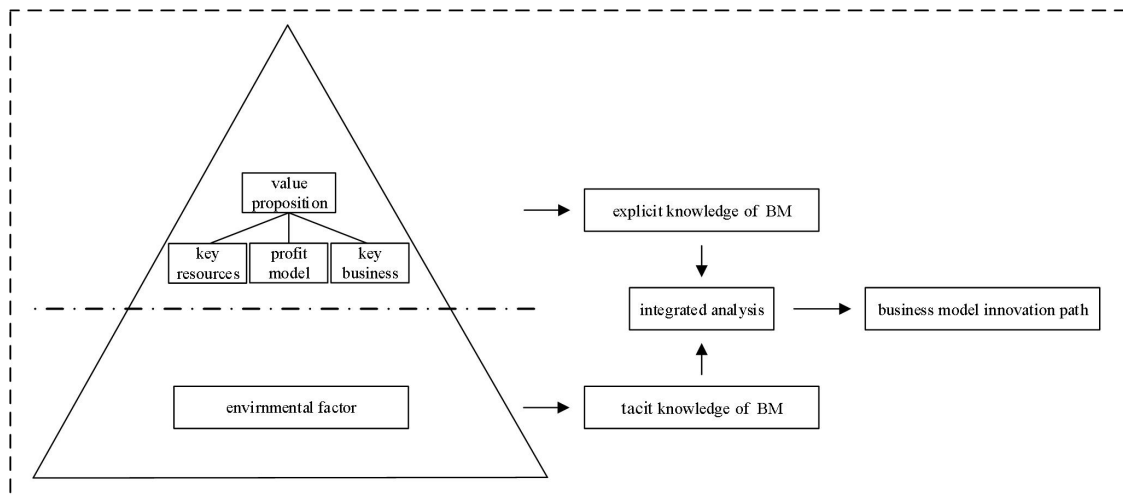


Figure 1 Business Mode Innovation Analysis Framework

#### 3.2 Case selection and data collection

According to the principle of typicality, this paper chooses HD as a case study sampled was established under the background of the implementation of government-affiliated institution reforms in China. The research on BMI of HD can provide important reference for the transformation of other government-affiliated institutions in China.

The data sources of this case include: (1) field investigation and interview.(2) internal information of enterprises including enterprise system documents, financial statements and s second-hand information.

## 4 Case Study

### 4.1 Company profile

HD was originally an institution affiliated to Guangxi Geological and Mineral Bureau. It was established at the end of 2015 on the basis of Guangxi Huadi Industry and Trade Center. It has 4 branches and more than 10 subsidiaries, the business areas of which include machinery manufacturing, import and export business agent, clothing wholesale market, real estate development, etc. The total value of HD assets is over 1 billion yuan.

Goose Mall, HD's subsidiary company, has become the gateway of Liuzhou's large-scale commodity wholesale market. In 2017, Goose Mall's rental income reached nearly 32 million yuan, which is the main source of profit for HD.

### 4.2 Business mode analysis

#### 4.2.1 The analysis of the explicit knowledge of HD's BM

Since HD has so many subsidiaries and branches, this paper divides HD's business into five modules: industry, commerce, real estate, finance and import and export trade.

(1) The industry module. This module is composed of three machinery factories. The module's value propositions include two parts: providing high quality diamond selection equipment and providing mechanical equipment and machinery parts. The key resources and capabilities of the module mainly contain two items: the "LiuTan" brand and the advanced manufacturing technology of diamond selector. The key business of the module is producing crushing and screening equipment, complete mineral processing equipment and machinery parts. The profit model of the module is selling products and services.

(2) The commerce module. This module comprises Goose Mall, JinDi Commercial Mall, and the Market Development Company. The module's value propositions include two parts: becoming a large-scale business center integrating shopping, dining and entertainment; becoming an influential and mature market of electromechanical hardware. The key resources and capabilities of the module mainly contain two items: 100,000 square meters of unsecured and debt-free commercial real estate; a strong operational capability for real estate. The key business of the module is renting shops. The profit models of the module include two ways: charging admission fees, rents and service fees; the wholesale and retail of goods.

(3) The real estate module. This module only has the Real Estate Development Company. The value proposition is providing safe and beautiful homes for people. The key capability is developing real estate. The key business contains two parts: developing real estate and leasing shops and warehouses. The profit models comprise two ways: house sales and rents.

(4) The finance module. This module is composed of the Investment Company and the Small Loan Company. The value propositions of the module mainly include two parts: building a fast and stable investment channel for investment and financing customers; providing various small loans for small and medium-sized enterprises, individual businessmen and natural persons. The key resource is the

strong capital strength. The key business mainly contains two parts: investing and financial consultation. The profit models comprise three ways: investment incomes, service fees and interest on loans.

(5) The import and export module. This module comprises the Import and Export Department of HD and the Goods and Materials Company. The value proposition of this module is providing high-quality goods and services for overseas customers. The key capability is having the right of independent import and export. The key business is exporting, and the profit model is sales profit.

#### 4.2.2 The analysis of the tacit knowledge of HD's BM

As the Sino-US trade disputes continue to intensify, the uncertainty of world economic development has gradually increased, and the downward pressure on China's economy has further mounted too. For the industry module, due to the adjustment of national energy and environmental protection policies in recent years, the market of mining equipment is becoming smaller and smaller with the increase of access threshold. For the commerce module, the rapid development of e-commerce has brought a huge threat to the survival of some traditional business, which has a great impact on HD's shop rental business. For the real estate module, housing sales of HD may continue to decline with the slowdown of China's economic growth. For the import and export module, the depreciation of RMB caused by Sino US trade war has a certain degree of promotion to the export trade. At the same time, with the continuous promotion of the "one belt and one way" initiative and the upgrading of China ASEAN Free Trade Area, the import and export business of HD has great opportunities.

### 4.3 Business mode innovation path

#### 4.3.1 Creating an innovation and start-up platform

In recent years, the government has vigorously promoted innovation and entrepreneurship, and constantly improves the support policies of innovation and entrepreneurship. HD should firmly grasp the opportunity, and integrate the internal and external resources to create an innovation and start-up platform which can provide entrepreneurs with office space and supporting services, entrepreneurship training services, information consulting services and financing services. At the same time, HD can seek financial subsidies from the government to reduce their running costs. The logic diagram of the innovation and start-up platform is shown in Figure 2.

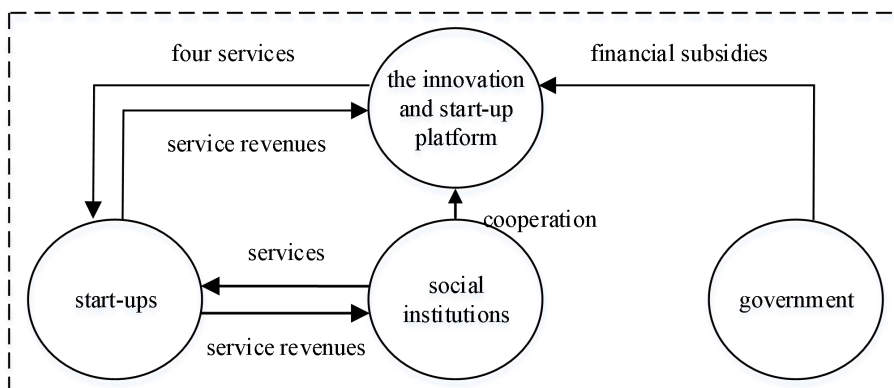


Figure 2 Logic Diagram of the Platform



(1) Office space and supporting services. HD can transform the large area of unrented shops in the Goose Mall into comfortable office space for start-ups, and equip it with complete hardware and software facilities such as computers and wireless networks.

(2) Entrepreneurship training services. HD can start various entrepreneurship training courses for entrepreneurs such as entrepreneurial marketing and financial management through utilizing the human resources of HD or employing college professors.

(3) Information consulting services. Taking advantage of the diversified business, HD can provide start-ups with technical information, market information, economic information and policy information consulting services covering various fields such as machinery manufacturing, commodity trading, real estate development, finance, and Internet.

(4) Financing services. HD can utilize the financial resources of subsidiaries to invest in potential start-ups, or provide financing services such as mortgage loans, orders loans and credit loans for start-ups.

#### 4.3.2 Establishing a community group purchase model

In recent years, the rise of e-commerce has occupied a large space for survival and development of traditional business. Only when traditional business is actively integrated into the Internet can they resolve their passive situation and find new growth points. Community group purchase is a kind of consumption behavior of resident groups. It is a regionalized and localized form of group buying relying on real communities. This model can realize mutual benefit and win-win between enterprises and consumers.

HD can establish a community group purchase model by updating the functions of the existing APP and developing corresponding WeChat applets, and target the community residents in Liuzhou city and attract them through the low prices and low transportation costs. The specific process of this model is as follows: First, each store publishes the products for sale through the APP or WeChat applet. Then the residents participate in the group purchase through the links posted by the community leaders in the WeChat group or through the APP. After the residents' payments are completed, the merchants deliver the goods to the community pick-up station. Finally, the residents take their packages at the pick-up station.

#### 4.4 Guarantee measures for business mode innovation

##### (1) Enhancing the resource integration capability of enterprises

Effective integration of enterprise resources is a critical guarantee for HD to build an innovation and entrepreneurship platform. Most of the diversified value-added services provided by the platform need to be realized through the integration of enterprise resources. Through the effective integration of internal and external resources, the enterprises can realize the maximum use effectiveness of resources and even create new resources so as to improve business performance.

##### (2) Strengthening the construction of the marketing team

To establish a community group purchase model, the most critical part is marketing. The

propaganda of the community group purchase model and the choose of a community leader really test the professional capability of the marketing team, so strengthening the construction of the marketing team is an important guarantee to establish a community group purchase model. HD needs to enhance the professional ability of the marketing team to establish a high-standard and high-quality marketing team.

### (3) Establishing a risk early warning mechanism

HD is bound to face many risks in the process of BMI. It is necessary to establish an effective risk early warning mechanism for BMI. HD should first establish the index system of BMI risk, and identify the dimensions of BMI risk and the definition of each index. Then HD should determine the weight of each index and prepare all kinds of emergency plans in advance. HD will be able to take corresponding measures to cope with possible risks through tracking the numerical changes of early warning indicators.

## 5 Conclusion

By reviewing related research on BMs, this paper divides the elements of a BM into value proposition, key resources and capabilities, key business and profit model. Combining with the iceberg theory of BM, an integrated BMI analysis framework is put forward, which may provide some guidance for enterprises to innovate their BMs. The paper applies the analytical framework to analyze the BMI of HD and presents the paths and guarantee measures for it, and gets the following management enlightenment:

(1) BMI is a dynamic process. Enterprises need to innovate constantly if they want to maintain their competitive advantage. Nowadays, the external environment that enterprises are facing is changing rapidly. Managers must have strong capabilities of analysis, forecast and plan, and make timely adjustments to the company's operation to realize the long-term development of enterprises.

(2) Effective resource integration is a critical guarantee for BMI. Resource integration capability is an important manifestation of an enterprise's competitiveness. By effectively integrating the internal and external resources of an enterprise, enterprises can realize the complementary advantages and the maximum use effectiveness of resources. In the process of BMI, the higher the degree of resource integration, the better the enterprise can play its own advantages, thus achieving high-level innovation.

## Acknowledgement

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# Research on B2C E-commerce Enterprise Logistics Mode Selection Based on Analytic Hierarchy Process: Taking Jindong Mall as an Example

Feng Lei

Wuhan Huaxia University of Technology, Wuhan, P.R.China, 430223

(E-mail: fl\_yutian@126.com)

**Abstract:** With the development of information technology, China's B2C e-commerce market has grown rapidly, but the logistics activities have seriously restricted the development of e-commerce, so we choose the logistics mode which adapts to the B2C e-commerce activities. It has become an important work for B2C e-commerce enterprises. First of all, this paper analyzes the influencing factors of e-commerce enterprises' selection of logistics mode. Using Analytic hierarchy process (AHP) to explore the selection of logistics mode for e-commerce enterprises, and taking Jindong Mall as an example, the analysis results are basically consistent with the actual situation, and the applicability of AHP in this issue is verified. It has some practical guiding significance.

**Key words:** E-commerce; Third-party logistics; Self-built logistics; Analytic hierarchy process

## 1 Introduction

With the rapid development of information technology and the improvement of the living standard of Chinese residents, many consumers like to shop on the Internet. At the same time, with the vigorous development of e-commerce, however, e-commerce enterprises are faced with logistics problems such as delayed distribution of goods, high logistics costs, damage or loss of goods and so on. Consumers' shopping experience is not good, and the interests and brands of e-commerce enterprises have also been seriously damaged(Wang Jiancheng,2016).

Foreign scholars began to study the selection of e-commerce enterprises logistics mode earlier. The results of the University of Tennessee show that the most effective e-commerce logistics distribution mode is the third-party logistics mode, which can reduce the logistics cost of enterprises and improve the service quality of logistics distribution(Andreas Klose,2005). Kaplinsky R and Morris M pointed out that the main factors affecting e-commerce logistics distribution are the cost of logistics distribution, inventory number, cargo characteristics, and logistics distribution mode. Lieb Robert and Miller John found that the third-party logistics can save the cost to a great extent(X.Sun,2015). Many American scholars have studied the operation mode of logistics distribution in B2C e-commerce environment, and many of them believed that third-party logistics will be the dominant mode of logistics distribution in e-commerce enterprise with the deepening of social division of labor and the rapid development of logistics industry(Yijun Huang,2014).

In China, HuangPengxiao has proposed that the difficulty of distribution of physical goods constitutes the primary bottleneck factor restricting the development of e-commerce in China, which is determined by China's objective geographical conditions and economic development

conditions(NiuXiaoxue,2016).Zhang Yuhong has proposed that many e-commerce enterprises begin to build their own logistics, and the trend is more and more obvious. The reasons for this phenomenon are the various defects of third-party logistics and the gradual growth of business volume of enterprises. Thus, enterprises have to solve all kinds of problems brought by third- party logistics in this way(Xiong Hui,2014).

## **2 Analysis on the Factors of Selecting Logistics Operation Mode in E-commerce Enterprises**

### **2.1 Size and growth rate of e-commerce online shopping market**

According to data released by iResearch, in 2017 the size of online shopping transactions in China reached 6.1 trillion yuan, up 30.3% compared with 2016, and the proportion of B2C e-commerce transactions has reached 57.6%. B2C e-commerce companies have endorsed the big platform as the brand and are more in line with e-commerce users to the quality of service and commodity security expectations(Xu Tingting,2018).Under China's economic development in a stable and positive situation, B2C e-commerce share will also be further enhanced. From the market share of online shopping, Tmall continues to lead the B2C market, while Jingdong, Vipshop and Suning grow rapidly.

### **2.2 The development level of third-party logistics industry**

China's logistics enterprises began to change from the previous mode of transportation and storage enterprises, the whole is still in the initial stage. With the development of the goods distribution industry, the third-party logistics also began to develop, and the logistics service function began to improve gradually. Now there are many domestic enterprises handing over the goods to the third-party logistics enterprises for distribution. However, the third-party logistics enterprises still have problems such as low level of logistics informatization and low level of logistics service(Wang Changqing,2016). With the rapid development of e-commerce in China, the third-party logistics industry has also gradually developed, indirectly affecting the pattern of China's logistics market, thereby indirectly affecting the selection of B2C enterprise logistics mode.

### **2.3 The enterprise strength**

The capital of the enterprise, the sales scale of the enterprise, the talent reserve of the enterprise and other indicators can measure the enterprise strength itself. For some enterprises, there are a lot of differences in the way of choosing logistics distribution, but they all start from the actual situation of the enterprise. Many small and medium-sized e-commerce enterprises, because of their own economic strength and cost factors, will choose third-party logistics enterprise with higher level of logistics services. Although self-built logistics can improve the control of logistics and customer satisfaction, due to the restrictions of funds, the most e-commerce enterprises rarely choose(Ma Shunshun,2015). At the same time, the logistics network system covering the whole country needs a large number of logistics professionals, such as supply chain managers, warehousing managers, express delivery person and so on.

### **2.4 The ability of enterprises to implement logistics management**

Even if e-commerce enterprises have the financial strength of self-built logistics, they may not be able to build the logistics system well. Because the logistics system is a very complicated system engineering, and it is not only able to establish and operate well at the expense of money. At the same time, enterprises need to have logistics information system including software and hardware technology, warehousing technology, supply chain management technology and so on. Taking Amazon as an example, it pays close attention to the research and development of software technology and storage technology from the beginning(J.Sun,2015). Relatively speaking, it has more advantages than other

enterprises in the self-built logistics system.

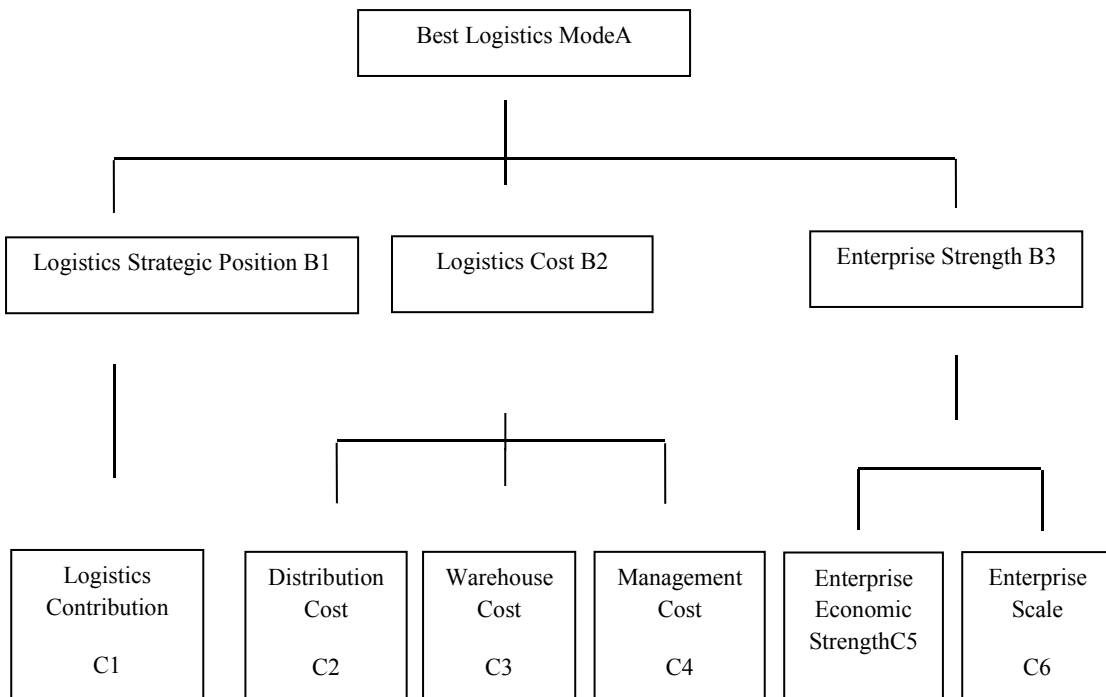
### 2.5 Logistics cost issue

Logistics cost affects the selection of e-commerce enterprise logistics mode to a certain extent. If the funds used by the self-built logistics are lower than the funds used by the third-party logistics enterprises, the enterprises can consider choose the self-built logistics, but this situation is less likely to occur; In more cases, the cost of self-built logistics is higher than the cost of using third-party logistics, which requires specific situation analysis. If the cost of self-built logistics is far greater than the cost of using third-party logistics, and the return can only be profitable in a long time, it will far exceed the enterprise's affordability. In this case, e-commerce enterprises choose third-party logistics better. If the cost of self-built logistics is only slightly higher than the cost of third-party logistics, and the revenue can be obtained in a short period of time, the self-built logistics mode can be considered.

## 3 Construction of Evaluation Model of Logistics Operation Mode in E-commerce Enterprises

### 3.1 Construction of evaluation index system with the analytic hierarchy process

Analytic hierarchy process (AHP) is a multi-objective decision analysis method which combines qualitative analysis with quantitative analysis. This method transforms the decision-making problem into three layers: objective, criterion and scheme, and then solves the eigenvectors by the method of judgment matrix. The weight of each level is obtained, and then the final weight of each scheme to the total goal is obtained by weighted sum methods(He Xinqian,2018).The final maximum weight is the optimal scheme.



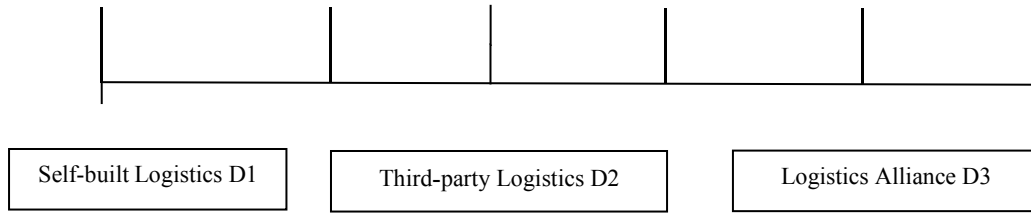


Figure1 Logistics Mode Selection Scenario

### 3.2 Establishment of judgment matrix

For the determination of the weight of each index, this paper adopts the form of questionnaire survey, through the online questionnaire website, invite the users of Jingdong Mall to fill in the questionnaire.

Write out all the judgment indexes, form a  $M \times M$  square matrix, then compare each index to score, and add up the scores of each index. Ranks score according to: very important, quite important, comparatively important, slightly important, equally important assigned to 9, 7, 5, 3, 1 respectively. Especially, the element on the diagonal of the square matrix relative to itself is equally important. On the other hand, they were given  $1/9, 1/7, 1/5, 1/3, 1$ .

For example, A is the best logistics mode for the enterprise, and B1 is the position of logistics in the enterprise, B2 is logistics cost, B3 is enterprise strength, as shown in Table 1.

Table 1 Judgment Matrix

A	B1	B2	B3
B1	9	1/3	2
B2	3	1	5
B3	1/2	1/5	9

Whether or not the judgment matrix is consistent with the judgment in the standard matrix? If the judgment matrix satisfies the following relations, then the judgment matrix is completely consistent.

$$B_{ij} = b_{ik} * b_{jk}$$

### 3.3 Calculating weight

Sum product method:

①Normalized processing:

$$B_{ij} = b_{ij} / \sum_{k=1}^n b_{kj} \dots\dots\dots (i, j = 1, 2, \dots, n)$$

②To add a normalized judgment matrix to a row:

$$W_i = \sum_{j=1}^n b_{ij} \dots\dots(i = 1,2, \dots\dots n)$$

③Pair vector  $W_i=(W_1, W_2, \dots\dots W_n)^T$  normalization:

$$W_i = W_i / \sum_{j=1}^n W_j \dots\dots(i = 1,2, \dots\dots n)$$

Obtained  $W_i=(W_1, W_2, \dots\dots W_n)^T$ , That is the weight coefficient.

### 3.4 Consistency check

Consistency check are performed with Coincidence Indicator (CI), Random Consistency Index (RI) and Consistency Ratio (CR).

Coincidence Indicator is:  $CI = \frac{\lambda_{max}-n}{n-1}$

In order to judge whether the judgment matrix of different orders have satisfactory consistency, we also need to introduce the Random Consistency Index (RI) of the judgment matrix. Table 2 lists the test values of the average random consistency index calculated by the judgment matrix.

Consistency Ratio is:  $CR=CI/RI$

When the calculated value CR is less than 0.1, the judgment matrix has satisfactory consistency. Otherwise, the judgment matrix at this level should be readjusted until satisfactory consistency is achieved.

**Table 2 The Numerical Table of Random Consistency Index**

Order number	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
RI	0	0	0.58	0.8	1.12	1.24	1.31	1.45	1.45	1.49	1.51	1.54	1.56	1.57	1.59

## 4. Data Analysis and Model Validation of Jingdong Mall

### 4.1 Construct judgment matrix

In the early days of the establishment of Jingdong Mall, Liu Qiangdong, the founder of Jingdong Mall, had a very clear understanding of the capability and development trend of China's third-party logistics enterprises, and predicted that this situation would not be greatly improved in the near future. Therefore, Jingdong Mall adopts self-built logistics as its main logistics operation mode. The self-built logistics mode enables Jingdong Mall to provide authentic guarantee for users, improve distribution speed, and rationally match the receiving time of users(He Fei,2017).Considering the limitation of working hours of many consumers, Jingdong Mall can provide home delivery service at three times a day, effectively improving the shopping experience and satisfaction of users.



**Table 3 Jingdong Mall Judgment Matrix Table 1**

A	B1	B2	B3	B1	C1	B2	C2	C3	C4	B3	C5	C6
B1	1	1	1	C1	1	C2	1	1	1	C5	1	3
B2		1	1			C3		1	1	C6		1
B3			1			C4			1			

**Table 4 Jingdong Mall Judgment Matrix Table 2**

C1	D1	D2	D3	C2	D1	D2	D3	C3	D1	D2	D3	D4
D1	1	3	5	D1	1	C2	1	1	1	C5	1	1
D2		1	3	D2		C3		1	1	C6		
D3			1	D3		C4			1			

**Table 5 Jingdong Mall Judgment Matrix Table 3**

C4	D1	D2	D3	C5	D1	D2	D3	C6	D1	D2	D3	D4
D1	1	1	1	D1	1	1	3	D1	1	1	3	3
D2		1	1	D2		1	3	D2		1	3	1
D3			1	D3			1	D3			1	

**4.2 Matrix table obtained by normalization processing**

**Table 6 Jingdong Mall Combination Matrix Table 1**

A	B1	B2	B3				
B1	0.322	C1	1	C2	0.322	C5	0.74
B2	0.322			C3	0.322	C6	0.24
B3	0.322			C4	0.322		

**Table 7 Jingdong Mall Combination Matrix Table 2**

C1	C2	C3	C4	C5	C6						
D1	0.641	D1	0.3	D1	0.3	D1	0.322	D1	0.4375	D1	0.4375
D2	0.208	D2	0.5	D2	0.5	D2	0.322	D2	0.4375	D2	0.4375
D3	0.210	D3	0.3	D3	0.1	D3	0.322	D3	0.1483	D3	0.1483

#### 4.3 Get the combination weight vector matrix and normalize it again

Normalized calculation showed that  $B1 = B2 = B3 = 0.322$ , substituting  $B1, B2, B3$ , it shows  $C1 = B1 \times 1 = 0.322$ ,  $C2 = C3 = C4 = B2 \times 0.322 = 0.111$ ,  $C5 = B \times 30.75 = 0.2498$ ,  $C6 = B3 \times 0.25 = 0.08325$ .

Then  $C1, C2, C3, C4, C5, C6$  are added into the weighted calculation.

$$D1 = 0.333 \times 0.652 + 0.111 \times 0.2 + 0.111 \times 0.2 + 0.111 \times 0.333 + 0.4286 \times 0.2 + 0.08325 \times 0.4286 = 0.41937$$

$$D2 = 0.333 \times 0.217 + 0.111 \times 0.6 + 0.111 \times 0.333 + 0.111 \times 0.2 + 0.2498 \times 0.4286 + 0.08325 \times 0.4286 = 0.34017$$

$$D3 = 0.333 \times 0.131 + 0.111 \times 0.2 + 0.111 \times 0.2 + 0.111 \times 0.333 + 0.2498 \times 0.1428 + 0.08325 \times 0.1428 = 0.17255$$

#### 4.4 Evaluation result

By using Analytic Hierarchy Process (AHP), the calculated score of self-built logistics mode is 0.41937, the calculated score of third-party logistics mode is 0.34017, and that of logistics alliance mode is 0.17255. So the self-built logistics mode is the optimal scheme, the third-party logistics mode is the sub-optimal scheme.

### 5 Conclusion

The result of Analytic Hierarchy Process (AHP) proved that Jingdong Mall should adopt self-built logistics mode in China, which is also in line with the actual logistics distribution model of Jingdong Mall. Therefore, the data collected in this paper, and the influencing factors and the distribution of importance degree are reasonable. Meanwhile, the Analytic Hierarchy Process (AHP) can be applied to other B2C e-commerce enterprises in the decision-making of logistics mode selection, which has a certain practical significance.

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# Synergetic Effect of Supply Chain in the Construction Industry

Chen Huilin

Logistics Affair Department ,Wuhan University of Technology, Wuhan, P.R.China, 430070

(E-mail: chenhuilin0127@163.com)

**Abstract:** On the basis of value chain theory, supply chain theory and synergy theory, this paper analyzes the supply chain synergy model and effects in construction industry. It establishes the index system and applies fuzzy hierarchy comprehensive evaluation method to analyze synergetic effects of supply chains in the construction industry. Finally, it applies a case to prove the index and method above.

**Keywords:** Supply chain; Synergetic effects; Construction industry; Proof

## 1 Introduction

Building enterprises are those specializing in producing building products such as civil engineering, building installations and so on. Building products are characteristic of regular worksites, large sizes, multiple types. The building processes are characteristic of mobile production, long production term and complicated coordinative relationships. Therefore, the construction industry is a widely scattered industry, in which large or small construction industry, material suppliers and design organizations are scattered all over the country, whose sizes are not big and competitiveness is not strong. The so-called scattered industrial structure results in low efficiency and high costs and thus affects the synergetic effects of supply chains in the industry. Therefore, construction industry needs synergy management of supply chains to integrate industrial resources and reduce chains without added values. This thesis applies supply chain theory and synergy theory to discuss the synergy mechanism and effects of supply in building industry, hoping to be theoretically and practically significant to promote healthy and sustainable development of Chinese building industry.

## 2 Literature Review

The supply chain synergy of construction industry refers to mutual coordination and mutual affection by enterprises in the chains such as suppliers, sub-contractors, owners and so on. Enterprises in the chains forms a network corporation through agreement or united organization, in which suppliers, sub-contractors and customers, on the basis of modern technologies, network technology and communication technology, dynamically share information, closely work together and go towards a common target, that is, leads to the lowest cost, highest profit and biggest customer benefit of the whole chain. The synergistic management of supply chain in construction industry is intended to seek for medial organizational effects, construct a group of competitiveness and keep strength of core culture, whose significance is reflected as follows:

First, to strengthen synergistic relationship of supply chain. The synergy is intended to break through limits and barriers between enterprises, enable them to share and make synergistic use of

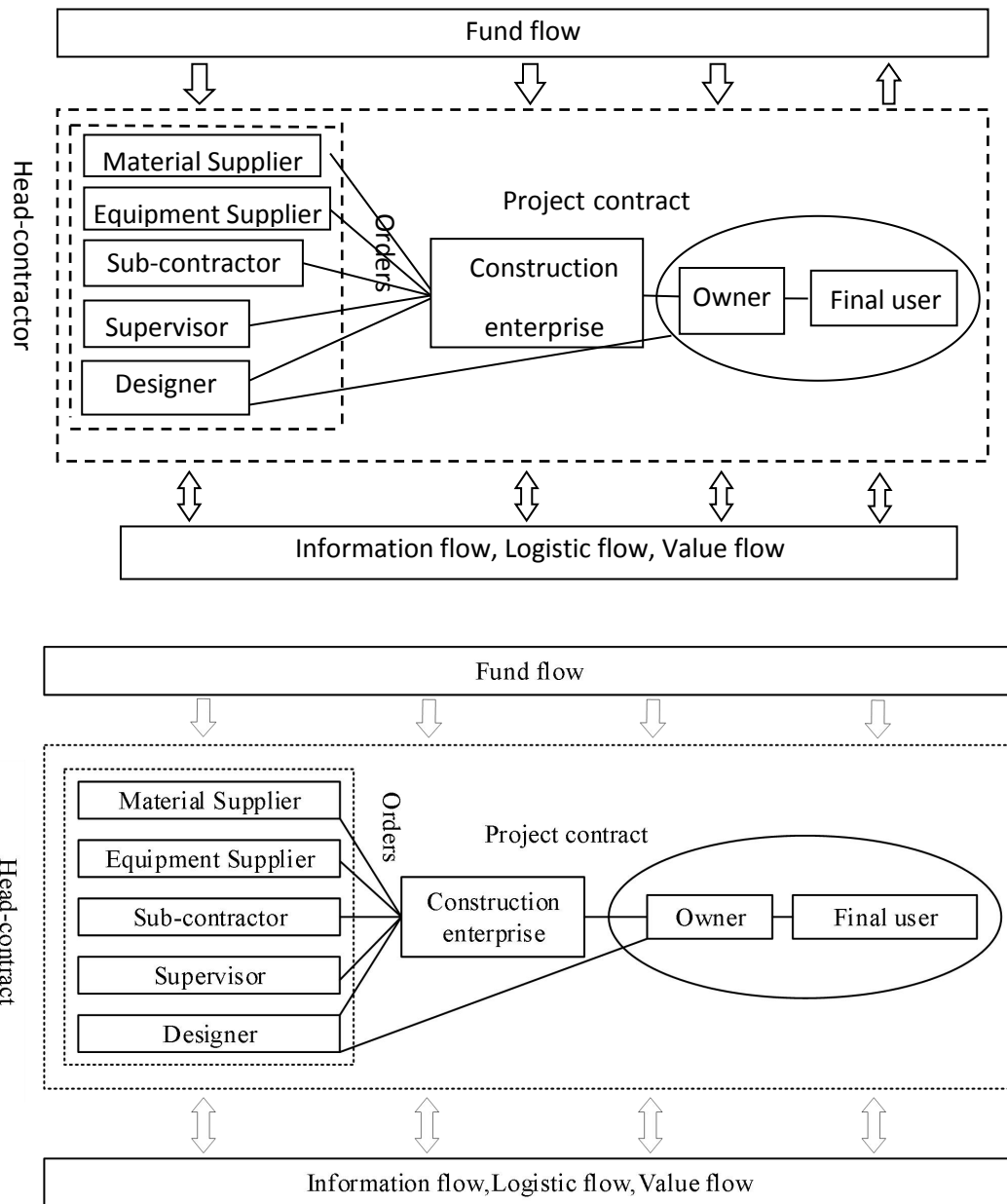
resources like people, money, materials and information on the basis of common targets. As the economy globalizes and market competition intensifies, construction industry who needs to consume large amounts of resources need the supply chain synergy to make efficient use of resources and thus optimize values.

Second, to bring synergistic effects of supply chain. The synergy is intended to obtain more benefits, that is, synergetic effects. Through synergistic operations enterprises will gain more competitiveness and more profits, which is considered as synergetic effects. Construction industry may synergize their operations like sharing knowledge or technologies in the chain to improve their efficiency of value creation and thus acquire synergetic effects.

Third, to reduce operational risks. Construction industry may expand their scales to achieve synergetic effects and create more values than rivals. While, scale expansion may lead to scale economy and upgrade of competitiveness but also may result in reducing enterprises' flexibility and strengthening barriers to withdrawal, which makes it necessary for enterprises to synergize supply chains to keep independence and obtain help from other enterprises and thus reduce operational risks.

### **3 Synergy Mechanisms of Supply Chains in Construction Industry**

The supply chain synergy is a highly integrated system of material flow, information flow, money flow and value flow, which means that in the whole process beginning from project contracting to completion, organizational members including suppliers, contractors, building enterprises, sub-contractors, owners as well as end users, based on the unitary target of the whole chain, will integrate and optimize the system, synergize operations, reduce costs, improve quality, shorten time, and thus maximize values of the whole chain. What is different from manufacture industry is that product designing and quality supervision will be carried on by independent juridical entities and thus they have to synergize operations to create values together for customers. Material flow including raw materials, equipment and so on will go from suppliers to demanders while money flow is just the opposite. Information flow includes demand information and supply information. The former such as project contracts and purchase orders will go from demanders to suppliers while the latter will go down entries and completion reports will go from suppliers to demanders. The value flow involves a set of operational activities to create values along with material flow until the end user accepts the product and finish the process, as shown in Figure 1 below.



**Figure 1** Frame Model of Supply Chain Synergy in the Construction Industry

The operational synergy involves three respects: organizational synergy, work synergy and informational synergy as follows.

-Organizational synergy. That is, building enterprises together with suppliers, the general contractor as well as sub-contractors and the owner synergize operations, form profit- and risk-sharing corporation to meet the end user's demand. Each member, based on maximizing the chain's value, shares the chain's resources and achieve high trust and synergy. Therefore, first of all, it is necessary to select those enterprises as strategic partners who have high reputation, similar values and operational ideology as well as strong core competitiveness. Secondly, in order to achieve the synergy of culture, strategy and managerial ideology, a kind of co-operating and trusting relationship based on sharing resources should

be established so as to make the culture open, make the institutions transparent and make targets coherent.

-Work synergy. Work flow differs from enterprise to enterprise in the chain. In order to maximize the chain's values, all enterprises must synergize their work flows. First of all, the end user and owner must sign a contract with the head contractor. Then the head contractor will subcontract the project to building enterprises. And then building enterprises will have to work with suppliers, supervisors, designers and sub-contractors to form the final products. Only if all enterprises in the chain work together closely, providing materials and equipment timely, design and supervise effectively, could the whole work flow be operated smoothly.

-Informational synergy. The supply chain synergy is based on information synergy, which means, the head contractor, suppliers, sub-contractors, owners and end users take advantage of modern network technology and value chain synergistic management technology to share and synergize demand and forecast information, order information, purchase information, supply information, stock information, contract information and other information. The information synergy may keep information transparent and real, and enable enterprises to reduce costs, shorten work time and guarantee quality.

In addition, the process of supply chain synergy in the construction industry may be divided into three phases: synergy formation, synergy operation and synergy control. Each phase has its corresponding contents and mechanism to make it go smoothly. The synergy process is as follows in Figure 2.

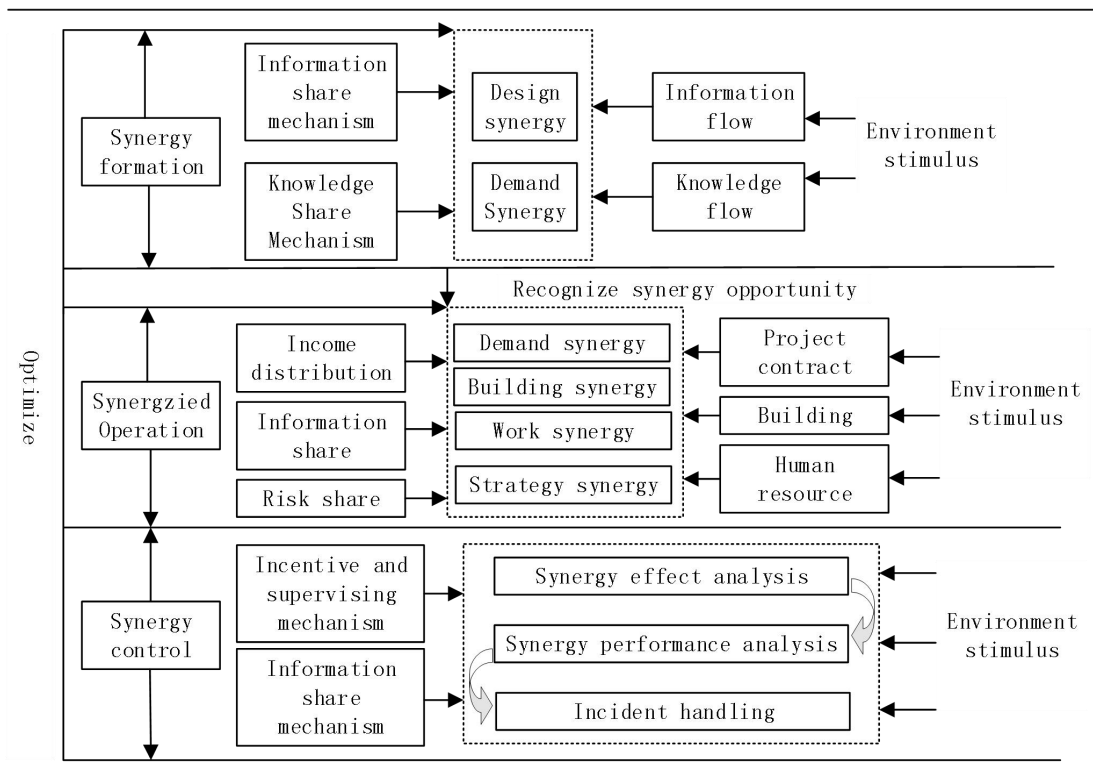


Figure 2 Supply Chain Synergy Process in the Construction Industry

As in Figure 2, in order to improve supply chain synergy, it is imperative to establish such synergy mechanisms as incentive mechanism, information share mechanism, profit distributing mechanism and trusting mechanism.

## 4 Index System, Method and Proof

The synergetic effect analysis is based on some mathematic methods to quantitatively and qualitatively calculate the total values created by such activities as project contracting, building and services. In order to put into use and improve building enterprises' synergetic effects, it is necessary to choose scientific and objective methods to comprehensively analyze the synergetic effects and find problems.

### 4.1 Index system to analyze the supply chain synergy in the construction industry

To analyze the supply chain synergetic effects in the construction industry, a scientific, reasonable and comprehensive system of indexes must be established according to the construction industry's behavioral features, work features and internal and external situation. The indexes are chosen as follows:

**Money flow.** Money is the foundation of supply chain synergy. The thesis chooses Cash turnover rate, Average loan on-time settlement rate and Cost saving rate to reflect the situation of money circulation in the chain.

**Information flow.** The information flow will go through the whole chain from the beginning to the end. The thesis chooses Information exchange rate, Information transmitting accuracy, Data sharing frequency, Timely information delivery rate and Unit cost of information exchange to reflect the statuesque of information flow.

**Work flow.** The work flow is the most important part of the synergy management of supply chain. The thesis chooses Material purchase period, Stock turnover rate, Material supply flexibility, Average timely material delivery rate, Project construction flexibility, Comprehensive quality conformance rate and Feedback question solving rate to reflect the synergizing ability the supply chain.

**Customer service.** Customers are fundamental for building enterprises' survival and development. Customers' demands are not fully satisfied are the mean reason for customer loss. The thesis chooses Customer satisfaction, Customer retention rate, Order completion rate and Order response speed to reflect customer services.

**System adaptability.** The supply chain synergy is nothing without the system's adaptability. The thesis chooses Target consistence, Coordinative and cooperative ability and Credibility to reflect the chain's synergetic ability.

**Table 1 Index System of Analyzing Supply Chain Synergy in the Construction Industry**

Primary index	Secondary index	Index quantization
Money	Cash turnover rate $A_{11}$	Total income/Total assets



flow A <sub>1</sub>	Average loan on-time settlement rate A <sub>12</sub>	Average of the times of timely account settlement in total times
	Cost saving rate A <sub>13</sub>	Actual cost/Total cost budgeted
Information flow A <sub>2</sub>	Information exchange rate A <sub>21</sub>	Times of information exchange in certain time/time length
	Information transmitting accuracy A <sub>22</sub>	times of accurate information delivery/total times of information delivery
	Data sharing frequency A <sub>23</sub>	Shared data amount/Total data
	Timely information delivery rate A <sub>24</sub>	Times of timely delivery/Total times of delivery
	Unit cost of information exchange A <sub>25</sub>	Total cost of information exchange/Total times of information exchange
Work flow A <sub>3</sub>	Material purchase period A <sub>31</sub>	Purchase period of certain material in certain time/Material purchase types
	Stock turnover rate A <sub>32</sub>	Sales amount/Stock amount
	Material supply flexibility A <sub>33</sub>	(Maximal supply quantity -minimal supply quantity)/Average supply quantity
	Average timely material delivery rate A <sub>34</sub>	Times of timely delivery/Total times of delivery
	Project construction flexibility A <sub>35</sub>	(the latest project completion time-the earliest project completion time/Acceptable project completion time
	Comprehensive quality conformance rate A <sub>36</sub>	Redone project number/Total project number
	Feedback question solving rate A <sub>37</sub>	Total producing amount/Total sales amount
Customer service A <sub>4</sub>	Customer satisfaction A <sub>41</sub>	(Total customer number-Complaining customer number)/Total customer number
	Customer retention rate A <sub>42</sub>	Old customer number/Total customer number
	Order completion rate A <sub>43</sub>	Actual delivered product number/Sellers' purchased product number
	Order response speed A <sub>44</sub>	The time from customer ordering to order finishing
System	Target consistence A <sub>51</sub>	Score by experts

adaptability A <sub>5</sub>	Coordinative and cooperative ability A <sub>52</sub>	Score by experts
	Credibility A <sub>53</sub>	Score by experts

**4.2 Method to analyze the supply chain synergy in the construction industry**

Because people do not fully understand evaluation indexes or people are possible to be disturbed by false information, meanwhile due to supply chain's complicacy and dynamics, there must be some imperfect information, that is, fuzzy information. Therefore, we choose fuzzy hierarchy comprehensive evaluation method, which integrates fuzzy mathematics and analytic hierarchy process, to comprehensively analyze the synergetic effects of supply in construction industry. The specific steps are as follows:

- Step 1: Establish index system to determine reasonable evaluating factor set;
- Step 2: Use the Analytical Hierarchy Process to determine weight of each index;
- Step 3: Establish comment set;
- Step 4: Establish fuzzy evaluation matrix;
- Step 5: Calculate comprehensively;
- Step 6: Determine score set; and
- Step 7: Calculate the results.

**4.3 Proof**

Company A is a large building enterprise while Company B is another one in the chain who synergize operations with A. According to the evaluating index system above, we apply AHP to determine the index system and check its consistency, we obtain  $W_i$ ,  $W_{ij}$ , as shown in Table 2 in which the comment is set as V1 {Excellent (>90%), V2 Good (80%-90%), V3 Average (65%-80%), V4 Fair (50%-65%) and V5 Poor(<50%)}

**Table 2 Fuzzy Computation**

Primary index		Secondary index			Fuzzy Matrix					
<i>i</i>	$U_i$	$W_i$	<i>j</i>	$U_{ij}$	$W_{ij}$	$V_1$	$V_2$	$V_3$	$V_4$	$V_5$
1	$B_1$	0.1289	1	$C_{11}$	0.6370	0	0	0.4	0.6	0
			2	$C_{12}$	0.2583	0	0.6	0.4	0	0
			3	$C_{13}$	0.1047	0	0.4	0.4	0.2	0
2	$B_2$	0.2615	1	$C_{21}$	0.1309	0	0.4	0.6	0	0
			2	$C_{22}$	0.5015	0	0.2	0.6	0.2	0

			3	$C_{23}$	0.1070	0	0.4	0.6	0	0
			4	$C_{24}$	0.2606	0	0	0	0.4	0.6
			1	$C_{31}$	0.0194	0	0	0	0.8	0.2
			2	$C_{32}$	0.0277	0	0	0	0.4	0.6
			3	$C_{33}$	0.0450	0	0.4	0.6	0	0
3	$B_3$	0.5128	4	$C_{34}$	0.2445	0	0.4	0.4	0.2	0
			5	$C_{35}$	0.0798	0	0.6	0.4	0	0
			6	$C_{36}$	0.2608	0	0.6	0.4	0	0
			7	$C_{37}$	0.3228	0.2	0.8	0	0	0
			1	$C_{41}$	0.1175	0.2	0.2	0.4	0.2	0
4	$B_4$	0.0634	2	$C_{42}$	0.5650	0.2	0.4	0.4	0	0
			3	$C_{43}$	0.2622	0	0.6	0.4	0	0
			4	$C_{44}$	0.0553	0	0	0.6	0.4	0
			1	$C_{51}$	0.1047	0	0.2	0.2	0.4	0.2
5	$B_5$	0.0334	2	$C_{52}$	0.6370	0.2	0	0.8	0	0
			3	$C_{53}$	0.2583	0	0.8	0.2	0	0

To calculate and normalize by the formula  $A=W \times R$ , the Membership vectors are as follows:

$$R_B = \begin{bmatrix} A'_{B_1} \\ A'_{B_2} \\ A'_{B_3} \\ A'_{B_4} \\ A'_{B_5} \end{bmatrix} = \begin{bmatrix} 0 & 0.1969 & 0.4000 & 0.4031 & 0 \\ 0 & 0.2039 & 0.4352 & 0.2045 & 0.1564 \\ 0.0646 & 0.5784 & 0.2610 & 0.0755 & 0.0205 \\ 0.1365 & 0.4068 & 0.4111 & 0.0456 & 0 \\ 0.1274 & 0.2276 & 0.5822 & 0.0419 & 0.0209 \end{bmatrix}$$

Then by the comprehensive evaluating model, we obtain:  $A=W \times R_B=(0.0461, 0.4087, 0.3447, 0.1484, 0.0521)$ .

When setting  $K_1=20, K_2=40, K_3=60, K_4=80, K_5=100$ , the score set is  $K=(20,40,60,80,100)^T$ . According to  $B=A \times K$ , we obtain the synergy value is:  $B=(0.0460, 0.4087, 0.3447, 0.1484, 0.0521) \times (20, 40, 60, 80, 100)^T=55.0320$ .

That is, when using the above index and method to calculate, the result is about 55, which shows that the synergetic effect is bad and which shows that they should analyze their actual situation and problems and take proper measures to optimize the synergy of their supply chain. In addition, we found the reason why their synergetic effect is bad is that their information synergy is bad. Therefore, they

should establish an effective information exchange platform, improve information exchange infrastructures and set up effective information exchange rules.

## 5 Conclusion

Products of construction industry are different from others in that they need to consume large amounts of human, money and material resources. The supply chain in construction industry is thus different so that it is urgent to use the synergy theory to analyze supply chain synergy in the construction industry. This thesis establishes a frame model and index system, uses the fuzzy hierarchical method to comprehensively analyze the supply chain synergy in the construction industry, on the basis of which it suggests as follows to improve synergetic effects in the construction industry:

-Chain members must take advantage of advanced network technology to effectively share information and synergize work flows;

-Chain members must set up an effective organizational structure to guarantee participation of leaders and close cooperation of members; and

-Chain members must set up effective rules as well as trusting mechanism, incentive mechanism, profit distributing mechanism and rewarding and punishing mechanism to promote strategic partnership.

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## Sick Organizational Culture: Leadership that Makes People Sick

Alan Tadeu de Moraes<sup>1</sup>; Luciano Ferreira da Silva<sup>2</sup>;  
Arnoldo José de Hoyos Guevara<sup>2</sup>, Gustavo Grandier<sup>1</sup>,  
Diego de Melo Conti<sup>1</sup>

<sup>1</sup> University Nove de Julho, São Paulo, Brazil

<sup>2</sup> Pontifical University Catholic of São Paulo, São Paulo, Brazil

(E-mail:alant.moraes@gmail.com, lf\_silvabr@yahoo.com.br,  
arnoldodehoyos@yahoo.com.br,grandergustavo@gmail.com,diegoconti@uol.com.br)

**Abstract:** This article aims to discuss the relationship of organizational culture represented in the leadership style in the health of the people in organization. In order to do so, a search was conducted into the literature by studies that addresses the theme and allowed us to contextualize it. A proposal of this discussion we can say that the environment organization can cause occupational diseases like the burnout syndrome explored in this article. A relevant point that should be emphasized in this study is that, although relatively new, studies explore the concept of toxic leadership, which consists of a series of problems caused by the leader that affect the life of the organization as well as the life and health of the employee. Therefore, an organizational disease can be caused by an unhealthy organizational culture and a toxic leadership style.

**Keywords:** Organizational culture; Organizational structure; Culture; Leadership style; Leadership; Burnout syndrome

### 1 Introduction

How could be possible people get sick just because they work? What factors are responsible for that? There are so many questions emerging from a single question: Are leaders leading people into sickness? What is known is that people tend to react when something is not accordingly to their expectations (Herzberg, 1966; Bakker & Demerouti, 2017). It is shown by several studies such as Hackman & Lawler (1971), Muller (2011), Putthiwani (2015), Chatterjee, Pereira & Bates (2018), Chong, Shang, Richards & Zhu (2018), among others scholar that study organization and its cultures over employees. These studies are important to establish what steps are needed to contribute with the field of literature about Human Resources Management disciplines.

The comprehension of what could be considered ill, it is important to clarify the concept of the word itself. So, according to English Oxford dictionary the word ill can be understood as “suffering from an illness or disease or feeling unwell”; “poor in quality”; “bad or harmful”; “not favorable or auspicious”; “problem or misfortune”, and “evil or harm” (Ill, 2019). For this research, the concept of the word will be understood under the standpoint of a consequence of a disease. So, it could be analogically understood like something that is developing over the time and based in some situations such as stress from organizational tasks.

Once it is considered that organizations create and transfer knowledge exactly like humans do, and the existence of a pleasant environment should be ubiquitous to happen the transference, it is essential for the development of the tasks the previous understanding about what factors contribute or not to the processes of employees health or lead them to Syndrome of Burnout (Nonaka & Takeuchi, 1995; Choo, 2001; Scatolin, 2015; Silva, Sabbadini & Desiderio, 2015; Latino, Corallo, Capone, Martino & Trifoglio, 2016; Budeva, 2016; Ribera & Ceja, 2017; eÖrtenblad, 2018). Due to that, it is *sine qua non* to provide a consistent understanding about what factors are responsible for the employee's health, culture, and leadership.

Culture can be understood as the values and beliefs shared in the company, in which it gives direction of the course to be followed to achieve the goals in the company (Kim, & Chang, 2018). Oyemomi, Liu, Neaga, Chen, & Nakpodia (2018) shows that culture not only leads to the identification of the company, but also is determinant for the organization growth. According to Tsai (2011), the beliefs and values influence the attitudes and behaviors that exist for a long time, and they are related to the organizational culture.

According to Nyberg, Bernin and Theorell (2005) the organizational culture reflects on the leisure time of the employees. Tsai (2001) complements that organizational culture also gives the directions and

leadership behavior of the administrators in order to reach what the company requires from their leaders. Therefore, the company success depends on the leadership effectiveness (Lin, Ma, Zhang, Li, & Jiang, 2016).

In organizational culture terms there are many factors related to the company success (Murphy & Pardeck, 1986), but there are also others factors as important as success, which contribute to the company success though. The fact of the health of the employees is understood as quite important to maintain the company working properly. This article aims to discuss the relationship of organizational culture represented in the leadership style in the health of the people in organization. Therefore, this study seeks into the literature **how does a company organization may sick people?**

## **2 Culture, Unhealthy People, and Leadership Style Influence**

### **2.1 Organizational culture and sickness**

Taking into consideration that inside the management of the organizational culture is included into the critical success factors, and it is also responsible for leading the company into a better position if compared to its concurrent (Santos, Damian, & Valentim, 2019). Other factors such as people must be considered, once as mentioned by Kim and Chang (2018) that everything is shared into a company to people is understood as an organizational culture. Therefore, a special attention should be given to people and their needs.

Kartolo and Kwantes (2019) state that values, attitudes, and expectations shape the organizational culture. The authors explain that organizational culture not only impact on employee levels, but also on the success or failure. According to Marguardt (2002, p.27) "culture refers to an organization's values, beliefs, practices, rituals, and customs." Organizational culture could be understood as a way of shaping behavior (Tseng, 2010).

Cameron and Quinn (2006) mention that it is quite important to bear in mind that there are different types of culture (clan, adhocracy, market, and hierarchy). The authors also mention about the leadership style which it reflects the organizational culture of the company. In other hand, the authors still highlighted about an indefinite organizational culture may cause several problems in what concerns the discomfort, lack of integration and bemoan the hypocrisy.

Not only may the indefinite organizational culture cause such instability to the organization, but also some psychic problems. One of these problems is known as Burnout Syndrome, which was presented in a review named 'Organizational Culture and Job Burnout', and was concluded that organizations should look for the qualified person that have the sense of right and be at the same time, able to listen and analyze dissonant points of view. The authors highlighted that stressing situations may cause to the employees confusion to sort out some tasks or make them inapt to quick answers. Furthermore, other problems such as weakness and high levels of emotions will lead to a psychic instability (Dimitrios & Konstantinos, 2014).

Independent of the field of study, the literature that covers the syndrome of Burnout relates problems that implies in the organization and consecutively in the employees. Burnout syndrome is quite related to working environments, and it is commonly characterized by 'exhaustion, depersonalization and reduced satisfaction in performance' (Weber & Jaekel-Reinhard, 2000, p. 512). Factors like recruitment modifications, training, and job design were suggested as a possible alternative to alleviate the problems caused by Burnout (Maslach & Jackson, 1981).

### **2.2 Syndrome of burnout in organizations**

Generally, some organization factors such as organizational structure and organizational culture might be considered as causing problems (Murphy & Pardeck, 1986). It is important to say that every process resulted from described and specified activities, in which may affect the organization environment can be understood as an organizational structure (PMI, 2017). Besides, when organizational, either structure or culture, problems are caused by factors such as communication, ambiguity roles and no work flexibility, consequences like growth inhibition, absenteeism, job satisfaction and turnover are more present (Murphy & Pardeck, 1986).

Either problems concerning the development of the employee or problems such as mental dysfunction, lack of precision, disorganization, lack of drive and mainly personality changes are diagnosed in Burnout syndrome (Maslach & Jackson, 1981). However, the term has been widely used and due to that was considered a catch-all term (Sack, 1980). Yet, according to Sack (1980), there are three stages defined as job stress, feeling of tension, fatigue and exhaustion, and attitude changes.

Lilly, Cucchi, Marshall, & Katz (2019) have considered the well-being of the company employees.

As employee's well-being it would be considered all stressors present in the company (Etzion, Eden, & Lapidot, 1998). However, according to Etzion, Eden, and Lapidot (1998) there is a tendency in considering only negative factors such role ambiguity or overload, but the absence of autonomy or challenge can also lead to Burnout syndrome. It is also interesting to mention the leader influence whether for good or not in the organizational environment and employee's health (Chen, & Chen, 2018).

It is also important to say that Burnout syndrome is an accumulative syndrome, in which events of stress or, as mentioned before, role ambiguity have their contributions to it (Budeva, 2016). The author also says that there are two groups, where the first one is related to the individual characteristics called subjective/individual and the second group is related to the work responsibilities called objective/situational. Both groups depict situations or problems that tend to happen in the Burnout syndrome.

An important aspect in the sickness of the people in the organization is the level of stress caused by leaders. We can say that leaders have a strong influence on the life quality in organizations as well as the satisfaction or dissatisfaction of people in conducting their tasks.

### **2.3 Leadership styles and sickness**

Compete to the leader to give the right direction in order to achieve the goal estimated by the company, as confirmed in a study, the toxic leadership influences interpersonal conflicts, organizational constraints, and the quantity of work (Uysal, 2019). However, a leader may cause a series of problems when the style used is not appropriated (Kanwal, Lodhi, & Kashif, 2019). Although the field of leadership had been aimed in several studies Putra and Cho (2019) said it is still focus of interest of many researchers. It is important to highlight that the leadership style adopted may lead the employees take conclusions about the organization (Dartey-Baah, & Addo, 2018).

A study about 'Leadership behavior and leader self-reported well-being: A review, integration and meta-analytic examination' in which exposed five leadership behaviors, as example of task-oriented, relational-oriented, change-oriented, passive and active-destructive. The task-oriented has the focus is the task, as the proper name suggests. The relational-oriented seeks to improve the relationships and give support to the employees while the change-oriented with focus in monitoring, identifying the changes and seeking for the involvement. The last ones, named as passive, in which there is a wait to the problems arise and then address them, and the active-destructive that is related perceived responses being direct (Kaluza, Boer, Buengeler, & van Dick, 2019).

It is known that there are different styles, only few will be discussed here, once the focus is those who are more injurious and misadjust the employees' mental health. Starting with the autocratic leadership, it is a style where the leader takes your decisions according to your own and they are more coercive with your employees (Jiang & Lou, 2019). Kanwal, Lodhi, & Kashif (2019) understand an autocratic leader as someone who wants to show its power (authority). This type of leadership is quite complicated once the employee has no chance of giving its opinion or any kind of contributions, because the leader has total control of the team and the organization sector (Shrestha, 2019).

Other style is the Laissez-faire, which is considered as an absence of leadership, where the employee takes decisions and also where the role ambiguity is very common, once the roles are not delegated (Kanwal, Lodhi, & Kashif, 2019). Besides that, the problems are in not feeling the expectations of the employees as leaders and the avoidance of organization (Nielsen, Skogstad, Gjerstad, & Valvatne Einarsen, 2019). Corroborating with the authors, the laissez-faire style is generally related to negative consequences, which there is no leader effectiveness and also a huge lack of trust (Breevaart, & Zacher, 2019).

Another style, this one fairly new which is known as toxic leadership consists of a series of problems caused by the leader that affect the organization life and also the employee's life and health (Winn, & Dykes, 2019). There are other names that toxic leadership can be find, such as dark style, destructive, abusive, ineffective, harmful, and one characteristic is the way this type of style use to reach your objectives and the manners in criticizing the work done by your partners or employees to others (Milosevic, Maric & Loncar, 2019). Winn and Dykes (2019) understand as a combination of a set of behaviors such as self-centered attitudes, and motivations that impact the organization and the employee's life.

## **3 Conclusion**

The XXI century has brought many theories and conceptions concerning the do's and don'ts in the companies, yet there are many companies that discredit the theories and studies. The adoption of the

leadership style itself, just according to the need of each sector in the company is not healthy, once studies like Kim and Chang (2018), and Lilly, Cucchi, Marshall, & Katz (2019) show the importance of a better consideration of their employee's needs. The literature has shown that if you consider the needs of the employees in what concern clear roles, better communication, and more flexibility companies will contribute to the improvement of their conditions and consequently higher performance.

The literature analysis has showed a couple of health and mental problems related to the adoption of the leadership style. Furthermore, a syndrome called Burnout has got special attention once it brings up a bunch of causes that lead the employee out of company due to medical certificate. Besides that, another factor is in the organizational culture adopted by the company.

The organizational culture is the sum of values, attitudes and expectations presented in the company (Kartolo & Kwantes, 2019). It is also suited to say that everything resulted from guided activities are parts of the organizational culture. The aim was not come to conclusion of a specific subject, but the catch the reader's eyes of a subject that has been researching, and also it has contributing to the literature in what may lead the company to reach better positions, and the same time maintain its employees in total *compos mentis*.

At the end of the discussion presented in this article it is important to emphasize the relevance of studying the influence of the leadership style on the health of the people of the organization. Research that deals with culture, leadership and organizational environment can contribute to improve the performance of the organization as well as studies that research the allocation of resources. Emotional issues of the people impact both productivity when stopping a machine or lack of physical and /or financial resources.

As a conclusion, this study shows the importance of controlling factors such as high levels of stress, lack of leadership and clear role, inflexibility, keeping a better communication in other to improve the quality of work in the companies and mainly the health of its employees. Not only will such measures prevent losses but also will gauge the leadership adoption. Finally, this study catches the reader's eyes to the impact of the adoption of certain leadership and its consequences of the company workforce.

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# **The Effect of Work-Family Enrichment on Employees' Task Performance: The Mediate-Moderate Effect of Work Satisfaction and Social Support**

Li Guiqing, Wang Minxia, Du Wanyan, Ji Pei

School of Management, Chengdu University of Information and Technology, Chengdu, P.R.China,  
610103

(E-mail: e2001011@163.com,742754606@qq.com,duwanyan81@foxmail.com,984342155@qq.com)

**Abstract:** There were studies found that the positive relationship between work and family helps employees improve their job satisfaction, while job satisfaction is related to employees' attitude, behavior and job performance. Enhancing employees' job satisfaction helps improving employees' work attitude, stimulating work motivation, promoting employees' performance, and thus achieve a win-win between enterprises and employees. The work-family enrichment is one of the important support resources to improve employees' task performance. This article built a theory model of work-family enrichment effect on task performance, in the model, the job satisfaction is a mediate between work-family enrichment and task performance, and the social support is a moderate. With 279 employees, the study found that work-family enrichment has a positive effect on task performance, the supervisor/colleagues support has a negative moderating effect between work-family enrichment and task performance, the family/friends support has a positive moderating effect between work-family enrichment and task performance, and job satisfaction has a partial-mediating effect between work-family enrichment and task performance.

**Key words:** Work-family enrichment; Task performance; Job satisfaction; Social support

## **1 Introduction**

The definition of work-family enrichment is based on a mechanism of Role Accumulation Theory, that is to say: the experience in one role can make positive experience and results in another role. Greenhaus& Powell (Greenhaus& Powell, 2006)suggested that this kind of mechanism well captured the concept of work-family enrichment, so that they defined work-family enrichment as the extent to which experiences in one role improve the quality of life in the other role.This definition implies the conversion of emotion, behavior or skills in one field has a beneficial impact to the receiving field, that is to say, involving in role A can make individuals perform better in role B.From the perspective of positive organizational behavior, a series of expressions similar to work-family enrichment have emerged, such as work-family positive spillover and work-family facilitation. Although these concepts are different, many scholars do not make a strict distinction in their practical application, because they actually express that the positive benefits people get in the work/family field can have a positive impact on them in another field.

The concept of work-family positive spillover was first put forward by Crouter (Crouter, 1984), which refers to the benefits individuals get in one role can be positively transferred to the other role.Clearly, both work-family enrichment and positive spillover stands on the individual level.

However, the difference is that enrichment implies the outcome of positive transfer can improve individual's performance or quality in another domain, while positive spillover just emphasize transfers. There is no agreement in the definition of work-family facilitation, but a general meaning. Wayne et al (Wayne et al , 2007) defined work-family facilitation as the development, affective, capital, or efficiency an individual acquired in one life domain (i.e. work/family) could enhance his or her function in another life domain (i.e. family/work). Grzywacz(Grzywacz, 2007)believed that work-family facilitation represents the process that the synergism of work and family playing a leading role, so that they defined work-family facilitation as the extent to which an individual's engagement in one social system, such as work or family, contributes to growth in another social system. Thus, the concept of facilitation goes further than enrichment since it emphasizes the performance improvement in the systemic level.

In summary, this paper defines work-family enrichment as follows: the emotions, behavior, skills or something else that individuals get in the domain of work (family) can improve their performance in the domain of family (work).

Through empirical research, RDJ Michel and CEJ Michel have proved that work-family enrichment is related to job satisfaction, while job satisfaction is related to organizational commitment, which shows that work-family enrichment has an indirect impact on organizational commitment(Michel & Michel,2012).

Judge et al (Judge et al, 2001). conducted a meta-analysis on 254 empirical studies made by European and American scholars from 1967 to 1979. The results showed that despite some important mediating variables, there was a significant positive correlation between job satisfaction and job performance (0.30).

In the research of the results of social support, previous studies tend to focus on the work-family field. Correspondingly, according to the different sources of social support, it can be divided into support in work situation and support in non-work situation. Among them, the social support in the work situation generally comes from the superiors, colleagues, organizations, etc., rather than the social support in the work situation, generally comes from family members, relatives, friends and so on. In empirical research, many scholars only study these two kinds of social support in two different situations. From the point of view of system engineering, these two kinds of social support are interrelated, and can play a role in different situations for employees. Therefore, this paper will include the support of both sides, mainly research the support of supervisors, colleagues, family members and friends.

Driven by global economic integration, China has entered into the economic new normal, shifting from pervious abnormal growth patterns that relied on investment, resources, export-led to the new sustainable development patterns that rely on innovation, markets and domestic demand-driven. Therefore, this is the time that best suited to innovation. Enterprises should continue to pursue innovation in order to ensure having lasting competitive advantage in this rapidly changing era. However, the innovation of a company is ultimately relied upon the employees who are the important component of the company. Thus, the actions that employees do for innovation is extremely important for the survival and development of enterprises. And studying the political measures of how to promote employees' innovative behavior is one of the focus that be concerned by behaviorists and entrepreneurs.

## **2 Theoretical Model and Research Hypothesis**

Research on the outcome variables of work-family enrichment mainly focuses on the three levels of individual, work and family, among which the most is at the work level, which is mainly reflected in the study of job performance and job satisfaction. Therefore, how to effectively motivate employees' task performance? According to Role Theory, employees play different roles in work and family, but the two roles attributed to the same person. Thus, there is always something affect to each other, and the experience, emotion and skills which be gained in the work will naturally have an impact on family life, vice versa. However, the good influence among them can be called work-family enrichment, yet, is it reasonable to have such speculation? Therefore, future research of the influence that work-family enrichment on employees' task performance should be increased, which is one of the starting points of this article. If it can be confirmed that work-family enrichment can significantly promote employees' task performance, namely, giving more attention to employees' family lives and providing much more welfare that is helpful to improving employees' family life so that it can be more easier to reach work-family balance. What's more, employees will have more willingness to making task performance in order to achieving win-win between business and employees.

### **2.1 Hypothesis**

#### **(1) The impact of work-family enrichment on employees' task performance**

Task performance, namely the traditional personnel evaluation, selection of concern, it is related to the work results, can directly, it includes two forms: one is the use of raw materials for organization to create products, services, activities and other tangible things; the other is to provide service for the organization's core technology or maintain work activities. Now, the task performance is more as a dimension of job performance, and job performance is a comprehensive concept, it is the combination of the results, behavior and personal qualities. Therefore, the author believes that can affect the performance of factors can impact on task performance have commonly. Overview of domestic and foreign scholars on the factors that affect job performance literature, can be found that it can be roughly divided into two aspects: on the one hand is the employee's own characteristics, such as personality, character and skill levels, also study more; On the other hand is to be able to affect employee performance environment characteristics, the scholars in the research is not many, the study also focused on the role of the environment for the staff's psychological aspects are studied, such as authorized, perceived organizational support, job satisfaction, the in the mind.

Wayne (Wayne, 2007) pointed out that work-to-family facilitation may has positive relationship with the relationship quality of leader and subordinate, the cohesion of the work teams and the performance of the teams. Woodman, Sawyer & Griffin (Woodman, Sawyer & Griffin, 1993) found that characteristics of team and organization have an impact on creative process and situation, resulting in organizational creative products. Therefore, we predict:

Hypothesis H1: Work-family enrichment has a significant positive impact on employees' Task performance.

#### **(2) The impact of work-family enrichment on employees' job satisfaction**

Job satisfaction is a state of mind that describes how pleasure people get form work. Job satisfaction determines employees' behavior, making individual performance clearly and affecting the function of organization as well as determining organizational performance (Danica,2012).

Employees' innovative behavior may be one of the consequences of job satisfaction, however, not too

much researches about it carried out by scholars.

The practical research took by Jaga & Bagraim (Jaga & Bagraim, 2011) showed that work-to-family enrichment can significantly predict job satisfaction and career satisfaction. Boyar & Mosley (Boyar & Mosley, 2007) found that work to family facilitation is significantly associated to job satisfaction, while job satisfaction negatively predict turnover intention. The meta-analysis of McNall et al (McNall et al, 2010) showed that both work-to-family enrichment and family-to-work enrichment positively correlated to job satisfaction and affective commitment. Therefore, we predict:

Hypothesis H2: Work-family enrichment has a significant positive impact on employees' job satisfaction.

Hypothesis H3: Job satisfaction plays a mediating role between work-family enrichment and task performance.

### **(3) The moderation of social support**

Social support the word first appeared in the 1970 s in the field of psychiatry, experts found that social support has positive effect to health of body and mind. Then, social support gradually into the organization behavior science and management science and other fields. Caplan and Cobb (Caplan and Cobb, 1975) points out that social support is an individual and between individuals or between individuals and groups. Cohen and Syne '(Syne, 1986) social support is defined as the individual can get help from others he provide tangible or intangible, such as all kinds of resources, wealth, friendship, affection, etc. Eisenberger (Eisenberger, 1986) after a series of studies have found that employees feel support from organizations will be encouraged and motivation, thus puts forward the theory of perceived organizational support, which is the so-called sense of organizational support staff for awareness from the support group, which is for the organization in the view of their work and take care of their interests in terms of perception and understanding.

Although on the definition of social support, different scholars view is not the same, but on the basic content of social support or classification is the basic consistent, that is, from nature, social support can be divided into two parts: the part is the objective support, including to the individual in material gifts, as well as the establishment of a social relation network, generally able to quantify; Is another part of the spiritual subjective support, such as for staff to understand, praise and attention, in the emotional support for employees, etc., that part of the support is reflected in the employee's subjective feeling, cannot be quantified.

Karatepe and Bekteshi (Karatepe and Bekteshi, 2008) by 107 Albania a gleam of hotel staff's investigation and study, using LISREL8.30 path analysis results show that the work of social support can enhance work (family) and family role between (work); And family social support can relieve work - family conflict, and increase the family - work to promote. When managers support, they care about employees' feelings and needs, encourage them to speak their own concerns, provide positive, concise information feedback and promote the development of employee skills (Oldham & Cummings, 1996). As a result, put forward the following hypothesis:

H4a: support of supervisor/colleagues play a moderation role between work-family enrichment and task performance.

H4b: support of family/friendlies play a moderation role between work-family enrichment and task performance.

And studies have shown that in the context of non-working staff for support in improving their life

satisfaction at the same time, also can have positive effect on their work behavior. For example, the support from the other half with the individual's physical health and positively related to job satisfaction (Karatepe & Bekteshi, 2008), As a result, put forward the following hypothesis:

H5: Social supports (support of supervisor/colleagues and support of family/friends moderate the work-family enrichment indirect effect on task performance through job satisfaction.

### 2.2 Model construction



Figure 1 Theoretical Model

## 3 Questionnaire Design and Sample Analysis

### 3.1 Questionnaire design

The scales in the questionnaire of this study all uses translated foreign mature scales and have been corrected according to actual Chinese mainland situation. The scales using Likert Scale method which value “1, 2, 3, 4, 5, 6, 7” reflecting respondents’ degree from totally disagree to totally agree of various questions of work-family enrichment, innovative behavior and job satisfaction. In addition, the questionnaire also includes demographic variables, such as gender, age, education, work experience, marriage, business size, business type and so on.

The specific sources of scales are shown in Table 1:

Table 1 Overview of Each Scale

scale name	source	No. of items	main content
work-family enrichment	Carlson et al(2004)	18	the development of work to family, the impact of work to family, the capital of work to family, the development of family to work, the impact of family to work, the efficiency of family to work, etc.
job satisfaction	Schreisheim&Tsui(1980)	6	employees' satisfaction of work itself, including payment, supervisor, colleagues, development opportunities, etc.
Task performance	Tsui(1997)	6	The quantity and quality of work outcome, work efficiency, quality standards, norms, etc.
Social support	Caplan (1975)	12	Support from supervisor, colleagues, family and friends.

### 3.2 Descriptive statistics and correlation analysis of the main variables

The main respondents of this survey are 2013 classes of part-time MBA students of University of Electronic Science and Technology of China, 2013 classes and 2012 classes of part-time MBA students of Sichuan University, as well as 2013 management training classes of Sichuan University and University of Electronic Science and Technology of China. These students come from various companies all across the country, having broad representation. In this study, a total of 350 questionnaires had been distributed, with 279 effective questionnaires been recycled. The effective rate of questionnaires was 79.71%. The sample of men (50.5%), women accounted for 49.5%. 20-30 years old (47.3%), 31-40 of accounted for 40.9%, 41 to 50 years old accounted for 11.8%. Table 2 shows the mean value, variance and correlation coefficient of each variable by using the SPSS statistical analysis software.

**Table 2 Mean, Variance and Correlation Matrix (N = 279)**

Dimension	Mean	Variance	1	2	3	4	5	6
work-family enrichment	5.095	0.888	(0.6810)					
Task performance	5.155	1.808	.730**	(0.8700)				
job satisfaction	4.87	1.933	.836**	.619**	(0.9100)			
Support of supervisor/colleagues	5.344	1.653	.795**	.558**	.793**	(0.8710)	(0.6630)	
Support of family/friends	5.792	1.171	.586**	.226**	.315**	.345**	.362**	(0.6630)

### 3.3 Reliability and validity analysis

#### 3.3.1 Reliability analysis

Reliability is an important indicator measuring the degree of the internal consistency of the results of the research. In order to ensure the quality of the measurement, it must examine the reliability of the questionnaire before doing data analysis. This study uses Cronbach's  $\alpha$  to evaluate the reliability of the scales. Generally, Cronbach's  $\alpha$  should be greater than 0.7, and the larger the value, the higher the reliability of the scale. The Cronbach's  $\alpha$  of work-family enrichment is 0.929, The Cronbach's  $\alpha$  of task performance is 0.892, The Cronbach's  $\alpha$  of job satisfaction is 0.823, The Cronbach's  $\alpha$  of support of supervisor/colleagues is 0.802, The Cronbach's  $\alpha$  of support of family/friends is 0.906.

#### 3.3.2 Confirmatory factor analysis

This study uses the method of confirmatory factor analysis (CFA) to verify the construct validity of each scale. In the overall goodness of fit indicators, this study chooses the absolute fit indicators used for evaluating of individual models like  $\chi^2 / df$ , RMSEA and RMR. Generally speaking, that the model can be accepted if  $\chi^2 / df < 5$ , RMSEA  $< 0.08$ , RMR  $< 0.08$ . In the relative fit index, this study chooses the index of GFI, NF and CFI. Generally speaking, these three indicators should be between 0.9 and 1, and

the closer to 1, the better the fitting degree. After amending and the correlation processing of part of the residuals, the major goodness of fit index of each scale are shown in Table 2.

**Table 3 The Goodness of Fit Index of Each Scale**

scale	$\chi^2$	df	$\chi^2/df$	RMSEA	RMR	GFI	NFI	CFI
work-family enrichment	297.062	112	2.652	0.077	0.081	0.901	0.95	0.968
Task performance	16.14	5	3.228	0.09	0.039	0.98	0.984	0.989
job satisfaction	27.076	6	4.513	0.112	0.059	0.972	0.955	0.964
Support of supervisor/colleagues	7.794	3	2.598	0.076	0.040	0.991	0.988	0.992
Support of family/friends	12.774	6	2.129	0.064	0.033	0.985	0.988	0.994

It can be known from Table 2 that except that RMSEA of job satisfaction is a little high, all the other goodness of fit index of the scales are perfect. Thus, the validity of the model can be accepted.

## 4 Hypothesis Testing

### 4.1 Test of moderation effect

This inspection doesn't consider the effect of moderation variable, before the inspection moderation effect, to avoid collinearity, separate the independent variables as moderation variable first centralized processing (minus the respective average), then after the centralized variables to build the product items, become interactive items. First step, the introduction of control variable demographic variables, independent variables (work-family enrichment), moderation variable (support of supervisor/colleagues, support of family/friends), the first step, the regression of the results variables; the second step, after centralized regression equation, introduced the product of item, if the product of the regression coefficient significantly, that regulation significantly, as a result, as a result, as shown in table 3 (it control variable regression coefficient).

**Table 4 The Multiple Linear Regression Analysis of Moderation Effect**

variables	Task performance( $\beta$ )	
	First step	Second step
gender	0.075	0.066
age	-0.261*	-0.162
marital status	-0.001	-0.005
position	-0.196*	-0.199**

education	0.062	0.036
tenure	0.114	0.037
regression analysis of independent variable and moderation variable on outcome variable	0.114	0.037
Work-family enrichment	0.427***	0.433***
Support of supervisor/colleagues	0.206***	0.185**
Support of family/friends	-0.065	-0.070
Work-family enrichment×Support of supervisor/colleagues		-0.135*
Work-family enrichment×Support of family/friends		0.125*
$\Delta R^2$	0.267	0.285
$\Delta F$	10.199***	9.533***

It can be seen in Table 5-1, in the absence of mediation variable, work-family enrichment have significant positive effects on task performance ( $\beta=0.427$ ,  $p<0.001$ ), it shows that H1 verified; Support of supervisor/colleagues play a moderation role between work-family enrichment and task performance( $\beta=0.135$ ,  $p<0.05$ ). It shows that H4 verified, support of family/friends paly a moderation role between work-family enrichment and task performance. Therefore, in the absence of mediation, social support plays a significant impact on task performance.

#### 4.2 The test of mediation-moderation effect

Step1: the influence of independent variable on the results variable. To do the regression of work-family enrichment, support of supervisor/colleagues, support of family/friends on task performance. The results of regression analysis are shown in Table 4.

After controlling for moderation variables, the results reflect that work-family enrichment has a significant influence on task performance ( $\beta_1=0.427$ ,  $p<0.001$ ), so that hypothesis H1 has been verified.

Step2: the influence of independent variable on the mediation variable. To do the regression of work-family enrichment, support of supervisor/colleagues, support of family/friends on job satisfaction. The results of regression analysis are shown in Table 4.

After controlling for moderation variables, the results reflect that work-family enrichment has a significant influence on job satisfaction ( $\beta_2=0.156$ ,  $p<0.05$ ), so that hypothesis H2 has been verified.

Step3: the effect of mediation effect. After controlling for moderation variables, it tests the influence of independent variable on results variable. To do the regression of work-family enrichment, support of supervisor/colleagues, support of family/friends and job satisfaction on task performance. The results of regression analysis are shown in Table 4.

The results reflect that job satisfaction has a significant influence on task performance ( $\beta_3=0.181$ ,  $p<0.01$ ). After controlling for job satisfaction, work-family enrichment has a significant influence on



task performance ( $\beta_4=0.339$ ,  $p<0.001$ ), so that hypothesis H3 has been verified.

Due to the  $\beta_3$  is significantly as well as  $\beta_4$ , and  $\beta_4$  less than  $\beta_1$ , so after controlling for moderation variable, job satisfaction has partial mediation effect between work-family enrichment and task performance.

Step4: the effect of mediation-moderation effect. To put the product results of mediation variable and moderation variable in the regression equation, to do regression test of work-family enrichment, job satisfaction, support of supervisor/colleagues, support of family/friends, the production results of job satisfaction and support of supervisor/colleagues, the production results of job satisfaction and support of support of family/friends on task performance, after controlling for work-family enrichment, job satisfaction, support of supervisor/colleagues, support of family/friends, the production results of job satisfaction and support of supervisor/colleagues has a significant influence on task performance ( $\beta_5=-0.177$ ,  $p<0.01$ ).

Due to the significantly of  $\beta_5$ , support of supervisor/colleagues moderate the work-family enrichment indirect effect on task performance through job satisfaction. so that hypothesis H5 has been verified.

**Table 5 The Multiple Linear Regression Analysis of Mediation-moderation Effect**

variable	Job satisfaction	Task performance
gender	-0.106	-0.119*
age	-0.360**	-0.215*
marital status	0.071	0.065
position	-0.062	-0.066
education	0.086	0.047
tenure	0.303*	0.191
First step: regression analysis of independent variable and moderation variable on outcome variable		
Work-family enrichment		0.427***
Support of supervisor/colleagues		0.206***
Support of family/friends		-0.065
$\Delta R^2$		0.267
$\Delta F$		10.199
second step: regression analysis of independent variable and moderation variable on mediation variable		
Work-family enrichment	0.156*	
Support of supervisor/colleagues	0.217***	

Support of family/friends	0.210**
$\Delta R^2$	0.207
$\Delta F$	7.595***
Third step: regression analysis on outcome variable absence of mediation variable	
Work-family enrichment	0.339***
Support of supervisor/colleagues	0.167**
Support of family/friends	-0.103
Job satisfaction	0.181**
$\Delta R^2$	0.29
$\Delta F$	10.476***
Fourth step: regression analysis on outcome variable absence of interaction term	
Work-family enrichment	0.404***
Support of supervisor/colleagues	0.137*
Support of family/friends	-0.089
Job satisfaction	0.179**
Job satisfaction $\times$ Support of supervisor/colleagues	-0.177**
Job satisfaction $\times$ Support of supervisor/colleagues	0.069
$\Delta R^2$	0.304
$\Delta F$	9.676***

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## 5 Conclusion

### 5.1 Social support plays a moderation role between work-family enrichment and task performance.

Social support at work - family rich and played a regulation role between employee task performance. Through multiple regression analysis found that, in the absence of job satisfaction as the intervening variable, two dimensions of social support (support supervisor/colleagues, family/friends) are rich with employees at work - family play a significant role in regulating between task performance, specific displays in: under the effect of the regulation of social support, the task performance is with the increase of work - family rich, and on the same level of work - family rich, task performance under high boss/colleagues support is higher than in lower boss/colleagues support, speed is also the former than the latter, and on the same level of work - family rich, task performance under low family/friends support than in high boss/colleagues support, speed is also the former than the latter.

## **5.2 Social support moderates the work-family enrichment indirect effect on task performance through job satisfaction.**

After controlling for social support, job satisfaction at work - family rich and played a partial intermediary role between task performances.

And the role of the two dimensions of social support are also different, the results of multiple linear regression analysis showed that boss/colleagues support through job satisfaction to adjust work - family rich and indirect influence task performance, namely a regulating intermediary effect is remarkable. And adjust the effect with the boss/colleagues support degree of different and different, although with the improvement of work - family is rich, the task of employee performance has improved, but the speed of increase is not the same, with low supervisor/colleagues support than with high boss/colleagues support, staff's task performance improve faster. However, family/friends support and failed to pass the job satisfaction to adjust the relationship between the work - family rich and task performance, namely a regulating intermediary effect was not significant. This explains the research model can only partially explain the role of social support, in the follow-up study, should be in-depth study.

Since the two dimensions of work-family enrichment——work-to-family enrichment and family-to-work enrichment both have a significant positive effect on employees' job satisfaction and innovative behavior, manager can try to make policies that are helpful to improve employees' family life when thinking hardly for making the work policies that can encourage employees' innovative behavior. For instance, give more freedom of working hours for employees, so that employees can take appropriate time to family life and then acquiring knowledge and skills that can't be acquired from the work. For another instance, establish internal nurseries, pensions and welfare institutions to help employees ease the burden of caring children and parents and improve the well-being of their family, helping employees become better workers and enhancing innovative thinking.

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## Amplification Results in Training and Development Processes

Siméia de Azevedo Santos<sup>1</sup>, Leonardo Nelmi Trevisan<sup>1</sup>,

Elza Fatima Rosa Veloso<sup>2</sup>, Arnoldo de Hoyos Guevara<sup>1</sup>

1 Pontifical Catholic University of Sao Paulo

2 FIA, Sao Paulo, Brazil.

(E-mail: sazevedotreinamentos@gmail.com , Intrevisan@pucsp.br,

elzafrv@gmail.com, arnoldodehoyos@yahoo.com.br)

**Abstract:** Gamification is the use of games elements in different contexts out of the games. It is a tool with potential application in several areas in management, like marketing and human resources, including training and development. Departing from this reference, this study has objective to identify the perception of efficiency and the measurable results in the gamification processes in training and development in a sample of the Brazilian market. This research is divided into two samples. The quantitative sample investigated the perception of efficiency of the professionals who already participated in the gamified training, the information was collected through an online form with Likert scale responses and treated with Minitab statistical software. The other sample was qualitative and sought to identify the perception of the professionals who developed the gamified training, and the results were submitted to the content analysis technique. The compiled results confirmed the presence of engagement and its influence on motivation as one of the advantage points for the application of gamification in training. It was also possible to find in these results the relevance of the design for the game / training interaction to work effectively. Among the trends of higher incidence found in this research are the possibility of associating gamification with virtual reality and augmented reality to enhance the experience lived by the player during training. As a secondary's incidents, but also relevant and congruent with market trends, are the incidents of concision with relevance, interaction, applicability and the digital trail, items present in the concept of learning in micro-moments.

**Key words:** Gamification; Training; Development; Engagement

### 1 Introduction

The last two decades have witnessed a rapid deployment of central human resources activities, making the area function responsibilities evolve to a more strategic level. The first evolution progressively added to human resources management procedures in the areas of labor and union relations, recruitment and selection, compensation and benefits, performance, quality of life, training and development. In a more recent cycle, this evolution also reached computerization and the use of algorithms in the composition of the management of these subsystems of human resources, as approached by Posthumus *et al.* (2017).

One of the subsystems is the training and development area, which is an effort to improve the skills of the people applied in their work context, and which progressively brings improvement of performance to the organization. Training is an education process that externalizes the individual's potentialities, providing information to learn new knowledge and to develop skills and new skills for application in the professional context. It is also a process of short-term assimilation that aims to recycle knowledge, skills or attitudes directly related to the tasks performed at work (Marras, 2016).

According Dutra (2016), the learning process goes through different stages, with actions of

different natures interacting synergistically among each other and allowing the individual to reach his personal development goals as well as contribution to the organization.

One of the pillars in the composition of a training process is the survey of needs and the selection of the method for its application that has adherence to the needs and the context, making possible to verify the advances and the points of improvement at the end of the training (Noe *et al.*, 2005).

With the emergence of new responsibilities in human resources management, new trends have become prominent in business in general. Meeker (2019) pointed to a trend report made possible by the widespread use of the Internet, the speed of adopting disruptive technologies, the availability of the internet and computing in the cloud, and how these new technologies are changing the way communication, learning and the world of work in general.

In the Meeker report (2019), in the list of online services that had the most increase of subscription during the years 2017 and 2018, the service of Sony PlayStation's access to games was in fourth place, behind only the popularity champions of content in entertainment Netflix, Amazon and Spotify.

In this context of increasing access to the use of new technologies, there are also new tools available, such as the increasing use of gamification based platforms for collaboration and sharing of information. The use of games in training and development is an issue addressed in the literature since the 1990s (Gramigna, 1994; Falcão, 2008), already approaching the theme of learning in a playful way, having a greater force at the time in face-to-face, board games, or offline, when compared to the years after 2000.

With the availability of technologies and their increasing cheapness and popularization, training possibilities with the use of gamified and computerized elements and through virtual reality also begin to be more widely used and listed among prominent trends for years to come, as defined in the Great Place To Work report<sup>72</sup>.

The projection that the market for digital games and serious games has been taking in Brazil in recent years is also notable, and in 2018 was published with the support of the Ministry of Culture, the II Census of the Brazilian Digital Games Industry. Among the companies participating in the census, 16.3% refers to the development of games used for corporate training purposes (Sakuda, Fortim, 2018).

According to Poyatos Neto (2015) and Mattar (2018), the term "gamification" originated in the 1980s, although the first documented uses of the term "gamification" appear only in 2008. However, only in the mid of 2010 the term was consolidated as a technical language and became widely adopted.

The classic, well-quoted definition by Deterding *et al.* (2011), approaches gamification as "the use of game design elements in non-game contexts." Gamification consists of the application of mechanisms, aesthetics and reasoning used in games, outside its usual context, associated with entertainment, with the purpose of solving practical problems, arousing engagement and promoting knowledge.

By elements of games, we refer to well-designed rules, points, challenges of competition, collaboration, puzzles, scenarios, among other factors related to the mechanics of motivation, interaction and reward (McGonigal, 2011; Marczewski, 2017). The use of the process of gamification is not synonymous of the use of games, but of the use of elements and mechanics present in game design.

Activities of different sectors can be gamified, such as in children's or adult education, in

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<sup>72</sup> <https://gptw.com.br/conteudo/>

administration, in marketing, applied for example in branding or sales to help relationship with a certain brand in tourism, as an example in programs of points that have seen discount on tickets offered by airlines, in the sciences, and in more diverse possibilities, activities and segments. Examples of papers in this line are presented by Mattar (2018), who also cites cases, already referenced in Meister (2013) and Vianna (2013), with applied examples of gamification aimed at the corporate and business area.

The main objective of the present study is to identify the perception of efficiency and measurable results in the gamification process, as an increase of high relevance in training and development actions, from the contextualization of the relationship between training, development and tendencies in gamification.

## **2 Theoretical Framework**

### **2.1 Training and development**

Authors who studied human resource management have been subdivided into three or four groups since the 1980s, with training and development being one of these areas, such as Tichy, Fombrun and Devana (1982). Fidelis and Banov (2006), define training as a process of qualification and supply of professional needs that prepares the person to perform specific tasks for the position he occupies. Marras (2016) conceptualizes training as a way to help the adaptations in the knowledge, skills and attitudes of the individual in relation to the job or position occupied.

In his studies, Swanson (2009) defines the area of training and development as a process of development and encouragement of proficiency in order to improve the performance of the organization, the work processes, the group and each worker, culminating beyond learning and performance, career development and leadership.

The training in corporations, managed by human resources, is a process that can be planned by the company to facilitate the learning of the employees of the functions or competencies related to the performance of their work (Noe *et al.*, 2005). These competencies include knowledge, skills, or behaviors that are elementary to performance that drives a successful performance. The learning that is generated by training can come through observing and experiencing doing together, and through interaction with other employees, and joint use of all these means is common.

As success metrics for evaluating a training module, we can use observation of increased productivity, improvement in quality of results, reduction of costs related to time and rework, optimization of efficiency, perception of change in behaviors, elevation of knowledge and awareness. It also leads to improved organizational climate and increased personal motivation according to the report published by McKinsey (2018).

In studies on the subject, training and development situations that were not effective when considered within the context of the organizational culture also have their own studies and are cited for example in Argyris (1986), which addresses the problems of actions in which the author names of 'defensive looping', with the training and development programs that appear for leadership, which even come in their purpose of developing new skills, but in practice the situations where one should put this knowledge into action simply does not happen, generating this ironic looping.

For the training, the concern is to execute with quality and efficiency the application of the modules that were planned, the factors influencing the quality of the program being according to Marras (2016): Didactics and technical preparation of the training disseminators; Logic of the module, which should show the learning proposal and its application in the daily work; The source of the resources

used, which can be diversified, such as the expository activities, with lectures, with the use of slides, films and audios; or interactive activities, with activities such as workshops, case studies, simulations, interactive activities on the internet, computer or smartphone, or the use of games or activities with elements of games that bring an experience of the context addressed.

New technologies are changing faster than at other times in history, the way people live, how they relate and how they work, thereby also substantially altering the way companies operate and how they interact, both internally and in the environment external and with the society (Folan, Browne, 2005; Malone, 2006; Cardador *et al.*, 2016; Schwab, 2016; ILO<sup>73</sup>, 2018).

## **2.2 Gamification**

Gamification through computerized elements becomes a resource that can be explored in training and development activities. The term "gamification" originated in the 1980s, when Essex University professor Richard Bartle used the term "to make something that is not a game in a game."

Marczewski (2017) also argues that the application of game elements in other contexts can be called gamification or game thinking design, which the author defines as application of mechanisms, philosophies and rules of games in different contexts. Werbach and Hunter (2012) defines gamification as "the use of game elements and game design techniques in contexts other than games".

According Brathwaite and Schreiber (2009), game design is the "process of creating the content and rules of a game", the process of creating goals that a player feels motivated to reach and rules that a player must follow as he makes making meaningful decisions in pursuit goals.

Zichermann and Linder (2013) argue that gamification can be defined as the inclusion of a mechanics, style, thinking or game design techniques to involve people in problem solving.

McGonigal (2011) and Marczewski (2017) explain the elements of games referring to well-defined rules, scoring score, competition challenges, collaboration, puzzles, among other factors related to the mechanics of motivation, interaction and reward. The use of the gamification process is not synonymous of the use of games, but the use of elements and mechanics present in game design.

## **2.3 Games, gamified elements and player profiles**

From Huizinga's (2000) survey on games and playability, it is possible to identify eight main characteristics common to all activities considered or classified as games. These are: voluntary participation; play as distraction; play as external to reality; with limits of space and time, with a defined goal; with clear rules; with feedback system; and with an end.

Gamification is a methodology based on the dynamics of games, and aims to use tools based on elements of games, such as involvement, engagement, use of rewards and awards, and feedback, for example. According to Penenberg (2015), gamification in the corporate context improves performance precisely because of factors such as the use of rewards that reinforce positives, and engagement. The objective of using this methodology is to use the reward and rewards strategy to stimulate the participant or player to achieve their goal, generating a sense of accomplishment, receiving continuous feedback, stimulating progress, and consequently progressing towards the ultimate goal, according to Marczewski (2017).

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<sup>73</sup> <https://www.ilo.org/global/topics/future-of-work/lang--en/index.htm>



The proposal of the gamification activities, when applied to the training processes, is to provide learning with playful, natural and dynamic, aiming to stimulate problem solving skills, motivate the player or participant to continue to reach the next objectives, supported by the feedback received in the (McGonigal, 2011, Adams, Dormans, 2012). A proposal of activity with the use of gamified tools is characterized by clear and well-defined objectives, which lead to the escalation of small achievements, which can be divided into specific moments and activities and with adaptive time, with advances evidenced through continuous feedback. The participation of the player must always be voluntary, with prior knowledge of the rules of the activity, just as it works in a game.

According to McGonigal (2011) and Deterding *et al.*, (2011), the game contains rules that will generally represent challenges to be faced by the player to achieve the ultimate goal. The gamified task, by providing continuous feedback and rewarding small goal achievements in the player's performance, allows the player to have a clear view of their progress, as well as recognition through awards or badges, elements that combined bring to these activities characteristics of engagement similar to what is perceived in games. Both in the material environment and in the digital environment, it is important that the game has its clear message, its goals and its objective must be clearly understood by the player.

Tracking progress through well-defined task completion is another point that must be made very clear (Chandler, 2012, McGonigal, 2016). This element is linked to the developmental issue perceived by the player, or the individual participating in the training, and also to the feedback issue that is received at the end of each small task, at the end of a phase or grouping of tasks. The feedback process is also tied to receiving the rewards, either by the scoring level or by the chosen award method used by the environment. Also, the user interface, especially in digital environments, also needs to be context-appropriate to achieve the desired results.

In order to understand how the game and its elements work in interaction with the player - an essential aspect in the interplay between game and training expectations - it is important to highlight which are the main profiles of players, since each profile participates in the game for a purpose or a motivation main. One popular type of player proposal is the 'Bartle Test', also explored by the studies of Zichermann and Cunningham (2011). The four basic player profiles are the conquerors or achievers, the explorers, the socializers, and the predators or killers.

According to Yee (2006), Salen and Zimmerman (2012), although each player has a dominant profile characteristic, all types can coexist with aspects of the other profiles of lower dominance, depending on the context and type of the game with which the player is interacting at a certain moment. In his analysis, Yee (2006) adds three types of components that influence the motivation of the players, composed of goals, social context and immersion in the game environment.

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Game dynamics are composed of elements that support the user or player over the duration of the game. Included in the dynamics proposed by Werbach and Hunter (2012) are the narrative that keeps the game coherent and the emotions that the player experiences during the game; Mechanics are actions that can be performed, directing and engaging the player, serving as an element of transition between the player's experience and their interaction with the digital medium. Werbach and Hunter (2012) list as

main mechanics the challenges, the rewards and the random elements; The components are elements that can be used in the interface of the game, such as defined goals, medals and avatars.

According to Marczewski (2017) and McGonigal (2011, 2016), the use of games may trigger some triggers for the player, especially regarding the mechanisms of motivation, emotion and behavior, due to the reactions generated by the activities of feedback that generate what these authors call engagement looping.

In the game environment, the unpredictability that in real life is viewed with tension, can take on a playful aspect and bring learning, exactly because the game environment represents safe space, away from real risks. According to Burke (2015), and Mullins and Sabherwal (2018), gamification involves people in an emotional context, and this is revealed as a powerful factor of engagement. Not forgetting the intrinsic motivation generated by the sense of autonomy, which progresses along with the domain of a certain topic, such as learning some subject addressed in a training.

Just as in a game, a tool has the essential characteristic of formulating clear and well-defined goals. The participation of the user must always be voluntary, with prior knowledge of the rules that will generally represent challenges to be faced by the player to achieve the goal. For Suits (2005) play is a voluntary attempt to overcome obstacles. According to McGonigal (2011), the presence of challenges requires the use of the player's creativity and skills to achieve the goal, which makes the task rewarding when solved. The game provides continuous feedback on performance in the activity, so that the player has a clear notion of their progress and is recognized by him, characteristics that, coordinated and combined, bring to the gamified activities similar engagement to that perceived in the users of games in relation tasks proposed by the games.

The authors Werbach and Hunter (2012) define six steps for a good implementation of gamification, the 6 D's of gamification. The six steps are:

- Define business objectives – understand and make clear the target goal. In order to define the objectives, the process suggested by the authors is to list the objectives in order of priority and to justify them;
- Delineate target behaviors – defined the objectives and the reason why gamification will be used, it is necessary to delineate what is expected of the users, their activities and behaviors in the system or in the game;
- Describe your players – what the relationship that the game will have with the players, if they are employees, if they are customers, what may motivate them to continue in the tasks are items to be described in this step;
- Devise activity cycles – define activity cycles so that players remain interested in participating in and overcoming the next challenges proposed, thinking about the type of feedback that will be provided to players or users of the game, and how these users will be engaged by activity loop based on tripod motivation , action and feedback;
- Don't forget fun! – users must voluntarily participate in the game, and this should be fun in the right measure;
- Deploy the appropriate tools – to check if there are tools already defined or developed for the proposed gamification that is to be implemented, to verify the possible tools to be used with the best cost-benefit.

With these steps suggested by Werbach and Hunter (2012) developed in a well-structured and well-linked way it is possible to develop a gamified process, but the authors do not guarantee that following these steps will be enough to succeed in the gamified process, if the design of the process as a whole makes sense in the context in question, if the elements are well designed, if the interaction with the game is satisfactory. As Chandler (2012), Adams, Dormans, (2012), Cherry (2012) and Alves (2015) insist, it is necessary to verify if the system interfaces are satisfactory, if the analysis of information transfer or, if knowledge also happens in a satisfactory way, to satisfy convincingly the objectives

proposed by the gamification.

#### **2.4 New technologies and trends**

Advances in technology have provided more efficient ways of performing activities and have increasingly transformed society's behavior in many ways, as we have seen in trend reports such as Meerker's (2018) for example.

The II Brazilian Census of the Digital Games Industry (Sakuda, Fortim, 2018) showed that about 43% of all games produced in Brazil are designed to run on mobile devices or smartphones, 24% are designed for computers, 16% are developed for the web platform, 10% are already developed to be executed with the aid of augmented reality and virtual reality technologies, 5% are executed via consoles, and about 0.5% are developed for social networks.

In comparison with the data of the I Census of the Brazilian Industry of Digital Games published in 2016 by the same researchers Sakuda and Fortim (2018), there was an average numerical growth of 290% of games developed to be executed with the aid of virtual reality technology or augmented reality, not only for games of pure and simple fun, but also for games of training processes for industries and for services. Gamification developed in digital and virtual environments, with the help of technology, has also generated new and incremental experiences.

The use of virtual reality and augmented reality to increase the experience of a game in the form of training (for experiences in situations that represent a greater degree of danger or insalubrity), as discussed in experiments exposed by Xtreme VR (2018) and by Kelly (2017).

Augmented reality is technology that allows the virtual world to blend in with the real world, opening up a greater number of possibilities for interaction and a new dimension in how to perform a task. Augmented reality literally 'augments' the real world with digital information from the virtual world (Godoy, 2017). Godoy (2017) also highlight that interactions can bring emotions as well as innovation to lived experiences.

The advantage of augmented reality in relation to virtual reality is mainly the cost of technology, more accessible thanks to the use of smartphones associated with augmented reality glasses (Xtreme VR, 2018). The challenge of its use is the same as mentioned in the process of gamification by Werbach and Hunter (2012), to define the points and the objective of the training, so that the transfer of the knowledge one wishes to do happens in an aggregating and satisfactory way.

In this process of evolution, it is mandatory to verify that technology is a tool, not an end in itself. The technological advance, therefore, assists and enhances the results sought by the training programs in the most varied contexts, but must be inserted together with relevant content (Sousa; Rocha, 2019; Gattulua *et al.*, 2019).

Another trend that has become possible with the features implemented by the smartphone and tested in many models of online courses is the use of small moments to learn something relevant, a resource exploited in models created by Google with the Primer app, and the LIT platform that received digital maturity recognition among Brazilian companies in the McKinsey survey in 2018.

Develop information technology enabled feedback systems it is a way that looking for interaction and mediation capabilities that can be harnessed to support more focused and timely feedback.

According Webb and Ifenthaler (2018), the results of an effective feedback process will be good teaching focused on students' needs and students who understand or are coming to understand their own

learning needs. This increased understanding is prerequisite for students to be able to self-regulate their learning and thus to achieve autonomy in learning.

Self-regulated learning is generally regarded as desirable for learning especially for online learning. There is evidence of improved performance in online learning correlating with some aspects of self-regulated learning. Furthermore, intelligent adaptive algorithms for personalized feedback also have been developed in informational ambiances, which collaborates in the context of self-regulated learning, that the participant shape their own rules of advancement in relation to their learning or their time and training.

### **3 Methodological Procedures**

This exploratory research intends to aid the systematization of information in the area (Selltiz, 1975), and is composed of two groups or steps:

The qualitative step, with data collection from interviews with semi structured questions, performed with professionals who have already applied or participated in the development of a trained training. The selection of this non-random sample was defined by the requirement that the interviewee work in companies that foster specific area of training by gamification or because they have developed solutions with specific and recognized consulting support, and the data are interpreted through content analysis according to with the proposal of semantic categorization of Bardin (1995).

The quantitative step, performed through a survey style questionnaire applied in an online environment for professionals who have already participated in some gamification training, with option of answer in Likert format arranged from 1 to 10, and with analysis of information through means and standard variance, Cooper and Schindler (2003), and research strategies with an approach and method designed in a manner appropriate to the research and its way of communication, according to Vergara (1998). and Creswell (2007).

## **4 Results**

### **4.1 Quantitative results**

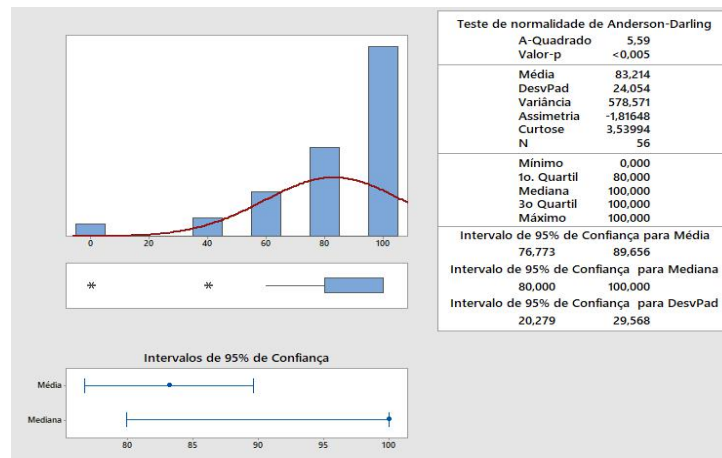
The form for the quantitative research step was built using the Google forms online tool, and received 56 valid responses, who said they had already participated in corporate training. The collected responses were stored in a spreadsheet automatically generated by the Google forms response manager, and for the treatment of the data the statistical software Minitab version 18 was used. With the database transferred to the Minitab 18 software, the database of questions Q07 to Q11 was normalized, assigning the scale from 0 to 100 for the answers. In this step questions Q01 to Q06 were characterized as validator fields, personal data or grouping profile.

From this range of questions, we highlight: Q07 – “When I start a gamification training, I feel motivated to continue until I move forward or finish the cycle of proposed tasks” and Q09 – “I realize that I have constant feedback on my advancement when I am on a gamified training”.

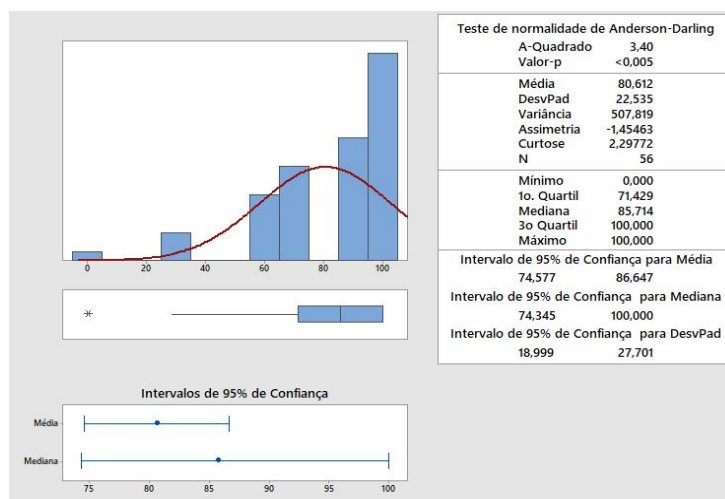
The indicator that had the best index was the question Q07 of perception of engagement by the participants, with 83.214 of average, who are mostly motivated to continue and advance in the training phase. But there is an outlier presence.

For the question about perception of feedback the average was 80,612, median 85,714, and standard deviation 22,535, being the second largest number average between the range of questions Q07 to Q11.

This index also follows in the direction of Marczewski's (2017) diagram on the feedback loop and on the advancement of the player or user in the game.



**Figure 1 Q07 - Motivation to Move forward**  
Source: Minitab research data, 2018.



**Figure 2 Q09 - Feedback**  
Source: Minitab research data, 2018.

#### 4.2 Qualitative results

The questions to construct the qualitative step of the research were elaborated in order to answer these objectives: to enumerate the main triggers of motivation of the gamification that can be explored in training and development; highlighting the main difficulties encountered in the application of gamification training; and describe characteristics that indicate a contribution to a skillful training and development.

The answers were given through an interview with ten professionals who have already participated in the construction and elaboration of gamification training. The contact with these professionals

occurred initially through events in the area of human resources and technology, endorsed in most cases through contact via LinkedIn social network. All professionals interviewed have relevant professional experience in this area, work in some position in development projects and implementation of corporate training, with an average time of experience of five years.

The questions Q09e and Q13e had their content analyzed according to the analysis of content and categorization proposed by Bardin (1995), highlighting the frequency with which certain content characteristics arise. In this step questions Q01e to Q08e were characterized as validator fields, personal data or grouping profile.

Starting from a global analysis of the categories listed by the research, we can highlight the frequency that the code "engagement" appears as an answer to questions Q09e and Q12e, about factors that the interviewee liked more and about what he believes to be an advantageous aspect in training. There is a link between engagement and the individual's intrinsic motivation, as can be seen in the excerpt: "E01: it signals its progress and engages, and it is by intrinsic motivation."

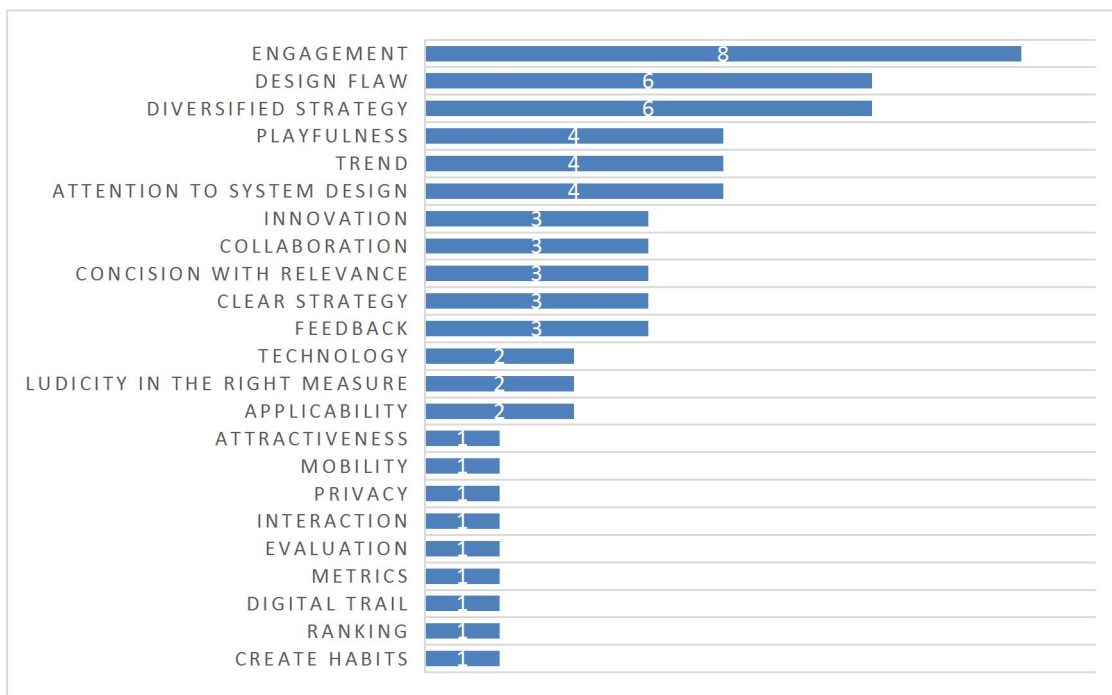
According to Alves (2015) approach, this engagement is directly linked to the relevance of the content addressed to the users of the game, and the form used to promote learning.

This factor is directly linked to the next major item of research codes, the "design flaw" issue, and the

strategy diversification, which is important to maintain attention and interest and achieve a satisfactory result with all player profiles, so its relevance and importance in appearing as a category in the analysis, as addressed by Zichermann and Cunningham (2011) in the main activities that interest each of the four player profiles.

According to Werbach and Hunter (2012), one of the six elements of gamification is the fun and playful factor that exists in the game, but Werbach and Hunter (2012) also point out the importance of using fun in the right measure, without exaggeration, a factor that also coincides with the results found in the interviews.

Following the code list, the "trend" category was singled out by four of the respondents in question Q13e on the general perception of training, and addresses interesting points, alluding to the use of gamification as a tool to reach the attention of generating new aspects inspired by games and citing even new technologies that can be associated with the gamification process, such as virtual reality or augmented reality, which can be used not only for corporate executive training but for many technical trainings, heavy industry or pharmaceutical industry. Kelly (2017) addresses in his history and studies on the "forces that will change the world", the way that smartphone has leveled and popularized the use of technologies such as augmented reality, which generally require lighter technology compared to programs that run virtual reality.



**Figure 3 Codes Incidence Q09e - Q13e**  
Source: Research data, 2018.

Dynamics, mechanics and components of game elements, as proposed by Werbach and Hunter (2012), also appear as categories in some responses: Dynamics of "interaction" with other players, Q12e response item on advantageous aspects, Mechanics of "collaboration", response item for Q09e about item you liked most in a gamified training; and mechanics of "feedback" on progression in the game, also listed in response to the Q09e; and Components, which are all the elements that can be used to build the game interface, represented in one of the answers found by the research by the category "diversified strategy" and also the category "ranking", both categories quoted for question Q09e .

Some of the categories cited relate closely to the objectives listed in training and development theory, before they even connect with the goals of gamification in any given process, but actually linking purposes to a better outcome, such as the categories:

- "Clear strategy ", one of the points of attention raised by Marras (2016) and by Noe *et al.* (2005) is the list of steps to establish the need for training, making sure what items are covered by both the individual and the organization's needs list, the readiness level of the individual who will receive the training and the environment, and material to be used for this purpose, and also in the game, item evidenced in the six 6 D's for the gamification of Werbach and Hunter (2012).
  - "Technology": one of the training strategies is the resources used in its application (Marras, 2016). In this category was mentioned the use of simulators and consoles as something that is used, but that has space and potential to evolve the quality.
  - "Applicability": In the context of the training, if the person does not see value or relevance in the proposed action, there will be no relevant results. As stated by Dutra (2016), if the need is not latent or perceived by the user, there will be insufficient engagement in development actions.
  - The category "concision with relevance" also demonstrates an aspect that encompasses the concern to present an efficient solution that is able to hold and maintain the attention of the user, and was cited as a category in the answers to question Q10e about what most contributed to the results.
- Another interesting aspect of concision with relevance is that it can work information more

accurately in shorter time frames, which is exactly the concept used in the theoretical example of Google Primer, and with the programs that are proposing activities in micro moments, that is, taking advantage of 5 or 10 minutes to learn something or to make some activity. Concision with relevance walks along with applicability, as it becomes clear if the concept is straight to the point.

For questions such as metrification and evaluation, the discussion is more advanced not only in measurement of results of the training, but also in other areas of human resources, such as recruitment and selection through gamification processes, according to the list and interviews of the Brazilian HRTech's report of LIGA Ventures<sup>74</sup>.

The "digital trail" issue relates directly to this "metrics" point as well as to "data privacy", with the additional fact that the information left by everyone in the online virtual environment and in the cloud is a history and can be used for customizations, but can also invade privacy, since the line is no longer so well delimited. Certainly, the issue of data privacy and authorization for its use is one of the global problems of modernity on the agenda for discussion in times of network data, process digitization and digital gamification. An early discussion in Brazilian legislation is the new LGPD - General Data Protection Act, which will take effect, if there are no changes, in August 2020, but this is already a subject for another study.

The "mobility" category was mentioned by only one of the interviewees, but also highlights the possibilities brought by technology, specifically with the possibility of carrying out more activities remotely through the internet on a computer or a smart phone.

## 5 Conclusion

The results of this research aimed to identify the main central elements of gamification and its relation with training and development practices, from the compilation of the two steps of the research.

The high frequency rate of the word "engagement" was the strongest indication of gamification agreement in training and development processes, because the game helps to encourage this engagement on the part of the individual, and on the other, a training that hopes to achieve results must have its members engaged to reach the final purpose. The engagement is well quoted by professionals, and also have a good index of perception by the users, which strengthens the information.

Another interesting aspect was the presence of the categories "playfulness" and "ludicity in the right measure", the first being addressed in its positive aspects, and the second, quoted negative in cases of exaggeration or in applications outside contexts.

The new forms of interaction brought into the theoretical framework, tools created from augmented reality and virtual reality, also appeared and were confirmed in the interviews through categories such as "trend" and "innovation".

The issue of technology insertion in this process also confirmed the facilities generated by the possibilities of large-scale application, metrics, mobility to access training through a game on a smartphone, but also brought insight into new issues, including "Data privacy" that gets registered on the network, and the question of history that people may end up leaving through their game logs, as quoted in the "digital trail" category.

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<sup>74</sup> <https://insights.liga.ventures/hrtechs/>



According to Meeker's Internet trends report (2019), gamification continues to grow in trends, bringing interaction through gaming, video, voice and text, has been used in online education and has also had significant growth in the problem-solving, stimulating recreation, collaboration and learning at the same time, as well as being pointed as a tool in the context of digitization.

Other categories such as "create habits", although it has been mentioned only once in the categorization, also makes ties with both the habit-forming proposed in the learning loop of Herger (2014) and what is expected of a development program, such as proposed by Marras (2016).

The results of feedback process increased understanding for participants to be able to self-regulate their learning and thus to achieve autonomy in learning. Self-regulated learning in the context of gamut activities linked to the categories "concision with relevance", "applicability" and "metrics" allows the training participant to have more control and mastery over the time he has available for each task, against the tendency of learning in micro moments, that is, in periods composed by half an hour or a quarter, for example.

The research sought to highlight what is applied in gamification of training processes with professionals who have already developed and applied training in this format successfully, but also listing difficulties and potential areas for improvement.

In the same way, we seek the opinion of professionals who have already been trained through this tool, so that each public could register their opinions and their perceptions for the composition of this scenario.

For games be considered a viable tool, they must provide some means of testing and progress tracking and the testing must be recognizable within the context of the training they are attempting to impart.

The subject that studies gamification focused on the actions of human resources still has space and potential for growth in its actions and applicability researches and its results, for this reason some of the suggestions for new studies are:

- (i) Continue to follow the growth of this market and the professional sectors that use gamification with more success, both in Brazil and in emerging markets;
- (ii) Understand more about the elements that can cause design flaws, and which ones are the most successful for the experiment,
- (iii) Investigate which common mistakes to avoid according to the type of training, the area of professional performance and the business segment, and
- (iv) Study the application of gamification in other areas of HR, such as recruitment, performance evaluation, or other business areas, such as marketing.

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## Research on the Influence Mechanism of Transformational Leadership on Enterprise Innovation Performance

Na Risu, Cui Hainan, Zhang Di

School of Management, Wuhan University of Technology, Wuhan, P.R.China, 430070

(E-mail: 1612480712@qq.com, 13213673837@163.com, 281855439@qq.com)

**Abstract:** This paper uses literature review method, questionnaire survey method and regression analysis empirical research method to propose the relationship between transformational leadership, enterprise innovation performance and innovation self-efficacy. It believes that transformational leadership has a significant positive impact on corporate innovation performance. This paper constructs a mediating role model of innovative self-efficacy between transformational leadership and corporate innovation performance. Finally, it is concluded that transformational leadership has a significant positive impact on corporate innovation performance, and innovation self-efficacy plays a part in mediating between the two. The result of the action. This paper enriches the research on transformational leadership and innovation performance, and provides a new theoretical perspective for the formation and promotion mechanism of organizational innovation performance.

**Key words:** Transformational leadership; Innovation performance; Innovative self-efficacy; Mediating Role

### 1 Introduction

The transformational leadership proposed by Bass in 1985 is an environment that builds trust commitments. Leaders encourage employees to make changes to adapt to the development of the company, that is, to make employees aware of the importance of self-ability in the work environment and to mobilize the work motivation of employees. Strengthen employees to sacrifice personal interests to realize the overall value of the organization's interests (Bass, 2003).

The style and behavior of leadership influences employees' work attitudes, motivations, and behaviors, which have an impact on job performance. Current research has shown that transformational leadership can exert influence and assume responsibility by encouraging employees to compete for their long-term goals.

Podsakoff demonstrates that demonstrative guidance of leaders' correct behavior can encourage employees to observe learning and improve self-efficacy. Innovation is the coexistence of risks and benefits, so for the employees of the organization, if you want to innovate, you must have strong support within the organization. This kind of support is to let employees have confidence in innovative behavior (Ma Lin et al., 2017). The famous American psychologist Bandura (Bandura, 2003) pointed out "innovation requires unwavering efficacy" (Bandura A et al., 2003). The concept of "self-efficacy" was also first proposed by Bandura in his book *The Social Basis of Thought and Behavior*, defined as "the belief that individuals have the ability to accomplish a certain task." Becoming a social cognitive theory, which not only affects the individual's ability to adapt and adapt, but also regulates the transformation of their thoughts and behaviors through their influence on their cognition, emotion, and motivation (Bandura A, 1997). Relevant empirical research has found that transformational leadership can improve organizational performance well, while self-efficacy and organizational identity play a mediating role between transformational leadership and employee performance. Self-efficacy also provides a new perspective for transformative leadership to promote innovation performance.

Based on the previous researches on the impact of transformational leadership on corporate performance, this paper further deepens the internal mechanism of the dynamic process of transformational leadership to organizational innovation performance, and introduces it in the model framework of transformational leadership and innovation performance relationship. This variable of innovation self-efficacy focuses on the mediating role of innovation self-efficacy between transformational leadership and organizational innovation performance.

## **2 Theory and Hypothesis**

### **2.1 Transformational leadership and organizational innovation performance**

Transformational leadership is considered by some scholars to be the most effective leader (Mhatre & Riggio, 2014), Transformational leadership is the process of linking the roles of leaders and employees to each other and trying to create a level of mutual improvement and motivation between roles (Burns, 1978). Li Chaoping and Shi Kan conduct in-depth research on transformational leadership and propose four-dimensional transformational leadership (Rosing & Zacher, 2017). They are vision incentives, leadership glamour, virtue and individual care.

Jansen and Ypere believe that innovation performance is a new concept proposed by the organization, which is actively generated, implemented and implemented by employees. The innovative performances pointed out by Rosing, Zacher and Baer are the design-to-execution efforts of employees for innovative activities, including the generation of ideas and actions put into practice .

In recent years, domestic and foreign scholars have combined revolutionary leadership with innovation performance. Basu and Green pointed out that transformational leadership stimulates employees to break the original situation and stimulate innovative behavior through the motivation of the vision. Research by Boehm shows that transformational leadership enhances the organization's innovative identity through the individualized care of the employees, and thus enhances the innovation performance (Boehm et al., 2015). Walumbwa believe that transformational leadership will lead organizations to challenge the status quo and continue to innovate and learn (Walumbwa et al., 2017). Zhu Shaoying and other domestic scholars have found that the organization led by transformational leadership has created a strong atmosphere of innovation, and the performance of innovation is more obvious. Chen Rui and Jing Runtian have demonstrated that there is a positive correlation between transformational leadership and creativity. They generally believe that transformational leadership expands the organization's stated goals and enhances work confidence, taps the creative thinking of employees, and makes the organization full of creativity (Chen Rui et al., 2012).

Therefore, transformational leadership has a guiding role in employee creativity, can promote the creation of employee innovation behavior and collaboratively organize the overall creative behavior, thereby enhancing the organization's innovation performance. Therefore, given that transformational leadership is validated in most cases to promote innovation performance, the paper proposes the hypothesis:

H1: There is a positive correlation between transformational leadership and innovation performance.

### **2.2 Analysis of the mediating role of innovative self-efficacy**

Self-efficacy is the result of social cognition theory. Innovative self-efficacy is a pioneering concept proposed by Tierney and Farmer (Tierney and Farmer, 2002) combined with Amabile's creativity theory along the theory of self-efficacy (Tierney & Farmer, 2002). The definition is "individuals are able to the belief in obtaining innovative results. Transformational leadership can be

motivated by the vision, internalized into the values of employees, and enhance employees' confidence in achieving the overall goals of the organization. Gong conducted a questionnaire survey with Taiwanese employees as a sample to explore the relationship between transformational leadership and employee innovation behavior. Research shows that transformational leadership is positively related to employee innovation behavior, and innovation self-efficacy plays a full intermediary role in this process. Therefore, in the process of transformational leadership affecting employee behavior, transformational leadership will benefit employees' sense of innovation and self-efficacy. Based on this, the paper proposes the hypothesis:

H2: There is a positive correlation between transformational leadership and innovation self-efficacy.

The improvement of innovative self-efficacy will inevitably improve innovation performance. Tierney and Farmer argue that when individuals work in an environment full of innovation, innovation self-efficacy positively affects innovation performance (Tierney & Farmer, 1999). Chinese scholars Gu Yuandong and Peng Jisheng divide organizational innovation into innovative thinking and implementation of innovative practices, and explore the relationship between innovation self-efficacy and finally conclude that innovation self-efficacy is positively related to organizational innovation process (Gu Yuandong & Peng Jisheng, 2010). Therefore, according to the research theories of the previous scholars, it can be considered that the sense of innovation self-efficacy has a positive effect on the improvement of innovation performance. Based on this, the paper proposes the hypothesis:

H3: There is a positive correlation between innovation self-efficacy and innovation performance.

H4: Innovative self-efficacy has a partial mediation between transformational leadership and innovation performance.

Through the above theory and hypothesis analysis, this paper explores the direct influence of transformational leadership on innovation performance and the indirect impact mechanism of innovation self-efficacy. The research model of this paper is shown in Figure 1:

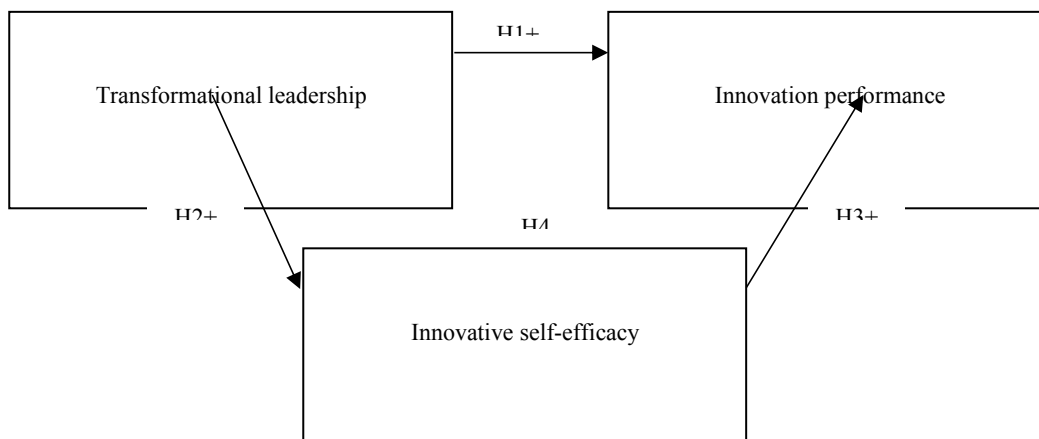


Figure 1 Hypothetical Model

### 3 Data and Methodology

In this paper, 316 questionnaires were distributed to employees of science and technology enterprises in Shanghai and Hangzhou, and 268 questionnaires were collected, of which 211 were valid questionnaires, the questionnaire recovery rate was 80.72%, and the questionnaire efficiency was 63.55%. After collecting the relevant data, the data analysis software SPSS22.0 was used to analyze the correlation and regression analysis of the questionnaire results.

#### 3.1 Scale of transformational leadership

The transformational leadership behavior measurement uses the four-dimensional scale of the transformational leadership behavior with Chinese cultural characteristics compiled by domestic scholar Li Chaoping and Shi Kanxue: leadership charm, vision incentive, morality and individualized care. The degree of validity was good. The survey used the Likert five-point scale (1-very non-conforming, 5-very consistent).

#### 3.2 Scale of innovation performance

Some items of innovative behavior in innovation performance measurement. This study combines the previous researchers' scales, drawing on some of them and adding some options. Using the Likert five-point scale (1-very non-conforming, 5-very consistent).

#### 3.3 Scale of innovative self-efficacy

Using Carmeli and Schaubroeck 's Creative Self-efficacy scale, all aspects of employee's creative performance, such as innovative work, creatively overcome the challenges at work Etc., the questionnaire is also based on the Likert five-point scale (1-very non-conforming, 5-very consistent).

## 4 Results

### 4.1 Statistical description

Table 1 gives the mean, standard deviation, and correlation coefficient between variables for all study variables. Among them, there is a significant correlation between transformational leadership and innovation performance (0.908). Transformational leadership is significantly correlated with innovation self-efficacy (0.850), and innovation self-efficacy is significantly correlated with innovation performance (0.910).

Variable	M	SD	1	2	3	4	5	6	7
Gender			0.40	0.500	1				
Age			2.20	0.913	-0.639**	1			
Education			2.96	1.020	0.376	-0.394	1		
			2.16	1.510	0.696**	0.727**	0.300*	1	

**Table 1 Correlation Coefficient Matrix**

Notes: \*\*\*p<0.01; \*\*p<0.05; \*p<0.1 . N=211.



#### 4.2 Verification hypothesis

To verify hypothesis 1, regression analysis was conducted on innovation performance with transformational leadership as an independent variable. According to Model 4, the regression coefficient of transformational leadership for innovation performance is significant ( $b=0.912$ ,  $p<0.01$ ), and Hypothesis 1 is validated: there is a positive correlation between transformational leadership and innovation performance. To verify hypothesis 2, a regression analysis of innovation self-efficacy was conducted with transformational leadership as an independent variable. According to Model 2, the regression coefficient of transformational leadership for innovation self-efficacy is significant ( $b=1.032$ ,  $p<0.01$ ), and Hypothesis 2 is validated: there is a positive correlation between transformational leadership and innovation self-efficacy. To verify hypothesis 3, regression analysis was conducted on innovation performance with innovation self-efficacy as an independent variable. According to Model 4, the regression coefficient of innovation self-efficacy on innovation performance was significant ( $b=0.753$ ,  $p<0.01$ ), and Hypothesis 3 was validated: there was a positive correlation between innovation self-efficacy and innovation performance. According to Model 5, when transformational leadership and innovative self-efficacy enter the regression equation together, the influence of transformational leadership on innovation performance is reduced ( $b=0.486$ ,  $p<0.01$ ), and the impact of innovation self-efficacy on innovation performance. The effect is still significant ( $b=0.413$ ,  $p<0.01$ ), and hypothesis 4 is validated: innovation self-efficacy has a partial mediation between transformational leadership and innovation performance.

**Table 2 Regression Analysis Table**

Variable	Dependent variable: Innovative self-efficacy			Dependent variable: Innovation performance				
	model1	model2	model3	model4	model5	model6		
Gender			0.244	0.235	0.143	0.135	-0.051	0.031
Age			0.370	-0.122	-0.199	0.047	0.097	0.101
Education			0.250	0.084	0.207	0.043	0.008	0.006
Working years			0.342	0.150	0.227	0.037	-0.046	0.030

Notes: \*\*\* $p<0.01$ ; \*\* $p<0.05$ ; \* $p<0.1$ . N=21

#### 5 Conclusions

This paper firstly reviews the literature on transformational leadership, innovation performance, and innovation self-efficacy. On this basis, the feasibility study direction is selected. Through sample survey, the transformational leadership and innovation performance and innovation self-efficacy are the relationship between these two variables has been studied and the conclusions are as follows:

- (1) Transformational leadership has a positive and significant impact on innovation performance.

(2) Innovative self-efficacy has a partial intermediary role between transformational leadership and innovation performance.

Through empirical analysis, this paper can prove the positive influence of transformational leadership on organizational innovation performance and the intermediary relationship between innovation self-efficacy. However, due to resource and time constraints, this study has some shortcomings, and it is hoped that it can be further improved in future research.

(1) The sample that should be selected is for enterprises with innovative agglomeration. The innovation performance of research and innovation enterprises is more targeted, and the applicability and rigor of the research conclusions can be guaranteed. Therefore, the organizational behavior of high-tech innovative enterprises should be explored in a targeted manner.

(2) A study of employees' innovative self-efficacy behaviors and transformational leadership behaviors, combined with horizontal and vertical data analysis, can better understand the impact of other variables on research variables and outcomes.

(3) Based on the previous researcher's maturity scale, combined with the actual situation of the respondents, the development and design of a specific questionnaire scale can be more targeted to the research group, making the research results more targeted and authoritative.

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## Impact of Emotions on Conflict Management Styles

Qamaruddin Maitlo, Farhan Aslam, Khaliq Ur Rehman

School of Management, Wuhan University of Technology, Wuhan, P.R. China, 430070

(E-mail: qamar.maitlo@iba-suk.edu.pk, aslam.farhan@outlook.com, khaliqcheema@gmail.com)

**Abstract:** The objective of the present study is to classify the factors underlying different conflict management styles of individuals (Integrating, Dominating, Compromising, Avoiding and obliging) with pertinence to their emotions (positive emotions and negative emotions). For this objective a sample of 178 individuals from three different banks in Pakistan were selected with proportions of 80% being male and 20% being female. To assess the conflict management styles of the individuals ROCI-II measure was used, and the emotions of the individuals measured using PANAS scale. The regression analysis was applied to test the hypothesis which concluded to Integrating and compromising tactic of conflict management positively related to positive emotions while Avoiding and Dominating styles were positively related to negative emotions. The conclusion is that emotions do play a prime role in addressing the type of conflict management style preferred by individuals.

**Key words:** Negative emotions; Positive emotions; Conflict; Conflict management; Styles.

### 1 Introduction

Much of the research done connecting emotions and conflict management takes the aspect of teams within an organizational perspective and few have looked upon interpersonal dimension of conflict and emotion. Many researchers have focused on the team aspect in order to develop quality and efficiency, and ascertain sustainability of an organization (Alper, Tjosvold, & Law, 2000). But again, as said 'history repeats its self' the individual difference element comes into play. As for an organization to develop and sustain, it is important to understand the teams working inside it similarly teams are made up of individuals, in order to increase the efficacy and effectiveness of the teams its internal blocks that is team members, have to be effective and efficient. One of the key issues that any organization would undertake to be effective at is to keep conflict at a minimum or turn it constructive. Therefore, the present study wishes to address the conflict management element of individuals with respect to their emotions.

### 2 Literature Review and Hypothesis Development

#### 2.1 Conflict and Conflict Management Styles

Conflict has been defined in a multitude of ways although being a challenge every time to be able to exactly elaborate its very nature. This is because of the term conflict itself being incommensurable in various disciplines (Obeidi, Hipel, & Kilgour, 2005) and differing perceptions of parties and interpretation of other's behavior (MAITLO, BHUTTO, ANWAR, & MAHAR, 2012). Nevertheless the efforts taken by researchers, specialists and practitioners who have defined conflict with myriad of facets is worth appreciation. Authors have an array of views about conflict each presenting a different perspective due to different presumptions underlined and depending on the discipline it is taken in (Hipel, 2002; Obeidi et al., 2005). generally conflict is believed to be as a contest of contrasting forces, striving over resources, struggle over one's ideas, beliefs, needs, wishes (Pondy, 1967). It is also viewed as a difference of opinions dissimilarity of interests (Thompson, 1998) and also as incongruity of goals (Carnevale, 1990). A more comprehensive and elaborative definition found yet is proposed by Sandole (1998, p.1) as a "situation in which at least two parties try to pursue their perceptions of mutually incompatible goals by undermining, directly or indirectly, opponent's goal-seeking capability". it is seen that even if the persons *perceive* that their goals, interests, values, beliefs, needs and wishes are opposed they take it as an actual conflict situation and tend to hinder their opponents from attaining their goals and aspirations or try to control (Elena Losa Iglesias & Becerro de Bengoa Vallejo, 2012; Fletcher, 2001). As rightly advocated by Obeidi, Hipel and Kilgour (2005) and Pondy (1967) conflict is the real or perceived perceptions of individuals. Perception of individuals is the initiation point of conflict and one of the pivotal property of conflict, one's perception may be far off from reality it may have nothing to do with the actual situation or context of the real issue but then again may impose quite an impact on the behavior of the individuals leading towards conflicting actions, which in turn lead the other opposing party to act in a similar way, hence giving rise to a conflict situation.

Conflict management started being recognized in literature mainly through the Dual Concern

Model proposed by (Blake & Mouton, 1964) and since then many research theories followed this framework. Most studies on interpersonal conflict-management patterns have adopted the Dual Model as a theoretical framework (Blake & Mouton, 1964; Prause & Mujtaba, 2015; Rahim, 1983). The Dual Concern Model postulates that there are two basic underlying motives shaping the individual's style of managing conflict: concern of one's own self that is to say when person gives more priority to himself rather than the other party, whereas the second facet is concern for other party as a priority over one's self, which makes it the opposite of the first point.

**Integrating:** It is characterized by high concern for self and high concern for others. Most experimental researches indicate that high mutual rewards are achieved through integrating styles such that of Pruitt et al. integrating style involves characteristics as openness, creative problem-solving exchange of information and examination of differences to reach an effective solution acceptable to both parties (Afzalur Rahim, 2002).

**Obliging:** It is low concern for self and high concern for others. This strategy involves giving-up of one's own interests, wishes, ambitions etc. in order that the other party's interests, wishes and objectives may be achieved. It is associated with attempting to play down the differences and emphasizing the commonalities to satisfy the concern of the other party. Researches indicate that individuals, who apply obliging style of conflict management especially in newly formed couples, tend to give in rapidly that they miss mutual rewards (Afzalur Rahim, 2002; Fletcher & Williams, 1996)

**Avoiding:** It is low concern for self and others. Avoiding approach is associated with withdrawal, buck-passing, or side-stepping situations. Individuals employing avoiding style lack consideration for self and others thereby lack awareness about themselves and the interests of others. They are also unaware about the actual problem or a better solution to it hence. With no effective solutions to the disagreement, the conditions elongate needlessly causing more troubles for the individuals.

**Dominating:** It is high concern for self and low concern for others. It is identified with win-lose orientation or with forcing behavior to win one's own position. Persons who use dominating method towards conflict fail to notice shared gains as with obliging style. With the dominating approach only half of the conflict aspect is addressed hence presenting a partial solution to the problem.

**Compromising:** It is intermediate concern for self and others. It involves give- and- take where by both parties give-up something to make a mutually acceptable decision.

## 2.2 Emotions

Emotions have been with human as long as human being itself, but understanding emotions and their impact has just started to blossom in research literature. It is quite difficult and the same time important to understand emotions especially in situations like conflict.

**Positive Emotions:** Many social psychological research suggests that positive affect leads to better decisions and improved consequences in an array of contexts (Isen, Daubman, & Nowicki, 1987; Kopelman, Rosette, & Thompson, 2006) it is common finding that positive emotions increase cooperative tactics and enhance the quality of agreements (Kopelman et al., 2006). As apparent from studies of Carnevale and Isen (1986), individuals with positive emotions achieve more mutually and individually beneficial outcomes. With the impact of positive emotions the consequences of conflicts becomes more favorable and satisfying because positive emotions lead to creative thinking and innovative problem solving (Isen et al., 1987), setting bigger, higher and challenging objectives (Baron, 1990) increased effectiveness in resolving the issues and individuals with positive emotions tend toward a more cooperative method in conflict handling and negotiation (Unkelbach, Forgas, & Denson, 2008)

**Negative emotions:** Negative emotions, for most reasons have their own benefits in conflict. Individuals displaying negative emotions can get their share by positioning the issue in their favor and influence the opposition to give in to their demands (Kopelman et al., 2006). With the use of negative emotions, parties get bigger concessions while bargaining According to (Sinaceur & Neale, 2005) individuals who openly display negative emotions in the form of threats to end the negotiation were likely to draw out concessions. on the other hand, prolonged exposure to negative emotions even takes away the greater favorable impact of positive emotions (Baumeister, Leith, Muraven and Bratslavsky, 1998). One other aspect of negative emotions is that these gains can only be achieved when one party perceives or believes that the other is a negative negotiator, then they incline towards giving in (Van Kleef, 2009; Van Kleef, De Dreu, Pietroni, & Manstead, 2006), and even when the negative negotiator sees that the opposite party is weak there happens to be a concession. But then again display of negative emotions reduces the probability of mutually achieving higher and the possibility of future negotiations as with the findings of Allred and co-workers.

## 2.4 Hypotheses

**Hypothesis 1: The individuals' positive emotions will be positively related to the integrating, compromising and obliging style of conflict management.**

**Hypothesis 2: The individuals' negative emotions will be positively related to the dominating and avoiding style of conflict management.**

## 3 Method

**Sampling:** The data was collected from the three different banks from the Pakistan. Total 415 questionnaires were distributed, out of which 205 return and 178 were used in the analysis, which comprises 43% response rate. The average age of participate were 36 years, the ration of the male and female were 80% and 20% respectively.

**ROCII-II:** Instrument used to measure the conflict managing styles in this paper is the Form C of Rahim Organizational Conflict Inventory (Rahim, 1983)The ROCII-II instrument consists of 28 items designed to assess the five different styles of conflict management which are: Avoiding, Compromising, Dominating, Integrating and Obliging. Individual will respond to each and every of the 28items corresponding to a five point Likert scale, where 1 represents strongly agree and 5 represents strongly disagree.

**PANAS scale:** The positive and negative emotions were measured using the PANAS scale which is developed by (Watson, Clark, & Tellegen, 1988). This scale measures 9 positive emotions which are interested, alert, attentive, excited, enthusiastic, inspired, proud, determined, strong and active. The 10 negative emotions measured with is scale are distressed, upset, guilty ashamed, hostile, irritable, nervous, jittery, scared and afraid. Respondents rate each of the emotion on a 5-point Likert scale where 5 being strongly agree and 1 being strongly disagrees.

## 4 Results

**Table 1 Descriptive Statistics**

	Mean	Std. Deviation
Positive Affect	3.1951	0.68984
Negative Affect	2.6618	0.62671
Integrating	3.9738	0.75670
Obliging	3.8567	0.87167
Dominating	3.7045	0.69215
Avoiding	3.7491	0.97750
Compromising	3.9368	0.64703

**Table 2 Correlation among the Conflict Management Style and Emotions**

		PA	NA	I	O	D	A
PA	Pearson Correlation						
NA	Pearson Correlation	-.152*					
		.043					
I	Pearson Correlation	.152*	-.056				
	Sig. (2-tailed)	.043	.462				
O	Pearson Correlation	.001	-.042	.311**			
		.990	.581	.000			
D	Pearson Correlation	.052	.046	.301**	.385**		
		.491	.543	.000	.000		
A	Pearson Correlation	.090	.006	.283**	.305**	.437**	
		.231	.936	.000	.000	.000	
C	Pearson Correlation	.003	.161*	.356**	.365**	.541**	.411**
		.965	.032	.000	.000	.000	.000

\*. Correlation is significant at the 0.05 level (2-tailed).

\*\* Correlation is significant at the 0.01 level (2-tailed).

PA: Positive Affects, NA: Negative Affects, I: Integrating, O: Obliging, D: Dominating A: Avoiding, C: Compromising.

**Table 3 Regression of Conflict Management Styles and Emotions**

	Integrating		Dominating		Avoiding		Compromising		Obliging	
	b	$\beta$	b	$\beta$	b	$\beta$	b	$\beta$	b	$\beta$
Positive Affects	0.44	.48**	0.23	0.1	0.12	0.09	0.39	35**	0.13	0.9
Negative Affects	-0.05	-0.9	0.22	.21*	0.28	0.21**	-0.7	-0.7	0.1	0.11

\*p <0.05 \*\*p <0.01

In the table 1 value of the mean and standard deviations are given. The mean values of conflict management styles (Integrating, Obliging, Dominating, Avoiding and compromising) are 3.9738, 3.8567, 3.7045, 3.7491, and 3.9368, and the values of standard deviations are 0.75670, 0.87167, 0.69215, 0.97750, and 0.64703 respectively. The mean values emotions (positive affects and negative affects) 3.1951, 2.6618 and the values of standard deviations are .68984 and .62671 respectively.

In the table 2 the set of analysis include Pearson correlations and in table 3 the regressions are given to test the hypothesis. In table 3 the values of the regression are given, it shows the regression of conflict management styles on emotions. It shows in the table that compromising and integrating conflict management styles were positive related to the positive emotions, which support the Hypothesis 1. Avoiding and dominating conflict management styles were positive related to the negative emotions; it means Hypothesis 2 was also conformed.

## 5 Conclusion

This study examined the relationship between the feelings of the individual and her/his preference for conflict management styles. Study show explicit role of emotions in the individual context. In present study finding shows that, there were positive association between the cooperative mood and positive emotions. Arguable conflict management styles were also positive related with the positive emotions. Emotions like “attentive”, “excited” or “alert” (PANAS) not only reflect the positive mood but also the alertness. Therefore, both types of the conflict management style, i.e., integrating and dominating were positive related to the positive emotions consist of the alert component. By contrast the inactive style of avoiding was associated to the negative emotions. This study contributes to enlightening the trend on conflict management style of the individual signifying the important role of emotions. It nearby expanded the preference of conflict management style outside of only rational elements. Study indicate the perception of the nature of conflict issues they face apply constitute the antecedent of their emotional reaction, linking indirectly to their preference of conflict management styles.

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## Review of Narcissistic Leadership Research

Wan Wei<sup>1</sup>, Li Mingze<sup>1</sup>, Yang Mengxi<sup>2</sup>

1 School of Management, Wuhan University of Technology, Wuhan, P.R.China, 430070

2 School of Mechanical and Electronic Engineering, Wuhan University of Technology, 430070

(E-mail: wanwei\_iris@whut.edu.cn, mingze@whut.edu.cn, yangmengxi@whut.edu.cn)

**Abstract:** Personality of leadership is one of the critical factors which influence team creativity. It is an unavoidable problem whether leaders could effectively integrate team knowledge and form innovation. Different leadership qualities have different effects on team creativity. This paper sorts out the concept of narcissistic leadership, the causes of narcissistic leadership, the behavioral performance and the factors that influence narcissistic leaders by reviewing the literature, and puts forward the key unresolved issues in the field of narcissistic leadership.

**Keywords:** Narcissistic leadership; Concept; Research Status; Prospect

### 1 Introduction

Latest studies have shown that the team's creativity is closely related to the characteristics and styles of the leadership (Zhang, Ou, Tsui & Wang, 2017; Boies, Fiset & Gill, 2015). However, an interesting phenomenon is that many leaders have an obvious trait which is narcissism. For example, Steve Jobs who is the Apple's brilliant founder was very famous for his narcissism; the CEO of the Gree, Dong Mingzhu who sets her computer startup screen as her own "beauty"; the founder of Alibaba Ma Yun etc. Some scholars point out that narcissism is a culture that exists among leaders (Feng Li and Li Feng, 2015). An interesting experimental study shows that narcissistic individuals could easily stand out and become the leaders in the fierce competition of organizations, namely narcissistic leadership (Ong et al., 2016). This paper sums up the concept of narcissistic leadership, the causes of narcissistic leadership, the behavioral performance and the influence resulted by reviewing the related literature home and abroad, and puts forward the key unresolved issues in the research of narcissistic leadership.

### 2 The Definition and Connotation of Narcissistic Leadership

The concept of narcissistic leadership stems from the concept of narcissism. Freud (Freud, 1914) systematically proposed the concept of narcissism in his book *On Narcissism: An Introduction*. He believes that individuals with narcissistic personality have a strong sense of independence, self-confidence, are unpersuadable and a strong desire to pursue power and honor, which could be regarded as a personality disorder. De Vries and Miller (De Vries and Miller, 1985) analyzed the behavior of leaders and found that leaders' behaviors were determined by their narcissistic personality, and proposed constructive narcissism leadership, reactive narcissism leadership and deceptive narcissism leadership based on psychology-related theories, as well as discussed the relationship between narcissism and leadership. Constructive narcissism leadership belongs to a benign narcissistic leadership, but reactive narcissism leadership and deceptive narcissism leadership is vicious, which is harmful to the organization. Rosenthal and Pittinsky (Rosenthal and Pittinsky, 2006) found that many leaders had narcissistic personality attributes, and summarized the characteristics of narcissistic

leadership. They believed that narcissistic leadership had the same characteristics, such as over-ambitiousness, arrogance, self-respect and fragility. They proposed that the behavior of the leader arose from extreme self-interest rather than organizational interests. Based on reviewing previous research, Ouimet (Ouimet, 2010) defined narcissistic leadership as a leadership style that was attractive, self-influenced, pursuing grand and self-interested goals, and suppressing and superficially caring for others. As for the conception of narcissistic leadership, scholars have basically completed the transition from a personality trait to a leadership type. Although, scholars have analyzed and concluded that the behavioral characteristics of narcissistic leadership are similar to narcissistic personality traits, they also affirm the uniqueness of narcissistic leadership (Rosenthal & Pittinsky, 2006; Huang Yili & Li Wei, 2014; Stein, 2013). But until now the scholars still hold different opinions of narcissistic leadership as a personality trait or a leadership behavior style (Liao Jianqiao, Shao Kanghua and Tian Ting, 2016). Although a few scholars have proposed the behavioral view of narcissistic leadership (Mai Reba, Mai Maiti, Li Ye and Wang Hui, 2017), a majority of scholars still equate narcissistic leadership to the leader's narcissistic personality. The concept of narcissistic leadership is not strictly defined. As for the measurement of narcissistic leadership, the Narcissistic Personality Inventory (NPI) is used to measure the narcissistic personality traits of leaders. It did not develop a special scale for the measurement of narcissistic leadership. Based on previous research, this paper defines narcissistic leadership as a type of leadership that is influenced by narcissistic traits.

### 3 Research Status of Narcissistic Leadership

Because of the universality and particularity of leadership narcissism in the organization, the scholars have paid more attention to this phenomenon. Previous studies have accumulated certain results in the field of psychology and management, especially in the field of psychology. A large number of studies have summarized the characteristics and behavioral tendencies of this personality trait. However, there are still relatively few studies on narcissistic leadership in the field of management. In general, the existing research focuses on the formation, behavioral performance and impact outcomes of narcissistic leadership. It goes as follows:

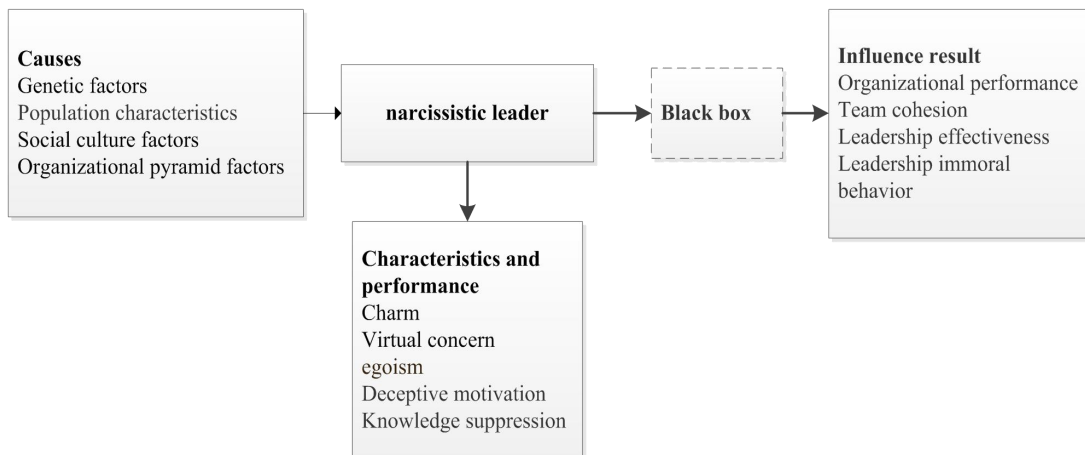


Figure 1 Distribution Map of Narcissistic Leadership Research Status

Firstly, the existing research has analyzed the formation of narcissistic leadership. The research mainly explores the causes of narcissistic leadership from genetic factors, demographic characteristics, environmental factors, social cultural and organizational structure. For example, Vernon et al. (Vernon et al., 2007) found that narcissistic personality is the same as that of extroverted and attached personality which is decided by genetic personality and environmental factors through analyzing the traditional dark triangle personality (narcissism, Machiavelli and psychopathology). The genetic factors explained the variation of narcissistic personality as high as 0.45. Foster (Foster, 2003) found that there is a negative

correlation between age and narcissism. He found young employees in the organization had higher narcissistic tendencies than older employees, which may be related to the experience of life and self-improvement. Kohut (Kohut, 2009) considered narcissistic personality as a morbid personality trait. It is a kind of personal center formed by individuals who have suffered setbacks or traumas during childhood (such as parental divorce) and cannot adjust through adaptive self-confidence. Duchon and Burns (Duchon and Burns, 2008) pointed out that the organization emphasized individualistic culture, requires self-transcendence, and pursuance of power and fame, which greatly promoted the formation of narcissists. A large number of empirical and experimental studies have shown that narcissists are more likely to be favored by enterprises because of organizational structure and environmental requirements, and are more likely to be in the leadership position in the fierce competition. Narcissistic leadership is more prominent under the high reward system (Brunell et al., 2008; Maccoby, 2004, 2007; Nevicka et al., 2011).

Second, due to the influence of narcissistic personality traits, narcissistic leaders also present some typical characteristics in behavior and psychological performance. In the concept of self-cognition, narcissistic leadership has a high sense of self-superiority (Chatterjee & Hambrick, 2007; Davis et al., 2008). In terms of behavioral motivation, narcissistic leadership usually has a strong self-improvement tendency, are more ambitious, and focus on self-influence, as well as pursue power and praise (O'Reilly III et al., 2014). In dealing with others, narcissistic leaders show false concerns about subordinates and tend to suppress the performance of others (Ouimet, 2010). Although narcissistic leaders usually have high social skills, they are self-centered, not good at understanding opinions, and sensitive to criticism, and are not good at reflection, so it is difficult for them to learn from mistakes (Morf & Rhodewalt, 2001; Exline et al., 2004). In terms of behavior, narcissistic leaders usually do things directly, recklessly, aggressively, vigorously, they like to create a sensational effect, tend to take risky behavior, and thus easily make corporate performance unsteady (Maccoby, 2004; Patel & Cooper, 2014). Rosenthal and Pittinsky (Rosenthal and Pittinsky, 2006) suggested that narcissistic leadership included arrogance, inferiority, pursuit of praise and superiority, high sensitivity, immorality, lack of compassion and paranoia based on summarizing previous studies. Ouimet (Ouimet, 2010) believes that narcissistic leadership includes charisma, selfish pursuit of self-influence, inhibition of others and hypocrisy. On the basis of reviewing previous studies, Huang Yili and Li Wei (Huang Yili and Li Wei, 2014) summarized the four behavioral tendencies and characteristics of narcissistic leadership, such as charm, self-interest, deception motivation and knowledge inhibition.

Third, the existing research has some controversy about the effectiveness of narcissistic leadership. On one hand, narcissistic leadership is overconfident and risky, and it is easy to make the organization in crisis (Brunell et al., 2008); liking false care and deception, it is easy to increase the ineffectiveness and immorality of the subordinates to the leader (Hoffman, et al., 2013). Similarly, narcissistic leaders are selfish, only care about themselves, ignoring the efforts of others thus easily destroying the good atmosphere of the team and ultimately reduce team cohesion (Morf & Rhodewalt, 2001). Chatterjee & Pollock (Chatterjee & Pollock, 2017) proposed that narcissistic CEOs meet two needs of people. Firstly, they are in pursuit of their praise by others and secondly they want to be in control of the needs of others, so they work hard and therefore can contribute to the organizational goals. The effect of existing research on narcissistic leadership tends to be negative and destructive, and its positive impact remains at the speculative stage, lacking sufficient empirical evidence. The existing research institutes target most of the leaders with absolute power such as CEO or political leaders, while the middle leaders who target small and medium-sized teams in the organization lack of sufficient attention.

#### **4 Conclusion**

Although the existing research has explored the conceptual characteristics, formation and influence of narcissistic leadership, it has unveiled narcissistic leadership to a certain extent, providing a research foundation for a correct understanding of narcissistic leadership. However, there are still some issues to be explored and solved for the study of narcissistic leadership. Firstly, the existing research on narcissistic leadership is mostly based on theory and lacks sufficient empirical research to test it and establish relationships between narcissistic leadership and important outcome variables, such as creativity, advice, and organizational citizenship behavior. Secondly, although previous studies have to some extent have explored, the relationship between narcissistic leadership and performance, the results

are controversial and needs further verification. Most of the research targets high-power leaders such as CEOs or political leaders, but there is a lack of attention to middle-level team leaders. Different levels of narcissistic leaders have different effects, but the existing research does not give an answer. In addition, the existing research on the effect of narcissistic leadership lacks the testing of its formation mechanism. There is also a need to clarify the behavioral tendencies of narcissistic leadership which are the key to the positive or negative outcomes of employees or organizations. Finally, the existing research on the effects of narcissistic leadership focuses on its internal influences, but lacks attention to external influences. The leader is the representative of the team, usually an important bridge between the team and outside the team (Yoon, Kim, & Mah, 2017).

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## Creativity in the Design Process: SNA of Fit Perceptions and Satisfaction among Tertiary Students in Ghana

Fortune Ama Amegah<sup>1</sup>, Patience Pokuaa Gambrah<sup>2</sup>, Isaac Kuma Yeboah<sup>3</sup>

<sup>1</sup> Department of Fashion Design, Wuhan Textile University, Wuhan, P.R. China, 430073

<sup>2</sup> School of Economics, Wuhan University of Technology, Wuhan, P.R. China, 430070

<sup>3</sup> School of Information Engineering, Wuhan University of Technology, Wuhan, P.R. China, 430070

(E-mail: fortuneamegah@gmail.com, patiencegambrah@yahoo.com, isaackyeboah77@gmail.com)

**Abstract:** In this study, we examine the fit perception and satisfaction obtain by students from their designers as part of the creativity in the design process. Empirical data on design processes were obtained from two locations in two different tertiary institutions in Ghana. Also, four experienced designers, whose designs were measured on general quality and on a range of aspects plus creativity were also involved. From the data, we identify aspects of creativity in design related to the formulation of the design problem and to the concept of originality and much-preferred designs by students. We also apply SNA to our data to evaluate the centrality of designers as preferred by students as to know what satisfaction they obtain from these designers. Our results confirmed that, although students preferred most of the designers and their garments fits them very well, their satisfaction was obtained from designers who were flexible with their little requests and quires which gives students the ability to wear those garments confidently. It is therefore recommended that designers should take into consideration the little inputs and comments of students to give them the needed satisfaction.

**Keywords:** Creative design; Design process; Garment satisfaction; Students fit perception; SNA

### 1 Introduction

Fit is a vital measure in a consumer's assessment of a designer's product. According to Kurt Salmon Associates, 2000, 50% of women and 62% of men cannot find a good fit. Other studies have shown that, fit problems to be the reason for 50% of catalog returns. With the widespread diversity of body shapes and sizes and a drift towards more fitted garments (Lee, Y., Hwang, C.&Baytar, F., 2019), fit difficulties continue to be an issue for garment manufacturers and designers, with no clear resolution. Creativity in the design process is often described by the number of important proceedings (C.H. Dorst and N.G. Cross, 2001). Such proceedings occur as a swift insight which the designer instantly sees as important, but often it is only in a survey that the designer is able to recognize a point in the design process by which the key idea begins to develop. Surveying accounts of creative proceedings in design made by the designers themselves may not be wholly reliable (Lawson, B., 2005). The increasing number of designers has brought more competition in the industry which is very healthy and this has shaped the behavior and activities of designers who intern try to give customers the needed satisfaction they deserved.

Designing to suit a group of people is seen as problematic because there can be no guarantee that a creative design will satisfy your customers which they will see as creative and unique and prefer yours to others (Hinds, B. K., & McCartney, J., 1990.). Social networks analysis is an extremely important area of research. With the advancement in areas of research, the growth of social networks is used in a lot of studies (Shiau, W. L., Dwivedi, Y. K., & Lai, H. H., 2018). The development of social networks have been concentrated on three branches of research, which are, the network's statistical properties (M. E. J. Newman, 2003), which characterize its structure and topology network models that represent and help to understand the meaning of a said properties and finally, the analysis of dynamics and developing behaviors within networks. While garment fits may be complicated by many factors including quality, price, delivery schedule and production operations, they are important because they lead directly to consumer satisfaction or dissatisfaction with fit. Designers that maximize the potential of their fit production, can generate better-fitting garment (Lee, Y., Hwang, C.&Baytar, F., 2019). This problem is common as far as design practice is concerned, which means, it calls for the combination of a diversity

of aspects, such as ergonomics, establishment, production, aesthetics and business aspects. The main aim of this study was to enrich the understanding of customer’s satisfaction with garment fit in general (i.e., the awareness of garment fit in a broad-spectrum which is possible when acquiring garment). The over-all perceptions of garment fit satisfaction may be influenced by many factors (Brownbridge, K. et al, 2018), all of which come into play when customers measure whether the garment fit meets their anticipations during and after purchasing garments. This study tries to refine the idea of garment fit and satisfaction with fit in particular as pointed out in existing studies, to qualitatively explore customers’ perceptions of garment fit and the factors that affect fit satisfaction, and to develop an understanding of customers’ general satisfaction with fit. This empirical study is aimed at examining the satisfaction students obtain from designs they chose from their designers, and how these satisfactions are obtained, which includes ways to measure the supposed inspiration and the overall ‘quality’ of the subsequent designs. The members we engaged for this study were four designers with over five years of professional skills. With two designers each from the two locations who were directly linked with these students. A total of 120 students were interviewed with 60 students from each location. The outline of the problem in the light of the designer is to, introduce the stakeholders and define the designer’s position. The limitation of the study was our inability to expand the participants of the study to both students and non-students, and also include more designers. It is therefore recommended that, to improve on this study, the participants should not be limited to only students, but workers and non-workers as well. In order to get a deeper understanding of fit satisfaction among people of different sense of taste. The paper is organized as follows. Section 2 describes the materials and method used in the study. Then the study’s data analysis is presented in Section 3 and then the discussion of the results would be in Section 4. Finally, we conclude with a summary of our study and a conclusion in Section 5

## 2 Materials and Method

A distinctive condition in the experiment was the way in which information was provided to the designers (Labaree, R. V. & Scimeca, R., 2016). All the needed information was prepared earlier, with specific areas on sheets. Areas involved interviews with the students, facts about supplies and production techniques, or a survey of students. If a designer wanted to know something, they asked the student, who would then hand over the appropriate sheet with their required need. The facts on the sheets were presented as if it had come from other sources other than students. In this study, we were concerned in the overall quality of the resultant design models produced (Niina H. et al, 2018) by the designers and how it satisfies the student who will be using the product.

The method was as follows:

- The task was read and instructions as to how to do it was also given to both students and designers. They were then allowed to ask questions for further explanation.
- Then shots of all the models were shown in random, together with a sentence summarizing the way each of them was happy with their models.
- The first scoring was then done, with each student grading the models individually in this category.
- Also, students were asked to give a total judgment of them all, which was the mean of the other scores.

This rather painstaking multi-step procedure enabled us to analyze the rationale behind the judging behavior and to test the consistency between students.

**Table 1 The Mean Scores of all Students (on a 1–10 Scale)**

Designer	Ergonomics	Technical aspect	Aesthetics	Business aspects	Creativity	Total judgement
Designer 1	6.2	5.5	6.3	6.4	7.2	5.2
Designer 2	7.3	6.3	7.5	7.2	6.3	7.1
Designer 3	4.4	4.1	5.4	3.2	2.2	4.8
Designer 4	6.3	7.4	7.1	7.7	7.6	7.8

## 3 Data Analysis

The authors observed fit sessions at six designers’ facilities. A survey was developed based on

these observations and was sent to 200 students who participate in fit sessions as part of their quest for satisfaction with their garment fits. The survey included multiple choice, Likert scale and open-ended questions. A return rate of 70% provided response from 120 students and four designers. It was from this 120 students and four designers that our empirical studies were done. Information on participants' overall satisfaction with fit in general as well as demographic data on participants' personal backgrounds were measured quantitatively. The quantitative phase was conducted using a paper-based survey, followed by focus group interviews to obtain qualitative data. The quantitative results are helpful in understanding the level to which participants are satisfied/dissatisfied with fit, and enable comparison of qualitative responses between gender groups. However, quantitative results are not sufficient to fully explain what participants think about fit and why they are satisfied or dissatisfied with fit; hence, the need for a qualitative component. The purpose of the qualitative phase was to explore possible dimensions of consumers' perceptions of fit and gain a deeper understanding of consumers' experiences and thoughts regarding garment fit. From the data obtained from our experiment, students and designers, we now transformed our data into matrices and use UCINET (Borgatti S. P., et al, 2002) to analyse it. These matrices were the basis for our social network analysis.

#### 4 Results and Discussion

An overview of the scores given for each design on the different aspects can be found in Table 1. The concepts of designers 2 and 4 clearly stand out as the best on most aspects (from table 1 and figure 1). Design concepts of Designer3 are consistently bad in all aspects. Which implies students have a taste for designers 2 and 4 although others are also interested in designers 1 and 3

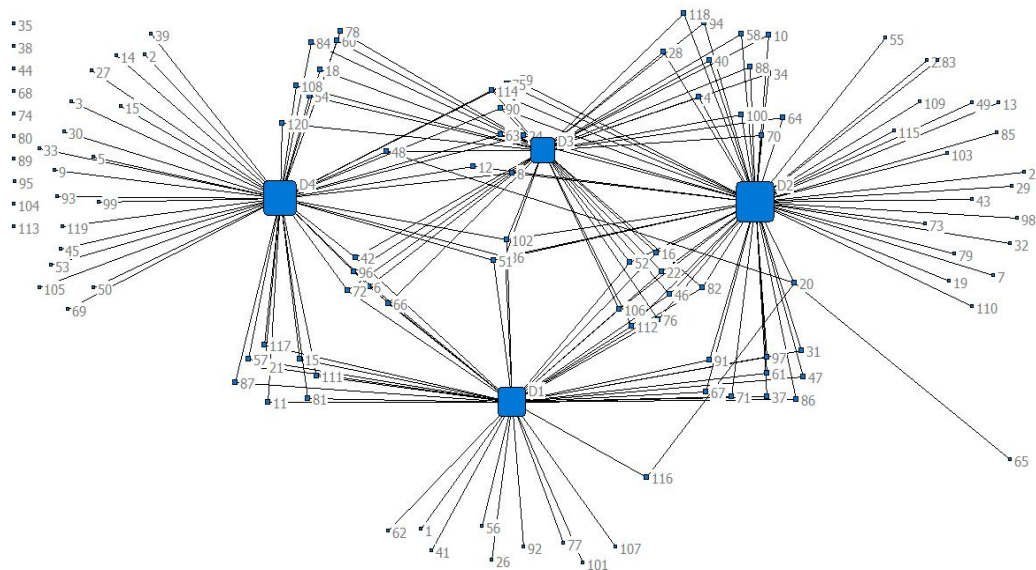
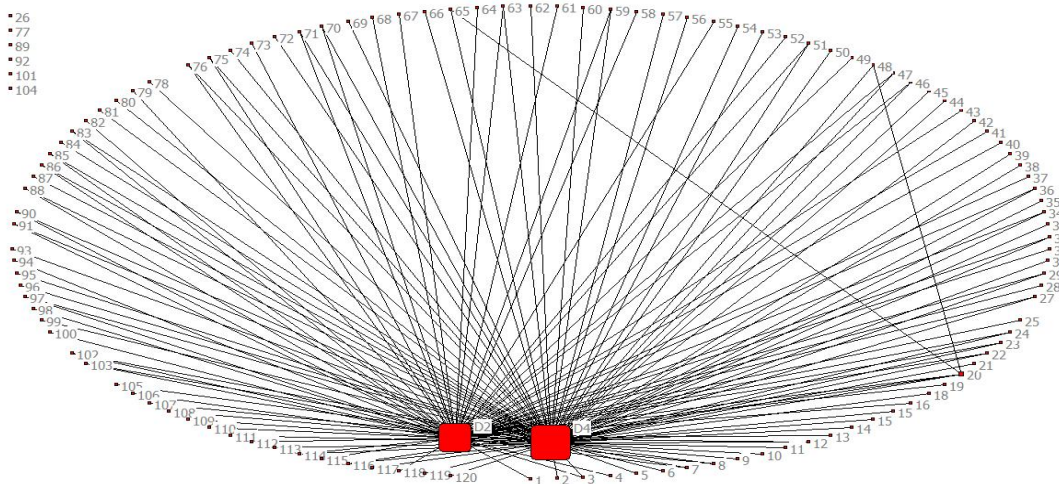


Figure 1 Degree Centrality Network of all 120 Students and 4 Designers

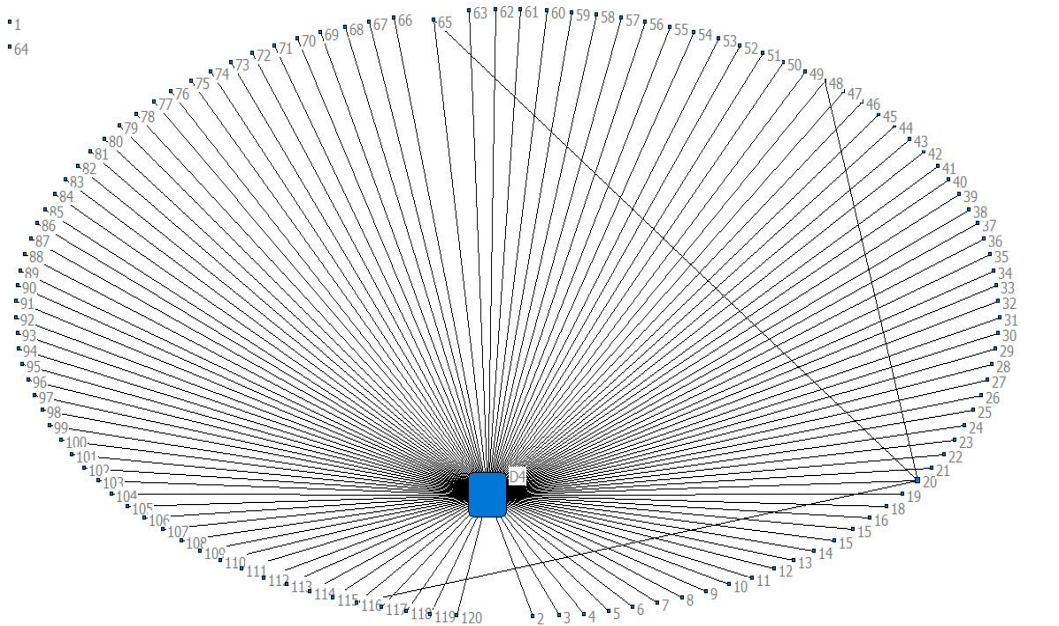
Figure1 shows us that, not all students were connected. There were 10 students who were not connected to any of the 4 designers which shows that they might have a special need which was not solved by any of the 4 designers. There are also students who were also connected to more than one designer which also indicates that their needs could be met if they connect to more designers. We now concentrate on designers 2 and 4 since they have the highest degree centrality and found out more from students how their products fit them and how they derive their satisfaction from those products.





**Figure 2 Degree Centrality Network of All 120 Students and the 2 Designers**

Figure 2 also shows that not all students were connected. There were 6 students who were not connected to any of the 2 designers which shows that they might still have a need which was not solved by any of the 2 centralized designers. There were also students who were still connected to more than one designer which also indicates that only one designer cannot satisfy their needs.



**Figure 3 Degree Centrality Network of All 120 Students and the Centralized Designer**

Figure 3 shows that almost all students are connected except student 1 and 64. This shows that, as the options for students get narrowed, they then tend to get more connected to the only option they have. This also means that, if the leader of the market is able to compete very well, he will in the long round take over the market.

A designer's aim is basically to attain high-quality models (Shin, E. & Damhorst, M. L, 2018), with freshness, uniqueness or originality being preserved as an overall, cohesive design model. A student aim is also to wear a garment that fits her very well and feels satisfied with it. They used a variety of techniques to ensure this freshness, such as searching for technical, social or cultural factors that were not addressed in the design of the current product. Our findings suggest that creativity can practically happen as follows:

- Free, surprising information is linked to a logical piece, which offers an outline of the design problem.
- The acknowledgment of the outline happens swiftly and is experienced as an idea.
- Thus the obvious choice and arrangement of information lead to the same core idea for all the modeled products.
- The designer only has to turn the problem around to arrive at a solution.
- The designer needs to take into consideration the customers' needs, comments, and request
- The customers' satisfaction is derived from the little input she is able to make in the design process.

## 5 Conclusion

In this paper, we examined how the creative and design process affects the fit perceptions and satisfaction among tertiary students in Ghana. We have shown that the 'problem-solving' aspect of design can be described usefully in terms of listening to the student who will be the user of the end product. The connectedness of a student to a designer was depending on the fit perception and satisfaction the student derives from that designers' product. As shown in the network, the degree centrality of a designer shows how many students are connected to that designer. And these decisions are made based on the perception and satisfaction the student derives from the designers' garment. Based on our analysis from the centrality measures used, the following results were obtained: For students, only fit perception will not attract them to a particular designer. Also, their friends fit perception on the garment they wear do not make much influence on their own perception, but what actually influences them most is their taste for the design and the satisfaction they derive from those garments from their designers. It is more likely also for a designer who takes the little comments into consideration to own the market. This means that the chances for the other designers to get more students to their side do not only depend on their designs but also taking into consideration the customers' needs and comments or little details. This also means that the probability for students to run to the designer with more customers is also very high. Naturally, firms with higher probability to satisfy the customers will have higher chances to take the marketplace in the end. It is therefore recommended that designers should take into consideration the little inputs and comments of students to give them the needed satisfaction.

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# **An Analysis and Solution Research of the Voluntary Unemployment of College Graduates from the Perspective of Employability**

Han Fang

School of Management, Wuhan University of Technology, Wuhan, P.R. China, 430070

(E-mail: 1149939096@qq.com)

**Abstract:** A large amount of statistics has indicated that the number of college graduates who intended to get employed has been dropping year by year, while the number of graduates who are voluntary to remain unemployed is growing. Such phenomenon, if unresolved, will bring about instability to society as well as market. The voluntary unemployment of college graduates posed new challenges to the building of harmonious society and work of college graduates' employment in the new era. This paper is innovatively based on the perspective of employability, analyzed reasons behind voluntary unemployment from the view of college graduates and enterprises, and, based on the perspective of employable ability, offered enlightenment and solutions to voluntary unemployment from the four dimensions of market, enterprises, college graduates and colleges.

**Key words:** Employability; College graduates; Voluntary unemployment; Analysis research

## **1 Introduction**

The employment situation of college graduates is becoming more and more serious. The unemployment rate of college graduate's half year after the graduation amounted to 8.1% in 2017. Among these graduates, demission rate within half year after the graduation surpassed 33%, and 98% of them voluntarily quit the job. The main reason for quitting is "not enough space for personal improvement," which accounts for 48% of unemployed group, while 42% of the rest quitted because of "relatively low income and compensation." The voluntary unemployment of college graduates has become a crucial point in college employment. Most of the voluntarily unemployed graduates chose to continue education or participated examination for civil servants so as to avoid employment. Unemployment of college graduates not only increase social cost, but hinder the further progress of education.

Literally, employable ability refers to "the quality, characteristics and capability of individuals, and to which extent the individual can be employed and remain employed." It is first proposed by the British scholar as regard to employment of college graduates (W.H.Beveridge, 1909). It refers to labors' potential to be employed, and later was used as public policy tools for "stimulating" environments as well as fighting against unemployment. Thus, this term is widely used in all walks of life and has spread in Europe and America. Scholars from China and abroad have carried out researches regarding this topic from various aspects.

Foreign scholars carried out researches mainly from such two aspects, the narrow sense and broad sense. In the narrow sense, Labor Development Committee of Canada (1994) defined employable ability from the perspective of supply-demand of labor force. It deemed that employable ability is an interaction based on personal condition and labor market and refers to the regarding ability that individual possess for acquiring meaningful jobs. Based on individual ability, HM Treasure (1997)

defined employable ability as that when exploring jobs with high demand and adaptability, individuals endeavor to explore their skills, knowledge, techniques and adaptability so as to guarantee that they remain employed throughout their careers. In a broad sense, market economic environment is also under consideration. Scholars take personal operation space, including living condition and status quo of labor market, into consideration, and deemed that employable ability is necessary for acquiring first jobs, remaining employed and seeking new jobs when necessary (Hillage and Pollard, 1998). This definition stressed the multidimension and dynamism of employable ability. From the perspective of Human Resources Management, employable ability is defined as the process of continuously completing tasks, getting jobs and creating jobs by making the best of abilities (Van der Heijde and Van derHeijden, 2006).

With a late start, China's researches regarding this topic show relatively consistent definition of employable ability. Employable ability refers to abilities that college graduates acquired through study and exploration of personalities during residency in school, with which college graduates could achieve career goals, meet social demand and fulfill personal value in social life (Zheng Xiaoming, 2002). Employable ability consists of ability in acquiring jobs, and must be renewed throughout careers (XieJinyu and Song Guoxue, 2005), that everyone possesses to successfully acquire various vocations of labor market, or individual's ability and willingness to attain success in various vocations (Zhou Lulu, 2008).

## **2 Category and Classification**

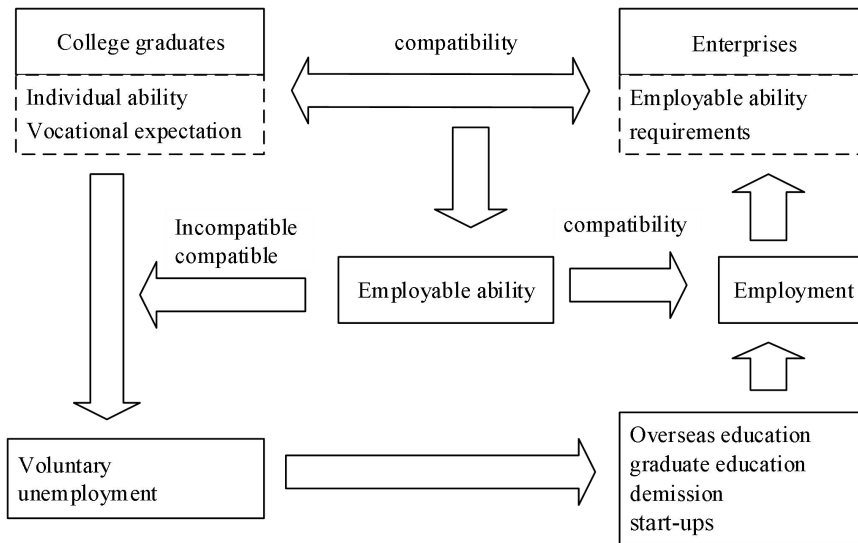
Unemployment refers to a state where workforce who reached the work age and work ability requirements fail to acquire the employment opportunity, and is further classified into passive unemployment and voluntary unemployment. Passive unemployment is also known as involuntary unemployment, which refers to people who are willingly to accept current income and working conditions yet fail to get employed. Compared with passive unemployment, voluntary unemployment is out of the individual's willingness.

The author classified the voluntary unemployment of college graduates into the following categories. First, voluntary employment out of the gap between expectations and reality. It refers to conditions where college graduates did not find their ideal jobs so that they voluntarily remain unemployed. Second, voluntary unemployment due to other career planning. This refers to the group of graduates who turned to overseas education, graduate education and start-ups so as to avoid employment. Third, voluntary unemployment out of voluntary demission. It includes people who had been employed but quitted jobs due to such reasons as "little promotion space", "incompatibility between the job and major". 49% was the match rate for college graduates in 2017 in terms of the jobs and vocation expectations. To be specific, the figure for undergraduate graduates and higher vocational school graduates in 2017 was 52% and 46% respectively. Voluntary unemployment not only add to the time cost and economic cost of employment, but easily develop laziness and idleness among job-seekers (Mi Lingjia, 2015). Therefore, despite the classifications, voluntary unemployment lead to resources waste to some extent, which should be avoided. We need to probe into the reasons behind voluntary unemployment.

## **3 Analyses of Reasons**

Based on previous research conclusions as well as characteristics of this paper, the author intended to carry out analysis from the narrow sense. In a narrow sense, employable ability focuses on the ability that an employee possesses so as to meet the employers demand in employment. The author started from the perspective of employability and concluded that the fundamental reason for voluntary employment

of college graduates lies in the incompatibility between the abilities that college graduates possess and abilities that enterprises require. The analysis of mechanism for reasons behind voluntary employment of college graduates from the perspective of employability is show as the figure 1 below.



**Figure 1 Reasons behind Voluntary Unemployment from the Perspective of Employability**

For a long time, most of employers have held contradictive views about the college graduates' highly employable abilities. On the one hand, enterprises have been longing for college graduates with highly employable abilities, because such graduates possess excellent qualities as well as abilities, and they can instantly achieve effective outcomes for enterprises. In the meantime, such graduates value personal development and are able to achieve self-value improvement through self-study or organizational training so that the total competitiveness of enterprises is improved as well. For college graduates, highly employable ability contributes to psychological feelings, including self-content, satisfaction and self-effectiveness, etc. On the other hand, out of avoiding risks and leveraging labor cost, enterprises are concerned about the return from investment in college graduates who are not equipped with enough employable abilities, hence, enterprises intend to avoid such responsibility(Fan Youmeng, 2019). Therefore, from the perspective of employability, this paper analyzed reasons behind voluntary unemployment from the view of two main parties, college students and enterprises.

### 3.1 View of college graduates

College graduates have a relative vague concept about their future vocational plan. They selected ideal jobs, vocational spots as well as income level, etc. However, most of graduate choosing voluntary unemployment have little social experience. They lack correct understanding about the ideal jobs and ideal income, and also fail to meet the ability requirements of the job they apply for. Therefore, during the process of finding jobs, college graduates are seriously frustrated by gap between reality and personal expectation as well as incompatibility between requirements of jobs and personal incompetence, which led to emergence of voluntary unemployment. Based on the classification of voluntary unemployment, this paper concluded that people who choose voluntary unemployment out of gap between expectation and reality or those who turn to voluntary unemployment because of career planning are consistent with the definition of voluntary unemployment. Due to lack of understanding about their own abilities, they over estimated themselves when targeting ideal jobs, which led to the

incompatibility between real vocational conditions and vocational requirements. Overseas education or graduate education, to some extent, is to meet the requirements of ideal jobs or to improve personal abilities so as to get the ideal job.

Through analyzing compatibility and employable ability, this paper also concluded reasons behind voluntary unemployment caused by voluntary demission. The reason behind voluntary demission lies in the fact that college graduates lack career planning before employment and lack basic understanding about future vocational promotion, income and other conditions so that job contents and income after the employment did not meet their expectations, thus, they choose demission or reemployment. Some of them also chose graduate education or start-ups.

### **3.2 View of enterprises**

College graduates turn to voluntary unemployment mainly because they lack comprehensive understanding about the jobs that enterprises offered and also the lack of hireable employability abilities in enterprises. The requirements enterprises have on employability abilities are on the opposite direction with current college education system. Enterprises usually conduct comprehensive evaluation on college graduates in terms of professional skills (including academic skills and practical skills), communications skills, personality (honesty, sense of obligation, self-management, etc.), learning ability, interpersonal skills and other aspects. However, most of college graduates lack understanding and acquaintance about the skills mentioned above. Hence, there is an incompatibility between employability abilities of enterprises and abilities that most college graduates master, which led to insufficient talent pool and contributed to voluntary unemployment.

## **4 Solutions**

Based on employability, this paper analyzed reasons behind voluntary unemployment of college graduates from the view of college graduates and enterprises. On such basis, this paper took market and colleges into consideration for policy-making process, because market and colleges are the closest factors interacting with enterprises and students. This paper will offer solutions and advice to voluntary unemployment from the following dimensions, including market, enterprises, college students and colleges.

### **4.1 Perspective of the market**

For market, increase the flow and transparency of information in the labor force market. There is a serious information asymmetry between the employment information that college graduates acquire and the information that market display, which is one of the most important reasons leading to unreasonable income expectation of college graduates. Therefore, the labor force market shall carry out effective reform so as to ensure that such information as vocations demand, income, and career development is transparent and instant among college graduates. On the one hand, the authority shall organize concerning department of labor force or human resource to conduct investigation on current labor force so as to report to society, and especially, college students about labor force market information, such as layers, structure and average income level, and carry out in-depth analysis on this information. Such measures will not only contribute to alleviating information asymmetry of work force in the labor force market, but help college graduates adjust reserve income so that it can match social real income and promote fair employment.

### **4.2 Perspective of enterprises**

As the demanding side in the labor force market, enterprises should develop talent program in

accordance to future plan and type of talents needed, and communicate closely with colleges about these programs. Such cooperation between enterprises and colleges could specifically trained students' abilities. On the basis of investigations this paper made and previous researches, employable ability is the key ability lying in enterprises' demand. Therefore, enterprises should closely cooperate with colleges to add employable ability training into daily disciplines and increase effectiveness of employable ability training. Hence, cooperation between enterprises and colleges not only help enterprises develop talents pool and lower the cost in labor force, but resolve the current incompatibility between ability college graduates possess and enterprises' demand, promoting positive employment and reducing voluntary unemployment. Colleges and enterprises should carry out cooperation mainly by establishing college-enterprise coalition, and carry out "order-based" training. Through college-enterprise coalition, students acquire internships from enterprises so that they can be involved in projects, strengthen abilities such as team management, cooperation and communication, allocation of talents and team cooperation. Such cooperation programs help college undergraduate students with employable ability and more social experience. In turn, enterprises provide college students with specific requirements of certain vocations, pointing directions for students and improving their ability in adapting to jobs.

#### **4.3 Perspective of college students**

College graduates should establish the concept of "employment first, selection second." During a given period, the resources that society provides are limited, and materials produced by the limited resources to meet our need are also limited. Limited resources as well as material produced from it shall never completely fulfill human' endless need, which is referred to as Scarcity. Similarly, the ideal jobs that graduates pursue are limited, as most of graduates could not get what they want. Therefore, graduates should develop reasonable employment value. They should get employed first, accumulate experience and then select their ideal jobs, rather than unreasonably go after better jobs. College graduates should improve themselves through employment, establish their advantages and be clear about the jobs that fit them. It is because only in practice can college graduates understand the value of their knowledge and gradually become aware of their orientation. In addition, besides knowledge acquiring during residency in college, students should actively participate in academic, scientific and entertainment activities of all kinds. College, in nature, is like a mini-society, of which students should be aware of. They should effectively use this opportunity to adapt themselves to the society, conduct specific trainings so as to improve their employable abilities.

#### **4.4 Perspective of colleges**

Colleges should integrate employable ability training into classroom instruction. Higher education and vocational education should be merged, while the key lies in that during training program, colleges should effectively respond to human resources demand of the society, and importantly, the training of employable ability for college graduates are links connecting higher education system with labor force market. Vocational undergraduate colleges should set clear goals on professional talents training, and integrate employable ability training into classroom instruction, or in other words, improve employable ability of college graduates through class instruction. Classroom instruction is the cornerstone where Vocational undergraduate colleges achieve employable ability training for students. The implementation and quality of classroom instruction play an important role in training students of vocational undergraduate colleges. To effectively integrate employable ability training into classroom instruction, colleges should start from the following aspects. First, colleges should classify core knowledge of each discipline into different groups, establishing a systematic and complete discipline theory system. In the meantime, colleges should integrate employable ability enterprises need into this system so that when studying theory and knowledge, college students understand what employable ability they need. By

doing so, colleges are able to guide students in establishing scientific career planning. Career demand should be regarded as the “mirror” to form self-awareness; social demand be regarded as the ruler to locate specific vocations; vocational experience be viewed as the basis for role adaptation; vocational activities be used as the platform for gaining experience. Second, colleges should upgrade courses design so that students effectively combine knowledge with skills. All phases of talents training should be appropriately designed. When carrying out academic education, colleges should integrate innovative start-up education, and imbed training of employable ability into various educational stage and methodology, including academic theory, class experiment, internship and others so that students can apply knowledge into practice and further improve their ability in innovation and start-ups through constant study in all these stages above. Also, graduate internship and academic paper should be improved as well. Graduate internship should integrate into vocations, combining the source of graduate papers with local economic growth and social development. By doing so, college students could acquire professional knowledge as much as possible and improve their employable ability. In addition, the voluntary unemployment can be solved as well.

## 5 Conclusion

Under the circumstance of serious employment condition, the training of employable abilities for college graduates should be based on the four-dimension employment guiding system with students at its core, government as the guider, colleges as the leader and enterprises as the guarantee. In accordance with employable ability of college graduates and the needs of enterprises, different parties in this regard should do their best to enhance the training of college graduates' disadvantaged aspects.

To sum up, first of all, college students should develop reasonable career value and design feasible career planning. Second, colleges should reform education methodologies in accordance to the training of employable ability and opinions from enterprises. In the meantime, enterprises are advised to upgrade cooperative interaction mechanism between colleges and enterprises, and enterprises should focus on the growth of their employees and organizations. Last, but not the least, government, as the coordinator of the overall social development, should play a leading role in this regard. An active labor market policy mainly improving employable ability of labor force should be formulated so as to increase the flexibility of policies. In cooperation with colleges, enterprises and college students in the labor force market, government should contribute to the successful compatibility of supply and demand in employable ability. It should also motivate college students to improve their employable ability so that the employment rate of college students will increase finally.

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## Research on the Influence of Salesperson's Characteristics on Customer Trust\*

Sun Wei<sup>1, 2</sup>, Pan Jieyun<sup>1</sup>, Zhang Jiajia<sup>1</sup>

1 School of Management, Wuhan University of Science and Technology, Wuhan, P.R.China, 430065

2 Hubei Industrial Policy and Management Research Center, Wuhan, P.R.China, 430065

(E-mail: sunwei@wust.edu.cn, 345461479@qq.com, 5403400@qq.com)

**Abstract:** Customer trust has a critical impact on its buying decisions. This paper examines the impact mechanism of Salesperson's Characteristics on customer trust through empirical studies. Empirical studies have shown that salesperson's affinity, response ability, sales ability, learning ability and communication ability have a positive impact on customer trust, but performance ability has a negative impact on customer trust. The research results provide valuable theoretical basis and suggestions for enterprises to enhance customer trust through effective salesperson management.

**Key words:** Salesperson's characteristics; Customer trust; Influence mechanism; Empirical studies

### 1 Introduction

Salesperson plays an important role between the company and the customer. Salesperson's personal performance not only affects the business-customer interaction, but also directly affects the company's sales performance. Winning customer trust is one of the keys to successful sales of salesperson. In recent years, salesperson trust issues have been increasingly valued by the business community and the academic community, but most of the research is based on the salesperson trust problem under the B2B marketing scenario, and there is little research on the trust between consumers and salesperson (Du Jiangang et al, 2006; Bateman, 2015), the theoretical community is still not deeply researching the factors affecting the trust of sales personnel (Zhang Shengliang, Liu Gang, 2013; Friend et al., 2018). This paper empirically tests the relationship between salesperson's characteristics and customer trust, enriches the theoretical research of customer relationship management, and provides valuable theoretical basis and suggestions for enterprises to enhance customer trust

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through effective salesperson management.

## **2 Theoretical Basis and Research Hypothesis**

### **2.1 Salesperson's characteristics**

Salesperson's characteristic refers to all the characteristics and attributes of the salesperson perceived by the customer. Scholars have studied the specific dimensions of salesperson's Characteristics. Brush and Wilson (Brush and Wilson, 1976) divided salesperson's characteristics into five dimensions: knowledge absorption, experience similarity, professional level, performance ability, and interpersonal communication. Weitz et al. (Weitz et al., 1986) divided it into three dimensions: internal reward-oriented and knowledge ability, and information acquisition ability. Swan et al. (Swan et al., 1988) divided it into five dimensions: honesty, reliability, responsibility, ability, and affinity. Erika (Erika, 1999) divides it into 10 dimensions: self-will, urgency, self-motivation, determination, and willingness to take risks, social ability, conceptualization ability, sound suspicion, creativity, empathy and so on. This paper divides the salesperson's Characteristics into three dimensions: personal characteristics, behavioral characteristics, and professional characteristics.

### **2.2 Customer trust**

Customer trust refers to the positive expectation that the customer can trust the transaction partner in the case of possible risks, and is the perception of the reliability of the transaction partner's integrity. In the fields of psychology and sociology, many scholars agree to divide trust into two dimensions of cognitive trust and emotional trust (Johnson, Grayson, 2005, Kanawattanachai, Yoo, 2002; Tyler et al., 1996). This paper agrees with this point of view. Cognitive trust is a customer's belief in the credibility and reliability of salesperson, based on certain reasons to believe the other person's ability, integrity, honesty, fairness and reliability. Emotional trust is the mutual relationship and care of customers based on each other, reflecting the specific emotional basis and emotional connections between the customer and the salesperson.

### **2.3 The impact of the personal characteristics of salesperson on customer trust**

Salesperson's characteristics can be divided into two dimensions: affinity and response ability. In the process of social cognition, the previous information will have an effect on the following cognition process. Goodwin and Smith (Goodwin and Smith, 1990) believe that customers have a strong preference for kindness and courtesy, which can shorten the social distance between customers and service providers, and develop friendly relationship. Individuals felt connected with each other due to the salesperson's friend behavior. The friendlier the salesperson is, the better the customer will feel good about the salesperson. This paper proposes the following assumptions:

H<sub>1</sub>: Salesperson's affinity has a positive impact on customer trust.

H<sub>1a</sub>: Salesperson's affinity has a positive impact on customer's cognitive trust.

H<sub>1b</sub>: Salesperson's affinity has a positive impact on customer's emotional trust.

Response ability refers to a collection of reaction states and coping capacities. Su Qin et al. (Su Qin et al., 2007) showed that the rapidity and response ability of salesperson could affect the quality of customer relationships. Response ability will make customers feel valued and strengthen the relationship between the company and the customer. In the sales process, if the salesperson can timely respond to the customer and quickly deal with the customer's needs, it should increase the customer trust. When the customer thinks that the object of trust really cares about the interests of the customer, it will generate emotional dependence and input. This paper proposes the following assumptions:

H<sub>2</sub>: Salesperson's response ability has a positive impact on customer trust.

H<sub>2a</sub>: Salesperson's reaction ability has a positive impact on customer's cognitive trust.

H<sub>2b</sub>: Salesperson's reaction ability has a positive impact on customer's emotional trust.

#### **2.4 The impact of salesperson's behavioral characteristics on customer trust**

The behavioral characteristics are composed of the actions exhibited and the states exhibited by the individual, including the two dimensions of communication ability and performance ability. Communication ability refers to the ability of salesperson to effectively communicate information with customers. Suprenant and Soloman (Suprenant and Soloman, 1987) showed that communication has a positive impact on the evaluation of employees and services. Morgan and Hunt (Morgan and Hunt, 1994) showed that smooth communication is an important factor in achieving close relationships. This paper proposes the following assumptions:

H<sub>3</sub>: Salesperson's communication ability has a positive impact on customer trust.

H<sub>3a</sub>: Salesperson's communication ability has a positive impact on customer's cognitive trust.

H<sub>3b</sub>: Salesperson's communication ability has a positive impact on customer's emotional trust.

The salesperson's performance ability is reflected an externally active expression in the whole process of contact between the salesperson and the customer. Cooper et al. (Cooper et al., 2003) show that salesperson's external behavior plays an important role in influencing customer relationships. This paper proposes the following assumptions:

H<sub>4</sub>: Salesperson's performance ability has a positive impact on customer trust.

H<sub>4a</sub>: Salesperson's performance ability has a positive impact on customer's cognitive trust.

H<sub>4b</sub>: Salesperson's performance ability has a positive impact on customer's emotional trust.

## **2.5 The impact of the professional characteristics of salesperson on customer trust**

Professional characteristics are a combination of specific specialized knowledge and abilities expressed in a particular position, including both sales skill and learning abilities. Sales skill refers to the degree of ability and knowledge that a customer has perceived salesperson possesses when providing basic services or products. Salesperson's professional skill is positively affecting the trust between buyers and sellers (Crosby et al., 1990; Doney, Cannon, 1997). Crosby et al. (Crosby et al., 1990) showed that salesperson's professionalism directly affects the sales effect, and affects the long-term sales effect through customer relationships. The more professional the salesperson is, the easier it is to adopt effective sales techniques, provide effective information to customers, and gain customer recognition. This paper proposes the following assumptions:

H<sub>5</sub>: Salesperson's sales ability has a positive impact on customer trust.

H<sub>5a</sub>: Salesperson's sales ability has a positive impact on customer's perception trust.

H<sub>5b</sub>: Salesperson's sales ability has a positive impact on customer's emotional trust.

Learning ability is the comprehensive ability of observation, memory, abstract generalization, attention, and understanding. Doney and Cannon (Doney and Cannon, 1997) have shown that the salesperson with efficient learning capabilities are more likely to change customer attitudes and opinions. The stronger the salesperson's learning ability, the more he can understand customer needs in shorter time, and use existing knowledge to meet customer needs, and the easier it is to build trust with customers. This paper proposes the following assumptions:

H<sub>6</sub>: Salesperson's learning ability has a positive impact on customer trust.

H<sub>6a</sub>: Salesperson's learning ability has a positive impact on customer's cognitive trust.

H<sub>6b</sub>: Salesperson's learning ability has a positive impact on customer's emotional trust.

## **3 Research Design**

### **3.1 Data collection**

This paper selects some customers of a beauty salon in Shenzhen and a large enterprise employee in Shenzhen as the survey object. Beauty salon customers often have relatively long-term contact with beauty salesmen during facial or weight loss treatments, and they have a clear perception of salesperson's characteristics. Large enterprise employees have relatively stable work and purchasing power. A total of 200 questionnaires were distributed in this survey, and 180 valid questionnaires were collected. The effective recovery rate was

90%. To ensure the validity of the survey results, respondents are asked to respond to the salesperson who has the deepest impression and the longest contact time. The questionnaire included six dimensions of salesperson's characteristics, cognitive trust, emotional trust, and personal background information (gender, age, education level, and monthly income, etc.).

### 3.2 Sample characteristics

The results of the demographic information in 180 valid questionnaires are shown in Table 1. Women accounted for 43.3% of the respondents and men accounted for 56.7%. The age of 20-29 years old accounted for 66.7%, and the age of 29-39 years old accounted for 24.4%. The proportion of university education was 78.3%, and the degree of graduate education was 12.2%. Respondents with a sales relationship of less than three months accounted for 54.4%, and respondents accounted for 90% within one year. The respondents with monthly income of 4,000-11,999 yuan accounted for 70.6%.

**Table 1 Sample Characteristics**

Item	Demographic characteristics	Sample size	Percent (%)	Item	Demographic characteristics	Sample size	Percent (%)
Gender	male	102	56.7	Relationship duration	Less than 3 months	98	54.4
	female	78	43.3		3 months to 6 months	46	25.6
Age	20-29 years old	120	66.7		6 months to 1 year	18	10
	30-39 years old	44	24.4		More than 1 year	18	10
	40-49 years old	8	4.4	monthly income	3,999 yuan and below	44	24.4
Education Level	50 years old and above	8	4.4		4,000 - 7,999 yuan	64	35.6
	High school	17	9.4		8,000 - 11,999 yuan	63	35
	University	141	78.3	More than 12,000 yuan	9	5	
	Graduate	22	12.2				

### 3.3 Measures

All the scales used in this study were adapted from previously published research. Affinity was measured with three-items from Swan et al. (Swan et al., 1988). Response ability was measured with three-items from Lee and Dubimky (Lee and Dubimky, 2003). Communication ability was measured with three-items from Hawes and Baker (Hawes and Baker, 1993). Performance ability was measured with three-items from Coulter and Coulter (Coulter and Coulter, 2002). Sales ability was measured with three-items from Pilling and

Eroglu (Pilling and Eroglu, 1994). Learning ability was measured with three-items from Doney and Cannon (Doney and Cannon, 1997). Cognitive trust was measured with four-items from Jollson et al. (Jollson et al., 1982). Emotional trust was measured with four-items from Jollson et al. (Jollson et al., 1982).

## 4 Data Analysis and Results

### 4.1 Reliability analysis

This paper used internal consistency to measure the reliability of the scale. The reliability analysis of the collected questionnaires using SPSS 17.0 showed that the Cronbach's  $\alpha$  value of the initial variables and factors ranged from .511 to .798, indicating that the scale had good internal consistency.

### 4.2 Validity analysis

In this paper, exploratory factor analysis was performed using SPSS 17.0 to test the validity of the questionnaire. The results show that the KMO value of each factor of the scale is between 0.611 and 0.768, both of which are greater than 0.6, indicating that the scale has a high construct validity. The value of Bartlett's test is  $p < .001$  indicated that the data has the conditions for factor analysis. As shown in table 2, the results of factor analysis showed that the normalized load factors of the observed variables were all above .7, and all passed the t-value test, which was significant at the level of  $p < .001$ , indicating that each variable has sufficient convergence validity.

**Table 2 Factor Analysis**

items	Factor load	Interpretation variation (%)	items	Factor load	Interpretation variation (%)
Affinity(A)			Sales ability(SA)		
A1	.786		SA1	.771	
A2	.806	64.465	SA2	.806	58.890
A3	.817		SA3	.723	
Response ability(RA)			Learning ability(LA)		
RA1	.847		LA1	.811	
RA2	.740	65.177	LA2	.762	56.176
RA3	.831		LA3	.669	
Communication ability(CA)			Cognitive trust(CT)		
CA1	.773		CT1	.812	

CA2	.882	65.521	CT2	.772	
CA3	.768		CT3	.706	54.509
			CT4	.653	
Performance ability(PA)			Emotional trust(ET)		
PA1	.761		ET1	.835	
PA2	.543	51.171	ET2	.710	
PA3	.813		ET3	.842	62.893
			ET4	.778	

### 4.3 Hypothesis verification

In order to test hypothesis 1, hypothesis 2, and hypothesis 3 is established or not, this paper carries out regression analysis, as shown in Table 3 and Table 4.

It can be seen from the regression coefficients of Tables 3 and Table 4 that the p-values are all less than .05, and the regression coefficients of performance ability and customer cognitive trust and emotional trust are negative. Except that H<sub>4a</sub> and H<sub>4b</sub> are not supported, all other hypotheses are established. That is, there is a positive correlation between the other five dimensions of the salesperson's characteristics and the customer's cognitive trust.

**Table 3 Regression Analysis of Salesperson's Characteristics on Customer Cognitive Trust**

	Non-standardized coefficient		standard coefficient	t value	sig.
Affinity	.608	.050	.646	2.213	.000
Response ability	.215	.047	.243	4.586	.000
Communication ability	.345	.056	.387	6.117	.000
Performance ability	-.036	.066	-.419	6.630	.003
Sales ability	.385	.075	.367	5.123	.000
Learning ability	.284	.070	.291	4.065	.000

**Table 4 Regression Analysis of Salesperson's Characteristics on Customer Emotional Trust**

	Non-standardized coefficient		standard coefficient	t value	sig.
Affinity	.699	.000	.127	2.755	.007
Response ability	.061	.056	.204	2.963	.003



Communication ability	.223	.063	.235	2.553	.000
Performance ability	-.070	.073	-.516	1.732	.003
Sales ability	.426	.084	.383	5.039	.000
Learning ability	.180	.079	.174	2.291	.023

## 5 Research Conclusions and Management Implications

### 5.1 Research conclusions

Empirical studies show that salesperson's affinity, response ability, sales ability, learning ability and communication ability have a positive impact on customer trust, and the performance ability of salesperson has a negative impact on customer trust.

(1) Salesperson's affinity as a special personal characteristic, build a bridge of trust between salesperson and customers.

(2) Salesperson's response ability is related to whether the customer's demand can be met in time, and affects the customer's shopping experience and the establishment of the trust relationship between the customer and the salesperson.

(3) Excellent salesmen with customers with good sales ability can influence customers, and establish trust relationship.

(4) The professional knowledge provided by salesmen with strong learning ability can effectively reduce the perceived risk of customer purchase decision and enhance customer trust.

(5) Effective communication between salesmen and customers enable the salesmen to timely understand the special needs of the customer, and can bring a good interactive communication experience to the customer and enhance the customer's trust level.

(6) The performance ability of salesperson may hinder the establishment of customer trust, which is contrary to the assumptions. The possible reason is: in the sales process, the customer really cares about whether their demand can be satisfied. The salesperson's initiative is too strong, which may put psychological pressure on the customer, increase their psychological resistance, and reduce the customer's trust.

### 5.2 Management implications

Through effective salesperson management, enterprises can shape salesperson's characteristics, improve customer trust, and establish a good interaction between customers and salesperson. (1) Enterprises should strengthen sales knowledge training in sales etiquette, sales methods and techniques, sales communication, customer service ability, etc., enhance

salesperson's affinity (service ability), sales ability, communication ability and response ability, and encourage salesperson. Continuously accumulate and exchange experience and enhance the professional quality of sales. (2) Salesperson should constantly update existing knowledge, pay attention to the daily learning and accumulation of sales knowledge, product knowledge and customer service knowledge, continuously sum up experience in the process of sales visit, provide accurate and valuable information to customers, and provide services to customers in good faith. Meet their needs and increase customer trust. (3) In the salesperson's recruitment process, companies need to correctly consider the importance of the sales staff's performance capabilities. Enterprises need to use sales training to help salesperson correctly understand the latest marketing concepts and sales concepts, and avoid the strong sales behavior of salesperson in order to excessively pursue performance, but reduce customer trust.

## 6 Conclusion

This paper examines the impact mechanism of salesperson's characteristics on customer trust through empirical research. The results of this study provide valuable theoretical foundations and recommendations for companies to improve customer trust through effective sales force management. Of course, this article still has the following shortcomings: (1) the survey respondents focused on a beauty salon in Shenzhen. Although the conclusions of this study are representative, it may be difficult to apply to all industries. Subsequent research will focus on expanding the sample size and make the sample more distributed in the industry. (2) This paper only discusses the impact of Salesperson's Characteristics on customer trust, but there are many factors that affect customer trust. This paper does not consider the impact of customer characteristics on customer trust. Subsequent research can consider incorporating customer personal characteristics into the research model to explore its role in regulating hypothesis.

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## Research Prospect of Children's Education Network Platform from the Perspective of Organizational Behavior

Chang Yuming

School of Management, Wuhan University of Technology, Wuhan, P.R.China, 430070

(E-mail: 1120105867@qq.com)

**Abstract:** Organizational behavior is mainly to study the impact of individuals, groups, and structures on behavior within the organization, with the aim of improving the effectiveness of the organization. This paper takes "family" as the organizational unit and adopts the behavior research method to analyze the behavioral rules and interactions between children and parents. It is believed that children's educational theory knowledge can be well integrated into mobile products. This paper proposes the idea of building a children's education network platform. Let children learn in a free environment, improve children's enthusiasm, enhance children's self-confidence, stimulate children's potential, and at the same time promote parent-child relationship, make families more harmonious, and make the relationship closer.

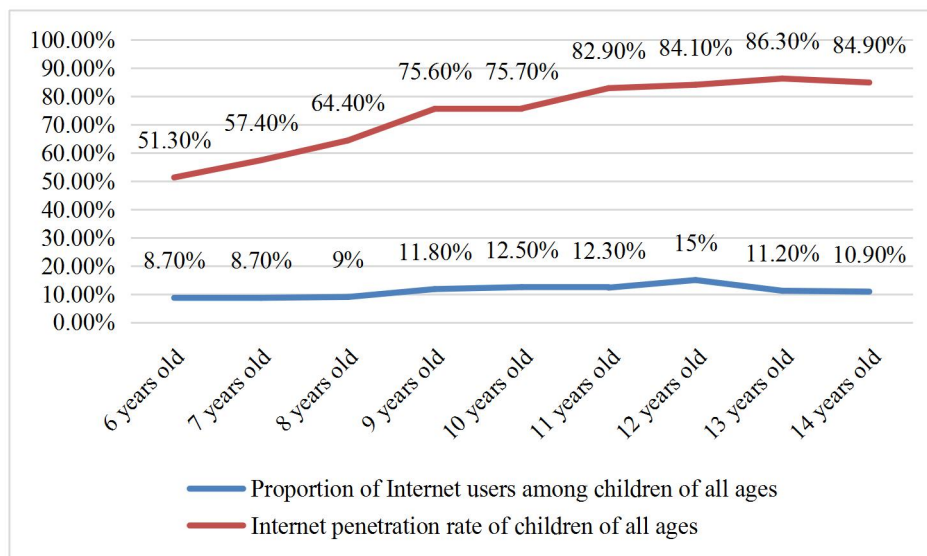
**Key words:** Organizational behavior; Children's education; Network platform; Parent-child relationship; Research prospect

### 1 Introduction

#### 1.1 Background of the external aspect of the organization

With the rapid development of the mobile internet, mobile application of children's education has become a new industry with great potential. By using fragmented time, children can learn scientific and cultural knowledge and common sense of life. (Zhao Wenyu, 2018) Overseas, universities, educational institutions and enterprises in developed countries, such as Europe, America, Japan, and Korea, have put the research on mobile application of children's education in key projects. (Xu Xin, Yin Jun, 2014)

In recent years, the number of netizens in China has increased dramatically, and the development of young netizens is on the increasing trend. The current situation of the development of children netizens cannot be ignored. (Dai Jiang, 2011) The Report on Internet Use and Reading Practice of Chinese Minors, published by the Institute of Journalism and Communication, Chinese Academy of Social Sciences, showed that the proportion of Chinese minors who had access to the Internet before the age of 10 is as high as 73.1%. 64.2% of primary school students had their own mobile phones, who were more active in network communication. 62.0% of teenagers used social networking sites, 74.8% of



teenagers liked online games, and 86.7% of pupils used online games.

(Data sources: 29th China Internet Development Statistics Report, China Internet Development Statistics Report, Erie Consulting Child Internet User Survey)

**Figure 1 Age Distribution and Internet Permeability of Chinese Children's Housing Netizens in 2011**

With the gradual coverage of home computers, teenagers have gradually diversified online sites. (Sun Jue, 2016) In today's era, the huge base of computer users determines that the mobile application industry of children's education has great potential for development, and the development of intelligence will change the way of education. (Liu Lu, 2016)

**1.2 Internal impact of the organization**

Primary school students are keen on chatting, playing games and doing homework on the network platform. Some parents joked that their children preferred mobile phones to parents. The jokes belong to jokes, but the problem behind it cannot be ignored. (Wang Xinzhuo, 2017) Children are addicted to the media and cannot extricate themselves, neglecting communication and interaction with their parents in reality, thus forming a spiritual barrier between the two generations. (Yin Guoqiang, 2019)

The traditional family education for children uses toys and books, which content is dull, the amount of information is small, and cannot arouse children's enthusiasm for learning. At present, although the number of mobile applications for children's education on major platforms in China is huge, the phenomenon of homogeneity is serious, the mode is monotonous, the innovation is insufficient, and the learning effect and quality performance are relatively weak. For children, playing is their natural instinct, and "learning by playing" is the ideal learning state. At the same time, parents also hope that children can learn knowledge while experiencing fun. (Wang Xiuli, 2016)

Based on the internal and external factors, this paper focuses on the development prospects of children's education network platform and analyses its benefits to complementary education and the parent-child relationship.

**2 The Impact of the Internet on Children's Education**

**2.1 The characteristics of children's mental development**

For children, the enlightenment education is very important, related to the formation of children's interests and personality, and the development of their studies. There is an old saying in China that "three-year-old look big, seven-year-old look old". The age of 3-12 is a person's preliminary understanding of world values but also a critical period for the development of mental and sensory abilities. With a solid foundation, children can achieve twice the result with half the effort in their future studies. (Sun Zilin, Li Shiguo, 2015)

**Table 1 Erickson's Children's Mental Growth Theory**

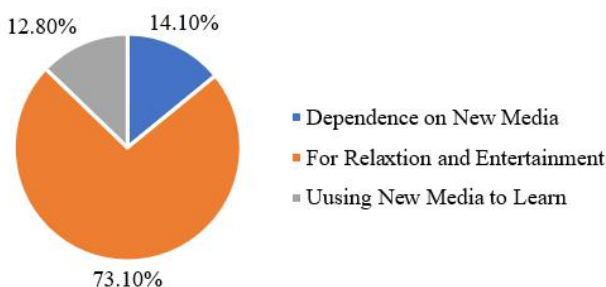
Approximate Age	Major Development Tasks	Positive and Important Influencing Factors
0-1 years old	Develop a full sense of trust in the world to explore	Mother, Warm and loving communication.

1-3 years old	Develop a sense of control over behavior, recognizing the ability to put goals and intentions into action	parental support, and imitation
3-6 years old	Developing the meaning of "self" through parents' identifying behavior and their sense of responsibility for their own behavior	believing that they are identical with others
6-Adolescence	Developing self-worth through communication with peers	schools, teachers; learning and education; encouragement
Adolescence	Developing a strong sense of identity-self; choosing among various potential selves	peer and role-building; social stress
Early adulthood	developing close relationships with others; gaining intimacy that requires a long-term commitment	spouses, colleagues, partners, Society
Mid-adulthood	An adult role that assumes responsibility in the community; contributes; is socially valuable	spouse, child, friend, colleague, community
Late adulthood: facing death	overcoming potential despair; understanding the meaning of life	support from friends, relatives, children, spouses, communities, and religions

In the process of children's growth and development, each stage has its own characteristics. According to Erickson's theory of children's mental growth, we can see that parental care has a great impact on children's growth. In the era of mobile Internet, the Internet isolates communication between parents and children, which will affect children's mental growth and development at this stage. How to use the "double-edged sword" of new media is particularly important in today's society. (Liu Xiaodan, 2016)

## 2.2 Current situation of adolescent students' use of the Internet

According to the survey on the dependence of adolescent students on new media, 14.1% of students have a psychological dependence on new media. More students (73.1%) use new media forms



such as the Internet to relax and entertain. Only 12.8% of students study through the Internet.

**Figure 2 Data on the Dependence of Adolescent Students on New Media**

It can be seen that although the phenomenon of Internet addiction dependence is not serious among adolescent students, online activities mainly focus on online entertainment such as chatting rather than learning. Children's education network platform is a cultural platform that integrates study, entertainment, and social interaction. In addition to the embedding of authoritative theory and quality of children's education content, it should also add many interactive elements and some puzzle game elements, which help to improve children's observation, memory and logical thinking, so as to construct a scientific and professional children's education product for children, making them happy to play, happy to learn.

### 2.3 The influence of the internet on children's communication

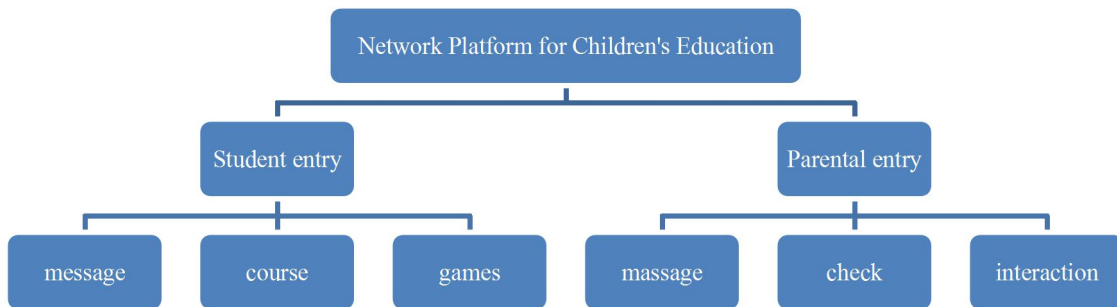
Children's values and behavior choices are based on the media, neglecting the traditional role of parents' words and deeds, and forming a spiritual gap between the two generations.

Although cities provide a variety of public leisure places, people are facing the double threats of television media, Internet resources and increasingly closed and independent buildings in their lives. Communities are always silent and quiet. Many communities can protect residents but cannot integrate them into the community. The lack of communication between children and their neighbors makes them timid and nervous in public

## 3 Content Prospect of Children's Education Network Platform Based on Organizational Behavior

### 3.1 The Enlightenment of organizational behavior to the construction of children's education network platform

Family is the organizational unit for children aged 6-13 and their parents. The preliminary structure



and content of the website are as follows.

**Figure 3 Preliminary Framework and Content of Website**

#### 3.1.1 Message

Parents can not only see whom their children are in contact with but also delete or add their children's contact list to control whom they can communicate with.

Turn off the child's communication function when the child needs to do his homework or go to bed.

Parents can recommend friends to the child, such as teachers, family members, and friends, with the child's consent.

### 3.1.2 Course

**Table 2 Course Content**

Language expression	Cognitive understanding	Learning ability	Mental control ability
A. Language imitation ability (pronunciation, word order, etc.)		A. 6-9 years old: operation and concentration ability.	Adaptability, self-control,
B. Language comprehension (objects, persons, instructions)	life cognition, social cognition, social basis, self-cognition,	B. 10-13 years old: memory ability, logic ability, thinking ability, learning method.	leadership, emotional control,
C. Language expression (see pictures, speak in an active language, ask and answer)	Self-management.		resistance to setbacks.

### 3.1.3 Game

Only when learning has reached a certain time or the homework has been completed well, can they start the game.

Game mode, K song mode, Self-presentation platform (short video).

## 3.2 Research issues

### 3.2.1 Parents' worries in the Internet Age

The virtual nature of the Internet world has realized the substitution and migration of real life, but adults' worries about children are increasing day by day. The previous generation was uneasy about the technology that children possessed, thus affecting the generation gap and the cold war between parents and children.

### 3.2.2 Intergenerational education

With the development of the times, some parents are busy working, divorcing or working in other places, neglecting the spiritual education of children, resulting in little communication between parents and children.

### 3.2.3 Loss of emotions

Children born in the one-child era will face the breakdown of traditional family relationships when they are born.

### 3.2.4 The influence of the Internet on children's growth

The Internet attracts children but also becomes the concern and anxiety of society.



### 3.2.5 The study of children's play psychology

Game spirit is the nature of children. The reality and the virtual world of games in the digital age influence children's various choices.

### 3.2.6 Social Relationship Research

The impact of modern online social tools on children's interpersonal relationships and countermeasures.

## **3.3 Problems to be solved**

### 3.3.1 Virtual and Reality

Children's behavior on the Internet is participated by their parents, and feedback to real-life enhances emotional communication.

### 3.3.2 Entertainment and education

Entertainment and education are both entertaining and educational in nature so that children can experience the joy of learning in a happy game. Parents can not only satisfy their children's curiosity but also guide their children in a safe and green atmosphere, and cultivate their scientific spirit and rational attitude to deal with problems.

### 3.3.3 Family emotional education and school knowledge education are useful supplements

The starting point of life to cultivate self-confidence in communication and life.

### 3.3.4 Children's self-organization in the new media network social environment

The network has changed the way of communication, children need to learn to play creative ability, and realize virtual and realistic community self-organization.

### 3.3.5 Parent control system

Parents can set up procedures and time to allow their children to use according to specific circumstances. Parents can manage their children's learning and playing time more easily so that they can learn happily without indulging in it.

### 3.3.6 User experience research on children's social networks

Many existing children's websites have a wide range of content, the target audience is not clear, and there are many problems with usability.

## **4 Conclusion**

It is both entertaining and educational, allowing children to experience the fun of learning in a cheerful game. Parents can satisfy their children's curiosity, guide children in a safe and green atmosphere, and cultivate children's scientific spirit and the attitude of dealing with the problem. The real user of children's educational products is children. Only by starting from the actual application needs of children, continuous research and exploration can be made to design products that are suitable for children.

New media is a "flood" but not a "beast". We should choose the method of dredging rather than blocking. Just like Dayu's water control, we should correctly guide young people to use new media.

According to children's personality characteristics and growth needs, combined with children's acceptance ability, on-line for children to build an advanced concept, rich content, vivid form of learning game world (children's education network platform). When children wander around the world and forget to return, over time, parents will find that children not only broaden their horizons, increase their knowledge and develop their intelligence but also become more interested and meet their growing needs. It can be anticipated that the future child education network platform will have broad development prospects.

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# Research on the Influence of College Students' Entrepreneurial Team Heterogeneity on Innovation Performance: Taking Team Cohesion as Moderator Variable

Zhou Yu, Hu Yan

School of Management, Wuhan University of Technology, Wuhan, P.R. China, 430070

(E-mail: 1264379036@qq.com, 898913420@qq.com)

**Abstract:** At present, college students' entrepreneurship is strongly supported by the government, which has become an important force to ease employment pressure and increase social innovation efficiency. Team heterogeneity, as an important factor of entrepreneurial team, has always been the focus of entrepreneurship research. This paper focuses on the particularity of college students' entrepreneurial team, screens the measurement indicators of team heterogeneity and innovation performance, and takes team cohesion as a moderator variable to explore the relationship between them. Empirical research found that: professional heterogeneity positively affects team innovation performance and value heterogeneity negatively affects team innovation performance, while team cohesion positively regulates the relationship between professional heterogeneity, value heterogeneity and team innovation performance. The research conclusion provides reference suggestions for college students to form an entrepreneurial team and improve innovation performance, and has certain theoretical and practical value.

**Key words:** Entrepreneurial team; Heterogeneity; Team cohesion; Innovation performance

## 1 Introduction

The call of the "mass innovation, mass entrepreneurship" policy has set off a new wave of entrepreneurship. As an important special group in the wave of entrepreneurship, college students' entrepreneurial team has played an important role in easing employment pressure and increasing social innovation benefits. In 2007, the Ministry of Education launched the "National Innovation and Entrepreneurship Training Program for College Students", which is funded by the state to encourage college students to engage in scientific research and entrepreneurial activities. Subsequently, colleges and universities have also successively established College Student Entrepreneurship Incubation Base and College Student Entrepreneurship Service Center. At the same time, various entrepreneurship competitions also provide opportunities for college students to practice entrepreneurship theory, and the entrepreneurship activities of college students are gradually valued by all sectors of the society.

Team heterogeneity is an important factor affecting team innovation performance. The relationship between heterogeneity of college students' entrepreneurial team and entrepreneurial performance has always been the focus of academic debate. There are two opposing views in the theoretical circle. Some studies show that team heterogeneity is closely related to team innovation decision-making optimization and organizational performance. In order to better deal with the complexity of entrepreneurial enterprises, skill diversification teams have more advantages than skill homogenization teams. Therefore, the study of the characteristics of entrepreneurial team should focus more on the heterogeneity of entrepreneurial team rather than homogeneity (Kamm, Shuman and Seeger, 1990). On the other hand, studies by some scholars show that the diversity of teams and organizations may increase conflicts within teams, lead to tension among members, and reduce the level of team

cooperation. At the same time, different types of heterogeneity may affect the team development process in different ways (Robert, Erich and Jonas, 2011). In the research of many scholars, the research results have no unified conclusion, both positive results and negative results. At the same time, member heterogeneity does not necessarily affect team performance directly, so people investigate and introduce moderating and mediating variables for further research.

In recent years, although the research on heterogeneity of the entrepreneurial team has gradually attracted the attention of academic circles, it is mainly focused on the senior management team, and the research on the entrepreneurial team of college students is relatively small. In view of the shortcomings of the current research, this paper introduces team cohesion as a moderator variable based on the reading, research and specific analysis of relevant literature at home and abroad, and explores the internal mechanism of team heterogeneity, team cohesion and team innovation performance in order to promote team innovation performance.

## **2 Framework Research Assumption and Theoretical Framework**

### **2.1 Heterogeneity and innovation performance of college students' entrepreneurial team**

Team heterogeneity has many dimensions. This paper focuses on the study of heterogeneity in grade, specialty and values.

The age span of college students' entrepreneurial team members is not large, which is concentrated between 19 and 28 years old. The age difference is reflected in grade. Faced with complex entrepreneurship activities, senior and junior members can form complementary functions, learn from each other, constantly improve, cooperate and communicate with each other, and share more efficient and valuable information. Based on this, this study proposes Hypothesis 1:

H1: The heterogeneity of the college students' entrepreneurial team grade has a positive impact on team performance.

Differences in professional background will bring about differences in cognitive level (Huang Yufang and Qin Mingqing, 2010). In the process of team development, they show rich experience and ability to deal with problems. They can respond differently when facing difficulties and crisis, and provide diversified solutions for the team to effectively deal with risks and crises. It is conducive to the innovative development of the team, the improvement of the team's ability to analyze and deal with problems, and the improvement of the team's performance. Also, the professional differences in the educational background of the entrepreneurial team heterogeneity can make members produce creative ideas in the process of cooperation (Sun Kai and Zhao Yang, 2015). Based on this, this study proposes Hypothesis 2:

H2: Heterogeneity of entrepreneurial team majors of college students has a positive impact on team performance.

Values heterogeneity mainly refers to the differences formed by the different beliefs, values, preferences and interests of members. The influences brought by such differences are various. Teams with large values heterogeneity may have different understanding of task objectives due to cognitive information processing, which hinders the team from achieving correct decision-making objectives. According to the research of scholars, heterogeneity of values may cause tension in team relations, resulting in misunderstanding bias and other adverse effects. When team members had highly consistent

values, their age and specialty contributed more to team effectiveness (Chatman, Polzer and Neale, 1998). Based on the above analysis, this study proposes Hypothesis 3:

H3: College students' entrepreneurial team values heterogeneity negatively affects team performance.

## 2.2 The regulating role of team coherence

Team cohesion is the emotional centripetal force and task aggregation force that brings team members together. A highly cohesive team has the following advantages in its development: high input, low tendency to absenteeism and high cooperation (Beal, Cohen and Burke, 2003). In a highly cohesive team, the atmosphere of innovation is more harmonious and more innovation performance can be produced. When used meta-analysis to test the relationship between team cohesion and team performance, it was confirmed that there was a stable positive relationship between them, and the relationship between them was stronger in the high collaborative and normative task environment (Evans and Dion, 1991). Enhancing team cohesion can effectively reduce internal conflicts and increase the frequency of message communication, thus further affecting team decision-making and promoting the development of team performance. Therefore, this study believes that team heterogeneity is a static description of the team structure, and the enhancement of team cohesion can help the team realize the potential benefits brought by heterogeneity and reduce the negative impact of heterogeneity. Based on the above analysis, this study puts forward the following assumptions:

H4: Team cohesion positively regulates the relationship between grade heterogeneity and innovation performance.

H5: Team cohesion positively regulates the relationship between professional heterogeneity and innovation performance.

H6: Team cohesion positively regulates the relationship between values heterogeneity and innovation performance.

Based on the above analysis, the theoretical framework of this study is proposed, as shown in Figure 1.

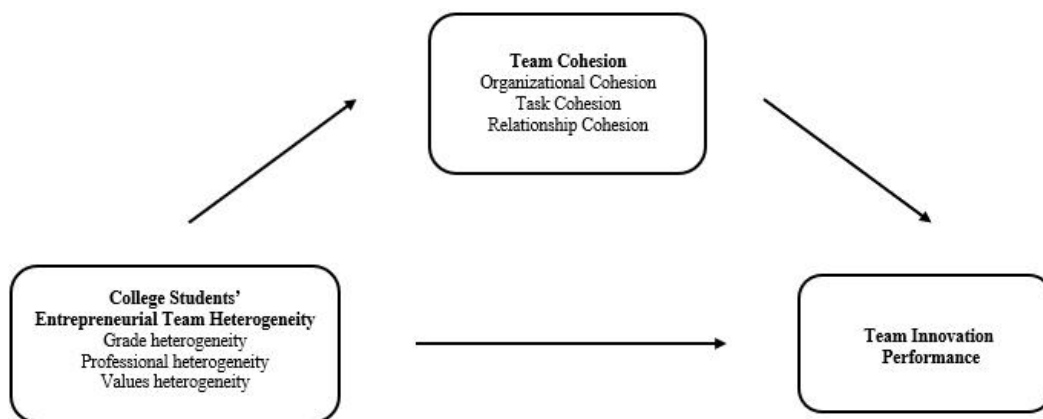


Figure 1 Theoretical Framework

### 3 Research Design

#### 3.1 Data source

This study collects relevant data by means of questionnaires. The object of study is college students' entrepreneurial team. The respondents were mainly from Wuhan University of Science and Technology Pioneer Park, as well as team members who participated in authoritative entrepreneurship competitions such as China Innovation and Entrepreneurship Competition. A total of 250 questionnaires were distributed in this survey, and 217 valid data were finally obtained after the questionnaires were recovered and the invalid questionnaires were filtered out. The recovery rate of valid questionnaires was 86.80%.

#### 3.2 Variable measurement

The scientific nature and rationality of the questionnaire are very important to the reliability of the research. The research adopts Likerts 5.0 Scale to score. The items in the questionnaire are declarative sentences. Each item has five choices, of which 1 represents "very disagree", 2 represents "disagree", 3 represents "neutral", 4 represents "agree" and 5 represents "very agree".

Regarding the design of the heterogeneity scale for college students' entrepreneurial teams, this paper finally determines the scales of grade heterogeneity, professional heterogeneity and values heterogeneity by referring to the existing research on team heterogeneity at home and abroad (Jehn, Northcraft and Neale, 2011). In the heterogeneity calculation of entrepreneurial team, the Herfindal-Hirschman coefficient proposed by Blau is used to measure the heterogeneity of transformed entrepreneurial team. The formula is: heterogeneity index  $D = 1 - \sum p_i^2$ , and  $p_i$  represents the proportion of members of the first category in the team.

The design of Team Cohesion Scale follows the team cohesion scale developed by Carless. The scale is widely accepted and used. It contains 12 items. Team cohesion is evaluated from three angles: organizational cohesion, task cohesion and relationship cohesion. Based on this design, this research has been slightly improved to make it more suitable for the research subjects of the university student entrepreneurial team.

The team innovation performance scale refers to many team performance measurement scales, including five items, such as "innovative ideas are often put forward in the process of team tasks"(Han Yi, Liao Jianqiao and Long Lirong, 2007), "team members can work efficiently"( Lovelace and Weingart, 2001), "team has the flexibility to deal with emergencies", etc.

### 4 Data Analysis and Hypothesis Testing

#### 4.1 Reliability and validity test

In this study, Cronbach's  $\alpha$  coefficient proposed by Cronbach was used to test the reliability of the questionnaire. After the initial scale data were collected, SPSS2.0 was used to test its reliability and validity. Through statistical analysis, we have obtained the following results: entrepreneurial team grade heterogeneity, professional heterogeneity, values heterogeneity, organizational cohesion. The Cronbach's  $\alpha$  coefficients of task cohesion, relationship cohesion and innovation performance are 0.767, 0.754, 0.869, 0.930, 0.922, 0.867 and 0.922 respectively, which are all greater than 0.7, with all variables  $KMO \geq 0.7$ . The significance probability of Bartlett Spherical Test is less than 0.001, which

indicates that the internal consistency of the factors tested is good, and the reliability and validity of the survey data are good.

#### 4.2 Descriptive statistics and correlation analysis of variables

The statistical results of the means and standard deviation of each variable and the correlation analysis results are shown in Table 1. In descriptive statistics, the means value of variables is between 2 and 4, and the standard deviation is greater than 0.5. The results of person correlation analysis show that college students' entrepreneurial team grade heterogeneity and professional heterogeneity are positively correlated with all dimensions of team cohesion, and their overall correlation coefficients are 0.407 ( $p < 0.01$ ) and 0.624 ( $p < 0.01$ ) respectively. Values heterogeneity is negatively correlated with team cohesion and its dimensions, with an overall correlation coefficient of -0.714 ( $p < 0.01$ ). In team heterogeneity, besides the negative correlation between value heterogeneity and innovation performance, grade heterogeneity and professional heterogeneity are positively correlated with team performance, with correlation coefficients of 0.437 ( $P < 0.01$ ) and 0.737 ( $P < 0.01$ ) respectively. All dimensions of team cohesion are positively correlated with innovation performance. The overall correlation coefficient was 0.871 ( $P < 0.01$ ). The results show that there is a good correlation between the variables, which is suitable for the next step of regression analysis to get the causal relationship between variables and the degree of influence.

**Table 1 Descriptive Statistics and Correlation Analysis**

	M	SD	1	2	3	4	4.a	4.b	4.c	5
1 Grade heterogeneity	3.264	.699	1							
2 Professional heterogeneity	3.612	.586	.616**	1						
3 Values heterogeneity	3.645	.648	.390**	.674**	1					
4 Team cohesion	3.729	.600	.407**	.624**	-.714**	1				
4.a organizational cohesion	3.884	.603	.361*	.616**	-.691**	.946**	1			
4.b task cohesion	3.628	.691	.314*	.537**	-.705**	.954**	.840**	1		
4.c relationship cohesion	3.674	.596	.500**	.641**	-.641**	.958**	.872**	.873**	1	
5 Innovation performance	3.721	.589	.437**	.737**	-.720**	.871**	.861**	.792**	.843**	1

\*\* . At the 0.01 level (two-tailed), the correlation is significant. \* . At the 0.05 level (two-tailed), the correlation is significant.

#### 4.3 Regression analysis

When testing the model, in order to avoid the influence of other factors in the analysis process, team size and gender are introduced as control variables. In this study, a multi-level regression method is used to analyze the data. Firstly, Model 1 is a regression model of control variables on team innovation performance. Secondly, Model 2 adds independent variables grade heterogeneity, professional heterogeneity and values heterogeneity to test its main effect. Thirdly, Model 3 introduces moderator variable to test its influence on dependent variables and the overall model. Finally, Model 4 is a full-effect regression model after all interaction items are added.

**Table 2 Regression Analysis Results**

	Independent variable: innovation performance			
	Model 1	Model 2	Model 3	Model 4
Team size	.062	.094	.014	.020
Gender	.005	.066	.035	.055
grade heterogeneity		.023	.052	.014
professional heterogeneity		.503*	.311*	.316*
values heterogeneity		-.401*	-.058*	-.520**
team cohesion			.521*	.537**
grade heterogeneity × team cohesion				.050
professional heterogeneity × team cohesion				.346**
values heterogeneity × team cohesion				.329*
R <sup>2</sup>	.004	.397	.427	.505
Adjusted R <sup>2</sup>	.046	.341	.397	.439

Listed are standardized regression coefficients. \* means  $p < 0.05$ , \*\* means  $p < 0.01$ .

As can be seen from Model 2 in Table 2, the regression coefficient of grade heterogeneity to team innovation performance is 0.023, which is not significant, assuming 1 is not valid. The regression coefficients of professional heterogeneity and values heterogeneity to team innovation performance are 0.503, -0.401, and both are significant at 0.05 level. The regression results prove that professional heterogeneity positively affects innovation performance and values heterogeneity negatively affects innovation performance. Assumptions 2 and 3 hold. In the interaction model of Model 4, team cohesion has no significant effect on the relationship between grade heterogeneity and team innovation performance, and Hypothesis 4 is not valid. Team cohesion positively regulates the relationship among professional heterogeneity, value heterogeneity and team innovation performance. The regression coefficients are 0.346 and 0.329 respectively. The regression coefficients are significant at 0.01 and 0.05 levels. Hypothesis 5 and 6 are valid.

## 5 Conclusion

This study analyzed the role of heterogeneity in innovation performance of college students' entrepreneurship team and the moderating role of team cohesion in it. The major conclusions are as follows: Firstly, professional heterogeneity presents a notable positive correlation with team innovation performance. The differences in team members' expertise can help provide multifaceted and



professional advice in the process of team development and improve the quality and efficiency of team processing issues. At the same time, professional heterogeneity can make team members have thinking collisions, which help team create more innovative ideas and improve innovation performance effectively. Secondly, values heterogeneity presents a significant negative correlation with team innovation performance. Excessive differences in values can lead to communication contradictions and team conflicts, hinder the cultivation of team cohesiveness, and are not conducive to creating a good atmosphere for cooperation and innovation, which can reduce the performance of the transform from innovation to technology. Thirdly, grade heterogeneity does not show a significant positive effect on innovation performance. This paper infers that the main reason is that the lower grade students account for a relatively small proportion of college students' entrepreneurial teams, and the grades of the team members are not much different. Although the grade heterogeneity is related to the team's innovation performance, the effect is not decisive. Fourthly, team cohesion positively regulates the impact of professional heterogeneity and values heterogeneity on innovation performance. Team cohesion can enhance the friendship between team members, strengthen the connection of social and emotional bonds and reduce unnecessary conflicts and contradictions. It also helps team members better understand the work objectives and promote cooperation and innovation of team members.

According to the research conclusion, college students should try their best to jump out of the circle of the same specialty when selecting members of the team, and consider more members from different specialties to form the team, paying attention to the complementarity of the team members in terms of knowledge and skills. A single specialty of the team is not conducive to improving innovation efficiency. At the same time, we should pay attention to the similarity and matching degree of team members' values, which can easily lead to team conflicts. Similar values can promote good team interaction, form a positive team atmosphere, and then promote team performance. Team cohesion needs to be strengthened within the team. Team members learn from each other, help each other, build deep friendship, solve the difficulties in team work together, and improve the efficiency of cooperation and innovation.

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# An Analysis on the Management Mode of Universities' Target Responsibility System

Ding Huifang

Personnel Office, Wuhan University of Technology, Wuhan, P.R. China, 430070

(Email: dinghuifang@whut.edu.cn)

**Abstract:** The target responsibility system is an effective management mode for the implementation of secondary management of universities. By means of literature research, survey analysis and interview, this paper analyzes the operation mechanism and achievements of target responsibility system in Wuhan University of Technology after consulting a large number of literatures and visiting many functional departments such as personnel department, party and government office and academic affairs office. On this basis, this paper deeply discusses the main problems existing in the implementation of target responsibility for colleges and universities, and puts forward effective ways to implement target responsibility system in colleges and universities.

**Keywords:** Goal management; Target responsibility system; Assessment; Result application

## 1 Introduction

The concept of target responsibility management stems from the goal management theory proposed in the book *Management Practices* published by American business management expert Drucker in 1954. Goal management refers to the modern management method, which aims at achieving goals by decomposing and executing goals, and makes management works closely surround and serve the goal center (Muhammad& Asad, 2016).

In recent years, the target responsibility system has been widely used in universities. The basic idea is to determine the overall goal according to the strategic direction and key work of the university's development, and then to decompose the overall goal and expand it to each secondary unit step by step to formulate the sub-goals at each level, thus establishing a target system that is developed from top to bottom and guaranteed from the bottom up. At the same time, the accomplishment of the goal is taken as the basis of the assessment of the secondary units, thus forming a management system with full participation, full management and full implementation.

Domestic and foreign scholars have carried out a lot of research on the target responsibility of colleges and universities. Liu Ye used the example method and STOW analysis method to put forward an effective way to implement the target management responsibility system in colleges and universities. Taylor used the assessment as a means to measure the achievements of college education activities, emphasizing that assessment is the best way to measure the educational activities to achieve the set goals. Qiu Yongmin took Shanghai Ocean University as an example to study how the management of target responsibility system in colleges and universities changed from rigid to rigid and soft.

This paper expounds the significance of the implementation of target responsibility system in universities, and introduces the organization and implementation of the target responsibility system with Wuhan University of Technology as an example. Finally, it analyzes the problems existing on the

current implementation of the target responsibility system in universities, and it gives the recommendations of the implementation of the target responsibility system in universities from three aspects, namely, the combination of the annual and cyclical goal assessment, the combination of the goal management and the post management, and the focus on the application of the assessment results.

## **2 The Significance of the Implementation of Target Responsibility System in Universities**

It is of great significance to construct a scientific and rational target responsibility system, to do well in the performance appraisal of secondary units, to establish and improve a modern university system, and to promote the development of the university's connotation.

( i ) It is conducive to the in-depth development of the management system reform of universities. It is the inevitable trend of modern university management to deepen the reform of the college as the entity and to implement the management mode of target responsibility system and the faculty-based management model, which also meet the requirements of scientific management. The implementation of the target responsibility system can not only realize the scientific operation and maximum management efficiency between universities and schools management, but also conform to the development law of the university system reform(Ning Jianan, 2016).

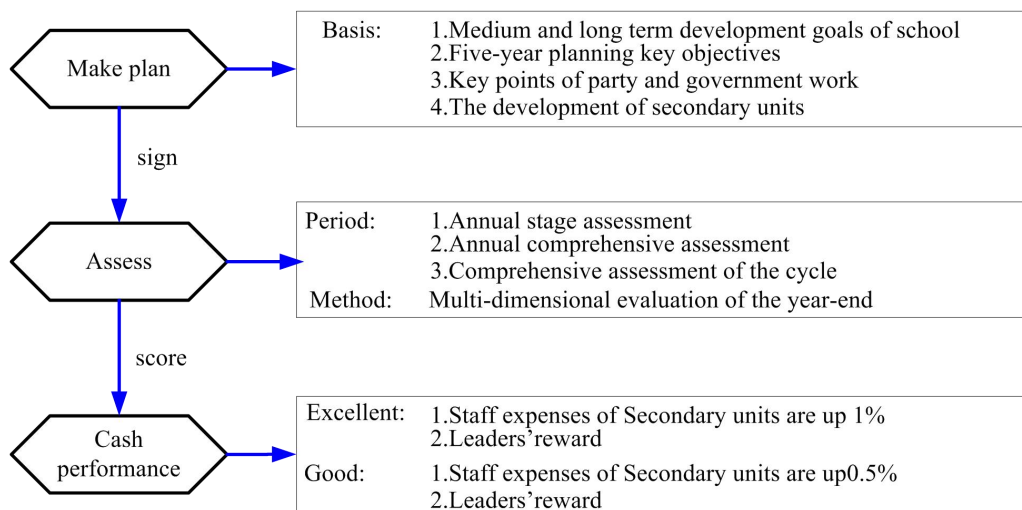
( ii ) It is beneficial to macroscopically supervise and guide the secondary colleges. After the focus on university management shifts to the college, the college has great autonomy in teaching, research, personnel and finance. It is necessary to establish a supervision system for the college in order to make rational use of these resources and promote the continuous development of university education. The establishment of the target responsibility system makes it feasible to assess the college from various indicators, so as to grasp and guide the development of each secondary college at a macro level (Guan Yan, 2017).

( iii ) It is conducive to promoting optimal allocation of resources. The resource allocation of each secondary unit on the basis of the completion of the target responsibility system, can effectively improve the current situation of waste of resources and unreasonable configuration(Meadows, 2015). Meanwhile, through the implementation of the target responsibility system, the university can supervise and constrain the whole process of the resource allocation and the benefits of resources, so as to ensure the overall resource utilization efficiency and the overall efficiency of the university.

## **3 The Organization and Implementation of Target Responsibility System in Universities**

In recent years, with the expansion of the enrollment scale of universities and the development of discipline construction, the administrative management model has gradually been transformed into a secondary administrative model based on schools and colleges from the model based on department and teaching and research section in the past. Under the secondary management system of the school and the college, the target responsibility system management mode can fully mobilize the motivation of the secondary units, further streamline administration and institute decentralization, and shift down the focus on management, which is conducive to promoting the development of various undertakings in universities, and comprehensively improving the quality of personnel training and scientific

research(Daniel L&Duke,2015). Taking Wuhan University of Technology as an example, which its content, formulation and assessment of the target responsibility system are all representative in universities, as shown in Figure 1.



**Figure 1 Operational Mechanism of Target Responsibility System of Wuhan University of Technology**

### 3.1 The content of target responsibility system

According to the actual situation of universities, the content of the target responsibility system generally includes teaching, scientific research, management work, team building and student work etc. Wuhan University of Technology's assessment of secondary units sets different indicator systems according to the nature of the unit. The first-level assessment indicators for teaching and research units are generally six: party and government management, undergraduate teaching, discipline construction and postgraduate training, scientific research, team building and student work. The assessment method of functional departments and subordinate units is mainly the multi-dimensional evaluation including online evaluation, conference evaluation and letter evaluation, which covers five aspects: evaluation of teaching and research units, evaluation of faculty representatives, and evaluation of work style construction (specific service objects), evaluation of key work completion and evaluation of party and government management work. In addition, Wuhan University of Technology has set up different secondary indicators, assessment requirements and proportion based on the full consideration of the differences between each secondary unit.

### 3.2 The formulation of target responsibility system

The School System Reform and Target Responsibility leading work group is responsible for the target responsibility system work of all secondary units of the university. The goal content is combined with the medium and long-term development strategic planning of the university, focusing on the orientation, representation and difference of the goal. The target responsibility system of teaching and research units should be formulated by different departments. The assessment of management objectives should be led by the principal's office and the party committee's office, and the relevant departments shall cooperate with them. The undergraduate teaching shall be undertaken by the Academic Affairs Office and the discipline construction and postgraduate training should be undertaken by the Graduate School. The Science and Technology Development Institute takes charge of scientific research and the

Personnel Department is responsible for the team building. The student work is led by the Student Affairs Department, with the cooperation of the Graduate School. The target responsibility system of the functional departments and subordinate units shall be formulated by the university. The common indicators shall be formulated by the System Reform and Target Responsibility leading work group. The individual indicators and additional indicators should be formulated respectively by each secondary unit according to their work duties and work characteristics (Donaldson & Morgaen L, 2016).

### **3.3 The assessment of target responsibility system**

The goal assessment is carried out by combining the phase assessment, the annual comprehensive assessment and the periodic comprehensive assessment, with the annual assessment as the main evaluation method. A multi-dimensional evaluation method is used to conduct the annual assessment.

#### **3.3.1 Phase Assessment**

The assessment of the phase of the year is carried out by all functional departments, combined with the phased work tasks and inspections, focusing on helping each unit to identify problems and solve problems, and supporting each unit in innovatively carrying out the work on the basis of the actual situation of their respective unit and accomplish the goal with high quality.

#### **3.3.2 Annual Comprehensive Assessment**

The annual assessment is organized by the School System Reform and Target Responsibility leading work group. The relevant functional departments make evaluation according to the completion of the work objectives of the teaching and research units. The assessment results are authorized by the Standing Committee of the Party Committee after review made by the School System Reform and Target Responsibility leading work group.

#### **3.3.3 Periodic Comprehensive Assessment**

After three years of expiration, the management work and business works objectives will be assessed according to the first-level indicators. The units that have completed the speriodic objectives, have made symbolic achievements and have ranked the top ones are rewarded; and their leading groups are also rewarded.

### **3.4 The effectiveness of the target responsibility system**

Since the implementation of the target responsibility system in 2002, Wuhan University of Technology has achieved remarkable results.

Firstly, the target responsibility system is closely integrated with the university's development plan, so that the school development plan can be completely implemented by target responsibility system.

Secondly, the school implements target management for the secondary units, shifts the management focus downward, strengthens the process management of the secondary units, and implements the supporting policies and binding requirements for the secondary units to give full play to the role of the two levels of the school.

Lastly, the target responsibility system has formed a management, assessment and evaluation system for the "three in one" of the secondary units. It has promoted the change of work style and the improvement on service quality. For example, it has promoted the improvement on teaching and scientific research capabilities of teaching and research units, and has transformed work style and improved service quality of functional departments and directly affiliated units.

## **4 Key Problems Existing in Universities' Target Responsibility System**

The target responsibility system is an important means for universities to improve management efficiency and quality of running schools. It is related to the development of schools and the vital interests in faculty and staff. However, there still exist many problems with the actual implementation process of it.

### **4.1 Too rigid and less flexible indicators**

According to the operational rules of the target responsibility system, the university decomposes the goal tasks into secondary colleges, and then the colleges decompose the goal tasks into individual teachers. Under the multiple pressures on teaching hours, number of papers, and scientific research funds, teachers must complete the teaching tasks of the college on the one hand, and try to apply for research projects and research funds, and write papers on the other hand. In this case, the academic freedom and creativity of teachers are squeezed from "administrative tasks". As the "de-administration" has not been put into practice from the concept, teachers can only concentrate on the production of "papers" and "projects" like the scientific research machine, and the quality and scientific value of the "papers" and "projects" that have been hurriedly produced are inevitably unsatisfactory. And they are probably "cultural rubbish" that does not have much value (Saniya Saniya, 2016). Therefore, the rigidity of indicators of the target responsibility system is in conflict with the academic freedom of the university.

### **4.2 The focus on result assessment and overlook of process management**

The university implements the target responsibility system management for the secondary units, aiming to improve the management efficiency of the secondary units and effectively supervise and guide their development. Process control is key to ensuring that performance goals are achieved. However, in the course of operation, the university only pays attention to the performance appraisal at the end of the year or the annual performance appraisal, with ignoring the process control (Zhang & Li, 2017). Under the guidance of the university's focus, the secondary colleges focus on short-term goals and only make efforts to complete the assessment tasks, neglecting the overall planning of the colleges' long-term development, which is undoubtedly not conducive to the long-term development of the university.

### **4.3 The focus on rewards and punishments of assessment and overlook the result uses**

The university implements the target responsibility system assessment for the secondary colleges, and its ultimate goal is to improve the quality of teaching and personnel training. Therefore, the analysis and application of the assessment results are particularly important. However, in actual operation, the assessment department of the target responsibility system only pays attention to the rewards and punishments according to assessment results. And the completion of the goal is only used as the basis for issuing performance subsidies, but the analysis and feedback of the assessment results are ignored. Emphasis on rewards and punishments and overlook of the uses of the results greatly reduce the implementation effects of the target responsibility system (Liang & Motoko, 2015).

## **5 Recommendations for the Implementation of the Target Responsibility System in Universities**

### **5.1 The combination of the annual and cyclical goal assessment**

In the formulation of the objectives of each secondary unit, the university atmosphere of academic

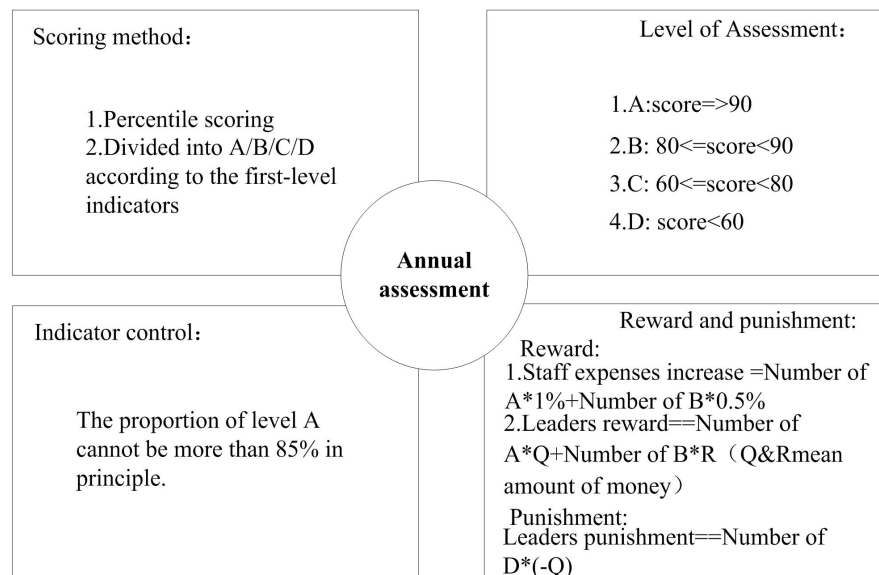
freedom and the management philosophy of “de-administration” should be fully considered. The indicators should be set in a relatively reasonable range so that they can not only motivate teachers, but also prevent teachers from becoming scientific research machines(Ho&Hui-Chung, 2017). To combine the annual assessment with the cyclical assessment and to fully consider the phenomenon those teachers may have “big years” and “small years” in scientific research are highly recommended. If the goal is not achieved at the end of the year, a certain buffer time will be given, and the overall goal of the cycle achieved within the cycle can be regarded as the achievement of the annual goal.

**5.2 The combination of the goal management and the post management**

To conduct post management and to clarify post duties are necessary and further corresponding post objectives with school strategic goals is to ensure consistency in development direction. At the same time, the development of the target responsibility system is combined with the promotion of posts, and the assessment indicators are set up, with the combination of the year-end assessment and job title evaluation, so as to play the practical role of the target responsibility system(Song Yafeng, 2018). Taking Wuhan University of Technology as an example, the assessment results of the target responsibility system serve as an important basis for the assessment of the leading group of the secondary unit.

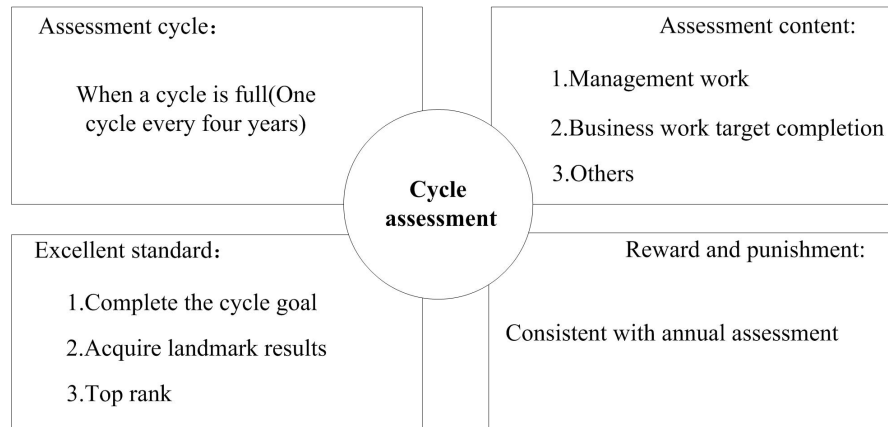
**5.3 The focus on the application of the assessment results**

In addition to being an important basis for the rewards and punishments of the secondary units, more importantly, the assessment results promotes the improvement of the work of various departments, which is an in-depth application of the results of the secondary target responsibility system. It is conducive to the management department to improve work efficiency and is beneficial to the improvement of the quality of running schools by teaching and research units. It is also conducive to the improvement of service standards by directly and indirectly affiliated units and to the promotion of institutionalization, standardization and scientization of school management. The annual assessment and cycle assessment results can be used as shown in Figure 2 and Figure 3.



**Figure 2 Annual Assessment Results and Application**





**Figure 3 Cycle Assessment Results and Application**

## 6 Conclusion

Under the secondary management system of the school and the college, the management mode of target responsibility system can fully arouse the initiative of the secondary units, further streamline administration and institute decentralization, and shift down the management focus, with the responsibility to the people, which is conducive to promoting the connotative development of universities. However, the target responsibility system of universities still has various problems, such as unreasonable indicators and inadequate implementation in terms of indicator setting, organization and implementation. Further reflection and studies are needed from the indicator setting of the target responsibility system and the application of assessment results.

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# The Influence of Teacher Support on the Positive Behavior of College Students

Duan Zhaolin

School of Management, Wuhan University of Technology, Wuhan, P.R.China, 430070

(E-mail:dzl@whut.edu.cn)

**Abstract:** From the perspective of social exchange theory, this paper studies the influence mechanism of teachers' support on college students' positive behaviors, and provides a new way to improve the relationship between teachers and students in undergraduate education. Undergraduates are the main research objects, and 128 valid questionnaires are collected. Data analysis shows that teacher support has a significant positive correlation with positive behaviors of college students. From this we have drawn the following conclusions and recommendations: 1. Teacher support has a positive effect on the positive behavior of college students, and the more teachers' support students perceive, the greater the internal incentive to make positive behavior; 2. Different teacher support produces different positive behaviors for College Students. It is suggested that in higher education, teachers and students should be attached to the support of teachers.

**Key words:** Teacher support; Positive behavior of college students; Out-of-role behavior; Social exchange theory

## 1 Introduction

The report of the Nineteenth National Congress pointed out that priority should be given to the development of education, the connotative development of higher education, the construction of teachers' morality and style, and the cultivation of high-quality teachers. Based on the above policy background and training objectives, teacher-student relationship as a special interpersonal relationship, with the further development of higher education, colleges and universities need students and teachers to participate in the construction of teacher-student relationship. Students and teachers are two kinds of social roles in social relations. The communication between teachers and students is a kind of social exchange. Teachers play an important role in students' learning and life. Teachers' teaching methods and personality characteristics will have a positive or negative impact on students. Although the theory of social exchange has a significant role in promoting the improvement of the incentive system of enterprises, there are some shortcomings in previous studies, and there is a lack of research and investigation in the context of universities. In recent years, with the increasing efforts of educational reform, teacher-student relationship has gradually been paid attention to by all walks of life, and there is a new research direction for teachers' behavior perceived by students. Previous studies have shown that teacher support has a significant relationship with college students' autonomous motivation. In view of the importance of teacher support to students, the research on the factors affecting teacher support has aroused heated discussion among scholars. The self-efficacy and perceived teacher support interact with mathematical CBM growth (Mercer S H, Nellis L M, Rebecca S. Martínez and Kirk.M,2011). Ouyang Dan believes that teacher support can be divided into competence support, emotional support and academic support (Ouyang Dan,2005). However, in the current research on teacher support, middle school students and online students are the main objects of study. It is lack of investigation and

Research on College students. The purpose of the research on teacher support is mostly to explore the influence of teacher support on students' learning motivation, while neglecting that teacher's support behavior can lead to students' positive behavior beyond academic level, such as mediating contradictions and caring for others. Out-of-role behavior is a positive, voluntary behavior that is not within the scope of the responsibility, but it has a significant positive impact on the organization. Among them, the out-of-role behavior is divided into: organizational citizenship behavior, peripheral performance, voice behavior, pro social organization behavior and organizational spontaneity (Jinyun Duan and Jianan Zhong, 2004). Therefore, based on the existing research and social exchange theory, this study explores the influence mechanism of teacher support on College Students' positive out behavior.

## **2 Literature Review**

### **2.1 Social exchange theory**

Social exchange theory generated from the late 1950s. It studies human behavior from a microscopic perspective using theories of economics, sociology, and psychology (Homans, 1958). Social exchange theory refers to the relationship between cost and remuneration in social communication. From the perspective of social exchange theory, teacher-student communication is also a social exchange. Because teachers and students have different "remuneration", "unequal social exchange" has become an important feature of current teacher-student exchanges in China. It also gives birth to the "power" of teachers to students in the communication between teachers and students.

### **2.2 Out-of-role behavior**

The Out-of-role behavior of employees is more dependent on the self-conscious voluntary dedication sacrifice from the heart to the organization, they will not follow the organization whether the giving and the self-pay to decide whether to put into the out-of-role behavior (Yi Fan, Yi Men and Yan Liang, 2013). In summary, external perception support is favorable for students to make positive extra-role behavior. However, the research on the out-of-role behavior mostly focuses on the incentive measures of internal employees of enterprises, and there are few related researches on college students.

### **2.3 Teacher support**

In foreign research on teacher support, teachers' support has a positive impact on student development and can stimulate students' interest and confidence in learning (Reeve and Johnmarshall, 2013). That means the young people who have strong learning ability and rich social skills are supported by more teachers, they will be more active in motivating themselves and more motivated to learn (Kathryn R. Wentzel, Ann Battle, et al., 2010).

Domestic research on teacher support currently indicates that teacher support can have a positive impact on students. Lei H showed that teacher support was significantly correlated with students' academic emotions (Lei H., 2017). From domestic research, some scholars believe that teacher support is an important component of the social support system and belongs to a kind of social support, which is of great significance to students' learning and mental health. The definition of teacher support can be divided into the perspective of teacher autonomy and student perception. From the perspective of teachers, the concept of teacher support behavior can be traced back to Deci and others who proposed "Teachers encourage students to consider the various elements of the problem, and let them find solutions themselves (Deci, E.L. Ryan and R. M, 1987). Ouyang Dan puts forward the behavior of students' perceived teacher support behavior from the perspective of students. It refers to the behaviors and attitudes that teachers perceive in their learning life, from the three dimensions of learning support, emotional support and ability support (Ouyang Dan, 2005). Therefore, teacher support may have a

certain impact on students' teaching efficacy and professional identity.

Comprehensive research at home and abroad has found that in the teaching of undergraduates, the communication between teachers and students, teachers are generally in a leadership position, so that students and teachers have a sense of distance, teachers' supportive behavior has certain stimulating effect on college students' psychology. But at present, in the existing research, there is still little research on how the teacher support will produce positive behaviors for college students, and the degree of influence needs further research. It provides a new direction to improve teacher-student relationship.

### 3 The Research Hypothesis

This study uses a questionnaire survey, which combined the Student Perceive Teacher Support Behavior Questionnaire compiled by Ouyang Dan (Ouyang Dan, 2005), and the "Organizational Citizenship Behavior Scale" compiled by Bachrac and Wang H et al. (Bachrac and Wang H et al.,2007). Research is conducted from two aspects: teacher support and positive behavior. The teacher support includes three dimensions: emotional support, academic support and ability support. The positive behavior includes two dimensions: civic moral behavior and help behavior. The purpose is to examine the influence of teacher support on the behavioral behavior of college students and to the differences in the positive behavior of college students with the different support of different teachers. Mostly theories and related research have shown that teacher support has an impact on students' academy motivation, but it does not affect all students. Because compared with college students, the time of communication with teachers is less than that of junior students and primary school students. Middle school and primary school teachers mostly provide support actively but students passively perceive. For college students, college students and teachers are mostly limited to communication in the classroom. College students rarely forwardly perceive teacher support, so the impact is different. Teacher support is divided into teacher self-support and student perception. Therefore, this study mainly proposes the following hypothesis based on the above-mentioned research on teacher support:

H<sub>1</sub>: Teacher support has a significant correlation with positive behavior

H<sub>2</sub>: There is a difference in the impact of teacher support on the positive behavior of college students

### 4 Empirical Analysis

The situation items that do not take college students as research objects are deleted, and the expressions of some problems are revised. After continuous testing and screening, a questionnaire on the impact of teachers' support on positive behaviors of college students is formed. Undergraduate students from major universities in Wuhan were the main research subjects. A random sampling method was adopted 150 students were randomly selected as research subjects. A total of 150 questionnaires were distributed and 128 copies were effectively collected, the effective recovery rate was 85.33%. Ratio of men to women were 42.97% and 57.03%, and the age distribution was between 18-24 years old. The impact of teacher support on the positive behavior of college students was analyzed by spssau18.0.

#### 4.1 Cronbach trust level analysis

Table 1 Cronbach Trust Level Analysis

Name	Correction Item Total Correlation (CITC)	Correction Item Total Correlation (CITC)	Correction Item Total Correlation (CITC)
Civic morality	0.579	0.815	0.834

Help behavior	0.735	0.785
Emotional support	0.631	0.801
Capacity support	0.6	0.831
Academic support	0.743	0.774

The reliability coefficient value is 0.834, which is greater than 0.8, thus indicating that the research data reliability is high. In summary, the value of the reliability coefficient of the research data is higher than 0.8 and the reliability coefficient value after the deletion of the item is not significantly improved. The comprehensive description indicates that the data reliability is high and it can be used for further analysis. There is an information can be effectively extracted.

#### 4.2 Teacher support validity analysis

**Table 2 Teacher Support Validity Analysis**

	Factor load factor	
	Factor 1	Commonality
Emotional support	0.834	0.696
Capacity support	0.791	0.626
Academic support	0.898	0.806
Characteristic root value (before rotation)	2.128	-
Variance interpretation rate % (before rotation)	70.931%	-
Cumulative variance interpretation rate % (before rotation)	70.931%	-
Characteristic root value (after rotation)	2.128	-
Variance interpretation rate % (after rotation)	70.931%	-
Cumulative variance interpretation rate % (after rotation)	70.931%	-
KMO value	0.659	-
Bart sphere value	124.736	-
Df	3	-
p value	0	-

It shows the KMO value is 0.659, which is greater than 0.6, which means that the data is valid. In addition, the variance interpretation rate values of one factor were 70.931%, and the cumulative variance interpretation rate after rotation was 70.931% > 50%. This means that the amount of information in the research item can be extracted efficiently. The absolute value of the factor load factor is greater than 0.4, there is a correspondence between the option and the factor. This means that the amount of

information in the research item can be extracted efficiently.

#### 4.3 Positive behavioral validity analysis

**Table 3 Positive Behavioral Validity Analysis**

	Factor load factor	Factor load factor
	Factor 1	
Civic morality	0.905	0.819
Help behavior	0.905	0.819
Characteristic root value (before rotation)	1.638	-
Variance interpretation rate % (before rotation)	81.913%	-
Cumulative variance interpretation rate % (before rotation)	81.913%	-
Characteristic root value (after rotation)	1.638	-
Variance interpretation rate % (after rotation)	81.913%	-
Cumulative variance interpretation rate % (after rotation)	81.913%	-
KMO value	0.5	-
Bart spherical value	65.663	-
Df	1	-
P value	0	-

It can be seen from the above table that the common value corresponding to all the research items is higher than 0.4. In addition, there are currently only 2 studies and the KMO value is 0.5. In addition, the variance interpretation rate values of one factor were 81.913%, and the cumulative variance interpretation rate after rotation was 81.913%>50%. It means that the information in the research item can be extracted efficiently.

#### 4.4 Analysis of teacher support and positive behavior

**Table 4 Analysis of Teacher Support And Positive Behavior**

	Civic morality	Civic morality
Emotional support	0.373**	0.623**
Capacity support	0.480**	0.465**
Academic support	0.443**	0.655**

\* p<0.05 \*\* p<0.01

From the above table, we can use correlation analysis to study civic ethics, help behavior and emotional support, academic support and ability support, and use Pearson correlation coefficient to indicate the strength of the relationship. The specific analysis shows that the correlation coefficients of citizen morality and emotional support, ability support and academic support are 0.373, 0.480 and 0.443, which indicates that there is a significant positive correlation between civic moral behavior and teacher support.

## **5 Conclusions and Recommendations**

### **5.1 Teacher support is significantly positively correlated with the positive behavior of college students**

In the past research, the influence of teacher support and academics was emphasized. Based on the previous studies, this study deeply studied the influence of teacher support on the out-of-role behavior of college students. The results of the study show that there is a significant positive correlation between teacher support and positive behavior of college students. This is consistent with the conclusion of previous scholars: the close relationship between college students' perception of teacher support and autonomous motivation. A foreign scholar Anna D et al. believes that although emotional support provided by teachers does not predict student engagement, teachers' emotional barriers are inversely related to student engagement (Strati, Anna D, J. A. Schmidt and K. S. Maier, 2016). It shows that in the undergraduate teaching of higher education, to improve the teacher-student relationship, teachers can give them more support from the three aspects of students' ability, academics and emotions, and encourage students to maintain a good mental. And motivating them to make some positive behaviors, so the research result supports the conclusion that "teacher support is a factor that influences college students to make positive behaviors". The more perceived teacher support, the richer the positive behavior. Teachers should give support that is more emotional to students, and they have already satisfied the students' emotional needs to encourage students to make more help behaviors. Teachers' support will enable students to pay attention to their own social citizenship behavior besides their studies to develop more comprehensively.

### **5.2 Difference in the influence of teacher support on the positive behavior of college students**

According to the data analysis, we can conclude that teacher Support Behavior in Different Aspects have different effects on college students' positive behaviors. Teachers' emotional support and academic support can promote students' help behaviors such as "helping students". In the study of Ouyang Dan, it was found that students of different grades perceived different support from teachers, so the incentive effect was different (Ouyang Dan, 2005). In some previous studies, more scholars focused on the analysis of the impact of teacher support on students' learning motivation. They believed that college students' perception of teacher support had different effects on their psychological needs and academic performance. Compared with previous studies, the results of this study suggest that college students' perception of teacher support can produce social behaviors other than students' roles, thus promoting their own more comprehensive development. Teacher-student relationship is a kind of social relationship, it is necessary to communicate with students equally and establish a social relationship of mutual trust. In terms of the method of teacher support, we should avoid using too harsh language in the process of communication between teachers and students.

### **5.3 Deficiencies and recommendations**

The scope of the study is limited. Only the undergraduate students in Wuhan are surveyed. It is not representative of the actual situation of all universities. The subjects are only from undergraduates. Neglected the research from the teacher's point of view and the students with higher education. In the



follow-up study, subjects from different sources can be considered and the influence of teacher support on college students can be further explored. Because the current higher education undertakings are constantly reforming and innovating, we should attach importance to teachers' support for students, especially action support.

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# The Influence of Differential Leadership on the Innovation Behavior of Platform-based Enterprises Employees

Yang Kun<sup>1</sup>, Gui Ping<sup>1</sup>, Xie Tong<sup>2</sup>

1 School of Management, Wuhan University of Technology, Wuhan, P. R. China, 430070

2 School of Economics and Management, Wuhan University, Wuhan, P. R. China, 430072

(E-mail: 1090019744@qq.com, guiping518@163.com, 1337347851@qq.com)

**Abstract:** Platform-based enterprises are the epitome of modern enterprises development. It is of great significance to study how platform-based enterprises can motivate employees to innovate. Based on the questionnaire survey of platform-based enterprises employees, this study discusses the mechanism of differential leadership affecting the innovation behavior of platform-based enterprises employees. The study results show that differential leadership has a positive impact on the innovation behavior of platform-based enterprises employees, and work autonomy plays a partial mediating role in the relationship between the two variables. The study results help platform-based enterprises to more effectively stimulate employees' innovation behavior, and thus promote enterprises' innovation performance, providing a certain management enlightenment for platform-based enterprises.

**Keywords:** Platform-based enterprises; Differential leadership; Work autonomy; Employees' innovation behavior

## 1 Introduction

In the context of the "Internet +" economy, innovation has increasingly become a decisive factor for enterprises, especially platform-based enterprises. Platform-based enterprises refer to a new type of enterprise organization model that forms a value-creating network, its employees are self-driven, self-managing, and self-innovative (Miron et al., 2018). Employees' innovation is the foundation of enterprises' innovation, it is important to motivate employees' innovation behavior (Amabile and Prat, 2016). Studies have shown that leadership style has a direct impact on employees' innovation behavior (Mokhber et al., 2018). However, at present, there is little research on the influence of local leaders who have Chinese social, cultural characteristics and connotations on employees' innovation behaviors. At the same time, the innovative research on emerging organizations such as platform-based enterprises focuses on the macro-organization level. Research on the micro level that employees' innovation behavior is even more limited.

Differential leadership means that the leadership will select the subordinates of the "circle" according to "pro, loyalty, talent" to show different treatment. Existing research shows that differential leadership has a positive impact on employees' social behavior, suggestive behavior, and team creativity (Wang et al., 2018; Tanget al., 2018); Yuan Ling and other studies show that differential leadership is positively correlated with employees' innovation behavior (Yuan Ling et al., 2016). However, some studies have shown that the team difference atmosphere or the differential mode of association is significantly negatively correlated with innovation performance (Wang, 2018). Compared with the Western leadership style that regards employees as equal individuals, whether the biased leadership with Chinese cultural characteristics will have an impact on the innovation behavior of

platform-based enterprises employees, compared with other leadership styles, what are the differences in the influence mechanism of innovation behavior, and what factors will be affected by the adjustment process, which are worthy of in-depth study and discussion. Therefore, it is of great significance to further study the internal mechanism of differential leadership affecting the innovation behavior of platform-based enterprises employees.

Work autonomy as a positive work attitude has a certain adjustment or mediation between leadership style and individual behavior. Platform-based Enterprises employees are self-driven, self-managing, and self-innovative (Miron et al., 2018), so work autonomy may be more important to employees of platform-based enterprises than to other traditional types of businesses. Therefore, this paper takes work autonomy as a mediating variable, and studies the mechanism of the influence of differential leadership on the innovation behavior of platform-based enterprises employees, in order to clarify the boundary conditions of differential leadership affecting employee innovation behavior, and enrich the theory of differential order leadership. At the same time, it helps platform-based enterprise managers to better understand and play the practical role of differential leadership to effectively stimulate employees' innovation behavior and enhance corporate innovation performance.

## **2 Theory and Hypothesis**

### **2.1 The influence of differential leadership on the innovation behavior of platform-based enterprises employees**

Individual innovation behavior refers to all individual actions that employees generate innovative ideas and apply to the organization, which contribute to the improvement of work efficiency or the improvement of management procedures and work relationships. Existing studies have shown that leadership style is an important factor affecting employees' innovative behavior. (Amankwaet al., 2019). In the previous research, scholars focus on the role of organizational leadership, but these studies mostly use Western-derived variables or constructs as research tools, and mainly focus on active leadership such as transformational leadership and participatory leadership. On the other hand, the leadership model developed by Chinese traditional culture and concepts has been less discussed. Differential leadership is a leadership style with Chinese local culture characteristics and widely exist in Chinese organizations, which refers to leaders taking different leadership styles for different subordinates and giving more bias to subordinates who are very preferred (Jiang Dingyu and Zhang Yuzhen, 2010).

According to the theory of social information processing, employees in the circle and outsiders will each have different classification model. The subordinates in the circle are treated with partiality, and they are grateful to the leader, who will improve their ability or actively cooperate with the leadership behavior. At the same time, some subordinates may not have a strong sense of injustice because they cannot obtain partiality, but try to enter the circle of leaders by showing loyalty to leaders, strengthening relationships with leaders, or improving their abilities. It is an inspiring leadership style. The leaders will be more tolerant of the mistakes made by the subordinates in the circle, so that the subordinates dare to innovate and take risks caused by innovative behavior (Bammens,2016). Leaders may improve the subordinates' work autonomy and studies have proved that work autonomy has a positive effect on employees' innovation behavior (Spiegelaere et al., 2014). At the same time the subordinates of the circle think that they are the cronies of the leader and believe that they are more likely to be promoted than others. In order to be promoted, the subordinates will continue to improve their working methods, propose new organizational improvement methods and processes. Not only that, the subordinates of the circle will also have a reciprocal attitude towards the bias and appreciation of the leader, will think about the problem from the perspective of the leaders, and try to put forward suggestions for leadership

and organization. , continuously improve their ability to innovate and contribute to the innovation of the company.

For outsider subordinates, the leader's bias towards the subordinates in the circle may provoke dissatisfaction and anxiety. The outsider subordinates often hold lower role expectations for the leader, keeping this anxiety and dissatisfaction within a moderate range. Studies have shown that moderate anxiety helps employees identify problems, and moderate dissatisfaction can be a driving force for innovative behavior. (Tunget al.,2018).And when a leader is biased towards a talented, loyal, or well-connected employee, if the outsider subordinates approve the leader's classification, they may be motivated to change their behavior to put themselves into the circle. This motivation for sub-private subordinates also motivates them to show their talents and loyalty by proposing new ideas or working methods. Not only that, but as a symbol of leadership and cronies, the creative work of the circle may become a role model for the outsider subordinates, and encourage the outsider subordinates to actively learn their innovative knowledge or skills, thereby improving their ability to innovate. Based on this, this study proposes hypothesis 1:

H1: Differential leadership will have a positive impact on the innovation behavior of platform-based enterprises employees

## **2.2 The mediating role of work autonomy**

Work autonomy refers to the degree of freedom of employees in their work and decision-making, that is, the extent to which employees can freely decide to dispose of and choose their own working methods. Employees who work in a high degree of autonomy can create positive benefits for the organization. (Nesheimet,et al., 2017).According to the theory of social information processing, employees will take certain actions of the leadership, such as: encouraging subordinates to participate in decision-making, allowing subordinates to have the opportunity to express their opinions on issues like working methods, work schedules and work standards, etc., as important social clues. Making employees believe that they can participate in discussions and decisions in my work, which will make employees feel more work autonomy. For subordinates, the differential leadership will have more authorization and less control over tolerance and trust, provide more training and education opportunities in promoting rewards, and provide timely feedback, care in communication to help improve work autonomy (Yuan Ling et al.,2016). For the subordinates, the role relationship caused by the differential pattern will not always be static, the harder work performance and more frequent leadership-member interaction will make the peripheral members realize the role of the outsiders to the insiders (Zhou et al., 2016).

Leaders motivate outsiders through a recognized biased approach (giving empowered or loyal employees in addition to recognition, promotion, rewards, interactions, etc.), which can be motivating. When they expect to be the leader's own person, they will want to express themselves to gain the favor of the leader. This kind of thinking will make them constantly strive to improve their various aspects and improve the work autonomy of the subordinates. Some researchers believe that work autonomy can promote innovation performance (Spiegelare, et al., 2014). In the work of high work autonomy, employees are free to choose their working methods, freely use company resources, and establish their own work standards based on organizational standards. These can encourage employees to break the rules and develop new ideas and ideas (Sappleton and Lourenco, 2016). On the contrary, if employees are engaged in work that lacks work autonomy, employees' creative behavior may be objectively suppressed. Employees do not have the opportunity to innovate and do not have the motivation to think creatively. Complete the work in accordance with the established procedures. Work autonomy gives employees the freedom to choose their work methods. Then employees will choose more efficient methods in their work, and they can think creatively, solve problems in a creative way, and help

employees innovate. Based on this, this study proposes hypothesis 2 3 4:

H2: Differential leadership will have a positive impact on the work autonomy of platform-based enterprises employees

H3: Work autonomy will have a positive impact on the innovation behavior of platform-based enterprises employees

H4: Work autonomy will play a mediating role in the influence of differential leadership on the innovation behavior of platform-based enterprises employees

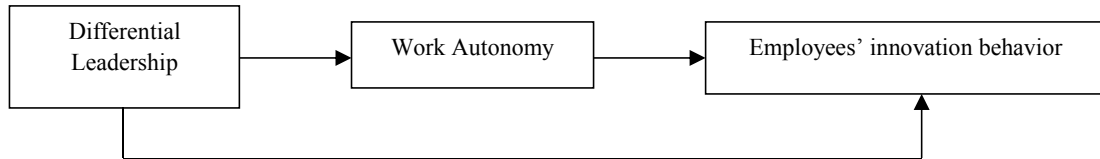


Figure 1 Hypothetical Model

### 3 Data and Methodology

#### 3.1 Simple

This paper mainly uses the questionnaire survey method to obtain research data, and the formal sample comes to two platform-based enterprises (fitness industry and volunteer service industry). In order to ensure that the samples are effectively recycled, this paper uses questionnaire network platform to issue and mail distribution and other methods and distributed 230 questionnaires for the platform-based enterprises employees in Wuhan. Finally, 215 questionnaires were returned and 208 questionnaires were valid. The recovery rate was 93.478%, and the effective questionnaires rate were 90.435%.

#### 3.2 Variables measurement

In addition to the control variables, the questions covered in this article use the Linkert 5-point scale. In order to ensure the reliability and reliability of the measurement tools, based on the existing scales at home and abroad, according to the characteristics of the platform-based enterprises employees, the wording of the questionnaire items has been appropriately revised. Finally, according to the results of pre-test research, the number of questionnaire items is deleted and improved, and the final scale is formed.

The differential leadership scale uses the 14-item Chinese differential leadership scale compiled by Jiang Dingyu and Zhang Yuzhen (2010). From the six dimensions of tolerance trust, communication care, and promotion rewards, the higher the score of each item, the stronger the difference in the leadership style that the subordinates feel. The scale is compiled in conjunction with China's national conditions and culture .After testing, the scale's Cronbach's  $\alpha$  coefficient is 0.917, and the reliability is good.

The work autonomy scale uses a nine-item work input brief questionnaire prepared by Kirkman et al (2004). After testing, the scale's Cronbach's  $\alpha$  coefficient is 0.877, and the reliability is good.

The employee innovation behavior scale uses a nine-entry scale developed by Janssen (2004).After

testing, the scale's Cronbach's  $\alpha$  coefficient is 0.867, and the reliability is good.

This study controls the platform-based enterprise employees' gender (male = 1, female = 2), age (24-30 years = 1, 31-37 years = 2, 38-43 years = 3, 44 and over = 4) and educated degrees (specialties and below=1, undergraduate=2, masters and above=3).

### 3.3 Confirmatory factor analysis

This Paper used Lisrel 8.80 to verify the discriminant validity of each variable by confirmatory factor analysis. It can be seen from the results in Table 1 that the Three-factor model ( $\chi^2=1275.15$ ;  $df=650$ ;  $\chi^2/df=1.96$ ; GFI= 0.912; IFI=0.960; CFI=0.959; NFI=0.959; RMSEA=0.046) fits the actual data better than the two- factor and single factor models, indicating that the three variables involved in this study do represent three different constructs with good discriminant validity. At the same time, this also indicates that the common method bias in this study is not obvious.

**Table 1 Confirmatory Factor Analysis Results**

Model	$\chi^2$	df	$\chi^2/df$	GFI	IFI	CFI	NFI	RMSEA
Three-factor model	1275.15	650	1.96	0.912	0.960	0.959	0.959	0.046
Two-factor model	2865.43	663	4.32	0.801	0.933	0.930	0.933	0.067
Single factor model	5796.19	674	8.6	0.553	0.920	0.913	0.921	0.183

## 4 Results

### 4.1 Correlation analysis

The mean, standard deviation, and correlation coefficients for all variables are shown in Table 2. From the correlation coefficient matrix table, we can find that differential leadership and work autonomy are significantly related (0.701), work autonomy and innovation behavior of platform-based enterprises employees are significantly related (0.695), and differential leadership is significantly related to innovation behavior of platform-based enterprises employees (0.737).Preliminary indicates that there is a positive correlation between three variables.

**Table 2 Correlation Coefficient Matrix**

Model	Mean	Standard deviation	1	2	3	4	5
1 Gender	1.30	0.462	1				
2 Age	2.18	0.922	0.212	1			
3 Educated Degree	2.36	0.650	0.254	-0.112	1		
4 Differential Leadership	3.17	0.383	0.112	0.312*	0.622**	1	

5 Work Autonomy	3.20	0.429	0.087	-0.271	0.332*	0.701**	1
6 Employees' Innovation Behavior	3.17	0.506	0.075	-0.025	0.263	0.737**	0.695 **

Notes: \*\*\*p<0.01; \*\*p<0.05; \*p<0.1. N=208.

#### 4.2 Hypothetical test

For hypothesis testing, SPSS 22.0 was used for multiple regression analysis in this study.

This study assumes that differential leadership has a positive impact on platform-based enterprises employees' innovation behavior. Models 3 and 4 in Table 3 show the test results of this hypothesis. In Model 3, we examined the effect of control variables on the innovation behavior of platform-based enterprises employees. Model 4 shows that after controlling the control variables, there is a significant positive correlation between differential leadership and the innovation behavior of the platform-based enterprises employees. Hypothesis 1 is verified.

This study assumes that differential leadership will have a positive impact on the work autonomy of platform-based enterprises employees. Model 1 of Table 2 examines the effect of control variables on work autonomy. Model 2 shows that there is a significant positive correlation between differential leadership and work autonomy after controlling for gender, age, and level of education. Hypothesis 2 is verified.

The hypothesis 3 in this study assumes that work autonomy has a positive impact on innovation behavior of platform-based enterprise employees. The model 5 in Table 2 shows that after controlling the control variables, there is a significant positive correlation between work autonomy and innovation behavior of platform-based enterprise employees. Hypothesis 3 is verified.

Next, we test the hypothesis 4. The model 6 in Table 2 shows that compared with model 4, after joining the work autonomy variable, the correlation coefficient of differential leadership becomes 0.632, and the correlation with the innovation behavior of platform-based enterprises employees is reduced, and the significance is also reduced. At the same time, the regression coefficient of work autonomy is 0.427, which is significant. This shows that after joining the work autonomy variable, differential leadership has a lesser impact on innovation behavior of platform-based enterprises employees, and work autonomy has partially replaced the effect of differential leadership on innovation behavior of platform-based enterprises employees. Therefore, work autonomy plays a partial mediating role between differential leadership and the innovation behavior of platform-based enterprises employees. Hypothesis 4 is verified.

**Table 3 Regression Analysis Table**

Variables	Work Autonomy			Employees' Innovation Behavior		
	Model1	Model2	Model3	Model4	Model5	Model6
Gender	0.346	0.357	0.158	0.170	0.085	0.057

Age	-0.353	-0.338	-0.012	0.001	0.233	0.108
Educated Degree	0.312	0.095	0.299	0.061	0.080	0.031
Differential Leadership		0.715***		0.767***		0.632**
Work Autonomy					0.745***	0.427*
R <sup>2</sup>	0.229	0.611	0.091	0.548	0.470	0.587

Notes: \*\*\*p<0.01; \*\*p<0.05; \*p<0.1. N=208

## 5 Conclusions

### 5.1 Results and contributions

The four hypotheses in this paper have been verified. This paper proves that:

(1) Differential leadership have a positive impact on the innovation behavior of platform-based enterprises employees.

(2) Differential leadership have a positive impact on the work autonomy of platform-based enterprises employees.

(3) Work autonomy have a positive impact on the innovation behavior of platform-based enterprises employees.

(4) Work autonomy plays a mediating role in the relationship between the relationship between differential leadership and innovation behavior of platform-based enterprises employees.

At the same time, this study has two contributions:

(1) Theoretical contribution: This paper verifies the positive role of differentiated leaders in the innovation behavior of platform-based enterprises employees and introduces work autonomy into the relationship between differentiated leadership and innovation behavior of platform-based enterprises employees. The empirical research on enriching the order of difference is of great significance to the research on the leadership behavior of platform-based enterprises in the context of network economy. And this paper reveals that the differential leadership is positively affecting the internal mechanism of the innovation behavior of platform-based enterprises employees, that is, the intermediary role of work autonomy and the adjustment role of the employment relationship atmosphere.

(2) Practical contribution: Leaders should control the level of differential treatment within the acceptable staff so that everyone can be persuaded. Leaders should fully examine the loyalty and talent of their subordinates. If the leader gives a medium-private, more diligent or loyal subordinate, the subordinate will feel the purpose of the leadership and strive to innovate in order to be appreciated by the leader in the future. And leaders should pay full attention to the individual's work autonomy. Focus on the design of work, improve the autonomy of employees, and expand and enrich the work content, so as to enhance the happiness experience of employees at work, and promote their high-level passion to work, thus promoting their innovative behavior.



## 5.2 Deficiency and prospect

The deficiency and the future research prospect of this paper are listed as follows:

(1) This paper takes the differential leadership as a whole study, and does not specifically refine the research dimension. In order to further clarify which kind of biased leadership leads to a greater impact on employees, follow-up research should analyze the role of employees in the three dimensions of differential leadership.

(2) This paper only considers the mediating role of work autonomy. Work autonomy plays a partial intermediary role between differential leadership and employee innovation behavior, indicating that there may be other intermediary variables. For example, the bias of the leader may motivate the subordinates who want to get promoted, the desire of the outsiders to be recognized, and the achievement motivation is positively related to the innovative behavior. Therefore, the achievement motivation may be an intermediary between the two, of course there are other possible intermediary mechanisms to be explored in the future.

(3) In terms of data collection, the source of the questionnaire in this paper is all employees, and the objective data such as the leadership questionnaire can be more convincing in the future.

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## Personality Traits of Risk-learning Serial Entrepreneur

Cao Qian

School of Management, Wuhan University of Technology, Wuhan, P.R.China,430070

(Email: 1428310202@qq.com)

**Abstract:** As the atmosphere of innovation and entrepreneurship continues to grow, the number of new entrepreneurs continues to increase, and serial entrepreneur play an important role in economic development. This paper discusses the personality traits of risk-learning serial entrepreneur. Through interviews, questionnaires, and SPSS software, regression analysis is conducted to try to explore the commonality of serial entrepreneurial personality traits, successful serial entrepreneur and personality traits. The relationship between the researches suggests that successful serial entrepreneurs are closely related to achievement motivation and personality traits of risk identification.

**Key words:** Serial entrepreneur; Personality traits; Risk learning; Competency model

### 1 Introduction

Serial entrepreneur plays an important role in the development of entrepreneurial economy worldwide. In European countries, a large number of entrepreneurs belong to serial entrepreneurs. In the UK, serial entrepreneur account for 19% to 25% of entrepreneurs. In the Netherlands, more than 30% of entrepreneurs are entrepreneurs in a row, even if In Germany, which has the lowest proportion, the proportion of consecutive entrepreneurs has also reached 18%.(Hyytinen & Ilmakunnas, 2007) Under the background of “mass entrepreneurship and innovation” in China, the scale of China's serial entrepreneur is increasing day by day, and the economic value it brings cannot be ignored. In order to start a business more efficiently, this study focuses on the personality traits of serial entrepreneur, analyzes the relationship between personality traits and the intentions of serial entrepreneur and the personality traits of successful entrepreneurs, and concludes that it provides a reference for successful entrepreneurs to succeed in entrepreneurship.

Domestic research on the personality traits of entrepreneurs mainly explores the personality traits of entrepreneurs by constructing competency factors. Most of them use questionnaires and in-depth interviews. Among them, Tao Man (Tao Man, 2018) adopts NEO Personality Measurement Questionnaire, Wang Haoquan (Wang Haoquan, 2007) The Essenck Personality Questionnaire (China Standard Edition) (EPQ-RSC) is used to better measure the personality traits of entrepreneurs through scientific methods. Domestic scholars usually use SPSS, Python language, and analytic hierarchy process (AHP) (Shi Zhenhua, 2018) to establish a variety of model analysis and verification, study the personality traits of entrepreneurs, and explore the relationship between entrepreneurial success and personality traits. This paper focuses on the personality traits of risk-learning serial entrepreneurs. However, at present, there is very little research literature on the personality traits of serial entrepreneurs in China. Wang Quanhao believes that there is a relationship between college students' entrepreneurial intention and personality traits. Correlation, entrepreneurial intention and extroversion are positively related, Neuroticism is negatively correlated, but from a correlation perspective, EPQ-RSC, which is difficult to use it alone as an evaluation tool for entrepreneurial intentions. (Wang Quanhao,2017) At the same time, in the field of entrepreneurial research, there is no conclusion about the relationship

between personality traits and entrepreneurial success.

Based on the competency model, this paper explores the intrinsic relationship between the personality traits of risk-learning serial entrepreneur and serial entrepreneurial experience, and has both theoretical and practical value. The theoretical significance of this project research is to reveal the personality traits of risk-learning serial entrepreneur, improve the research theory of serial entrepreneur, and fill in the gaps in the research field of risk-learning serial entrepreneur. The practical significance of this project research is that the research in this paper is helpful to help serial entrepreneur to consciously cultivate self-personality traits in the process of entrepreneurship, improve the risk identification ability and risk aversion ability of serial entrepreneur, and thus improve the chance of serial entrepreneurial success and improve the economic efficiency.

## **2 Theoretical Framework**

### **2.1 Personality trait**

Personality traits are the psychological characteristics of individuals who are influenced by genetic and environmental interactions, as well as the ability to control individual activities. They are also reactions that are consistent with their thoughts, feelings, and behaviors in the process of contact with the environment and others.(Chen Anning, Zhu Guanghua,2017)In the study of long-term personality traits, the most widely identifiable personality traits that scholars admire and widely recognize are some research findings, and there is a link between general personality traits and entrepreneurship. The most common application in the general personality trait theory is the Big Five personality theory. The Big Five personality theory has been widely used in organizational behavior.(Tao Man,2018;Costa & McCrae, 1992) Five factors of personality include neuroticism (N), extraversion (E), openness of experience (O), seriousness (C), and amenity (A). This paper attempts to use the in-depth interviews with consecutive entrepreneurs to issue questionnaires and use software to analyze the relationship between Big Five personality and successful entrepreneurship, especially the commonality of the Big Five personality of successful consecutive entrepreneurs.

### **2.2 Serial entrepreneur**

A serial entrepreneur is an entrepreneur who has more than one entrepreneurial experience and starts his next business after the end of his previous entrepreneurial activities (Wright et al., 1997; Westhead & Wright, 1998; Lin lin, Peng Huatao,2016). The process of serial entrepreneur in serial entrepreneur is essentially a process of serial learning. Entrepreneurial learning is the risk identification of entrepreneurs based on previous work or entrepreneurial experience, which serially accumulates experience and transforms into new knowledge to improve entrepreneurship, risk aversion ability, and the act of increasing the chances of success in entrepreneurship. This paper assumes from a practical point of view that the personality traits shaped in the process of serial entrepreneur and serial learning are general.

### **2.3 Competency model**

Competency models are related knowledge, skills, and attitudes that affect most of a person's work (role or responsibilities). They are closely tied to the performance of the work and can be measured by some widely accepted criteria and can be trained. In recent years, there has been some research on entrepreneurial competence in China. Zhang Wei and Wang Chongming (2004) pointed out the combination model of entrepreneurship and conducted a preliminary analysis of the competency

characteristics of entrepreneurs.(Zhang Wei ,Wang Chongming,2004).Feng Hua and Du Hong (2005) established a relationship model between entrepreneurial competence and entrepreneurial performance through research, and systematically analyzed the model (Feng Hua, 2005).In recent years, domestic scholars have gradually begun to study the competence of entrepreneurs, but in general, the scope and depth of research are still relatively small, and further research is needed. This paper uses the literature survey method to design a competency model questionnaire for serial entrepreneur to explore the commonality of personality traits of serial entrepreneur.

### 3 Data Sources and Methodology

#### 3.1 Data sources

##### 3.1.1 Depth interviews

This study conducts in-depth interviews with two serial entrepreneurs with more than ten years of entrepreneurial experience, and designs an interview outline for the personality traits of risk-learning serial entrepreneurs. Based on the interview content, the author extracts the competency personality elements of consecutive entrepreneurs. At the same time, this study designed a questionnaire, distributed a total of 40 questionnaires, received 31 valid questionnaires, extracted relevant data according to the questionnaire scale, and analyzed the relationship between successful serial entrepreneurship and the personality traits of serial entrepreneurs. Part of the interview content and the corresponding competency elements are as follows.

**Table 1 Serial Entrepreneur Interview**

Entrepreneur	Interview Record	Competency Elements
	1. Finally, you still chose to do this. That is to make up your mind, and don't sway.	Decisiveness, persistence, self-reflection,
	2. From the objective evaluation, this thing I did is not right. Although I am a girl, he does not know that I am very powerful. First, my personality is very strong. Second, my management experience is very good. Third, my technical ability is very strong.	self-confidence
Miss Huang	3. I have trained employees to improve efficiency and polish the team...	cultivating others' awareness and ability, organizational cognitive ability, analytical thinking ability
	4. When they contacted me, they felt that I was not the kind of business person. They felt that this person is very honest, worthy of cooperation, people with word of mouth,	principle, honest
	5. His idea is to be an industrial Internet of Things, to be made that kind of unmanned. Automated, intelligent factory, this is my dream.	enterprising spirit, innovation ability, achievement motivation

Mr. Liu	1. The partner lacks cooperation awareness and strategic vision. It is easy to be proud of satisfying the changes in the market. Therefore, the wrong decision has been made and the market demand has been miscalculated. The national policy misled enterprises to expand production, and there are risks	organizational cognitive skills, self-reflection, insight, conceptual thinking, risk anchoring, risk learning
	2. I cut through the layoffs, bad customers, slim down, stop loss, sell old equipment, invest in new equipment, and gradually realize profitability.	management expertise, technology, self-confidence
	3. Years of entrepreneurial experience tells me that people are the most difficult to copy.	teamwork spirit and ability to develop others
	4. Entrepreneurship has risks. To avoid risks, you must improve your own strength. At the same time, accumulate experience and improve the ability of enterprise risk identification and risk resistance.	risk learning ability, risk anchoring ability,

Based on the above analysis, the study concludes that the competency model entry for risk-learning serial entrepreneur.

Decisiveness, persistence, self-reflection, self-confidence, enterprising, cultivating others' awareness and ability, organizational cognitive ability, insight, innovation ability, principle, achievement motivation, risk anchoring ability, analytical thinking ability, self-confidence, management expertise, technology, teamwork spirit, conceptual thinking ability, risk learning ability.

**Figure 1 The Competency Model Keyword**

3.1.2 Questionnaire

The content of the questionnaire and its corresponding competency elements are as follows.

**Table 2 Questionnaire**

Family	Competency elements	Question
Opportunity strategy family	Risk propensity	You tend to risk more opportunities
	Risk Aversion	Based on past entrepreneurial experience, you can better avoid risks
	Exposures	You bear the consequences of risk
	Risk Identification	You can identify the risk
	Risk learning	Is your first entrepreneurial experience a big second for entrepreneurship?
Shock and influence	Interpersonal understanding	You are good at building good relationships with your customers and profiting from them.
	Influence	You gain new entrepreneurial opportunities with your own influence

	confidence	Every time you start a business, you believe that you can succeed.
	self-reflection	You can reflect on yourself from past entrepreneurial experiences and lessons.
	Organizational cognitive ability	You realize the importance of the team
Management family	the awareness and ability of Cultivating others	You will polish the team to start a better business.
	spirit of teamwork	You obey the opinions of the majority of the team
	Team leadership	You are good at team division
	Command/decisive force	You can make decisive decisions when opinions are not uniform
	Analytical thinking ability	You are good at analyzing and summarizing the reasons for entrepreneurial success.
	Conceptual thinking ability	You are good at combining various factors to decide whether to start your next business.
Cognitive family	technology	You know the basic technology every time you start a business.
	Management expertise	You have basic management knowledge
	Enterprising heart	You will actively learn and learn the advantages of your competitors.
	Insight	You are good at discovering the nature of things and the direction of development and the ability to do things new.

According to the characteristics of the serial entrepreneur and the competency model elements, the competency quality table is divided into 5 families and 22 elements. Each question corresponds to different competency factors. It is impossible to correspond to 0-10 points. The items designed by the questionnaire and their corresponding competencies in this study are shown in the table above.

Analysis of the reliability and validity of the questionnaire

### 3.1.3 Reliability analysis

Questionnaire reliability index was calculated by using SPSS22.0. The overall  $\alpha$  coefficient of the questionnaire was 0.961, and the half-point reliability reached 0.949, which exceeded the reliability standard value of 0.9. Therefore, the questionnaire measurement results can be considered to be highly credible. After the SPSS reliability test, the overall alpha coefficient of the questionnaire of the personality traits of the serial entrepreneur was 0.961, indicating that the reliability of the questionnaire was very high and fully met the requirements of the questionnaire.

### 3.1.4 Validity analysis

Exploratory factor analysis was carried out on the 22 competencies in the questionnaire. Four

factors with initial eigenvalues greater than 1 were extracted. The variance interpretation rate of the first factor reached 57.0%, and the first factor eigenvalue and the second factor. The factor characteristic value ratio is much larger than 3, so the data result can be considered to have a higher single dimension.

The sub-model loads 22 competencies into five factors: achievement and action family, opportunity strategy family, and calculates the load of five factors and serial entrepreneur. The model fitting calculation results are shown in the following table.

**Table 3 Questionnaire Validity Analysis**

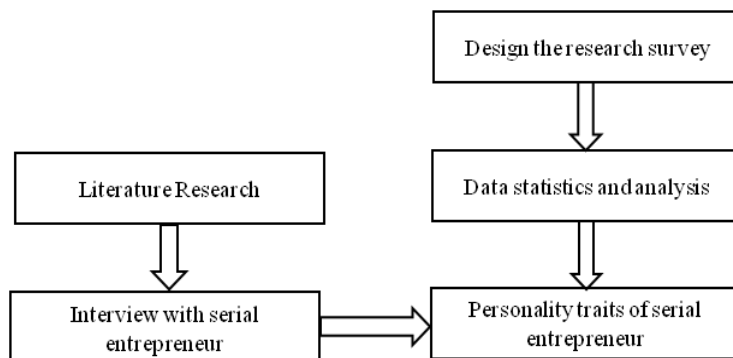
Model	RMSEA	CFI	TLI	Bangla/df
Model 1	0.000	1	1	1
Model 2		unfit		

Note: model 2 is unfit.

According to the data in the table, the model 1 will directly load the competency elements to the serial entrepreneurial success indicator, and the model fits the standard.

### 3.2 Methodology

This research combines literature research methods, interview methods, questionnaire survey methods



and statistical analysis methods to reveal the personality traits of risk-learning serial entrepreneur. The research map is below and the main research methods used in this study are as follows:

**Figure 2 Research Roadmap**

#### 3.2.1 Literature research

In CNKI China Knowledge Network (full text), through the selection of "serial entrepreneur", "personality traits" and other key words to review and collate relevant literature, summed up the emergence of research conclusions and opinions, inspiring the author on research issues Further thinking. The literature research method guarantees the scientific, accurate and cutting-edge information of the information obtained by the author, which is conducive to ensuring the quality and benefit of the author's research content.

#### 3.2.2 Interview

In order to collect the core competency indicators of authoritative entrepreneurs, this article conducts in-depth interviews with typical small and micro enterprise serial entrepreneur, and generates



text data in the later stage, which is conducive to qualitative analysis and more in-depth understanding the personality traits of risk-learning serial entrepreneur. The interview outlines and interviews with consecutive entrepreneurs are as follows.

What changes have you made in your first business and the second to deal with risks?

Do you have a systematic summary of the reasons for the failure of entrepreneurship?

Why do you want to start a business serially?

Do you think that you have succeeded because of the experience of previous entrepreneurship?

What is the difference between subjective and objective after you start your business and experience many times?

Based on the relevant literature of the competency model, the elements of the competency model of the serial entrepreneur are refined, the survey scale is designed, and a questionnaire about the competency of the risk-learning serial entrepreneur is prepared. By issuing 40 questionnaires, we obtained 31 effective questionnaires and established a large number of sample libraries to improve the scientific and reliability of the research.

### 3.2.4 Statistical analysis

This paper uses statistical analysis method to process the collected data. It mainly measures the reliability and validity of the questionnaires of consecutive entrepreneurs by SPSS22.0, and analyzes the relationship between the success serial entrepreneur and personality traits using the multiple linear regression methods in the later stage.

## 4 Model Constructions and Statistic Analysis

Since the dependent variable “serial entrepreneurial success” is a dichotomous variable, a two-class logistic regression model will be established for analysis in the regression analysis.

First, 22 competency elements are included in the model. The method is input, and the HL model fit is calculated. At this time, the model does not reach the convergence state. The Block0 results show that when the first, second, fourth, 23, 8, 10, 11, 13, 15, 18, 20, 21 and other topics are included in the model, the model changes significantly and can enter the equation, as shown in the table below.

**Table 4 Variable Not In Equation**

Step	Variable	Score	Degree of freedom	Significant
	T1, you have a strong passion and sense of accomplishment for serial entrepreneur.	12.253	1	0
Step 0	T2 you have the sense of innovation and ability	4.796	1	0.029
	T3 you tend to risk more opportunities	1.571	1	0.21
	T4 based on past entrepreneurial experience, you can better	4.992	1	0.025

avoid risks			
T5 you can take on the risk consequences of starting a business	1.534	1	0.215
T23 Is your first entrepreneurial experience a big second venture?	5.091	1	0.024
T6, you are good at building good relationships with customers and profiting from them.	1.901	1	0.168
T7, you gain new entrepreneurial opportunities with your own influence	3.620	1	0.057
Every time T8 starts a business, you believe that you can succeed.	4.368	1	0.037
T9, you can reflect on yourself from past entrepreneurial experiences and lessons.	3.449	1	0.063
T10, you realize the importance of the team	5.632	1	0.018
T11, you will polish the team to start a better business.	5.428	1	0.02
T12, you will obey the opinions of the majority of the team.	3.66	1	0.056
T13, you are good at team division	6.344	1	0.012
T14, you can make a decisive decision when opinions are not uniform.	3.838	1	0.05
T15, you are good at analyzing and summarizing the reasons for entrepreneurial success.	3.879	1	0.049
T16, you are good at combining various factors to decide whether to start your next business.	2.938	1	0.087
T17, you know the basic technology of every business.	1.593	1	0.207
T18 you have basic management knowledge	4.158	1	0.041
T19, you will learn to learn the advantages of competitors.	2.556	1	0.11
T20, you are good at discovering the nature and direction of things and emerging things.	4.403	1	0.036
T21 you can identify the risk	9.385	1	0.002

Note: Overall statistics: score: 27.985; Degree of freedom: 22; Significant: 0.176

The above questions were included as explanatory variables in the model. The independent variable screening method was forward and the likelihood ratio test using maximum partial likelihood estimation was used to eliminate the independent variables. The coefficient test results are shown in the following table, and the model is statistically significant.

**Table 5 Omnibus Test Of Model Coefficients**

Step		Bangla	Degree of freedom	Significant
Step 1	Step size (T)	13.996	1	0
	Piece	13.996	1	0
	Model	13.996	1	0
Step 2	Step size (T)	4.348	1	0.037
	Piece	18.344	2	0
	Model	18.344	2	0

When T1 and T2 are used as explanatory variables, the load factor reaches the significance level, and when the remaining variables are included in the model, the change of interpretation rate is not significant. Therefore, T1 and T2 are used as the final explanatory variables of the model. The regression equation is:

$$\text{Logit (T22)} = 0.703 * T1 + 0.671 * T21 - 8.518$$

**Table 6 Variable In the Equation**

Step	Variable	B	S.E.	Wald	Degree of freedom	Significant	Exp(B)
Step 1 <sup>a</sup>	T1, you have a strong passion and sense of accomplishment for serial entrepreneur.	0.802	0.29	7.62	1	0.006	2.229
	constant	-4.643	1.917	5.866	1	0.015	0.01
Step 2 <sup>b</sup>	T1, you have a strong passion and sense of accomplishment for serial entrepreneur.	0.703	0.293	5.758	1	0.016	2.019
	T21 you can identify the risk	0.671	0.339	3.911	1	0.048	1.956
	constant	-8.518	3.109	7.509	1	0.006	0

a. Step 1 : [%1:, 1:

b. Step 2 : [%1:, 2:

**Table 7 Variables Not In The Equation**

Step	Variable	Score	Degree of freedom	Significant
Step 1	T2 you have the sense of innovation and ability	1.217	1	0.27
	T4 based on past entrepreneurial experience, you can better avoid risks	1.401	1	0.237
	T23 Is your first entrepreneurial experience a big second venture?	1.392	1	0.238
	Every time T8 starts a business, you believe that you can succeed.	0.936	1	0.333
	T10, you realize the importance of the team	1.108	1	0.293
	T11, you will polish the team to start a better business.	2.868	1	0.09
	T13, you are good at team division	0.257	1	0.612
	T15, you are good at analyzing and summarizing the reasons for entrepreneurial success.	0.331	1	0.565
	T18 you have basic management knowledge	0.21	1	0.647
	T20, you are good at discovering the nature and direction of things and emerging things.	1.965	1	0.161
Step 2	T21 you can identify the risk	4.789	1	0.029
	T2 you have the sense of innovation and ability	0.319	1	0.572
	T4 based on past entrepreneurial experience, you can better avoid risks	0.264	1	0.607
	T23 Is your first entrepreneurial experience a big second venture?	0.281	1	0.596
	T8 Every time starts a business, you believe that you can succeed.	0	1	0.987
	T10, you realize the importance of the team	0.06	1	0.806
	T11, you will polish the team to start a better business.	0.877	1	0.349
	T13, you are good at team division	0.443	1	0.506
	T15, you are good at analyzing and summarizing the reasons for entrepreneurial success.	0.494	1	0.482
	T18 you have basic management knowledge	1.744	1	0.187
T20, you are good at discovering the nature and	0.252	1	0.615	

direction of things and emerging things.

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Note: step 1 overall statistics: score: 11.335; degree of freedom: 11; significant: 0.416

step 2 overall statistics: score:8.939;degree of freedom:10;significant:0.538

From the above data analysis, the significance of the two variables in Table 6 indicates that the strong enthusiasm of serial entrepreneurship and the sense of accomplishment gained in the entrepreneurial process and the ability to identify and anchor risks have the greatest contribution to successful serial entrepreneurship.

## 5 Conclusion

Based on comprehensive regression analysis and interview records, we can conclude that the success factors of successful continuous entrepreneurs are mainly self-confidence, awareness of others, risk anchoring ability, risk learning ability, sense of achievement, etc.

Through regression analysis and other methods, it can be known that the personality traits of successful risk-learning serial entrepreneur are mainly achievement motivation and risk identification, and other personality traits have low contribution to the success of serial entrepreneur. It is hoped that through this research, it will be able to inspire the risk-learning serial entrepreneur, strengthen the risk identification and risk aversion ability, and maintain the motivation for serial entrepreneur, which is the key to success. The research field of personality traits of risk-learning serial entrepreneur in China is not mature yet, and there is a lack of a complete scientific theoretical system. It is hoped that more scholars will pay attention to this field, enrich the theoretical system and provide theoretical guidance for serial entrepreneur.

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# Research on the Effect of Human Capital on the Producer Service Industry

Zou Wei <sup>1,2</sup>, Liu Changjian<sup>1</sup>

1 Business School, Jiangnan University, Wuhan, P. R. China, 4300056

2 Research Center of Industry Development in Wuhan City Circle Wuhan, P.R.China, 430056

(Email: zou\_wei@126.com, 1079944195@qq.com)

**Abstract:** As time goes by, the service industry plays an increasingly important role in the development of developed countries and developing countries, and has gradually become an important index to measure the national economic strength and the core competitiveness of the country. Since human capital is the main input of producer service industry, the competitiveness of human capital plays a vital role in the development of producer service industry. Based on substantial literature research, this paper objectively analyzes Chinese GDP, service industry and producer service industry from 2000, and the research method of location quotient is used to compare and analyze the human capital competitiveness and the development of producer service industry in 31 regions of China from 2005 to 2016 by constructing “human capital-added value” location quotient average value matrix, and then put forward policy recommendations to accelerate the development of producer service.

**Keywords:** Human capital; Producer service industry; Location quotient; Location quotient average value matrix.

## 1 Introduction

### 1.1 Producer service industry

American economist Greenfield firstly put the definition of producer service forward (Greenfield H I, 1966). He defined producer service as the products and labors provided by enterprises, governments and non-profit organizations for producers but not for ultimate customers. From the concept of the functions of products, Coffey deemed that producer service is the intermediate input in the form of other products or services but not the ultimate services that costumed by customers (Coffey J, 2000). Jiao Pin argued that producer service should include Transportation; Technology service; scientific research; financial service; Software and Information technology service and Wholesale and retail trade (Jiao Pin, Lin Xiumei, 2016). In one word, scientists think that producer service should have characteristics that including: meet intermediate need, divestiture from manufacturing, directly provided for producers, human capital is the main input, do not have direct material output.

Based on the definitions given by *the Outline of the Eleventh Five-Year Plan* and *China Statistical Yearbook*, in this paper, producer include Transportation, warehousing and postal service (T service); Information transmission, software and information technology service (I service); financial service (F service); Real estate service (R service); Leasing and business service and scientific research (L service) and Technology service (S service).

## 1.2 Literature review

In 1989, economists Grubel and Walker insisted that human capital is the most important input for the development of producer service (Grubel H G, Walker M A, 1989). They thought that producer service industry could make a great contribution for increasing the productivity of labor and improving the quality of products. High-quality human capital is the fundamental requirement of high-speed and steady growth of producer service. At the same time, Sven Illeris argued that the aggregation of producer service was caused by the aggregation of human capital with the aim of enjoying the profit produced by producers and consumers (Sven Illeris, 1989).

Since knowledge and human capital was the major input of producer service, Chinese economists gradually attached great importance to human capital and started to investigate what is the functions of human capital for producer service. Yang Ling, Guo Yudan pointed out that producer service was the most influential reason why considerable rise could be seen in the ratio of labor capacity to output (Yang Ling, Guo Yudan, 2010). Yang Qinghai argued that under the background of new knowledge production model where the infrastructure of public knowledge and the knowledge-intensive service industry were closely integrated, if China wants to achieve successful economic catch-up, it must firstly realize the catch-up of human capital by system innovation (Yang Qinghai, 2005). Tong Rui, Gao Xu, Wang Weiqin argued that technic was the most crucial input for the high-speed development of Chinese brand-new high-tech industry and it was high-quality human capital that created technic (Tong Rui, Gao Xu, Wang Weiqin, 2008). Zhang Ziran got the conclusion that technological progress and improvement of technological efficiency devoted to Chinese huge development in producer service by TFP model (Zhang Ziran, 2009). Since technological progress and improvement of technological efficiency are the results of high-quality human capital, human capital is the main cause of Chinese rapid economic growth.

## 1.3 Basic facts about Chinese producer service industry form 2005

### 1.3.1 China's GDP soared in the period of 11 years.

As shown in Figure 1, steady growth can be seen in the development of Chinese producer service from 2005 to 2016. In 2005 the total added value of Chinese producer service is only 35466.6 billion RMB, it soared to 198344.5 billion RMB in 2016, average annual increase of 17.08% is far more higher than that of China's GDP (13.30%) and the added value of China's third industry (10.40%).

### 1.3.2 The development of producer service was the main reason why China's GDP soared.

As shown in Figure 1, share of added value of producer service in GDP also increased sharply from 18.93% to 26.67% in the period from 2005 to 2016. Devoting more than a quarter of China's GDP made producer service became one of the most important industry of China. Besides producer service is helpful for the development of both the secondary industry and the tertiary industry, it's very crucial to the improvement of the Chinese industrial structure.



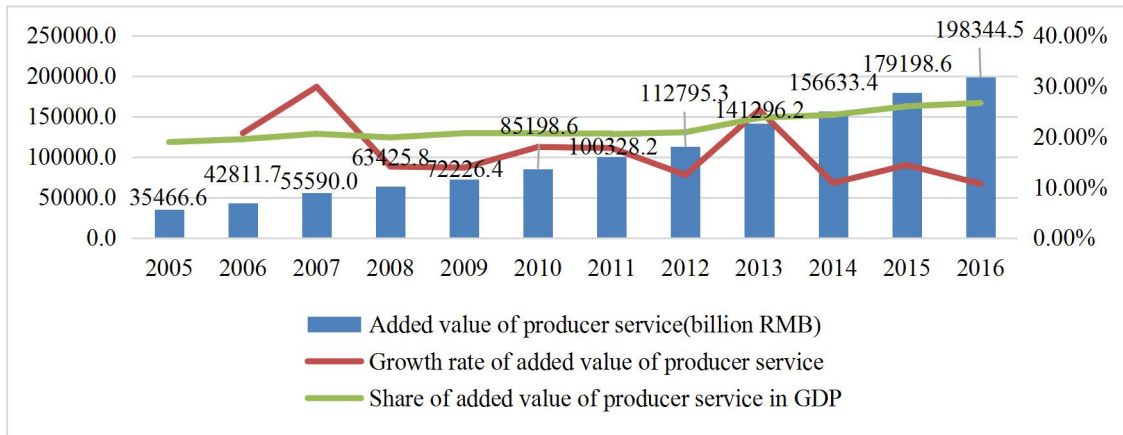


Figure 1 The Added Value and Growth Rate of Producer Service in China from 2005~2016

Data sources: China Statistical Yearbook, 2006-2018.

## 2 LQ of Chinese Producer Service Industry

### 2.1 Location quotient

Location quotient was first used by Haggett in location analysis. It can measure the spatial distribution of elements within a given region, to evaluate the specialization in the industry (Cui Gonghao, Wei Qingquan, Chen Zongxing, 1999).

The location quotient was calculated by:  $LQ_{ij} = (L_{ij}/L_j)/(L_i/L)$ ,  $LQ_{ij}$  is the location quotient of added value of the region  $j$  in  $i$  industry;  $L_{ij}$  is the added value of region  $j$  in  $i$  industry;  $L_i$  is the added value of the whole country in  $i$  industry,  $L_j$  in the added value of region  $j$  in all industries.  $LQ_{ij} < 1.00$ ,  $LQ_{ij} = 1.00$  and  $LQ_{ij} > 1.00$  means the  $i$  of region  $j$  less, equal and better than the average level of the whole country.

### 2.2 Location quotient of added value & human Capital

Due to the different statistical standards, Hebei, Liaoning, etc. 13 regions lack the added value data of Information transmission, software and information technology service, Leasing and business service and Scientific research and technology service industry from 2005~2016. So this paper only research the left 18 regions of China in Information transmission, software and information technology service, Leasing and business service and Scientific research and technology service industry.

### 2.3 Human capital-added value location quotient matrix

Figure 2 is Human Capital-Added Value Location Quotient Matrix of Transportation, warehousing and postal service (T service) in 2005~2016, and Figure 3~7 are Human Capital-Added Value Location Quotient Matrix of Information transmission, software and information technology service (I service); Financial service (F service); Real estate service (R service); Leasing and business service and Scientific research (L service) and technology service (S service) in 2005~2016.

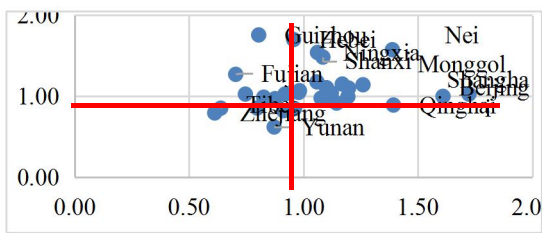
*Table 1 Average of Location Quotient of Added Value (AV) and Urban Employees (UE) 2005~2016*

Industry	T service		I service		F service		R service		L service		S service	
	AV	UE	AV	UE	AV	UE	AV	UE	AV	UE	AV	UE
Beijing	1.00	1.61	3.83	4.33	2.27	1.39	1.24	2.90	3.46	4.36	4.71	3.37
Tianjin	1.10	1.10	0.70	0.82	1.08	1.00	0.68	1.04	1.30	1.31	1.89	1.47
Hebei	1.70	0.96	\	0.77	0.53	1.28	0.64	0.55	\	0.57	\	0.89
Shanxi	1.48	1.08	0.98	0.77	0.79	1.06	0.54	0.34	0.60	0.71	0.43	0.73
Nei Monggol	1.57	1.39	0.48	1.01	0.48	1.11	0.46	0.55	0.56	0.56	0.43	0.85
Liaoning	1.14	1.26	\	0.98	0.61	1.16	0.69	0.97	\	0.89	\	1.04
Jilin	0.91	1.14	0.93	1.12	0.43	1.06	0.51	0.90	0.84	0.68	0.53	1.11
Heilongjiang	0.99	1.19	\	0.84	0.46	0.98	0.65	0.65	\	0.51	\	1.10
Shanghai	1.02	1.72	1.85	1.48	1.88	1.56	1.19	1.74	2.32	2.41	1.72	1.81
Jiangsu	0.85	0.80	0.82	0.86	0.85	0.88	0.94	0.62	1.20	0.72	0.66	0.65
Zhejiang	0.79	0.61	1.14	0.86	1.13	1.04	1.00	0.86	0.99	1.21	0.67	0.69
Anhui	0.97	0.88	0.63	0.75	0.54	1.09	0.76	0.80	1.07	0.55	0.61	0.79
Fujian	1.27	0.70	0.93	0.66	0.77	0.73	0.91	1.01	1.04	0.76	0.49	0.50
Jiangxi	1.07	0.98	\	0.77	0.46	0.87	0.65	0.58	\	0.45	\	0.73
Shandong	1.02	0.75	0.58	0.59	0.58	0.92	0.71	0.79	0.71	0.59	0.54	0.54
Henan	0.99	0.83	0.56	0.50	0.49	0.79	0.63	0.75	0.50	0.65	0.48	0.71
Hubei	0.98	1.08	\	0.74	0.62	0.82	0.67	0.81	\	0.51	\	0.97
Hunan	1.03	0.92	0.97	0.75	0.45	1.09	0.55	1.02	0.80	0.64	0.59	0.80
Guangdong	0.85	0.96	1.25	1.11	0.90	0.89	1.21	1.52	1.75	1.27	0.72	0.71
Guangxi	1.04	1.12	\	0.77	0.63	0.91	0.74	0.85	\	1.10	\	1.00
Hainan	1.15	1.17	0.97	0.78	0.59	0.90	1.21	2.51	0.55	1.01	0.56	0.94
Chongqing	1.10	1.20	\	0.74	0.95	1.00	0.83	1.26	\	0.88	\	0.92
Sichuan	0.82	0.91	\	0.89	0.77	0.98	0.66	0.78	\	0.57	\	1.11
Guizhou	1.76	0.80	\	0.67	0.77	0.80	0.57	1.20	\	0.65	\	0.95
Yunnan	0.62	0.87	\	0.80	0.83	0.77	0.57	0.92	\	0.83	\	0.99
Tibet	0.85	0.64	\	1.04	0.69	0.98	0.68	0.09	\	0.38	\	1.49

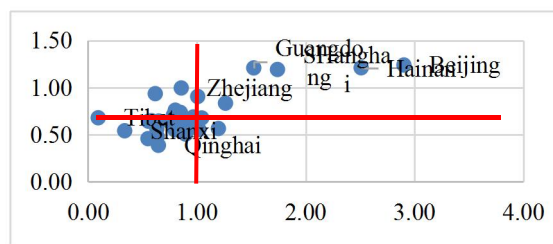
Shaanxi	0.98	1.11	\	1.07	0.62	1.00	0.55	0.80	\	0.54	\	1.65
Gansu	1.18	1.06	\	0.65	0.55	0.93	0.56	0.63	\	0.49	\	1.20
Qinghai	0.89	1.39	1.09	1.05	0.78	1.03	0.39	0.65	0.67	0.62	0.83	1.82
Ningxia	1.54	1.06	1.29	0.66	1.05	1.35	0.64	0.90	0.46	0.94	0.59	0.93
Xinjiang	1.05	0.98	0.72	0.55	0.73	0.79	0.48	0.64	0.51	0.92	0.62	0.89
Average	1.09	1.04	1.09	0.95	0.78	1.01	.073	0.96	1.07	0.91	0.95	1.08

**Data sources:** Statistical yearbook of each region.

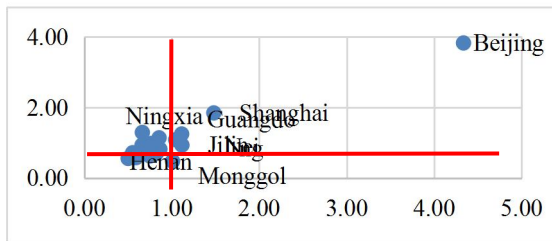
Calculated by the formula, the averages of location quotient of added value and human capital from 2005~2016 in each producer service industry are shown at Table 1.



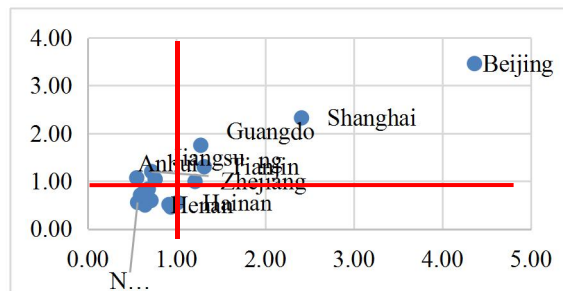
**Figure 2 Human Capital-Added Value Location Quotient Matrix of T Service in 2005~2016**



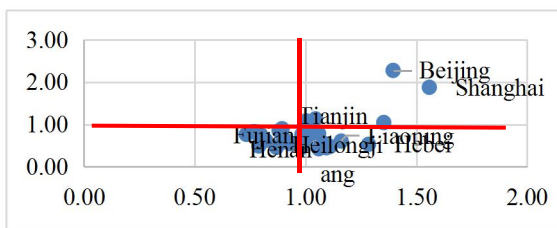
**Figure 5 Human Capital-Added Value Location Quotient Matrix of R Service in 2005~2016**



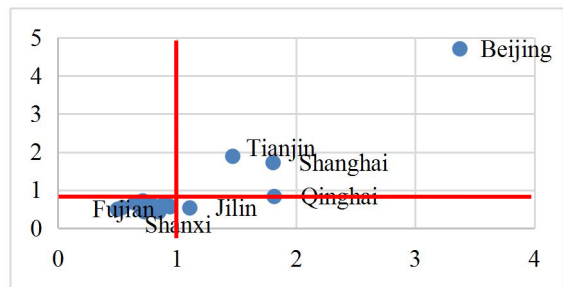
**Figure 3 Human Capital-Added Value Location Quotient Matrix of I Service in 2005~2016**



**Figure 6 Human Capital-Added Value Location Quotient Matrix of L Service in 2005~2016**



**Figure 4 Human Capital-Added Value Location Quotient Matrix of F Service in 2005~2016**



**Figure 7 Human Capital-Added Value Location Quotient Matrix of S Service in 2005~2016**

Regions located at top right of the diagram are more developed than the average level of the whole country at both human capital and added value in the industry; regions located at bottom left of the diagram lag behind the average level of the whole country at both human capital and added value in the industry; regions located at bottom right of the diagram are more developed than the average level of the whole country at human capital in the industry but lag behind the average level of the whole country at added value; regions located at top left of the diagram are more developed than the average level of the whole country at added value in the industry but lag behind the average level of the whole country at human capital.

### 3 Conclusion

Based on above, the development of producer service and human capital are shown in Table 2, 3.

To improve Chinese producer service industry China should:

**Table 2 Regions Where Industry LQ of Added Value > 1.00**

Industry	LQ of urban employees < 1.00	LQ of urban employees > 1.00
T service	Guizhou, Hebei, Fujian, Jiangxi, Xinjiang, Hunan, Shandong	Nei Monggol, Ningxia, Shanxi, Gansu, Hainan, Liaoning, Tianjin, Chongqing, Guangxi, Shanghai, Beijing
I service	Ningxia, Zhejiang	Beijing, Shanghai, Guangdong, Qinghai
F service	—	Beijing, Shanghai, Zhejiang, Tianjin, Ningxia
R service	Zhejiang	Beijing, Hainan, Guangdong, Shanghai
L service	Jiangsu, Anhui, Fujian	Beijing, Shanghai, Guangdong, Tianjin
S service	—	Beijing, Tianjin, Shanghai

**Table 3 Regions Where Industry LQ of Added Value < 1.00**

Industry	LQ of urban employees < 1.00	LQ of urban employees > 1.00
T service	Henan, Anhui, Jiangsu, Xizang, Guangdong, Sichuan, Zhejiang, Yunnan	Heilongjiang, Shaanxi, Hubei, Jilin, Qinghai
I service	Shanxi, Hainan, Hunan, Fujian, Jiangsu, Xinjiang, Tianjin, Anhui, Shandong, Henan	Jilin, Nei Monggol
F service	Guangdong, Jiangsu, Yunnan, Sichuan, Guizhou, Fujian, Xinjiang, Tibet, Guangxi, Hubei, Hainan, Shandong, Gansu, Henan, Jiangxi, Heilongjiang	Chongqing, Shanxi, Qinghai, Shaanxi, Liaoning, Anhui, Hebei, Nei Monggol, Hunan, Jilin

	Jiangsu, Anhui, Guangxi, Shandong, Liaoning, Tibet, Hubei,	Fujian, Chongqing, Tianjin,
R service	Sichuan, Jiangxi, Heilongjiang, Ningxia, Hebei, Henan, Yunnan,	Guizhou, Hunan
	Gansu, Shaanxi, Shanxi, Jilin, Xinjiang, Nei Monggol, Qinghai	
L service	Jilin, Hunan, Shandong, Qinghai, Shanxi,	Zhejiang, Hainan
	Nei Monggol, Xinjiang, Henan, Ningxia	
S service	Guangdong, Zhejiang, Jiangsu, Xinjiang, Anhui, Hunan, Ningxia,	Qinghai, Jilin
	Hainan, Shandong, Fujian, Henan, Shanxi, Nei Monggol	

### 3.1 Attach more importance to human capital, invite and cultivate talents

Since China is the most populous country in the world, human capital is the most precious resource for the economic development. Human capital is the main input of producer service, the knowledge and intelligence of human capital realize the rapid growth of producer service, so China should attach enough importance to human capital and try it's best to invite and cultivate talents. As shown in Sheet5-2, regions where the averages of location quotient of added value and urban employees are both less than 1.00 in one industry are not competitive at human capital in this industry, so their government should come up with policies inviting talents in this field to the regions, hope to make progress in the industry with the help of them. As for regions where the averages of added value are less than 1.00 but the averages of urban employee are more than 1.00, they do have large numbers of human resource but they cannot support the development of producer service industry. So they should attach great importance to the cultivation of human resource, governments and enterprises should educate employees and promote the upgrade of knowledge and skills.

### 3.2 Enhance communications and collaborations among regions of producer service industry

Devoting a quarter of China's GDP, producer service becomes more and more important in the development of Chinese economy. But Hebei, Liaoning, etc.13 regions ignore the added value data of information transmission, software and information technology service, leasing and business service and scientific research and technology service industry from 2005~2016. So government should attach great importance to the producer service because it can promote the development of both second industry and third industry. Due to the geographical difference unbalanced development can be seen in China, the enhancement of communications and collaborations between regions will help them help each other and benefit all of them.

### 3.3 Keep optimizing the inner structure of producer service industry

Regions where are not competitive in producer service industry should follow the trend, try their best to develop high-tech industry such as Information transmission, software and information technology service and Scientific research and technology service in the future. Hope to realize the high added value industry with the help of development of science and human capital. Meanwhile they should try to accept the transfer of industry construction. In this way they can improve their inner structure of producer service industry and realize the high-speed growth of producer service industry.

### 3.4 Promote integration of producer service industry and manufacturing industry

Producer service is the combination of manufacturing and services, China should know that

nowadays producer service is not the accessory of manufacturing anymore, producer service is as important as manufacturing for the development of China's economy. Industry like Information transmission, software and information technology service and scientific research and technology service are helpful for the development of high-end manufacturing, high-end manufacturing can also prosper and optimize producer service industry, the integration of producer service industry and manufacturing can accelerate the growth of China's GDP.

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## **Research on Ecological Niche Optimization of College Students' Ideological and Political Education**

Wang Wenhui<sup>1</sup>, Sun Xu<sup>2</sup>

1 Human Resource Department, Wuhan University of Technology, Wuhan, P.R. China, 430070

2 School of Safety Science and Emergency Management, Wuhan University of Technology, Wuhan, P.R. China, 430070

(E-mail: 30893173@qq.com, 1801071431@qq.com)

**Abstract:** Based on the feature of times and the theory of educational ecology, this paper explores the problem of the ecological niche change of college students' ideological and political education from the perspective of crisis. The evolution of the ecological niche of college students' ideological and political education is analyzed, and the performance of ecological crisis of college students' ideological and political education is revealed, including the failure of vertical subject connection and the lack of horizontal subject interaction. Meanwhile, it traces the reasons for the ecological crisis of college students' ideological and political education, and analyzes the ecological upgrade path of college students' ideological and political education from the niche theory, and proposes suggestions for ecological niche optimization of college students' ideological and political education, such as suitable misplaced participation, distributed extension width and breaking the negative effect cycle.

**Key words:** Crisis; Ideological and political education; College students; Ecological niche

### **1 Introduction**

After more than 100 years' development, the niche theory has gradually enriched and improved its connotation. Now it has formed a number of niche theory points, including niche separation theory, niche expansion theory, niche optimization theory, and niche coordination theory. The "educational ecology" was proposed by the famous American educational historian Lawrence Cremin (1983), using the general principles and methods of modern ecology to study a new educational concept system formed by educational phenomena (Wennersten, 1977). The educational ecological balance mainly refers to the comprehensive balance of the education system, efficient operation, perfect function and coordination of social environment (Carruthers P, 2012). Educational ecology regards relevant educational elements as a complex network (Russell J L, 2013), and education ecology can effectively describe and explore the complex phenomenon of the subject interaction of ideological and political education and its internal mechanisms. Ecological niche has a unique position in educational ecology. It refers to the time and space position and functional relationship of individuals or groups in a population or community. The subject should have its own unique

niche (Jia C, 2016). Besides these, Internet and Internet of Things become a powerful phenomenon, which is radically transforming much of our economy, politics, culture, education, business and social processes, and almost everything else. This brings many differences to our thinking and lifestyle.

At present, in the practice of college students' ideological and political education, the awareness to ecological or ecological niche of college students' ideological and political education activities is not enough. In order to improve the quality and level of ideological and political education, "time, degree, and efficiency" must be grasped. Big data is changing the way people live, work and think, and has a major influence on the educational environment of college students. The exploration of the ecological nature of college students' ideological and political education is conducive to the integration of college students and social environment, which in turn affects college students' acceptance of ideological and political education, thus forming a positive cycle. However, there are still various crises in the education ecosystem, such as the niche deviation of educator, the biased responsibility in the ecosystem, and the incoordination between educational ecology and the characteristics of the new age. With the help of the education ecosystem, from the perspective of crisis, this paper conducts an ecological discussion on ideological and political education, guides the practice of ideological and political education, and innovates the ideological and political education mode of college students.

## **2 Evolution of the New Niche**

### **2.1 The performance of ecological crisis of college students' ideological and political education**

Solving the contradiction among college students' ideological and political education, social environment, and individualized development of college students, and solving the contradiction between production and ecology in talent cultivation is the key to solve the ecological crisis of ideological and political education for college students.

#### **2.1.1 The failure of vertical subject connection**

The ecological system of college students' ideological and political education is a balanced situation in which the energy flow, material circulation and information transmission of the open system adapt to each other, coordinate and unify (Hickman R, 2017). At present, with the continuous impact of the external ecological environment, the ideological and political education of college students is alienated, the main ecological chain is broken, and the main power imbalance is prominent. It faces the dilemma of convergence failure, which is mainly manifested by the alienation of ecological niche, that is, for different universities' ideological and political education, the particularity of its structural function in the ecological environment of college students' ideological and political education is incorrectly considered. It fails to fully consider the balance between the basic resources that different subjects can use and the basic functions they should assume. There is no strict definition and distinction aimed the relationship between their rights, responsibility and interests. The ecological niche of the subject of ideological and political education of college students has made a major deviation.



### 2.1.2 The lack of horizontal subject interaction

In practice, the task of the horizontal subject of ideological and political education of college students is unclear, their responsibilities are unclear. They have low degree of cooperation, and lack effective resource integration mechanism, leading to insufficient in horizontal interaction between college students' ideological and political education. The main performance is that they are mutual independent (LI Xinyi, 2016), for example, the work scope of counselors is expanding, diversity of professional theory is weak, so it is difficult for them to be competent in the increasingly generalized ideological and political education work under the existing system

## **2.2 Reasons for the ecological crisis of college students' ideological and political education**

The source of the ecological crisis of college students' ideological and political education is in many aspects, but it also has its own characteristics, mainly manifested in diversity, uncontrollability, overall relevance, high diffusion, and strong dynamics.

College students have diverse ideas and diverse personality characteristics, which are easily influenced by the external environment. The ecological dilemma is a mixture of multiple interrelated factors, and the possibility of accumulation and evolution is extremely high. In the times of big data, the relationship between college education and society transcends the distance between time and space, and the ideological and political education of college students depends more on the "climate" of society (Weaver-Hightower, M. B, 2008). The source of the ecological crisis of college students' ideological and political education can be traced back to the following points:

### 2.2.1 The niche is not clear

Ideological and political educators are not clear about their own niche, their ideological concepts have not been effectively improved, and they have not clearly realized that their own qualities are related to dominant effect they play a part in.

### 2.2.2 Inaccurate grasp of the relationship between the host and the guest

Some ideological and political educators position themselves in an unequal position above the educated, and the deviation and absence of the ideological and political educators' orientation in colleges and universities highlights the contradiction between the educator's "discourse hegemony" status and negligence for the individual life of the educated, which causes the relationship between the two to be uncoordinated.

### 2.2.3 The role of factors is not well understood

The educational goals of "high, big, far, and empty" in ideological and political education, single and single-board educational methods, too abstract theoretical concepts, boring and monotonous educational contents, and the misunderstanding of the role of goals, content, and method elements, leads to the effectiveness not obvious. In the implementation, the relaxation of the human nature of the educated, the law, characteristics and continuous process of individual self-education are neglected (WANG Abdul-Kadir S, 2011).

### 2.2.4 The ecosystem mechanism is not sound

An important reason for the imbalance of the ideological and political education

ecosystem of college students is that the internal mechanisms of the system are not perfect, resulting in inadequate system functions, defects, looseness or breakage (Wen P, 2009).

#### 2.2.5 Ignoring the law of ecological chain

The ecological chain law refers to the influence of different educational environments on students in the ideological and political education ecosystem of colleges and universities. Ignoring the law of ecological chain leads to the division of time and space for all employees, and it is difficult to form a synergy. The speed of adjustment and reform of ideological and political education planning lags behind the reform of society.

### 3 The Upgrade Path of the 'Ecological Niche'

The effectiveness of the dissemination of ideological and political education for college students is not only reflected in the realization of social values such as the dissemination of social dominant ideology and value orientation, the function of political education, but also the realization of personal values (GUO Yi, 2016). In the process of college students' ideological and political education, it is necessary to identify the resonance point of college students' thoughts and the intersection of college students' interests, and to define the niche of each university student, considered the differences in the basic niche of each university student and the possibility of changes in actual and potential, respect the subjective status of college students, attach importance to the personality development and diversity needs of college students, and create an ecological environment suitable for the free growth of college students, so that each college student's niche enhancement ability is strengthened.

This paper mainly explains the upgrading path of the "ecological niche" of ideological and political education for college students through the theoretical application of niche separation, niche expansion, niche optimization and niche coordination. The theory of niche separation is the elimination of niche overlap and the generation of niche differences, mainly emphasizing the "The degree of separation of resources used by two species in resource series" to achieve dislocation development, that is, how to use limited resources in a specific environment. To reduce competitive exclusion and achieve symbiosis between species. The purpose of niche expansion is to open up new resources and living spaces for living things to maintain the dynamic balance of the entire ecosystem. Niche optimization optimizes its niche by improving the structure of its internal elements or improving external eco-environmental factors. The main purpose of niche coordination is to enable a species or population to maximize the use of matter and energy in the environment within ecosystems and to enable species in the natural ecosystems to co-evolve.

The "top limit" of population growth is analyzed from the niche dimension. The performance characteristics of this "top limit" are diverse, and the high overlap of niche within the limit threshold is also a feature. Therefore, ecological carrying capacity is an important condition for the rational layout of higher education niche. Among the elements of ecological carrying capacity, environmental carrying capacity plays a central role in the corresponding relationship between carrying capacity and niche. By improving the environmental carrying

capacity of various subjects in the ideological and political education system, the occupational niche of education is optimized. The pursuit for ecological evolution according with sustainable development of ideological and political education is also an environmental support for the optimization of the niche of higher education.

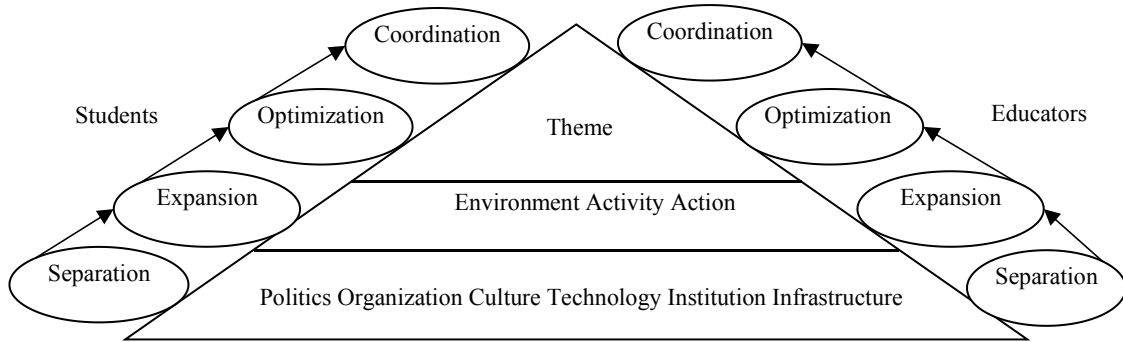


Figure 1 Niche Development Framework of Ideological and Political Education System

As shown in Figure 1, the politics, organization, culture, technology, system and infrastructure in the ideological and political education system are the basis of education, and synthesize the basic ecological factors of ideological and political education. Based on this, students and educators aiming at a certain theme, form environmental, behavior and activities according to the policy system. And each level involves the separation, expansion, optimization and coordination of the niche, which makes the ideological and political education system share a common vision and resources, thus expand the influence of ideological and political education.

Due to the complex dimensions of the educational ecosystem, the actual university ideological and political education will face many uncertain factors around students' mental health, academic development, career planning and personality development. The strength of ideological and political education has a direct influence on the niche. The niche breadth can characterize the extent to which an organism unit occupies a sequence of resources. The niche breadth of ideological and political education in colleges and universities can be quantitatively calculated by Levin formula.

$$B = \frac{1}{\sum_{i=1}^s P_i(s)} \quad (1)$$

In the above formula,  $P_i$  is the proportion of ideological and political education subjects in the  $i$  unit of a subject resource sequence;  $S$  is the total number of units of each subject resource sequence.  $B$  is in the range of  $[0, 1]$ ,  $B_{max}=1$ , the wider the niche breadth of ideological and political education, indicating that the higher the diversification of the subject resources utilization by the ideological and political education subject, the stronger the ideological and political education role; The closer to 0, the subject of ideological and political education is

less adaptable and weaker. The niche breadth of ideological and political education is static at a certain time point, but the niche breadth is in a random dynamic change as measured by the overall ecological dimension, showing the phenomenon of “generalization” and “specialization”. It can be obtained from the formula that with the expansion of the niche, the ecological complexity and diversity will be improved, and the resources and space that can be used will also be expanded, giving ideological and political education more space and mobilizing resources.

Batstone R T (2018) Used niche breadth theory to explain generalization in mutualisms. By viewing mutualisms through the lens of niche breadth evolution, Batstone R T outlined how the environment shapes partner availability and relative quality, and ultimately a focal mutualist's partner breadth.

## **4 The Ecological Niche Optimization Strategy**

### **4.1 Suitable misplaced participation**

Strive to maintain a balance between the internal tension of the ecosystem and the external environmental pressure. Regulate the disorder of various levels of relationships and ecological imbalances, attach importance to the internal tension of the ecosystem, and pay attention to external environmental pressures. Continuously optimize teaching methods, enrich teaching content, and establish a harmonious interaction between teachers and students. In the design of specific higher education governance process, the misplaced participation in different aspects of higher education governance should be realized, such as job experience among educators, student management experience, and activity planning training.

### **4.2 Step-by-step expansion of width**

Construct an ecological mechanism of “three in one” of schools, families and society. For college students at different stages, design a niche supplement program to strengthen the physical and mental perception of each educated person.

The prerequisite for realizing the ecological interaction between school, family and social education is the secret communication, intensive communication and continuous communication among the three. Support and encourage parents to actively participate in the schools' educational activities. We must actively promote mutual penetration and participation of families, schools and social education through various means, channels and channels, and promote mutual understanding, understanding and supervision of families, schools and society. Encourage parents to participate in school education's enthusiasm and initiative, and jointly strengthen the cultivation of students' ideological and moral qualities.

### **4.3 Breaking the negative effect cycle**

Use advanced thought and culture to occupy public opinion. Strengthen the positive guidance and propaganda work, create a healthy and harmonious campus public opinion environment, be highly vigilant against non-mainstream or wrong values intrusion to the audience, and open channels for weak opinions. The phenomenon of “silent spirals” often leads to unbalanced discourse imbalances in ideological and political education. Once a “silent spiral” is formed, educators cannot understand the true state of the audience's acceptance of

information, and only get false feedback (Tian Liangchen, 2016).

## **5 Conclusion**

In the same ecosystem, multiple species or populations will evolve different competitive strategies to have a better niche, and thus occupy more resources and adapt to a wider ecological space. Eventually they show commonality or similarity in the environment and resource dimensions, which is called niche overlap. Appropriate niche overlap can improve resource utilization, such as ideological and political material and facility sharing across sub-units. Through an ecological discussion on ideological and political education, this paper proposes several suggestions including suitable misplaced participation, step-by-step expansion of width and breaking the negative effect cycle, which could enhance ecological environment in universities. Moreover, some practices and survey on feedback of political education mode should be supplemented in the future study. The ecosystem is an open and dynamic system. Various ecological factors are externally driven by social development and technological renewal, and its internal systems are in a state of continuous evolution and optimization. As a subsystem of ideological and political education, it is also in a corresponding state of evolution. The formation of the niche of ideological and political education in colleges and universities is the result of interaction with factors such as environment and information resources. The ideological and political education in colleges and universities must adjust and optimize the educational content, educational methods and educational technology in real time according to the changes of the situation. If we maintain the inherent niche and do not adapt to the new ecological environment, we will eventually weaken our competitiveness and even be excluded from the network ecosystem.

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# Institutional Transformation of Public Institutions to Enterprises

Xian Lei<sup>1</sup>, Wu Xiaoyan<sup>2</sup>

School of Management, Wuhan University of Technology, Wuhan, P.R.China, 430070

(E-mail: 454573637@qq.com,1055383683@qq.com)

**Abstract:** With the deepening transformation of public institutions to enterprises, the institutional transformation of enterprises in China are facing severe challenges. This paper constructs the theoretical framework for public institutions into enterprises. Based on the existing research integration and in-depth interviews, this study takes Guangxi Geology & Mineral HuaDi Industry and Trade Group Co., Ltd. (“HD”) as an example to analyze the reasons and potential risks of the transformation. Using the starting-development-complement system transformation dynamic process, proposes the transformation framework of HD, and gives the policy recommendations that can be used for the transformation of the public institutions to enterprises.

**Keywords:** Public institutions to enterprises; Institutional transformation; Transformation framework; Case study

## 1 Introduction

Institution is not the subject of collective interests, but is created and reconstructed by a group of people. It is sometimes harmonious and sometimes conflicting (Figart, 2017). Studying institutional design and transformation can help us understand the changes that have taken place in enterprises (Thornton, 2012). A large number of scholars have studied the problems of enterprises in institutional transformation, convergence and countermeasures, which provide a theoretical basis for promoting the transformation of public institutions into enterprises.

Existing researches mainly focus on the institutional transformation of state-owned enterprises and private enterprises. The main reason for the institutional transformation of Guangxi Geology & Mineral HuaDi Industry and Trade Group Co., Ltd. (“HD”) is that the state promotes the transformation of public institutions. Based on literature analysis and in-depth interviews, this paper constructs a theoretical analysis framework for institutional transformation of public institutions. Taking HD as an example, it deeply analyses the process, path and potential risks of institutional transformation. Finally, it puts forward relevant policy suggestions for ensuring the success of institutional transformation of public institutions.

## 2 Literature Review and Theoretical Framework

### 2.1 Literature reviews

Overseas, public institutions correspond to non-profit organizations (NPO) and non-governmental organizations (NGO). Lakmal mentioned that NGOs and NPOs are facing a decline in government funding and the instability of limited resources as government support shifts and social expectations continue to rise (Lakmal, 2019). This is also the case in China. The government hopes to reduce

financial pressure and improve the efficiency of enterprises by transforming public institutions into enterprises.

In previous literature, there are different definitions of "institution". Bush believes that "institution" is a mode of behavior related to social regulations (Bush, 1987). Hodgson proposed that "the institution" is a common rule of interaction in society (Hodgson, 2006). This paper adopts North's viewpoint that institution is the norm of human behavior. In the enterprise institution, Lin studied the power sector in China, systematically understood the problems of the system, and pointed out the institutional form and effectiveness under the new model (Lin, 2019). Azaaviele pointed out the importance of institutional background for company development (Azaaviele, 2018). When there are bottlenecks or turning points in the development of enterprises, it is the focus of this paper that policy makers change the existing institution in order to bring enterprises into the right track as soon as possible.

Institutional transformation involves transformation, which is equally important for the study of institutions. It is becoming more and more important in strategic and organizational behavior research (Dean, 2010). Enacted through the system, constrains organizational behavior and safeguards organizational interests.

At the same time, previous studies did not clearly point out that institutional transformation has brought development to enterprises. The existing literature does not have a definitive framework for institutional research, and companies need a theoretical framework that comprehensively guides future work. Therefore, based on the study of the HD history and the existing institution, this paper analyzes the impact of internal and external environmental impacts on the system.

Based on the above theoretical basis, this paper proposes a start-development-complete institutional transformation research framework. This paper draws lessons from the combination of top-down institutional transformation and practice (Cloutier, 2016), emphasizing process analysis (Haigh, 2009). This paper mainly provides suggestions for institutional transformation from top to bottom and from the inside out from the perspective of the leadership of HD.

## **2.2 Theoretical frameworks**

Based on the integration of literature on enterprises institutional transformation, this paper compares the changes before and after enterprises institutional transformation, and provides some ideas for the transformation framework. At the same time, the feasibility of the theoretical framework is determined according to the in-depth interview method and the actual situation of the enterprise. Finally, the theoretical framework is revised according to the actual case. Through this series of processes, the theoretical framework of institutional transformation from starting-development-complement put forward.

As shown in Figure 1.



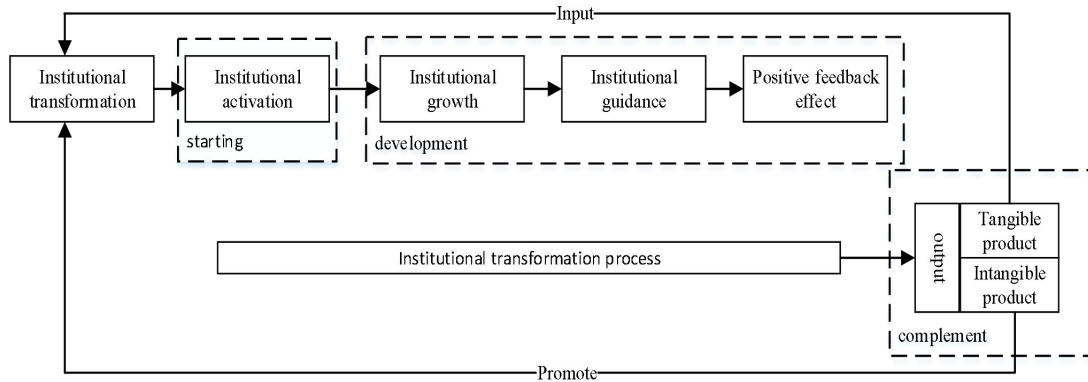


Figure 1 Institutional Transformation Model

### 3 A Case Study of HD Institution

#### 3.1 Overview of institutional transformation

This paper analyzes the public institutions, current enterprises, and HD from the perspective of property, governance structure, organizational structure and institution.

As shown in Table 1.

Table 1 Before and after the Transformation of HD

Compare Content	Public Institutions	Enterprises	HD
Property	State funding	Investor is clear	Investor isn't clear
Property	People	Separation of ownership and property rights	Property isn't clear
Property	/	Separation of decision-making power, executive power and supervision power	The three powers are not separated
Organization structure	/	Separate functions	Basic match
Organization structure	/	Unity of rights, responsibility, unity of interests	Incompatible
Organization structure	/	Crisscross	Basic match
Institution	/	Strategic management institution	Missing
Institution	Clear financial institution	Financial institution	Basic match

/	Market institution	Missing
Clear personal institution	Human resource management institution	No system
Clear security institution	Security institution	Basic match

Institution system is not perfect. With the reform of the government and the liberalization of the market economy, the drawbacks of public institutions have become increasingly prominent. First, the administrative functions of public institutions are not clear, and the overlapping of government subordinate units makes it difficult to carry out horizontal and vertical work. Secondly, past wages, finance, auditing and other institutions have not been applied to the market economy. Thirdly, in today's market segmentation, government functions are also broadening, and the more subdivided the institutions, the more serious the overlap of functions. Fourth, practitioners choose institutions because of this "iron rice bowl", the transparency of public institutions is not high, and the unit "big pot" is serious. Fifth, different units belong to different government departments and their functions are repeated.

Convergence of restructuring environment. Our country is moving from a planned economy to a socialist market economy. The open market environment requires enterprises to continuously improve product quality and service level in order to have their own place. The government receives market conditions and needs to change the original solidified structure to optimize the overall structure.

The personnel structure is redundant. The unclear structure of personnel causes financial waste and becomes an obstacle to government reform. At the beginning, most of the personnel of public institutions introduced "backdoor" and secondment by their relatives. The number of staff and registered personnel was too high, which was not conducive to the smooth development of the unit functions

### 3.2 Risk analysis of institutional transformation

Employee concerns. In the process of visiting, we can clearly feel the doubts and conflicting mentality of the employees of HD. The average age of HD staff is old. Most of them have been working in the institutions for a long time. The idea of "big pot rice" has been deeply rooted. At the same time, although HD has completed the transformation of enterprises, but the salary system still follows the public institutions. For enterprises, employees' salary mainly depends on their performance and encourages them to exert their greatest creativity. Secondly, the retirement security of retired employees. In the process of enterprise transformation, we should not only ensure the welfare of employees, but also ensure the interests of retirees.

Not suitable for market development. In the process of transforming public institutions into enterprises, it is necessary to change various institutions. Public institutions were born in the planned economy era. Institutional transformation needs to adapt to the development of market economy and adjust enterprises from function and structure. From a higher perspective, the state should not only take control of the functions of public institutions, but also bear part of the responsibility of transferring enterprises, and share some pressure for the public institutions. Such production and operation institutions such as HD after the transfer of enterprises, mainly create profits through their own operation and management. Such institutions are prone to capital chain breakage in the process of transferring enterprises.

Talent loss. Many employees choose to enter the public institutions because of the "iron rice bowl"

in the system. Most of them adapt to the comfortable and comfortable environment in the system and do not want to work hard. After the transformation, the company pursues high profits and high performance. The employees can't afford the work intensity and choose to return to the public institutions in other systems. After the transformation to the enterprise, there is no financial allocation, the enterprise's capital chain breaks the competitiveness, and the employees may choose stronger business employment. After the transformation of enterprises, different people will have different choices according to their own will. Whether or not they continue to stay in the enterprise after the transformation, they need to make reasonable and excessive arrangements. The stability of talents and the stability of capital are equally important to the development of the company and are the key factors in maintaining the competitiveness of the company in the market

E-commerce shocks. Flying Goose Mall, the pillar industry of HD, mainly adopts off-line store management mode, which is greatly impacted by e-commerce. With the rapid development of science and technology, people's shopping will mainly focus on the Internet world in the future, and the competitiveness of the offline market will be greatly reduced. At the same time, online shopping reduces the time and money costs of intermediaries' transactions and facilitates consumer purchase steps. Secondly, the convenience brought by online sales is widely recognized in consumption, and shopping habits and shopping preferences are deeply rooted.

### **3.3 Implementing path of institutional transformation**

#### **(1) Starting**

Institutional activation. In the transformation of public institutions into enterprises, not only the promotion of the external environment of the market, but also the driving force of the enterprises themselves is needed. People-oriented, unify the company's development and employee development, and enhance employee recognition, integration and support for the system. Ensure that the institution is implemented, comprehensive and systematic implementation. Promote the enthusiasm of employees through institutional activation. In the process of the transformation of the HD, employees were twisted into a rope to stimulate employee enthusiasm and potential creativity. Formulate effective reward and punishment measures to allow employees to dispel their concerns. Incentives are used to motivate employees' creativity, and punitive measures are used to regulate employee behavior, which will lay a solid foundation for the initial stage of transformation. At the same time, we will attract outstanding talents and continuously improve the work ability of employees to develop enterprises.

#### **(2) Development**

Institutional growth. On the basis of the existing institutions, through continuous growth, the system is perfected. Firstly, HD should pay attention to the existing institutions, continuously improve the institutions and gradually try it out. Secondly, the whole and internal components of the growth process are connected, interact and promote each other. For example, CCTV animation clearly distinguishes itself from modern enterprises in the transformation of enterprises, and does a good job of connecting itself. Thirdly, the whole and internal components of the growth process are connected, interact and promote each other. In this process, HD should pay attention to feedback and adjustment, collect opinions and suggestions from employees, and constantly improve and improve the existing system.

Institutional guidance. At this stage, the institution has been developed relatively well. Leaders actively guide employees to propose amendments to the institution that does not adapt to formal development, to ensure that the system does not deviate from the actual situation.

Positive feedback effect. After the initial stage of starting and development, a certain feedback mechanism is formed. On the one hand, it can reduce the loss of business operations, and on the other hand, motivate employees to work.

### (3) Complement

Output. Finally the sum of the tangible and intangible products created in the completion phase. The tangible products produced, such as the revised institution and the outstanding talents will be invested in the transformation of the institution. Intangible products such as corporate culture, employee enthusiasm, and employee cohesiveness promote the cycle of institutional transformation.

### **3.4 Guarantee measures for institutional transformation**

Take the improvement of the original online mall as a guarantee. Flying Goose Mall is the main business of HD. First, companies should provide more training for merchants and let them fully realize the popularity of e-commerce in life. Second, in the early stage of the website promotion, a large discount was used to provide personalized service to each user system and establish user loyalty.

Design of performance appraisal institution as a guaranteed. In the visit, the post-enterprise salary structure is a key factor in employee concerns. The assessment of the employee's situation is conducive to the company's leaders to understand the current situation of employees, work ability, and completion of work indicators.

Established with a good corporate image as a guarantee. Actively participate in activities such as donating blood, donating money, caring for the elderly, and establishing an excellent corporate spirit. Strengthen the construction of its own website, provide investors with more corporate information, and understand the dynamics of the company in real time.

## **4 Conclusion**

This paper takes HD as an example to explore the institutional transformation of public institutions to enterprises. The article takes the starting-development-complement as the theoretical framework, and proposes the system according to the comparison, transformation reasons and transformation obstacles before and after the transformation of HD. Transform the research framework and propose transformation guarantee according to its own situation.

Taking HD as an example, this paper hopes to provide reference for other public institutions to enterprises with guidance. At the same time, it also hopes to provide comparisons for other enterprises that have already transferred enterprises, analyze their own advantages and disadvantages, and effectively control their own internal and external environmental risks.

Because the institutional transformation model used in this paper is not a mature model of existing research, there may be some inapplicability to other enterprises. At the same time, this paper does not adopt a vertical analysis of the historical system of HD, and there are deficiencies in the case study.

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## Influencing Mechanisms of Responsible Leadership towards Employees' Voluntary Green Behavior: A Multi-theory Perspective

Ma Ying, Naveed Ahmad Faraz, Cheng Yanxia, Hammad Mushtaq, Ali Raza  
School of Management, Wuhan University of Technology, Wuhan, P.R. China, 430070  
(E-mail: mying331@163.com, naveedahmadfaraz@outlook.com, chengyanxia221@126.com, hammadmushtaq@hotmail.com, ali\_khawaja818@hotmail.com)

**Abstract:** Environmental issues pose a great challenge for the sustainability of organizations. Employees' voluntary green behavior (EVGB) is indispensable in realizing the environmental sustainability goals of organizations. Building upon responsible leadership (RL), self-determination, and social identity theories we first examined the effects of RL on EVGB directly and then through the mediation of autonomous motivation for environment and leader's identification. Cross-sectional data from the dyadic sample of 357 subordinate-supervisors were collected from the Power Sector of Pakistan. Partial least squares structural equation modeling employed through Smart-PLS 3.2.8 software to analyze the hypothesized relationships. The results revealed interesting findings. Theoretical and managerial implications are offered along with the suggestions for future research.

**Key words:** Responsible leadership; Employees' voluntary green behavior; Autonomous motivation for environment; Leader identification

### 1 Introduction

The physical and psychological well-being and collective future of the humanity depends upon reinstating and reserving the quality of environment. Organizations significantly contribute in the climate change (Robertson & Barling, 2013). Environmental issues pose a great challenge for organizations and require considerable resources and capabilities to achieve a transition towards sustainability (Andersson, Jackson, & Russell, 2013). Corporate greening is one of the grave problems that organizational world is facing today (Andersson et al., 2013). Corporate greening objectives are widely recognized to be dependent on the employees' wide range of pro-environmental behaviors (Lülf & Hahn, 2014). Employees' inertia pertaining to the environmental issues had been a major concern for managers that lead to explore a wide range of research avenues in the hope of gaining a better understanding of the factors related to environmentally responsible behaviors. In recent years, there is a burgeoning scholarly interest to explore employees' pro-environmental behaviors (Yuriev, Boiral, Francoeur, & Paille, 2018) providing valuable insights on promoting employees' green behaviors at workplace. Despite progress on academic and business fronts, organizations continue to face significant human resource challenges in implementing environmental sustainability initiatives (Daily, Bishop, & Govindarajulu, 2009). EVGB is defined as green behavior involving personal initiative that exceeds organizational expectations including prioritizing environmental interests, initiating environmental programs and policies, lobbying and activism, and boosting others (Norton, Parker, Zacher, & Ashkanasy, 2015). The concept of EVGB closely aligns with the notions of pro environmental behaviors or organizational citizenship behavior for the environment (OCBE)(Norton et al., 2015). Leadership is considered to be at the heart to nurture individual, group and organizational outcomes (Yukl, 2013). Leaders are usually in a position to influence diversified organizational outcomes including environmental considerations (Priyankara, Luo, Saeed, Nubuor, & Jayasuriya, 2018). Albeit literature reported the influence of different leadership styles like transformational leadership, transactional leadership, ethical leadership, and spiritual leadership on employees' extra role behaviors towards the environment. Noticeably there is scarcity of research investigating the effect of responsible leadership on EVGB. Maak and Pless (2006) define RL as a "social-relational and ethical phenomenon, which occurs in social processes of interaction". They argued that the key distinction between other leadership styles and RL is the latter's focus on environmental and social objectives of sustainable value creation and positive change. Besides, responsible leaders can transform their subordinates' into other 'responsible leaders' who can further help others to engage in VGBs and contribute to the environmental sustainability. Hence, investigating the influencing mechanism of RL in relation to EVGB is genuinely justified.

Besides investigating the direct impact of RL on EVGB, a comprehensive understanding of the mechanisms through which RL predicts EVGB is also under consideration of this research. Autonomous motivation for the environment (AME) examined as mediator through which RL exerts its influence on EVGB. To enhance explanatory power of the research model and better understanding of the paths through which RL leads to EVGB, leader identification (LI) employed as another mediating variable. The theoretical lens for this research based on self-determination theory and social identity theory in addition to responsible leadership theory.

From the above discussion, this research aimed to offer three substantial contributions. At first, despite call for research to explore the influence of different leadership styles on EVGB (Norton et al., 2015), there is scarcity of empirical studies that examined the influence of responsible leadership on EVGB. Second, understanding the mechanisms through which leaders exerts their influence towards employees' outcomes is of vital importance for academicians and practitioners (Van Dierendonck, Stam, Boersma, De Windt, & Alkema, 2014). Third, this study is being conducted in Pakistan that is among the top in the list of badly affected countries due to environmental change and global warming. Thus, the context of this research is highly meaningful.

## **2 Literature Review and Hypotheses**

### **2.1 Responsible leadership and employees' voluntary green behavior**

EVGB refers to those discretionary actions of the employees that contribute to the sustainability of the environment and such behaviors are often not rewarded or required by the organization's formal reward system (Boiral, 2009). Employees' such behavior is a useful supplement to the environmental protection behavior of citizens and the green development strategy of the enterprise (Daily et al., 2009). Employees' saving paper in the workplace, reducing energy consumption, assisting colleagues to practice green behavior, and making environmental protection recommendations are typical examples of EVGB. Norton et al. (Norton et al., 2015) clarified that the concept of EVGB aligns closely with the notions of pro-environmental behaviors or organizational citizenship behavior for the environment. RL occupies a central position in the stakeholder relation network and plays a variety of roles (Maak & Pless, 2006). The key difference between RL and other traditional forms of leadership is its focuses on the society and the environment, sustainable value creation and positive change (Pless & Maak, 2011). Responsible leaders' considers the interests of various stakeholders related to the business and exchanges information and opinions with employees. Through such behavior, RL transmits relevant information to employees by interacting with them, and the subordinates gradually accept and internalize these values of the leadership through observing and imitating. Existing studies revealed that RL significantly affects various employees' outcomes including organizational citizenship behavior for the environment (Han, Wang, & Yan, 2019). In the light of this discussion, we hypothesize:

**H1:** Responsible leadership positively related to EVGB

### **2.2 Mediating role of autonomous motivation for the environment**

According to self-determination theory (SDT) there are three types of motivation that an individual can have namely: amotivation, autonomous motivation, and controlled motivation (Deci & Ryan, 2008). Autonomous motivation highlights that the self-determination of an individual that consist of identified motivation, integrated motivation and intrinsic motivation (Gagné & Deci, 2005). Under identified motivation, an individual performs those actions that are consistent with his/her goals and values. Within integrated motivation "people have a full sense that the behavior is an integral part of who they are, that it emanates from their sense of self and is thus self-determined" (Gagné & Deci, 2005). The last component of AM is the intrinsic motivation wherein people perform those actions that are inherently exciting or pleasing for them to involve in. Generally, people with AM experience self-endorsement or volition of their actions (Deci & Ryan, 2000). Leader's support for environment augments the sense of competence and autonomy of employees' which provides nutriments of autonomous motivation for the environment. Most recently, AME investigated as predictor of OCBE and a mediator in the relationship between RL and OCBE (Han et al., 2019). It is argued that autonomous motivation is one of the mechanisms through which RL would exert its positive influence on EVGB. Through internalizing the values of RL and aligning themselves with the environmental goals of such leadership, employees enhance their AME, which in turn further prompts the employees to participate in EVGB. Therefore, we hypothesize:

**H2:** Autonomous motivation for environment positively mediates the influence of RL on EVGB

### **2.3 Mediating role of leader identification**

According to social identity theory, identification is the process in which an individual forms a mental connection with “targets”, including organization, occupation, leaders, or co-workers (Scott, Corman, & Cheney, 1998). Among the different “targets”, leader identification implies that the ways in which subordinates emulate and learn from their leaders depend on the level at which those subordinates identify with their leaders (Li & Sun, 2015). RL transforms traditional leadership from the dyadic leader-follower model to leader-stakeholder interactions (Pless, 2007). As a key stakeholder, RL takes employees seriously and exerts its influence on employee self-concepts such as personal identification. Responsible leaders show commitment in articulating a promising vision and they also pay greater attention to the needs of their subordinates’. For example, responsible leaders are willing to produce humanized decisions, care about employee benefit and, if possible, seek mutually beneficial solutions (Pless, 2007). These measures express leaders’ concerns and attract employee sympathy, while increasing their sense of higher purpose. Employees’ identify more with leaders when their needs are satisfied (Van Knippenberg, Van Knippenberg, De Cremer, & Hogg, 2004). Under these circumstances, RL can increase employee-leader identification. Further, RL is seen as a leadership style of great charm because of its characteristics such as global view, CSR consciousness, long-term perspective, etc. In the presence of these characteristics, the emulation process will help subordinates foster a mental connection with responsible leaders. RL is likely to encourage employees to share the leader’s norms and goals, and thus, to incorporate the leader as an essential partner in their own self-identity. Social identity theory further proposes that when subordinates’ are feeling greater leader identification, they tend to be more willing to act on the leader’s behalf. Because they share similar interests with their leaders and treat the leader’s perspectives and beliefs as their own, they become inclined to imitate and respond to the leader’s values, norms, and visions to define their own job roles. More recently Zhao and Zhou (2019) found positive results where LI was investigated as a mediator between RL and OCBE. Thus, we hypothesize the following:

**H3:** Leader identification positively mediates the influence of RL on EVGB

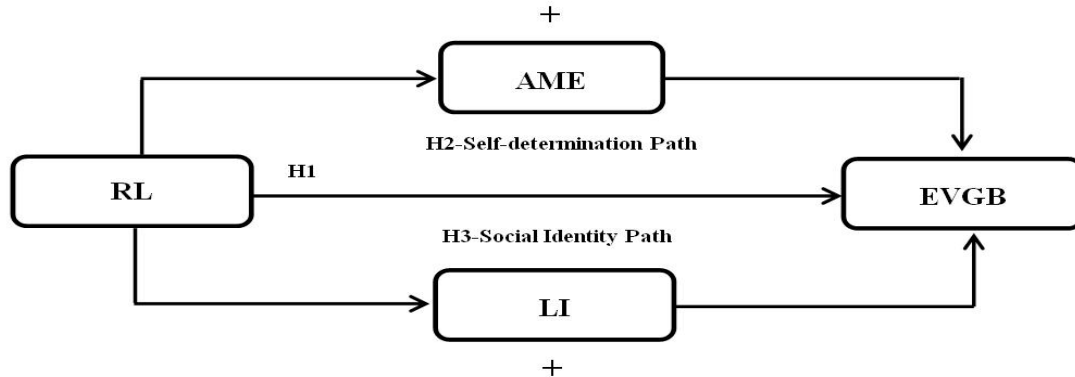


Figure 1 Theoretical Model

### 3 Methodology

#### 3.1 Sample and procedure

Data were collected from multi sources to alleviate the likely occurrence of the common method bias (Podsakoff, MacKenzie, & Podsakoff, 2012). Two separate questionnaires with the help of Google docs were prepared, one each for entry level officers (subordinates) and their immediate supervisors (Managers). The questionnaire for subordinates’ contains questions related to RL, AME and LI. On the other hand, the questionnaire for supervisors consists of questions related to EVGB. Webb-links of the questionnaires were sent to respondents through an email requesting their voluntary participation. Through systematic sampling technique, 701 subordinates and their immediate supervisors were selected as participants of this research. The final matched responses included a dyad of 357 ‘subordinate-supervisor’ with a response rate of 50.93 percent.

#### 3.2 Measures

All the constructs were measured on a 7-point Likert scale ranging ‘1’ strongly disagree to ‘7’ strongly agree. **EVGB** measured by the supervisors’ rating on a ten-item scale developed for organizational environmental citizenship behavior (Robertson & Barling, 2017). Employees assessed the level of **RL** of their immediate supervisors’ on a five-item scale developed by Voegtlin (2011). **AME** measured by the twelve-item from the Motivation towards Environment Scale of Pelletier, Tuson,



Green - Demers, Noels, and Beaton (1998). LI scale consisted of five-item adopted from the studies of (Mael & Ashforth, 1992) and (Shamir, Zakay & Popper, 1998).

**4 Results**

The analysis of this study was carried out by employing partial least squares structural equation modeling (PLS-SEM) through the Smart-PLS 3.2.8 software. In recent years PLS-SEM has shown its footprints over diversified management disciplines (Joseph F Hair, Sarstedt, & Ringle, 2019). A two stages approach namely (i) measurement model evaluation, (ii) structural model evaluation was employed to analyze the results of PLS-SEM.

**4.1 Measurement model evaluation**

In the evaluation of measurement model, distinction between ‘reflectively’ and ‘formatively’ designed constructs must be considered at the outset. All the constructs in this study were reflectively designed. The evaluation of the reflectively designed models in PLS-SEM ensured through individual indicator reliability, internal consistency-reliability of the construct, convergent validity, and discriminant validity (Joe F Hair, Risher, Sarstedt, & Ringle, 2018). At first, individual indicator reliability was examined by the standardized factor loadings. Reliability is established when an indicator has a standardized factor loading of  $\geq 0.708$  on its respective construct (Joe F Hair et al., 2018). Values of the factor loadings for all the constructs are presented in Table-1. Second step requires examining internal consistency/reliability of the reflectively designed constructs. The latest guidelines recommended the use of Dijkstra and Henseler (2015) ‘ $\rho_A$ ’ as an approximately precise measure. Third step requires establishing convergent validity of the constructs and for this purpose average variance extracted (AVE) is a widely used metric. Findings presented at Table-1.

**Table 1 Reliability, Convergent Validity, and Quality Indicators**

Construct	Loading (Range)	Cronbach’s ( $\alpha$ )	Rho-a	CR	AVE	R <sup>2</sup>	Q <sup>2</sup>
EVGB	[0.737, 0.876]	0.866	0.806	0.897	0.728	0.820	0.552
AME	[0.812, 0.875]	0.831	0.826	0.848	0.826	0.517	0.401
LI	[0.791, 0.827]	0.825	0.830	0.895	0.825	0.616	0.408
RL	[0.801, 0.859]	0.823	0.828	0.839	0.687	---	---

Lastly, to establish discriminant validity of the constructs, Henseler, Ringle, and Sarstedt (2015) proposed Heterotrait-monotrait (HTMT) ratio of the correlations. A threshold value upto 0.85 is recommended. The HTMT values are presented at Table-2.

**Table 2 Assessment of the Discriminant Validity through HTMT Approach**

Construct	AME	EVGB	LI	RL
Autonomous Motivation for Environment				
Employees’ Voluntary Green Behavior	0.825			
Leader Identification	0.803	0.811		
Responsible Leadership	0.815	0.702	0.815	

**4.2 Structural model evaluation**

The standard criteria for evaluating the structural model includes the statistical significance of the path coefficients ( $\beta$ ), the coefficient of determination (R<sup>2</sup>), the blindfolding based cross validated redundancy measure (Q<sup>2</sup>), and the effect size (f<sup>2</sup>). Values of all of these indicators are consistent with the established threshold. Results are presented at Table-3.

**Table 3 Results of Hypothesized Relationships**

Direct Path	$\beta$	t-Value	p-value	f <sup>2</sup>	Confidence Interval		Decision
					5 % LL	95 % UL	
RL -> EVGB	0.727	17.529	0.000	0.290	0.675	0.790	Supported
Indirect Path	DE	IE	TE	Confidence Interval		Nature of Mediation	
RL -> AME -> EVGB	0.053	0.419	0.725	0.332	0.513	Partial	
RL -> LI -> EVGB	0.053	0.253	0.725	0.162	0.348	Partial	

Note: LL (Lower limit), UP (Upper limit), DE (Direct Effect), IE (Indirect Effect), TE (Total Effect), and  $p < .01$  (one-tailed).

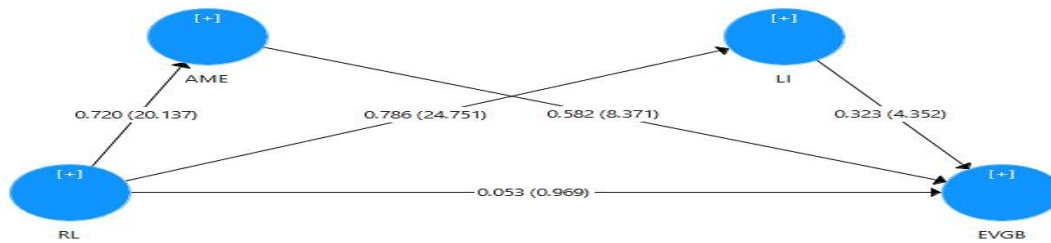


Figure 2 Structural Model

## 5 Conclusion

The results showed that 82% of the variance in EVGB was explained by RL, AME and LI. After introducing multiple mediators (AME & LI), the direct effect of RL on EVGB becomes non-significant which confirms that AME and LI fully mediate the relationship between RL and EVGB. This means that whatever the influence RL exerts on EVGB is through AME and LI. However, the mediation through AME yielded more values of  $\beta$  and  $t$  as compared to LI. Overall the results are consistent with theoretical underpinnings and empirical evidences.

Although, some studies have already investigated the impact of RL on concepts like OCBE, however, the first theoretical contribution of this study is that it is the pioneer to investigate influence of RL on EVGB. Secondly, this study employed self-determination and social identity theories to investigate the influencing mechanism of RL towards EVGB. Employing a multi-theory perspective is another unique contribution of this study. Lastly, the mediation results give deeper insights where AME is found to be more closely associated with RL and EVGB relationship as compared to leader identification. Moreover, the results also shown a full mediation model which highlights that whatever the influence RL exerts on EVGB is through AME and LI.

In the developing economies, organizations can enhance EVGB through RL. RL promotes employees' independent motivation for the environment and enhance their leader identification. Thus, there is dire need to emphasize the role of responsible leadership in the sustainable development of organizations. It is imperative to inspire the AME of employees' to engage in environmental activities. Responsible leaders can shift the continuum of employee's autonomous motivation from identified motivation to intrinsic motivation. RL also enhances EVGB through leader identification. Therefore, organizational leaders should pay attention on those attributes that can enhance their identification with their employees. An environment of trust, support, and satisfaction should be developed to encourage EVGB.

Besides above mentioned theoretical and managerial implications, this study also has some limitations. At the outset, it is accepted that this is a cross-sectional study and hence lacks in proving causality. This limitation can be undermined through a longitudinal research design. Further, this research investigated the role of only two mediators (AME & LI); future research should include additional mediators and moderators to enrich understanding about the RL and EVGB relationship. Lastly, this research included employees only from the Power Sector of Pakistan. Inclusion of multiple industries and contextual settings will enhance the generalizability of our findings.

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# Research on the Relationship between Work Stress, Psychological Capital and Turnover Intention of Frontline Service Personnel

Xiao Shuzhen, Qin Yuanjian

School of Management, Wuhan University of Technology, Wuhan, P.R.China, 430070

(E-mail: 2725626785@qq.com, qyjhb@163.com)

**Abstract:** This paper takes the frontline employees of China's service industry as the research object, and uses questionnaires and field interviews to explore the relationship between employees' work stress, psychological capital and turnover intention from the perspective of psychological capital theory. The results show that work stress correlates with employee turnover intention significantly and positively; employee's psychological capital plays a mediating role between work stress and turnover intention. This study is important for service industry practitioners looking for solutions to work stress and turnover.

**Key words:** Work stress; Psychological capital; Turnover intention; Frontline service personnel

## 1 Introduction

The departure of qualified employees is a headache for any business, and previous research has shown that one of the most important factors that disrupt employees is work stress. As we all know, high levels of work stress can easily induce physical and psychological problems for employees, which in turn leads to a series of problems such as work slack and turnover. There are two ways to effectively address employee turnover: reducing workplace stress and increasing employee stress tolerance.

With the rising of positive psychology and active organizational behavior, psychological capital has been widely concerned by scholars at home and abroad. Psychological capital transcends human capital and social capital and is a core positive psychological element that can be effectively developed and managed and can have a significant impact on individual performance (Luthans, Youssef, & Avolio, 2007). Some scholars believe that psychological capital affects employees' attitudes toward work and increases employee endurance (Avey, J. B. et al., 2009). Some scholars have confirmed that psychological capital can positively predict employee organizational citizenship behavior and negatively predict employee cynical and anti-production behavior (Avey, Luthans, and Youssef, 2010). Some Chinese researchers have explored the relationship between teachers' psychological capital and professional well-being. It is found that psychological capital promotes professional well-being through energy supplementation and motivation-inducing dual processes, and in the context of Chinese culture, interpersonal psychological capital (compared to transactional psychological capital) has a greater impact on professional well-being (Wu Weijiong et al., 2012).

This research is important because there is some room for development in the subject of observation. The existing research on the problem of this paper mostly carried out within the framework of Western culture, and the research in this paper mainly develops some arguments within the framework of Chinese culture. According to Hofstede's research, Chinese culture differs from other cultures in collectivism and has a high avoidance rate in terms of ambiguity and power distance (Lerner W J, Berry J W, Hofstede G H., 1981). Just as centralized decision made, strong leadership and limited empowerment are prominent features of Chinese culture. Therefore, testing the results of Avey et al, in a

culture different from the West, will make a significant contribution to the existing literature on this topic, both in terms of norms and values.

In addition, the object of this research - frontline service personnel, which characterized by high contact and interaction between employees and customers. The mistakes of employees in the service industry directly affect customer satisfaction, and the work stresses quite high, too. The results of this research can help organizations implement preventive measures or develop actions to reduce employee stress levels at work and separation from work stress. A reduction in work stress will also result in a worker's reduced level of error, resulting in a high level of customer satisfaction.

## **2 Theories and Hypotheses**

### **2.1 Work stress and turnover intention**

The turnover intentions defined as the probability that an employee will leave his or her job within a certain time/period (Chao M C et al., 2015). In short, turnover intention refers to the idea or willingness of an individual that want to leave the current job and look for other job opportunities. Turnover intention has been widely shown to be an important, practical antecedent variable of turnover and is the best predictor of actual turnover behavior. The turnover of employees is mostly unpredictable and often unwilling to see. Employee turnover will bring a series of costs to the organization, including acquisition costs, development costs, vacancy costs, mental impact on other employees, and threats to the company after knowledge workers (such as important technologies or trade secrets Leaked, customer lost), opportunity cost, etc.

As stress becoming more prevalent, research on stress and turnover tendencies has increased. Work stress is the change and reaction process of employees' physical, psychological and behavioral problems caused by stressors from inside or outside the employee's individual during work (Büssing A et al., 2017). Work stress is the product of the interaction between people and the environment. Existing research has shown that employees with higher pressures have higher dissatisfaction with the workplace and are more likely to lead to career withdrawal. For example, two Chinese scholars used the Guangxi Provincial Hospital as an example to study the relationship between work stress and turnover intention. The results show that work stress have a positive impact on turnover intention(Lin Yuanjie and Li Guangyu, 2018). Li conducted research on the work stress and turnover intention of 153 middle managers in private enterprises. The results showed that work stress correlate with turnover intention positively and had a positive predictive effect on turnover intention(Li li, 2017). Therefore, forming the following hypotheses:

H1: Work stress correlate with turnover intention positively.

### **2.2 Work stress and psychological capital**

Work stress refers to factors that affect the work of the members of the organization. These factors act on the members of the organization and cause them to produce abnormal psychological performance, physiological performance and behavioral performance(Han Ping et al.,2017).Studies have shown that organizational trustcorrelatewith work stress significantly and negatively, and psychological security plays a mediating role between organizational trust and work stress (Han Ping et al.,2017).In the context of the positive psychology movement, Luthans et a proposed the concept of psychological capital and

defined it as “an individual’s positive psychological state of development” that is characterized by self-efficacy, optimism, hope and resilience(Luthans et al., 2017).

Although the number of studies on stress and its coping strategies has been increasing, research on the causes of stress, coping mechanisms, and methods for effective management of stress are still insufficient. Psychological capital considered as a very important variable in dealing with stress. People believe that psychological capital can improve by training, and plays an important role in reducing the cause of stress, gaining resilience and fostering a positive working attitude (Luthans, F.et al.,2008). Based on the theory of resource conservation and social exchange theory, Song Yuan explored the impact of work stress on employee behaviors, and constructed a research model of psychological capital mediated work stress and employee behavior. The results show that psychological capital has a negative impact on work stress(Song Yuan, 2018). Fu Yao et al used knowledge surveys and multi-level regression analysis methods to study the relationship between work stress, work input and psychological capital of knowledge workers. The results also show that psychological capital has a negative impact on work stress(Fu Yao et al., 2017). Based on theoretical interpretations and research results, forming the following hypotheses:

H2: The psychological capital of employees will have a negative relationship with their work stress.

## 2.4 Psychological capital and turnover intention

At present, there are relatively few articles directly studying psychological capital and turnover intentions. Most studies focus on the process of negative adjustment of psychological capital to turnover. For example, there is a scholar pointed out that psychological capital regulates the effect of organizational support on turnover intention, and psychological capital reduces the high turnover intention when organizational support is low(Ipek, 2014). People who are satisfied with work and the workplace are less likely to leave, which indicates the positive impact of psychological capital on turnover intention. In fact, as Avey et al had confirmed, psychological capital has a negative impact on employee turnover and the tendency to find new jobs(Avey et al., 2009). Two Chinese scholars conducted a survey of 224 special teachers in Hebei Province, and found that the psychological capital of the special post teachers correlate with their turnover intention negatively(Yan Xiaojun&Zeng Xiaojuan, 2018). Wei Fengxu surveyed knowledge workers in different industries and regions, and found that psychological capital has a significant negative impact on employee turnover intention(Wei Fengxu, 2017). Therefore, forming the following hypotheses:

H3: The psychological capital of employees correlate with their turnover intention negatively.

Because psychological capital has an impact on turnover intention and work stress, and because work stress has an impact on turnover intention, the impact of a certain degree of psychological capital on turnover intention may transfer through work stress. Therefore, in order to verify this point, forming the following hypotheses:

H4: Work stress mediates the relationship between psychological capital and turnover intention.

The following is the research model of this paper.

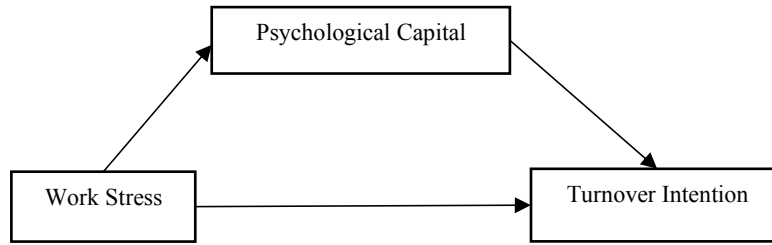


Figure 1 Research Model

### 3 Data and Methodology

#### 3.1 Data collection

The survey respondents are mainly frontline service personnel. The survey covers a wide range of industries, including catering, clothing, and tourism. The way of collecting data in this study are questionnaire survey and field interview. The questionnaires were answered anonymously. The questionnaires conducted in a small-scale pilot survey firstly, if it is feasible, then to carry out large-scale distribution. There are 400 questionnaires were distributed, 324 were recovered, and 275 valid questionnaires were obtained. Among them, there are 98 males and 177 females, and the age group is concentrated between 20 to 45 years old, mostly college degree or below.

#### 3.2 Measurements

Independent variable: work stress. Using the Occupational Stress Indicator (OSI). Work stress measurement system mainly including the work itself, the work stress source outside the work itself, the evaluation of the stress strategy method, and the impact of stress on the individual (Cooper, Cary L., 2013). The measurement of the four major parts, a total of 23 topics.

Mediator variable: psychological capital. In order to determine the level of psychological capital of employees, we used the psychological capital scale developed by Luthans et al. The 24 mental capital scales consist of four parts, including hope, self-efficacy, resilience and optimism, each of which contains six projects (Luthans et al., 2008).

Dependent variable: turnover intention. The current turnover scale which widely accepted by foreign scholars was developed by Mobley. Mobley believes that employees' turnover intention can change their organizational cognition, generate exit ideas, find new jobs, and find new jobs (Mobley, 1997). The measurement of the four aspects. The scale is widely used and the reliability and validity are creditable.

All survey items are using the Likert 5-point scale to score. The Likert 5-point scoring standard has the following meanings: 1 means "completely disagree" and 5 means "completely agree". We used SPSS software 22.0 in data processing. The analysis methods of data including reliability and validity



analysis, descriptive statistical analysis, correlation analysis, and simple multiple linear regression analysis.

## 4 Results

### 4.1 Reliability and validity analysis

The KMO values of all the scales were above 0.7, the Cronbach coefficients of the work stress scale, the psychological capital scale, and the turnover intention scale were 0.804, 0.873, and 0.902, which indicating good internal consistency. Since all measured subjects from the maturity scale, we used the confirmatory factor analysis (CFA) to evaluate the discriminant validity between variables, and used the Mplus7.0 software to compare the three-factor, two-factor and single-factor models. As shown in Table 1, the three-factor model has the best fitting effect (CFI=0.92, TLI=0.91, RMSEA=0.08). This shows that there is a high degree of discriminant validity between work stress, psychological capital and turnover intention, and further statistical analysis can be carried out.

**Table 1 Confirmatory Factor Analysis (CFA)**

Model	$\chi^2$	df	CFI	TLI	RMSEA
Three-factor model	481.85	183	0.92	0.91	0.08
Two-factor model	1078.42	186	0.76	0.73	0.14
Single-factor model	1416.75	189	0.67	0.63	0.16

### 4.2 Descriptive statistics and correlation analysis

The results of the correlation analysis of the study variables are shown in Table 2. As we can see from Table 2, the work stress and turnover intention were significantly and positively correlated ( $r=0.74$ ,  $p<0.01$ ), and had a significant negative correlation with psychological capital ( $r=-0.605$ ),  $p<0.01$ ). There was a significant negative correlation between psychological capital and turnover intention ( $r=-0.725$ ,  $p<0.01$ ).

**Table 2 Mean, Standard Deviation and Correlation Coefficient of Study Variables**

Variables	Mean	SD	1	2	3
Work stress	3.64	0.87	1		
Psychological capital	4.05	0.79	-0.605**	1	
Turnover intention	4.17	0.86	0.74**	-0.725**	1

notes: \*\* $p<0.05$ ; \* $p<0.1$ (Two-tailed).N=275.

### 4.3 Hypothesis testing

This study analyzed the 275 valid questionnaires that we collected to examine the main effects of work stress and turnover intention. We also examined the mediating role of psychological capital in work stress and turnover intention. In this study, the hypothesis was tested by using the hierarchical regression method. The results are shown in Table 3.

**Table 3 Hierarchical Regression Results**

Variables	Psychological capital			Turnover intention		
	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6
1. Control variables						
Gender	0.05	0.02	0.01	0.05	0.03	0.02
Age	0.04	0.04	0.01	0.04	0.04	0.02
Education	-0.04	-0.01	-0.02	0.06	0.08	0.08*
2. Independent variable						
Work stress		-0.66***		0.74***		0.46***
3. Mediating variable						
Psychological capital					-0.43***	0.37***
R <sup>2</sup>	0.08	0.24	0.31	0.08	0.26	0.31
Adj. R <sup>2</sup>	0.01	0.16	0.29	0.01	0.23	0.27
F	2.083*	18.199***	2.98**	20.642***	27.081***	46.016***

notes: \*\*\*p<0.01; \*\*p<0.05; \*p<0.1(Two-tailed). N=275.

#### 4.3.1 Main effect

In the model of Table 3, gender, age, and education level are control variables. Model 3 is the relationship among control variables and turnover intention. Model 4 added independent variables and dependent variables. The results show that work stress has a positive impact on employee turnover intention ( $\beta=0.74, p<0.01$ ). Thus, Hypothesis 1 is supported.

#### 4.3.2 Mediating effect

As mentioned earlier, we already know that work stress related to turnover intentions significantly and positively. In order to test the mediation effect, we still need to take three steps.

First, we tested whether the mediator is affected significantly by the independent variables. As shown in Table 4, Model 2 is a regression model of the psychological capital independent variable. The results reveal that work stress is significantly negatively correlated with psychological capital ( $\beta = -0.66,$

$p < 0.01$ ). Therefore, Hypothesis 2 is supported.

Second, we tested whether the mediator has a significant effect on the dependent variable. Model 5 shows a significant negative correlation between psychological capital and turnover intention ( $\beta = -0.43$ ,  $p < 0.01$ ), which means that the higher the psychological capital level of frontline service personnel, the lower their turnover intention. Therefore, Hypothesis 3 is supported.

Third, we put the mediator into the equation at the same time and tested whether the independent variable still significantly affects the dependent variable. Compared with model 5, after adding mediator variables, the positive impact of work stress on turnover intention is weakened ( $\beta = 0.46$ ,  $p < 0.01$ ), indicating that psychological capital plays a partial mediating role between work stress and employee turnover intention, and Hypothesis 4 is supported.

## 5 Conclusions

This study focused on the relationship between job stress, psychological capital and turnover intention of the frontline service personnel and the possible mechanism of action. It is expected to achieve the goal of further reducing the turnover intention by intervening psychological capital level.

### 5.1 Theoretical significance

The analysis results show that there is a significant relationship between the three variables. First, work stress correlates with employee turnover significantly and positively. The greater the work pressure, the mental state and physiological state of the employees cannot be guaranteed, it is easy to occur late, early leave, absenteeism, and even leave, and other counter-productive behaviors. This conclusion is consistent with previous studies. Second, work stress correlates with employee psychological capital negatively. The higher the level of psychological capital, the stronger the self-regulation ability and the higher the ability to withstand stress. Finally, psychological capital correlates with turnover intentions negatively. Psychological capital plays a mediating role between work stress and turnover intention. That is to say, psychological capital can improve employees' ability to withstand stress to a certain extent, and alleviate the tight mental state of employees, thereby reducing a series of absenteeism and turnover intentions.

### 5.2 Managerial implications

Analysis of the research data demonstrates that lowering employee stress levels by raising employees' psychological capital levels, initial expectations of implementing preventive measures or taking action may help reduce employees' turnover. Some HR departments will adopt some methods before they finally decide to recruit. One way is to conduct some tests on potential candidates during the recruitment process to determine their ability to withstand stress. Unfortunately, in these tests, some candidates were disqualified due to their weak stress. However, these candidates can get professional assistance to strengthen their ability to withstand stress. Therefore, psychological capital helps to increase an individual's resilience threshold by providing them with resistance to stress skills and it has been seen as a very important factor in this regard. With the help of training programs, applicants with weaker resistance to stress are no longer as barriers to the workplace. Department managers and HR departments should consider these conclusions more seriously.

## 5.3 Limitations and future prospects

One limitation of this study is that employees have predicted their perception of stress levels. This is a very important limitation considering the psychological state of the participants at the time of the survey and the stress in life. Another limitation is the employee's tendency to quit. Many employees may not be honest with their ideas because they are afraid to be known by their superiors, even though they were told that their identity would be kept confidential. At the same time, the research framework of this paper is relatively simple, and can be discussed in more detail and in-depth in future research.

There is a need to strengthen longitudinal tracking and intervention research on psychological capital. Most of the existing researches use horizontal research, and there are few longitudinal tracking studies, which are difficult to reveal the dynamic laws and specific mechanisms of psychological capital development. Therefore, on the one hand, longitudinal research on psychological capital should be intensified (such as investigating the cross-time effect of psychological capital through multiple measurements). On the other hand, intervention experiments should be conducted for different groups to reveal the specific mechanisms of psychological capital and the utility of intervention.

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## Research about Precision Incubation Model of Innovation and Entrepreneurship Based on the Incubation Network

Wen Ge, Xia Yongmei, Huang Yangbo, Han Yu

School of Management, Chengdu University of Information Technology, Chengdu, P.R.China, 610103

(E-mail: 8829177@qq.com, 1061525967@qq.com, 404387471@qq.com, 2443326672@qq.com)

**Abstract:** Traditional incubation network emphasizes the link function of network resource, ignores the supply ability and actual demand of network members, and lacks precise and effective resource matching. In this paper, the causal analysis method of system dynamics is used to analyze the main influencing factors in incubation network. It further analyses the recognition and matching mechanism of precise incubation and constructs the framework of precise incubation network platform. The function orientation of precise incubation network platform is to integrate different incubating functions, refine incubation services, avoid information asymmetry, and provide highly matched cooperation between supply and demand in the incubation process, to solve the contradiction that single incubator cannot meet the needs of incubating enterprises and form idle resources or insufficient resources.

**Key words:** Innovation and entrepreneurship; Precision Incubation; Incubation Network; System dynamics

### 1 Introduction

Innovation and entrepreneurship incubation promote all kinds of ideas and projects to stand out, so that start-ups can improve the speed of development and build stronger vitality. Incubator organically links scientific and technological innovation with the growth of industrial economy and becomes the key link of national innovation system (Baraldi, 2016). Incubator achieves information and knowledge transfer and improves incubation efficiency by continuously improving the process of enterprise residence and graduation, building platform for start-up enterprises and resource sharing platform (Vanderstraeten et al., 2014). At the same time, the growth of enterprises has its own regularity. Simply emphasizing resource support is not conducive to the effective growth of start-up enterprises, but will cause the waste of entrepreneurial resources (Dirk, 2015). The process of entrepreneurship is a complex and dynamic process. Enterprises in different growth stages should adjust dynamically. As incubators, they should make corresponding adjustments to match the development of enterprises.

According to China's "Thirteenth Five-Year Plan for the Development of National Science and Technology Business Incubators", by the end of 2020, there will be 10,000 entrepreneurship incubators, more than 1,500 state-level incubators and more than 3,000 state-recorded incubators. Faced with such a huge number of innovative and entrepreneurship incubators, how to provide precise and targeted services according to the actual needs of different stages of business activities from the "demand side" is an important issue facing the incubator platform. Accordingly, this paper analyses the dynamic mechanism of each element in the incubation network, studies the precise identification mechanism of supply and demand and the precise matching mechanism of supply and demand, and puts forward the framework of precise incubation platform, which has three functions. One is to put the specific services

provided by multiple incubators on one platform, the other is to link incubating enterprises on the network platform, and the third is to provide incubation services according to the specific needs of incubating enterprises in different development periods. This study has a certain reference value for the rational and effective use of limited resources to achieve precise service in the incubation of innovation and entrepreneurship.

## 2 System Dynamics Analysis of Main Influencing Factors in Incubation Network

### 2.1 Causality diagram of elements

As a platform of social resources integration, incubator can conclude the competitive and cooperative relationship between upstream and downstream enterprises, and establish a platform of production, education and research among universities, research and development institutions and enterprises (Zhou Jianhua et al., 2011). Incubation network is an organizational network with resource sharing effect produced by the close cooperation between incubator and other kinds of behavior nodes in the network. (Tiago et al., 2010). Incubator operation capability enhancement is the core driving force of regional incubation network collaborative innovation. With this goal, local governments, incubators and related auxiliary entities are unified in the framework of collaborative innovation system (Li Zhenhua et al., 2016). incubating enterprises or project and the incubation chain constitutes the core of the incubation network, which includes links with the government, universities and research institution, financial institutions, intermediaries, and trade associations. These links have a systematic impact on incubating enterprises through incubators. At the same time, resource complementarity among incubating enterprises will affect the evolution effect of incubation network (Zhang Han et al., 2014). The causality of each element of incubation network is shown in Figure 1.

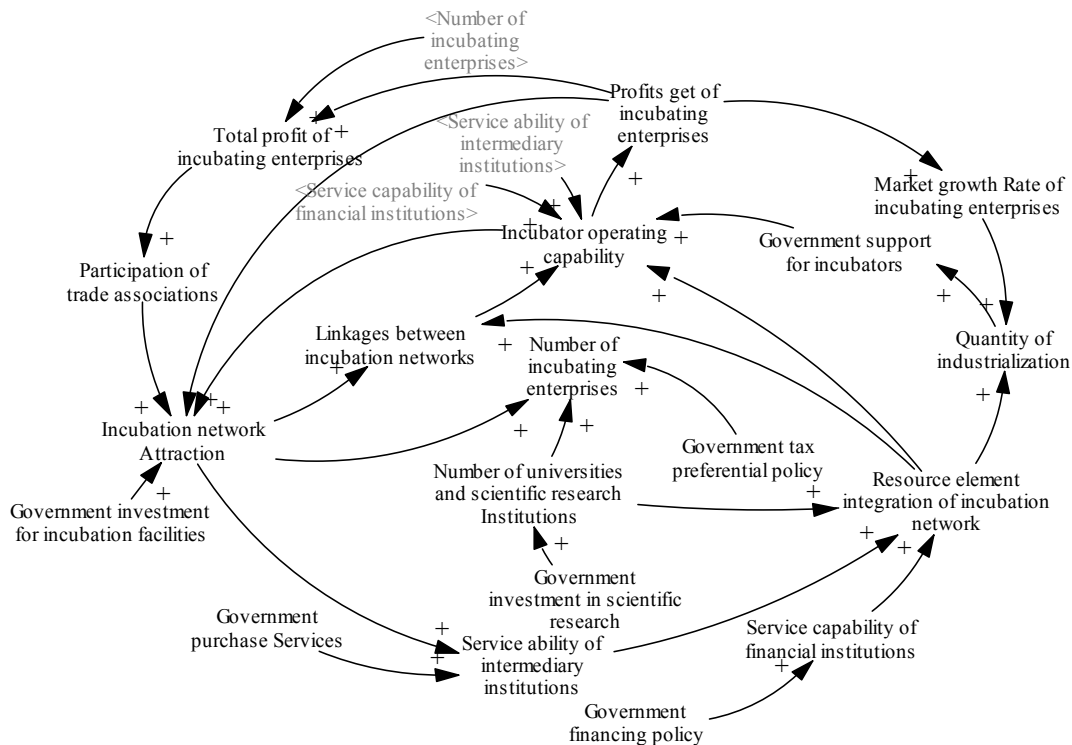
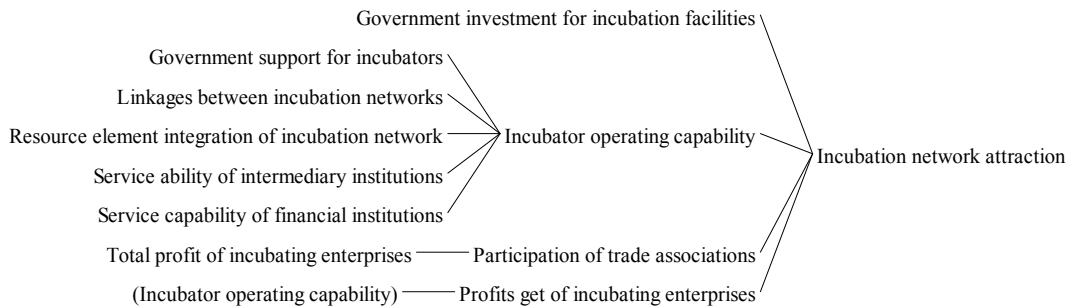


Figure 1 Causality Among Elements in Incubation Network

This is a positive feedback system with 24 elements, forming a positive feedback loop, each of which reflects the interaction between the elements. Among them, there are four direct factors affecting the attractiveness of incubation network, namely, the profit gets of incubating enterprise, the incubator operation, the government investment for incubator facilities, and the participation of trade associations. There are six indirect influencing factors, namely, service capability of intermediary institutions, linkages between incubation networks, resource elements integration of incubation network, and government support for incubators.

**2.2 Analysis of the dynamic mechanism of the attraction of incubation network**

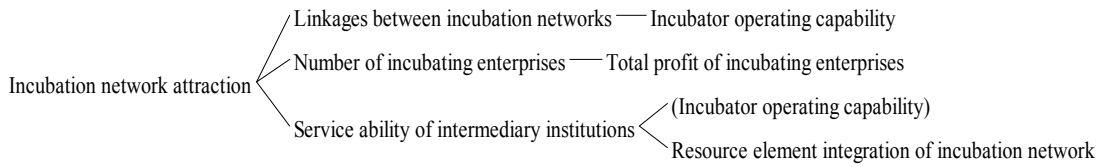
There are four direct factors affecting the incubation network attraction, which are government investment for incubation for facilities, incubator-operating capability, participation of trade associations, and profits get of incubating enterprises. There are six indirect influencing factors, namely, government support for incubators, linkages between incubation networks, resource element integration of incubation network, service ability of intermediary institutions, service capability of financial institution, and total profit of incubating enterprises. As shown in Figure 2. Incubation networks need to pay attention to these factors if they want to enhance their attractiveness. Among these factors, the operating capacity of incubator is within its control. It can be improved by choosing intermediary agencies, establishing good incubation network relationship and strengthening communication with the government. The government's investment in incubation facilities is uncontrollable by themselves, because it is influenced by many factors such as national policy, financial budget and so on.



**Figure 2 Cause Tree Analysis of the Incubation Network Attraction**

At the same time, the incubation network attraction will have a direct impact on the linkages between incubation networks, number of incubation enterprises and service ability of intermediary institution, and indirectly affect the incubator operating capability, total profit of incubating enterprises, and resource element integration of incubation network. Shown as Figure 3. Combining with the analysis of Figure 2, it can be found that the incubation network attraction is not only affected by the service ability of intermediary institutions, but also affect it, which cause a positive feedback. Therefore, the incubation network needs to make a thorough investigation and be cautious when introducing intermediary service institutions. After introducing intermediary service institutions, it needs to cooperate sincerely with intermediary service institutions and make win-win situation.

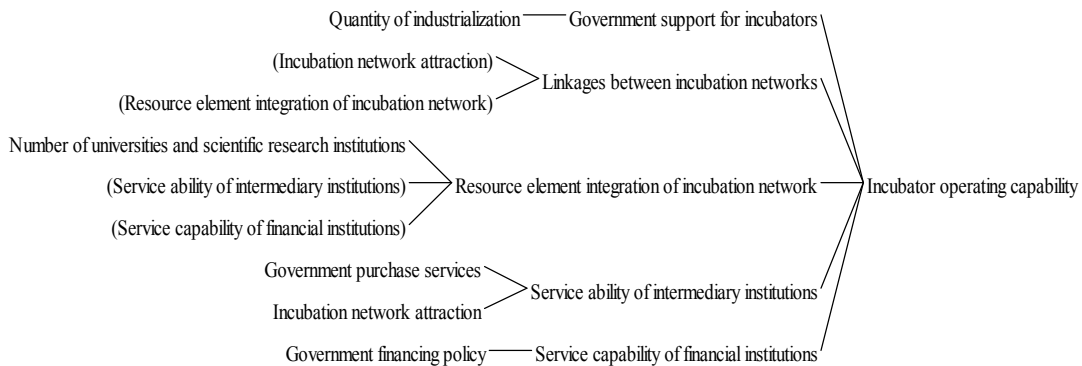




**Figure 3 Result Tree Analysis of the Incubation Network Attraction**

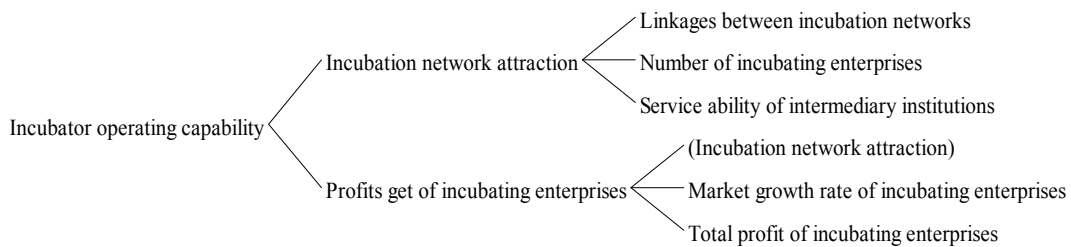
**2.3 Dynamic mechanism analysis of incubator operating capability**

There are five direct factors affecting incubator's operation capability, namely, government support for incubators, linkages between incubation networks, resource element integration of incubations, service ability intermediary institutions, and service capability of financial institutions. There are also five indirect factors, namely, quantity of industrialization, number of universities and scientific research institutions, government purchase services, and government financing policy. As shown in Figure 4. There are many factors affecting the operation ability of incubators. It is obvious that the operation of incubators is a systematic project. It is not only to select the incubated enterprises or projects, but also to carry out the work from all directions and from many angles. Incubator can further establish the index system of self-operation ability, analyze its advantages and disadvantages one by one, make up for the shortcomings and improve the operation ability.



**Figure 4 Cause Tree Analysis of Incubator Operating Capability**

At the same time, the incubator operating ability directly affects the incubation network attraction and the profit of incubating enterprises, and indirectly affects the linkages between incubation networks, number of incubating enterprises, service ability of intermediary institutions, market growth rate of incubating enterprises and total profit of incubating enterprises. As shown in Figure 5.



**Figure 5 Result Tree Analysis of the Incubation Operating Capability**

### 3 Analysis of Recognition and Matching Mechanism of Precision Incubation

#### 3.1 Accurate identification mechanism of supply and demand

Simply increasing the supply of entrepreneurial resources does not bring about changes in the number of incubating enterprises and hatched rate. Only by combining the supply of entrepreneurial resources with the promotion transformation ratio of enterprises in each stage can improve the efficiency and income of entrepreneurial incubation (Zhang Baojian et al., 2017). It can be seen that accurate identification of supply and demand is the premise of effective resource provision of incubators. In order to realize the accurate identification of supply and demand, On the one hand, it should have the data about incubating enterprises for incubating enterprises from gestation period to establish a detailed database. It contents mainly three aspects. Firstly, the basic information of an enterprise, include registered capital, shareholder structure, industry structure, enterprise type and business scope. Secondly, the business data of an enterprise, include market share, market growth rate, sales revenue, and profit and tax payment. Thirdly, the management data of an enterprise include its organizational structure, number of enterprises, personnel structure and personnel increase or decrease, etc. On the other hand, it should have data about hatching which also contains three aspects. One is the detailed decomposition of services provided by incubators within or even across regions; the other is the latest developments of industries or industrial technologies in the whole country; and the third is successful incubation cases at home and abroad. These data are the basis of accurate identification. The finer the classification, the more real the data, and the stronger the recognition ability. Through the coupling of supply and demand data, the accurate identification can be achieved, as shown in Figure 6.

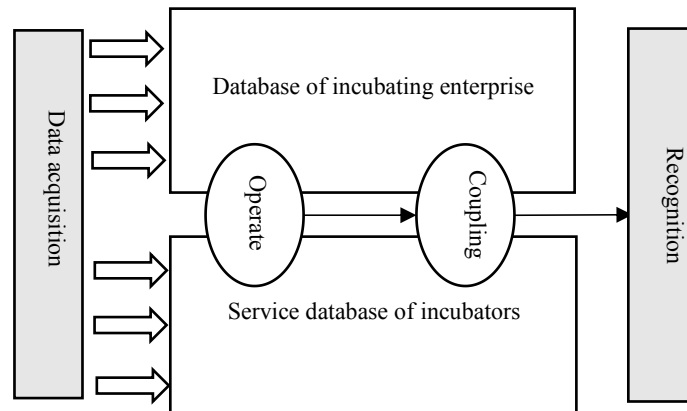


Figure 6 Accurate Identification Mechanism of Supply and Demand

#### 3.2 Precise matching mechanism between supply and demand

In the process of incubation, because the policies supporting SMEs are not clear, the driving force of incubators is insufficient, and the effect of resource investment is not clear, the establishment of incubation network relationship and the resource allocation are greatly uncertainty. Therefore, incubators and incubating enterprise will pay more for this. On the other hand, in the process of incubation cooperation, information asymmetry is also a problem that perplexes incubators and incubating enterprise, forming obstacles to effective cooperation between them. It is necessary to improve the efficiency of incubation services by effectively matching service providers and consumers and choosing appropriate service implementation paths to reflect the customization of service content and process (Zhang Li et al., 2018). In the incubation network, there are such situations. Firstly, multiple

incubators will provide the same incubating enterprise. Secondly, different incubators will provide different services even for the same incubating enterprise. Thirdly, different institutions provide different services for same demand. Fourthly, the demands of incubating enterprises are different. Fifthly, Even if the demand is the same, the effect of the same service is quite different due to the differences of the industry, scale, product characteristics and managers of the enterprise. Precise matching of supply and demand is to solve the waste of resources caused by uncertainty and information asymmetry, so that incubators can provide accurate services for incubating enterprises. When matching, big data is needed to calculate the data of incubating enterprises and the specific services of incubating institutions. At the same time, we also need to refer to the relevant case base to predict the effect of service matching, as shown in Figure 7.

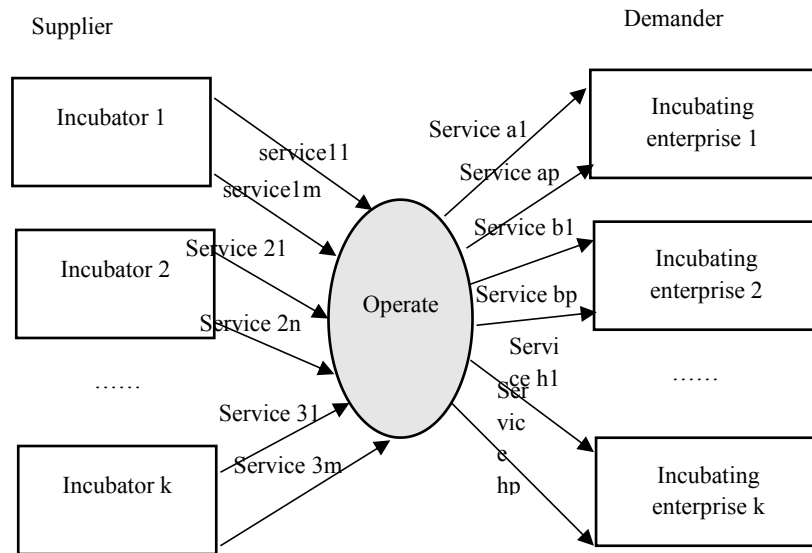


Figure 7 Precise Matching Mechanism Between Supply and Demand

## 4 Construction of Precision Incubation Network Platform Framework

### 4.1 Functional orientation of precision incubation network platform

At different stages of the development of incubators, the demand for the use of incubating resources is changing (Cheng Xiaoxiao, 2016). There are three functions of the Precision Incubation Network Platform. One is to put specific services provided by multiple incubators on one platform. Second, the incubating enterprises will be linked to the network platform. Thirdly, according to the specific needs of incubating enterprises in different development stages, it should provide incubation services in a targeted manner.

Unlike traditional incubation networks. First, on the precise incubation network platform, the specific services provided by incubators need to be refined as much as possible. On the one hand, due to different specific needs of different incubating enterprises, on the other hand, based on resource saving, it is reflected in reducing costs for incubating enterprises and reducing waste for incubator's resource. Secondly, it is able to accurately judge the development stage of incubating enterprises, complete recording and analysis of data, suggesting for incubation service demand of incubating enterprises, which is important, because many enterprises are unable to carry out objective quantitative analysis of themselves. Thirdly, the matching of incubation services must be targeted.

#### 4.2 Network architecture model

Network architecture model is divided into three layers, which is core layer, support layer and external environment layer. The core layer is mainly the interaction between incubator and incubating enterprises, and its interaction foundation depends on the support of big data. From the choice of incubating project to the final completion of incubation, there are big data analysis as the technical basis for decision-making. Because of the precise calculation of big data, the boundaries of "entrepreneurial nursery", "incubator" and "accelerator" becomes indistinct on the precise incubator platform. The support layer mainly includes universities and research institution, relevant intermediaries and regional incubator associations, etc. Universities and research institution provide a continuous stream of innovative entrepreneurship projects. Relevant intermediaries provide various differentiated services, while regional incubator associations monitor incubation behavior, they make incubation network run orderly. The external environment includes the policy support, external markets and industry associations. At the same time, there are talent flow, policy flow, knowledge flow and capital flow in the whole network, which constantly form internal and external interaction, making the whole platform a developed system that constantly exchanges energy with the outside world.

The framework model of precise incubation network platform is shown in Figure 8.

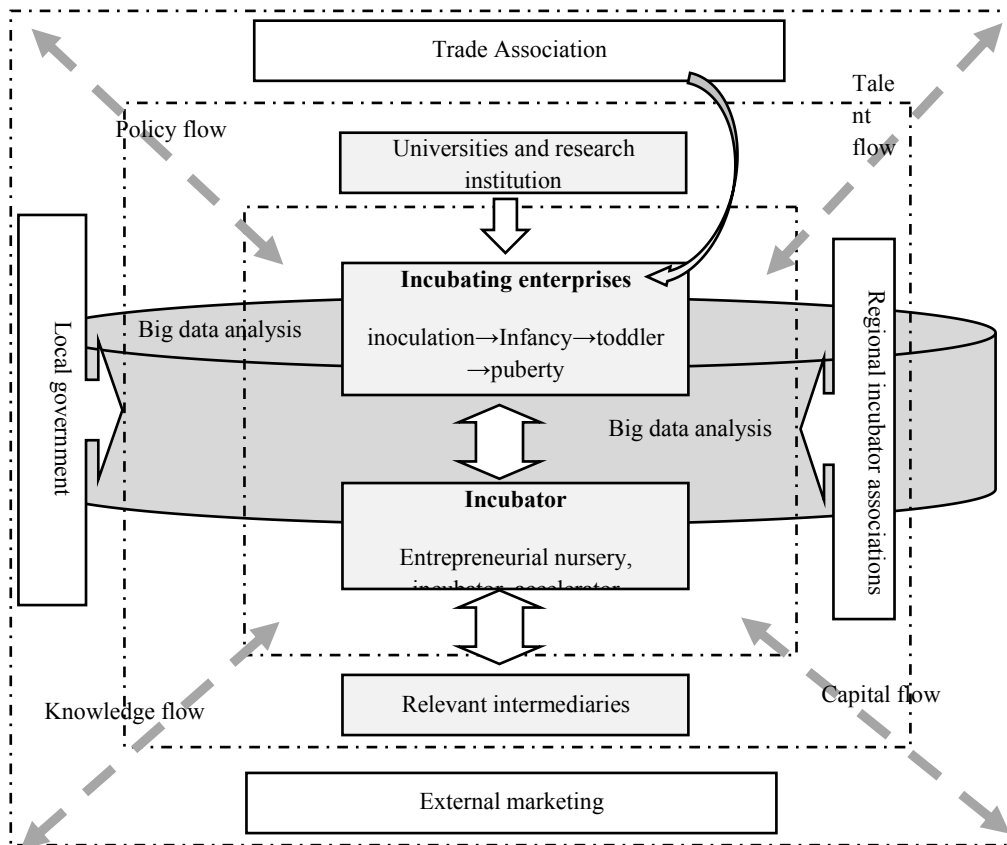


Figure 8 Framework Model of Precision Incubation Network Platform

Network members with high overlap of technology build incubation network around core node professional incubator. The homogeneity of technology, knowledge and resources is conducive to the

construction of ability trust and behavior ability among network members (Wang Zhaoqun et al., 2018). Multi-center governance is simpler through the network platform. Local governments, regional incubators associations, incubators, related intermediaries and incubating enterprises integrate their data on one platform to achieve the cumulative effect of incubation resources. The coalition of incubators and related incubator service providers is the core component of the network. It provides services for incubating enterprises, provides policy support for local governments, and supervises and maintains the network by regional incubator associations.

## 5 Conclusion

Traditional incubation network emphasizes the link function of network resource, ignores the supply ability and demand of network members, and lacks precise and effective resource matching. Precision incubation mode is to make the information function of innovation and entrepreneurship incubator more perfect and precise through incubation network platform. Through large data analysis, it can improve the ability of information analysis and processing, and make the incubators and incubating enterprises effectively avoid the waste of resources caused by information asymmetry. Incubator network platform integrates different functions of incubators, provides a high degree of matching between supply and demand in the process of incubation, resolves the contradiction that single function of incubator cannot meet the needs of incubating enterprises, and forms the contradiction of idle or insufficient resources. Incubator can realize dynamic and timely adjustment and maintenance on the network platform that keep the vitality of the whole incubation behavior.

Achieving precise incubation requires the necessary supporting elements and service segmentation. Therefore, future research can further study the stage division index of start-up enterprises and the segmentation method of incubation business.

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## **Curve Impact of Knowledge Heterogeneity on Team Creativity: The Moderating Effect of Internal Social Capital**

Dai Wanliang<sup>1</sup>, Lu Wenling<sup>1</sup>, Su Lin<sup>2</sup>

1 College of Management, Bohai University, Jinzhou, P.R. China, 121013

2 College of Engineering, Bohai University, Jinzhou, P.R.China, 121013

(E-mail: daiwanliang@yeah.net, 23809162@qq.com, 1735742119@qq.com)

**Abstract:** Based on Knowledge integration theory and social exchange theory, the conceptual model of the influence of knowledge heterogeneity on team creativity is constructed in Chinese cultural context. Based on multiple regression analysis based on 308 samples, the findings are as follow. On the one hand, the relationship between knowledge heterogeneity and team creativity is inverted U type. On the other hand, as the moderating variables, the three dimensions of internal social capital positively moderate the relationship between knowledge heterogeneity and team creativity. The implications and limitations of this study are put forward.

**Key words:** Team creativity; Knowledge heterogeneity; Internal social capital; Curve Impact

### **1 Introduction**

Team cooperation is one of the effective ways to promote innovation, but it does not necessarily mean that it must be able to promote innovation. The biggest problem limited team creativity is low working enthusiasm and creativity of team members. Team creativity is not the simple addition of individual creativity, but it is the crystallization and sublimation of knowledge exchange and thinking collision of team members. It becomes the key issues to be solved by the team to improve the creativity how to motivate team members to actively expand knowledge exchange and thinking collision.

It is one of the hot topics in innovation research how to form creative force by condensing team members effectively. Scholars have discussed the external factors that affect the team creativity, such as leadership behavior (Luo, Men and Zhong, 2014), innovation culture (Li, Yang and Ma, 2018), organizational climate (Young, Jing and Nam, 2018), innovation support (Eisenbeiss, Knippenberg and Boerner, 2008) and so on. However, it still fails to discern the mechanism of team creativity. On the one hand, there is little literature on team creativity focused on the external knowledge network produced by knowledge heterogeneity.

There is a gap between the team members, so how to cross the knowledge gap is a key issue to solve for team cooperation. Creativity is the result of continuous collision and integration of heterogeneity knowledge, rather than individual "behind closed doors". On the other hand, the study on the relationship between team members and team creativity is not much. It is the key to gain the benefits of knowledge heterogeneity completely that connecting the knowledge heterogeneity completely (Ni and Xue, 2013). Therefore, it is very important for knowledge sharing among members to keep good communication and cooperation.

As far as team creativity is concerned, the greater the degree of knowledge heterogeneity is the better. Knowledge heterogeneity is bound to lead to creative thinking. There is no conclusion about these questions above. For the lack of existing research, this paper is devoted to analyzing the influence of knowledge heterogeneity among team members on the team creativity, and to exploring the moderating effect of different dimensions of internal social capital. The conclusions could enrich the research of team creativity from the theoretical level, and provide some practical support to improve the creativity for the team.

## **2 Research Hypothesis**

### **2.1 Creativity**

The study of creativity is a classical psychological proposition. Based on different perspectives, scholars have different understanding on creativity. On the one hand, based on the trait theory, creativity is a kind of characteristic and that the individual has in itself and a kind of ability to show. On the other hand, creativity is the process by which an individual puts forward and actually uses novel and useful ideas for work tasks. Innovation is the impact of various thinking; collaborative innovation relies on team operation gradually replace the "heroism" innovation rely on individuals' power in the rapidly changing market demands. On the one hand, innovation is a new combination of production function, so knowledge reorganization is an inevitable requirement. In this process, knowledge heterogeneity is an important source of stimulating team creativity. On the other hand, team creative activity has a high complexity; therefore, seamless cooperation between team members is highly required. As the interests of the team members are not unique, the mechanism is necessary to promote team members to work together for innovation.

### **2.2 Knowledge heterogeneity**

According to the definition of Tiwana and McLean, knowledge heterogeneity refers to the extent of the expertise differences among team members (Tiwana and Mclean, 2005). According to the classification of team heterogeneity, knowledge heterogeneity is subordinate to task-related heterogeneity and underlying diversity (Lv and Zhang, 2015). This indicates that knowledge heterogeneity directly points to the completion of the task, by which a series of team behavior caused will have a role in the team's tasks and objectives. In addition, the difference is not significant, and it is not easy to be directly found by team members. Knowledge heterogeneity would gradually appear when team members communicate, discuss and argue in order to accomplish teamwork. The impact of knowledge heterogeneity on the



team has been controversial. On the one hand, cognitive resource theory believes that knowledge heterogeneity can bring a variety of knowledge to the team and improve the degree of diversification of team cognition, and ultimately improve team output (Chow, 2018). On the other hand, social classification theory believes that knowledge heterogeneity can lead to team members' Stratification and the problem of small groups, which is not conducive to cooperation and even lead to vicious competition, and ultimately limit team production (Vegt and Bunderson, 2005).

### **2.3 Internal social capital**

Social capital is derived from the field of sociology, which refers to the "relationship assets" such as relationship and friendship between people. After the introduction of the field of management and organizational behavior, social capital is generally used to characterize the structure and characteristics of social networks in the modern sense. It is generally believed that social capital has the same importance as other capital, and even more important. According to different levels of research, social capital can be divided into external social capital and internal social capital. Within the organization, individual activities are more influenced by internal social capital. Internal social capital mainly refers to personal communication and exchange, trust and common values and common language, which is called structural social capital, relational social capital and cognitive social capital (Nahapiet and Ghoshal, 1998).

### **2.4 The influence of knowledge heterogeneity on team creativity**

Previous research shows that knowledge heterogeneity and innovation team performance have a strong correlation, but the correlation is not unique. Most of the research points out that knowledge heterogeneity implies that there are differences in cognitive basis, and these differences will facilitate the team's positive discuss related issues. First, knowledge heterogeneity can stimulate knowledge exchange and promote the generation of knowledge conflict that can cause ideas that are more creative. Secondly, the cognitive differences caused by the knowledge heterogeneity can make the team member's vision become open and help to break the thinking mode, which is conducive to the burst of creative sparks (Amason, 1996). Finally, knowledge heterogeneity can increase the centrifugal force, and thus it is helpful to integrate potential ideas based on different fields and perspectives (Dong, Yang and Li, 2015).

However, some scholars believe that the team members are not willing to communicate with each other in heterogeneous team, and the lack of communication leads to a lower cohesion and a higher cost to absorb and utilize knowledge (Shin, Kim and Lee, 2012). Excessive heterogeneity leads to an increase in coordination costs. At the same time, the conflicts caused by the coordinated difficulty of the heterogeneous knowledge will have a negative impact on innovation (Fong, et al, 2018). Low compatibility among heterogeneous members increases the learning input of team members and reduces the utilization of knowledge. Sampson (Sampson, 2007) pointed out that a certain degree of overlap in knowledge and ability is required in terms of the best use of partner learning.

In view of knowledge view, the overlapping knowledge and distributed knowledge also named heterogeneous knowledge exist in the team at the same time. For the overlapping

knowledge, the team can achieve a tacit understanding without too much communication and sharing. By contrast, sparkle generated by the diversity of resources brought by knowledge the heterogeneity may be conducive to the creation of a revolutionary innovation, but it is also possible to burn the team out. In general, the role of overlapping knowledge in the team is essential, which makes the team members to coordinate action. However, more is not necessarily better. Too many overlapping knowledges not only limits the team knowledge innovation but also wastes the team's cognitive resources (Hughes, et al, 2018). Theoretically, the reduction of knowledge collision caused by cognitive differences can lead to a very difficult to produce innovative ideas, when knowledge heterogeneity is too low. However, when knowledge heterogeneity is too high, poor team communication and lower member satisfaction will lead to team members to ignore the value of each other's views and even generate emotional confrontation (Wang and Peng, 2011).

Therefore, this study proposes the following research hypothesis:

Hypothesis 1: there is an inverted U relationship between Knowledge heterogeneity and team creativity.

## **2.5 The moderating effect of internal social capital**

Social cognitive theory points out that the factors that affect the team may be rooted in their internal core beliefs. Internal social capital, the perception of internal relations of team members, can well explain the complexity of the relationship between knowledge heterogeneity and team creativity. Firstly, it will often require more communication to integrate these views and solutions caused by knowledge heterogeneity. Therefore, the communication and exchange among team members both promote the full collision of heterogeneous knowledge and avoid knowledge misunderstanding. Secondly, common belief is the key factor to influence knowledge sharing (Goh and Hooper, 2009). According to the "similar-attract" paradigm, individuals with the same attributes tend to have higher mutual recognition. The degree of knowledge sharing between individuals belonging to the same group is relatively high, and knowledge conflict is unlikely to occur. Conversely, team members belong to different groups realize each other that they are not easy to cooperate with each other and their ability is limited. In this case, Knowledge will not be fully shared, and knowledge conflict will appear accompanied by the disagreement with each other. Thirdly, Dai, Yang and Li (2019) believe that one of the main important factors influencing knowledge sharing is the establishment of trust relationship. The trust in each other can reduce the doubt and resistance to heterogeneous knowledge, and upgrade the courage to accept and absorb heterogeneity knowledge for their own use. Once the trust is missing, the knowledge-isolated island caused by the knowledge heterogeneity will appear.

Therefore, this study proposes the following research hypothesis:

Hypothesis 2: The structural social capital has a positive moderating effect on the relationship between knowledge heterogeneity and team creativity.

Hypothesis 3: The cognitive social capital has a positive moderating effect on the relationship between knowledge heterogeneity and team creativity.

Hypothesis 4: The relational social capital has a positive moderating effect on the relationship between knowledge heterogeneity and team creativity.

Based on the above analysis, the conceptual model of this study is shown in Figure 1.

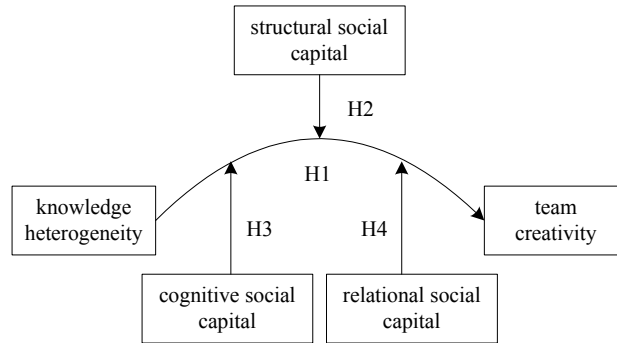


Figure 1 The Conceptual Model

### 3 Research Design

#### 3.1 Sample collection

High tech enterprise, the most obvious creative industries, was selected as the research object. The sample includes 6 main categories of high-tech industry statistics. At the same time, in order to make the research conclusion both representative and universal, the sample of this study will try to contain the most active areas of innovation, including Bohai Rim, Yangtse River Delta area, Pearl River Delta area and Hubei and Hunan Economic Zone. Data collection was from July 2017 to January 2019, and data collection method is a field survey. The respondents were R & D team leader. A total of 500 questionnaires were distributed, 399 copies were collected, and the recovery rate was 79.8%. After rejecting invalid samples, 308 samples are remained as formal research object with 77.19% efficiency.

#### 3.2 Variable measurement

The scale of team creativity adapted from Dai, Yang & Li (2019), which is total of 3 questions (Cronbach'a = 0.71).

The scale of knowledge heterogeneity adapted from Tiwana & McLean (2005), which is total of 3 questions (Cronbach'a = 0.71).

The scale of internal social capital adapted from the internal social capital scale in Tsai & Ghoshal (1998), which is total of 9 questions, including structural capital (Cronbach'a = 0.80), relational capital (Cronbach'a = 0.90) and cognitive capital (Cronbach'a = 0.93).

The above scales are used in the 5-Likert scale. Meanwhile, in order to avoid the interference of population statistics, we chose region, primary business, property and size as control variables.

## 4 Results

The results of this study are verified by regression analysis by SPSS 22.0. Before the construction of the square item and the interaction term, the variables are standardized to further solve multicollinearity. The results are shown in Table 1.

**Table 1 Results of the Regression Analysis (Dependent Variable = Creativity)**

		M0	M1	M2	M3	M4	M5
Control variables	Region	-0.09	-0.11	-0.12	-0.12	0.09	-0.09
	Primary business	-0.11	-0.10	-0.10	-0.10	-0.12	-0.07
	Property	-0.02	-0.02	-0.02	0.01	0.01	0.01
	Size	0.03	-0.01	-0.01	0.02	0.02	0.02
Independent variables	Knowledge heterogeneity		0.32***	0.13*	0.14*	0.16*	0.17*
	Knowledge heterogeneity <sup>2</sup>			-0.20**	-0.17*	-0.15*	-0.12
Moderating variables	Structural social capital				0.21**		
	Cognitive social capital					0.24**	
	Relational social capital						0.20**
Interactive items	Structural social capital × Knowledge heterogeneity <sup>2</sup>				0.12*		
	Structural social capital × Knowledge heterogeneity				0.23**		
	Cognitive social capital × Knowledge heterogeneity <sup>2</sup>					0.15*	
	Cognitive social capital × Knowledge heterogeneity					0.20**	
	Relational social capital × Knowledge heterogeneity <sup>2</sup>						0.17*
	Relational social capital × Knowledge heterogeneity						0.17*

\*\*\*. Correlation is significant at the 0.001 level (2-tailed).

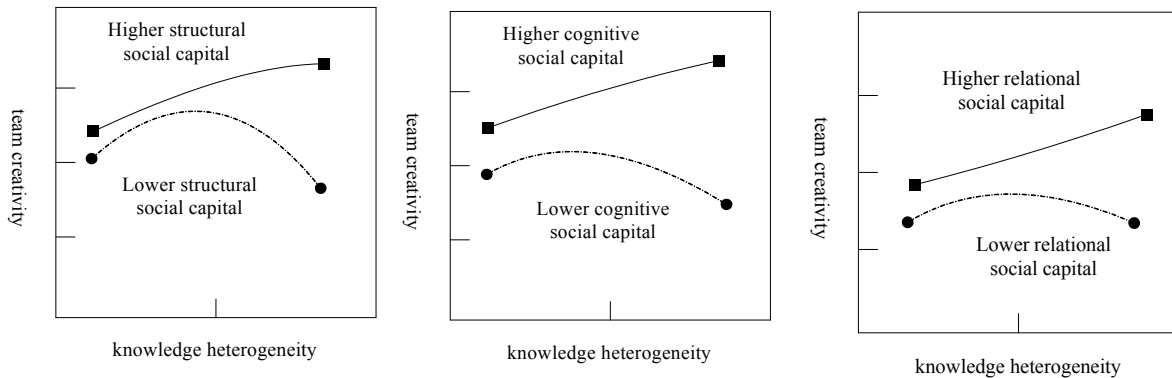
\*\* . Correlation is significant at the 0.01 level (2-tailed).

\*. Correlation is significant at the 0.05 level (2-tailed).

First, the influence of control variables on team creativity is tested. By model 0, the effect of region, primary business, property and size on team creativity is not significant.

Secondly, the direct influence of knowledge heterogeneity on team creativity is tested. By model 1, Knowledge heterogeneity is significantly positive effecting team creativity ( $B=0.32$ ,  $p<0.001$ ). Moreover, nonlinear effect of knowledge heterogeneity on team creativity is tested by model 2. As can be seen from the regression results, the square of knowledge heterogeneity is significantly negatively influencing team creativity ( $B=-0.20$ ,  $p<0.01$ ). Therefore, hypothesis 1 is supported.

Thirdly, the moderating effect of structural social capital on the relationship between knowledge heterogeneity and team creativity is tested. By model 3, the interaction between structural social capital and the square of knowledge heterogeneity has a significantly positive effect on team creativity ( $B=0.12$ ,  $p<0.05$ ), and the interaction between structural social capital and knowledge heterogeneity has a significantly positive effect on team creativity ( $B=0.23$ ,



$p<0.01$ ). Therefore, hypothesis 2 is supported. By model 4, the interaction between cognitive social capital and the square of knowledge heterogeneity has a significantly positive effect on team creativity ( $B=0.15$ ,  $p<0.05$ ), and the interaction between cognitive social capital and knowledge heterogeneity has a significantly positive effect on team creativity ( $B=0.20$ ,  $p<0.01$ ). Therefore, hypothesis 3 is supported. By model 5, the interaction between relational social capital and the square of knowledge heterogeneity has a significantly positive effect on team creativity ( $B=0.17$ ,  $p<0.05$ ), and the interaction between relational social capital and knowledge heterogeneity has a significantly positive effect on team creativity ( $B=0.17$ ,  $p<0.05$ ). Therefore, hypothesis 4 also is supported. In order to show the moderating effects of three dimensions of internal social capital more intuitively, this study draws the simple slope interaction plots, as shown in Figure 2.

**Figure 2 The Simple Slope Interaction Plots**

## 5 Conclusions

### 5.1 Discussion

*Based on the Chinese culture situation, this study explored the influence of knowledge heterogeneity on the team creativity, and explored the moderating effect of different dimensions of internal social capital using 308 samples. Two conclusions are as follow.*

First of all, as a "double-edged sword", knowledge heterogeneity has an inverted U-shaped effect on team creativity. This indicates that there is an optimal heterogeneous knowledge combination for team creativity. Before reaching the optimal level of knowledge heterogeneity, the increase of knowledge heterogeneity can improve the innovation performance. However, the increase of knowledge heterogeneity will result in the decrease of the innovation performance after the optimal level. This is consistent with the latest research conclusions (Ye, Ren and Hao, 2015). This means that team members should not only pay attention to the importance of knowledge heterogeneity, but also avoid the negative effects of high heterogeneity.

Secondly, the three dimensions of internal social capital have positive moderating effect on the relationship between knowledge heterogeneity and team creativity. This shows that knowledge heterogeneity would promote the improvement of team creativity, when the value of be fully utilized with the increase of communication, the promotion of trust and the integration of common values among team members. Therefore, it is very important to construct a good atmosphere for cooperation.

## **5.2 Implications**

There are two implications for management practice in this paper. On the one hand, knowledge heterogeneity among team members can promote the integration of knowledge and innovative ideas within a certain range, but it only limits the creativity of team members when more than this degree. This finding has some reference value for the settlement of the mainstream literature. On the other hand, Chinese people have always attached importance to "Guanxi", especially in cooperation. In this paper, we find that the positive effect of knowledge heterogeneity is significantly greater in a relatively harmonious relationship than in a team that is not so harmonious. This conclusion not only reveals the effect of knowledge heterogeneity on the team creativity, but also helps to enlighten the follow-up study from different perspectives to analyze and define the function boundaries of knowledge.

## **5.3 Limitations**

There are still some limitations in this research. On the one hand, the data were from self-reporting, thus, there may be a homologous bias. Data collection with a combination of superior supervisor reports and self report is research trends in the future. On the other hand, the internal social capital is introduced as an only moderating variable between knowledge heterogeneity and team creativity in this study. However, leadership style, governance structure, organizational support and other variables may also affect the relationship between knowledge heterogeneity and team creativity. Future research can further explore that which factors improve or worsen the relationship between knowledge heterogeneity and creativity.

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# Impact of Employee's Resilience on Organizational Resilience: Mediating Role of Compassion

Khaliq Ur Rehman, Farhan Aslam, Qamar Uddin Maitlo

School of Management, Wuhan University of Technology, Wuhan, P.R.China, 430070

(E-mail: khaliqcheema@gmail.com, aslam.farhan@outlook.com, qamar.maitlo@iba-suk.edu.pk)

**Abstract:** Main aim of this research was to investigate the protagonist of individual's resilience to build up organizational resilience. Individual's resilience is much needed at the time of crises, restructuring, transformation, turbulent and unfavorable conditions. Second objective of this research is to test the mediating role of compassion between the relationships of individual's resilience and organizational resilience. This research contributed in the body of knowledge while bring new concepts together and the main contribution is testing the role of compassion between the relationships. Empirical test like correlation, regression and Sobel test was run to test the hypothesis. Test of the correlation and regression analysis demonstrate that there exist a positive and momentous association Employee's Resilience and Organizational Resilience. Sobel test was used to test the mediating role on compassion and results show that there is a partial mediation, but results are significant.

**Key words:** Organizational Resilience; Individual Resilience; Compassion; SMEs of Pakistan

## 1 Introduction

Term resilience basically adopted from microbiology and cell regeneration studies, material processing and other aspects of engineering into the organizational sciences. In organizational studies the term resilience introduces first in psychology, economics and then the financial management especially managing risk in financial crises and stock exchange crises (Hamel and Valikangas, 2003). Resilience was defined by several authors in its parent school of thought and after its adoption into the organizational studies. But for the sake of simplification and operationalization current research defines resilience as "The maintenance of positive adjustment under challenging conditions" (Sutcliffe and Vogus, 2003). This study is basically designed to investigate the role of individual's resilience in developing the organizational resilience Werner conducted a study amid the children whose parents were facing problems and suffering from the miseries of psychological illnesses. While living in those conditions, children capacity/resilience was one of the most important reasons behind their survival. Their capacity to bounce back from these severe conditions helps these children to survive (Werner and Smith, 2001). So same is the case with organizations as it was with the children. The resilient behavior of employees and organizations itself, allows companies the development of new learning and implementing new routines and a better use of its resources under uncertainty conditions (Lengnick-Hall and Beck, 2009).

One of the main reasons for failure in business / organizations is the doubts and non-believe of the businessmen towards their own ideas, and the other problem is with the organizations are they are not sure that they can transform gradually or they need to of repair or reinvention the business model(Lingard, 2007). The authors believe that the adaptability or resilience capacity must be a strategic aspect and should not respond to specific crises or momentary losses, but being able to anticipate changes and prevent their businesses from being adversely affected by them. According to Hamel and Valikangas (2003), an organization is resilient when it is able to build the future, rather than defending the past.

### **1.1 Objective of this study**

Objective of this study is twofold, one major objective of this study is to investigate individuals/ employees/ Intrapreneurs resilience capacity on organizational resilience, or in other word we can say that how individual resilience helps to develop organizational resilience. Second objective of current research was to examine the mediating role of organizational compassion between the relationship of organizational resilience and individual resilience.

### **1.2 Research questions**

What is the relationship between individual resilience and organizational resilience?

What is the relationship between individual/organizational resilience and compassion?

Does compassion mediate the relationship between individual resilience and organizational resilience?

### **1.3 Significance of research**

This research is bringing entirely new concepts together. This research basically tries to validate and expand the theory of resilience both individual / organizational, as we are testing this theory into entirely different setting. Second important contribution of this research is that this research has test the role of compassion between the relationship of individual resilience and organizational resilience. Compassion is not studied as mediator before in any of the research. As compassion is very important for developing resilience, theoretically it is well proven but not empirically yet tested.

## **2 Literature Review**

This section briefly discusses or provides overview of available literature on the variables of this research study i.e. Organizational Resilience, Individual/Employee/ Intrapreneurs resilience, and compassion in organization. This section will also discuss about the mutual relationship between these variables.

### **2.1 Organizational resilience**

From Vieira et al. (2012)point of view, those organizations are considered as resilient organizations which have the aptitude to acclimatize to change, fitting the trends and being able to change the generation of profit. Authors like Ortiz-de-Mandojana and Bansal (2016)and Lewis and

McCann (2004) relate resilience to the strategic agility of an organization and also its performance. (Lengnick-Hall and Beck, 2009) Point out that the ability of an organization to resilience occurs by incorporating a set of policies and reforms. Concept of resilience was introduced to the organizational studies literature through crisis and disaster management concept has discussed in preview of high-reliability organizations and positive organizational scholarship literatures (Weick, 1993 , Weick et al., 2005 , Bruneau et al., 2003 , Griffiths et al., 2001). In the organizational field and in competition scenarios, the organizations' success depends on the ability to understand and adapt to the nature and dynamics of the business environment. These elements are related to: competition, technology, costs, taxation, policies and customer expectations (Hamel and Valikangas, 2003). The adaptive management is an integrated and multidisciplinary approach to address uncertainty, which is necessitated by the recognition that the managed resources are changeable as a result of human intervention new uncertainties, will emerge. Resilience is the most important area of research where the recent literature is more available. And from the below mentioned diagram one can clearly identify that this area of research is trending.

## **2.2 Employee / Intrapreneurs resilience**

Resilience as a psychological capacity of employees has recently come into focus with the rise of Positive Psychology. A critical element of a positive view of resilience involves viewing adverse events as an opportunity to develop and become a better person. A review of previous measures and theories of resilience shows this perspective is largely missing and suggests possible dimensions of it. Survival, high tolerance, adaptation and "bounce back" are amongst the synonyms for resilience adopted in recent psychological and organizational studies. Resilience in the Psychological capital model is characterized as "having the ability to bob once more from difficulty, disappointment or even positive yet apparently overpowering changes, for example, expanded duty" (Luthans et al., 2007) Of all the part influence expresses that involve Psychological capital, resilience has been given minimal consideration in authoritative writing. Prior work in any case, especially in the zone of kid brain science, recommends that resilience is a marvel coming about because of typical human adaptation reactions and is "described by great results notwithstanding genuine dangers to adjustment or advancement"(Masten, 2001). Masten goes ahead to infer that building resilience ought to along these lines require the improvement of the versatile frameworks (counting psychological and learning forms). Adding to the versatile procedure both a clear impression of reality, taking into account powerful and discerning reactions to given conditions, and the slant to look for or make significance from occasions, permitting them to "manufacture spans from present-day hardships to a more full, better built future" (Luthar et al., 2000 , Britt et al., 2016). Little research has been finished with respect to Resilience in the working environment. However, there is impressive proof that Resilience, once accepted to be an uncommon dis-positional quality, is state-like and open to advancement.

## **2.3 Compassion**

(Goetz et al., 2010 , Lazarus, 1991 , Coetzee, 2016) posited, —one of humankind's noblest virtues seems to arise incidentally from our sympathies becoming softer and more widely diffused, until they are extended to all sentient beings." According to the (Lama, 2002) who finds much inspiration in Darwinism, "Compassion is a state of mind that is non-violent, non-harming, and non-aggressive. It is a

mental attitude based on the wish for others to be free of their suffering and is associated with a sense of commitment, responsibility, and respect towards the other". In essence, compassion is based on the rationale that all human beings have an innate desire to overcome suffering in order to be happy, and that they have the natural right to fulfill this fundamental aspiration. (Lama and Kit, 1995) Identified that interior plays a key role in empathy, which indicates a neural mechanism for empathetic aspects of compassion. It is debatable whether compassion for others and self-compassion are in fact part of the same overarching construct. While Buddhist thinking argues that differentiating compassion for others from self-compassion means drawing a false distinction between the self and others, and moreover that self-compassion is a prerequisite for showing 'true' compassion towards others, recent research has found that associations between self-compassion and other-focused compassion may be weak, or even non-existent for some populations (Shoss et al., 2018).

### 3 Conceptual Framework



Figure 1 Proposed Framework for Research Hypothesis

In the light of above mentioned literature and theoretical framework following hypothesis were developed for testing.

- Individual resilience has positive impact on organizational resilience
- Individual resilience has positive impact on compassion
- Compassion has positive impact on organizational resilience
- Compassion mediates the impact of individual resilience on organizational resilience

### 4 Research Methodology

Following the positivist paradigm current research adopts the quantitative research strategy and collects the data from 930 individual employees working in Small and Medium Enterprises of Pakistan through a self-administrative questionnaire. Internal consistency/reliability of the used questionnaire was tested through Cronbach's Alpha and instrument was found reliable. Correlation and simple linear regression was conducted to test the direct hypothesis. And to test the mediating hypothesis Sobel test was used. According to the results of the research all the hypothesis were accepted.

### 5 Results and Discussion

This section of the research papers deals with empirical investigation and involves some statistical tools to empirically validate some of our claims.

### 5.1 Reliability of scale

Before going towards further analysis adopted instrument were tested for reliability/ internal consistency through Cronbach’s alpha test. Hair Jr et al., 2016 suggested that value of cronbach’s alpha should be greater than 0.70 in order to claim that the instrument is exactly measuring what it is expected to measure. Results mentioned in table 1 clearly shows that every variable has successfully pass the test.

**Table 1 Reliability Test**

Instrument /Variable	Reliability
Organizational Resilience Questionnaire	0.87
Compassion Questionnaire	0.91
Employees Resilience Questionnaire	0.89

### 5.2 Correlations

**Table 2 Correlations**

		Organizational Resilience	Employee Resilience
Employee Resilience	Pearson Correlation	.469*	
	Sig. (2-tailed)	.000	
Compassion	Pearson Correlation	.461*	.907*
	Sig. (2-tailed)	.000	.000

Correlation was analyzed through Cronbach’s Alpha, results of the correlation in Table 2 shows that organizational resilience is 47% positively and significantly related to employees resilience which means one unit change in employee resilience will enhance the organizational resilience by 47% results are supporting the findings of (Shin et al., 2012). Compassion also has moderate positive relationship with organizational resilience, whereas compassion has highly positive and significant relationship with employee resilience. All the relationship are very significant as (p<0.05) as suggested by (Zhu, 2012).

### 5.3 Regression

**Table 3 Impact of Employees’ Resilience on Organizational Resilience**

Model Summary						
Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Durbin Watson	
1	.593 <sup>a</sup>	.352	.350	.15861	1.7	

a. Predictors: (Constant), ER

**Table 4 ANOVA Table for Regression**

ANOVA							
Model		Sum of Squares	df	Mean Square	F	Sig.	
1	Regression	4.955	1	4.955	196.953	.000 <sup>b</sup>	
	Residual	9.132	363	.025			

b. Predictors: (Constant), ER

To analyse the impact of employee resilience on organizational resilience, simple linear regression was used. Results of the regressions shows that organizational resilience is almost 35% being explained by employee resilience, which means the organizations that have resilient employees are tend to be

more resilient than the other competitor organizations. There are very less chances of failure for such type of organizations. Durbin Watson and significance values are also within the standard range. Standard values of Durbin Watson should be between “1.5 and 2.5”(White, 1992), and p value should also be less than 0.05(Hair Jr et al., 2016).

### 5.4 Mediation

Mediation analysis is basically a chain of analysis in which relationship of variables are being explained through another variable. In Mediation analysis, an interaction term is being created and in result of this interruption the second variable influence the third one. This second variable is also known as intervening variable and in particular we name it as mediator and it is being denoted as “M”. This intervening variable mediates the relationship or influence of first/Independent/predictor variable on dependent/outcome variable. There are several methods to test the mediation but this research opted to use **Sobel test** to test the mediating role of individual/employee’s compassion towards organization in relationship between employee’s resilience and organizational resilience. Below mentioned tables are the results of the mediation analysis.

### 5.5 Sobel test

**Table 5 Sobel Test**

\$`Mod1: Y~X`				
	Estimate	Std. Error	t value	Pr (> t )
(Intercept)	2.3271275	0.05079715	45.81217	5.860e-153
Pred	0.0089744	0.01242392	34.52811	9.848739e-117
\$`Mod2: Y~X+M`				
	Estimate	Std. Error	t value	Pr (> t )
(Intercept)	1.97212952	0.06683661	29.506727	2.408445e-98
Pred	0.41410475	0.01173814	35.278557	3.431392e-119
Med	0.09846866	0.01309613	7.518914	4.391746e-13
\$`Mod3: M~X`				
	Estimate	Std. Error	t value	Pr (> t )
(Intercept)	3.6051873	0.1895968	19.015021	1.948963e-56
Pred	0.1510089	0.0463714	3.256508	1.234130e-03

\$Indirect Effect: **[1] 0.01486964**  
 \$SE: [1] 0.004975999  
**\$z. Value: [1] 2.988272**

Sobel test for mediation provides the detailed results in which it tests the relationship between predictor and outcome variable in presence of mediator and it also test their relationship without the

presence of mediating variable. Results indicate that Indirect Effect, which means the influence of independent variable in presence of mediating variable, is greater than direct effect. Significance of the mediating relationship is always denoted as  $z$  and  $Z$  value should be greater than **1.96** to prove that the mediating effect of intervening variable is significant, which is **2.98** in this research which clearly indicates that compassion act as a partial mediator between organizational resilience and employee resilience.

## 6 Conclusion

According to available body of knowledge and results of the current research, we can withdraw the following conclusion. Individual resilience is very important in organizations especially at the time of crises management, change management, organizational development and transformation. In turbulent conditions of the organizations individuals to be more resilient. Individuals/Intrapreneurs compassionate actions towards organizations are much more needed in the organizations. Compassion is one of the key trigger of resilience in the organization. Individual resilience impacts the organizational resilience. Compassion mediates the relationship between individual resilience and organizational resilience. The authors believe that the adaptability or resilience capacity must be a strategic aspect and should not respond to specific crises or momentary losses, but being able to anticipate changes and prevent their businesses from being adversely affected by them.

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# **Study on Employee Reward System Satisfaction and the Impact on Their Sustainable Behavior: A Case of High Learning Institution Employees in Tanzania**

Jacob Julius Rombo, Luo Fan, Monhesea Obrey Patrick Bah

School of Management, Wuhan University of Technology, P.R. China, 430070

(Email: jajurombo@yahoo.com, sailluof@126.com, monheseabah@yahoo.com)

**Abstract:** This paper examines the role played by the employees rewarding system satisfaction and its impact on their continuous productive behavior-sustainable behavior as observed from the practices of higher learning employees in Tanzania. As well known that the sustainable behavior of the employees in any organization has a direct relationship with the performance of that organization. From the secondary data as well as the interviews and author's personal experience and observation of the working conditions in Tanzania, this paper entails the existing relationship of the sustainable behavior of the employees when they are highly satisfied by the rewarding system employed by any institution as the focus for this paper is on the high learning institutions.

**Key words:** Reward system; Employee satisfaction; Sustainable behavior; Productive behavior

## **1. Introduction**

For the better performance of the employees in any institution, there should be several factors to observe including the rewarding system of the employees. To satisfy the employees, rewarding system of the organization (Variable 1: Reward System) this variable has the direct impact on the Satisfaction of the employee to keep staying and deliver to the organization (Variable 2: Employee Satisfaction); meanwhile the well rewarded and satisfied employee will always create a good working spirit for the organization or company, this is what is known as sustainable behaviour of an employee in an organization (variable 3: Sustainable Behaviour).

Reward system is a planned and structured approach to reward one or more persons who act in good way. Mostly studies are done to look on to customer satisfaction with regards to the services provided by the companies or organizations, whereas companies marketing departments often facilitate customer rewards systems or programs to motivate people to buy more or to purchase certain things.

Rewarding system is such a way that, the institution or company designs several ways onto how they can get their employees satisfied so that they can be well performing.

Employee Satisfaction is the term used to describe whether employees are happy and contented and fulfilling their desires and needs at work. Many measures purport that employee satisfaction is a factor in employee motivation, employee goal achievement, and positive employee morale in the workplace. Employee satisfaction, while generally a positive in any organization or company, can also become a problem if mediocre employees stay because they are satisfied and happy with your work environment. Factors contributing to employee satisfaction include treating employees with respect, providing regular employee recognition, empowering employees, offering above industry-average benefits and compensation, providing employee benefits and company activities, and positive management within a success framework of goals, measurements, and expectations.

The critical factor with employee satisfaction is that satisfied employees must do the job and make the contributions that the employer needs. If they do not, all that the employer does to provide an environment that satisfies employees is for naught.

Sustainable behaviour is the ability to continue a defined behaviour indefinitely, as for an employee the sustainable behaviour, that the company or organization would like its employees to retain indefinitely is the working spirit that results to the major performance of an organization or company. Therefore, the employee is usually motivated to retain their well working spirit in order to make the company keep performing well to achieve its objectives. The companies nowadays try to motivate the employees to ensure that the green or good behaviour of the employees sustained for the sake of the well performance of the companies.

Paying employees for productivity has been the cornerstone of industrial and business development for centuries. Financial reward has always been important in managing employee's performance, but over the last 29-year other elements of compensation have developed to provide employers with more scope to reward and ensure that employees poses the working behaviour and sustain it, thus, by motivating employees the concept of the green working behaviour would be achieved.

Performance is a behaviour that accomplishes results. Performance management influences performance by helping people to understand what good performance means and by providing the information needed to improve it (Armstrong & Taylor 2010). Reward management influences performance by recognising and rewarding good performance and by providing incentives to improve it and for that it has, seems the direct link between the performance of an individual and the resulted objectives of the company or organizations.

### **1.1 Statement of the Problem**

High turnover is a well-pronounced trend in most private as well as public institutions in nowadays the labour mobility has highly increased. One of the main challenges faced by organisations in employee retention is the competition factor. Many professional organisations are in a dilemma because of the competition that is present in attracting and retaining highly skilled workers because they fail to match the salaries offered by their competitors or to offer more than the competitor does (Frost,2001). The challenge for many organisations today is therefore is to come up with an efficient reward system and strategy for retaining these core employees for the success of the organisation.

That is to say, the choice of the study intends to determine the inter-relationship that exist between the reward system satisfaction and the sustainable behaviour of the employees to be retained in the high learning institutions in Tanzania by considering the outlined factors above.

## **2 Theoretical Background**

Scholars have come up with various theories that hold in the rewarding system, for the interest of reviewing in order to better analyse and understand the real situation that happens in the Tanzania context. The motivational and two Factor theories are well preferred thus for an institution to be able or to be able to create a sustainable behaviour for an employee, there should be certain theories that would lead to the best practice on observing whether there is an impact of the reward system satisfaction. With reference to this study, the two-factor motivational theory.

Companies rely on their employees to produce products or provide services in a timely fashion. In addition, while employees can easily learn the tasks and procedures required to carry out their roles, organizations can benefit from providing motivational incentives for exceptional job performance. Motivational theory in an organization has to do with the way in which a company motivates its employees to perform as a group and within their individual job roles.

Being a successful business leader involves a lot more than making good products or understanding marketing and sales reports in understanding the performance of the company or organization. One need to be able to motivate and inspire the employees to work toward the organizational vision. At times, it may seem like degree in psychology needed to understand what to do in ensuring that the employee do sustain their productive behaviour. There are basics of applying the various motivational theories developed to help to get the results that are expected from the employees.

This theory considers two factors: motivation and hygiene. Motivation factors include receiving recognition for good efforts, enjoying work and having a career path. Hygiene factors include salary,

benefits and relationships with co-workers and managers. The two factors applied in the workplace through comprehensive salary and benefits programs, developing team-building workshops and creating ways to recognize good performance. Be competitive when recruiting so you motivate people to stay and remain loyal.

### **3 Methodology Applied and the Model**

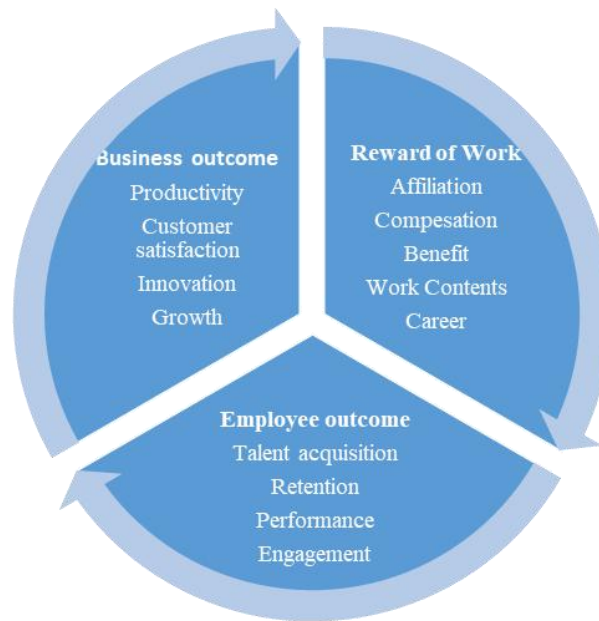
The present research aims to determine the impact of incentives, rewards and recognition on employee's sustainable behaviour of high learning institutions. The study adopted a qualitative approach/paradigm and it specifically made use of case study in its design. Case study helps the researcher to develop an in-depth analysis of a case, often a programme, event, activity, process, or one or more individuals. It bounded by time and activity and the researcher collects detailed information using a variety of data collection procedures over a sustained period (Creswell, 2014). A case study consists of the intensive observation of a single unit and this may be an individual person, company, the researcher may prefer institution and more. Hence, for this case, the study was done keenly by observing and reviewing various literatures in regards to the concept of sustainable behaviour of employees as maybe affected by the rewarding system, the attention was paid to the Tanzania contexts by studying the characteristics and issues that happening in the higher learning institutions in Tanzania.

#### **3.1 Demographics characteristics**

The demographic section of the questionnaire shows the information about the age, gender, marital status, sector, industrial composition, establishment size, job tenure and position of employees to have a better understanding of their responses and resulting conclusion for the research. In the current sample, the number of male respondents is more than females, as there are N=160, (81%) males and (19%), N=40 are females. The majority of the respondents are of age between 25-30 years (43.2%), N=95 whereas the lowest majority of the respondents fall in the age of 20 or less (.9%), N=2 the demographics showed that majority of the respondents in the sample are married (55%), N=121 whereas unmarried respondents are (45%), N=99. Majority of the respondents belongs to the organizations having an establishment size of more than 500 employees, N=74 (34%) whereas the least respondents are from organizations with 100 to 199 employees, N=24 (11%). Most of the respondents have a job tenure between 2 to 3 years, N=64 (29%) while least respondents having job tenure of less than one year are N=12 (6%). Most of the respondents in the sample having a non-managerial position in the job, N=161 (73%). While N=59, (28%) have a managerial position in their respective organizations.

The Reward of Work Mode is as Figure 1. This model is for employee compensation that links Business results to employee compensation. Its entails that, the reward for work of an individual in an

organization comprises of compensation procedures, benefits, the work contents and well as the presence of clear career development for an individual (Segal and Sibson 2006)



**Figure 1 The Reward for Work Model**

When the stipulated ingredients forming rewarding system above are present, then the employee is likely to create a loyalty to the organization with a working spirit (sustainable behaviour) thus employee is likely to retain and the performance will improve. As results, the productivity, customer satisfaction, innovation and growth will be the business outcomes.

### **3.2 Hypothesis development**

The reward system has studied from different aspects; this proposed study topic aims to find out the relationship between the reward System Satisfaction and the sustainable behaviour of an employee. The proposed study topic intended to use two-dimensional point of view; Transactional Contract and Relational Contract. In case of a workplace performance deviance, the study intended to investigate the organizational level work place performance deviances.

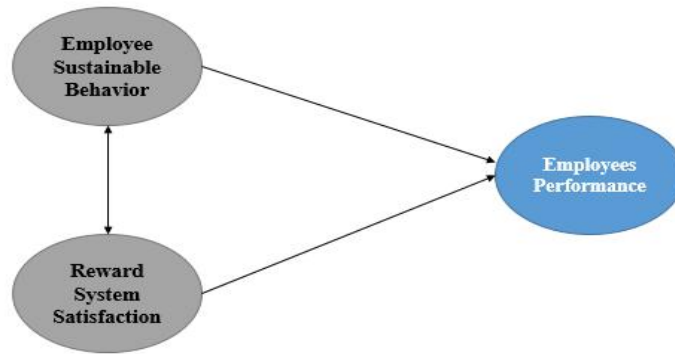
As per the topic, the following hypothesis are obtained in making the close look and close study of the Impact of Reward System Satisfaction on Sustainable Behaviour of Employees.

H1: There is a significant positive relationship between rewards system satisfaction and employee sustainable behaviour

H2: Employee rewards system leads to employee performance at a work place.

H3: There is a significant positive relationship between employee sustainable behaviour and employee performance at work place.

Following these hypotheses, we have drawn the research model as Figure 2.



**Figure 2 The Conceptual Model**

## 4 Results

In order to create the proper sustainable working and peacefully working behaviour that would pronounce to the better performance of higher learning institutions in Tanzania, several of the factors need to be paid attention and considerations as since they do play an important role as the rewarding system concept is concerned. The followings are the rewarding and motivational factors that play important roles for the high learning institutions employees in Tanzania and as results of the better performance of those institutions.

The recruitment, appointment and promotional procedures: this realizes to be among the rewarding factors that has the direct influences to the employees in the high learning institutions in Tanzania. Thus, the more employees of any institution or organization realizes the procedures used for promotion and recruitment, the more they get motivated and as a result they do work hard to attain the target and objectives of the institution hence the creation of a sustainable behaviour.

The working Conditions and leadership: From the study done the observation is that, the working conditions can affect the sustainable working behaviour of an employee at any institution. In the context of Tanzania learning institution, the employees who are having good working conditions seems to have a morally in their working behaviour.

The Salary package and Compensation Strategies: for several years now in most of African high learning institutions for which Tanzania context is not an exception, there tensions between academic staff and students on one side and the administration and proprietors/government on the other. In several instances academic staff has withdrawn their labour (laying down their tools) due to inadequate remuneration and scholastic materials. The academic intellectuals are the most highly trained human resource in society and yet they are poorly paid or rewarded.

This is why there is a high turnover of academic staff in African institutions of higher learning. Its therefore, recommended that for the high learning institutions to retain the working behaviour/sustainable behaviour, attention should be given onto the packaging and benefit strategies.

Government and International policies: the policies provided by both government of Tanzania as well as international educational partners also has direct influence to the creation of the sustainable working behaviour of the high learning institutions employees in Tanzania. This is due to the facts that, if the policies do not put into account the hard work done by the employees at that level, they will definitely be demotivated and as a result, there will not be the proper creation and retaining of the hard-working spirit of an individual in an organization.

## **5 Conclusion**

In this study, our contribution focuses on identifying the impact of reward and recognition on job satisfaction and motivation to the sustainable behaviour of employees. The findings of this paper have exposed a significant relationship among numerous dimensions of job satisfaction and motivation.

Numerous scholars have given evidence that employees are satisfied and motivated by financial rewards. Moreover, the findings are also consistent with previous research results that generally employees are satisfied and motivated with incentives and financial rewards.

Reward system of the organization is an integral part of the measure of the competitiveness of an organization. As a key component of the overall human resource strategy, reward system management is central to the productivity of employees, which is a link to the overall profitability of an organization, as well as its long-term survival and the sustainable behaviour of the employees. As according to the study done, when the reward to the employee is well, their performance becomes higher than those who do not get satisfactory reward. This study as discussed above on the various models and consideration of various theories of motivation has established a clear link between reward management system of an organization and the sustainable behaviour of employees in attainment of organization goals and objectives through the contribution of extrinsically and intrinsically motivated employees.

In establishing the reward policy for an organization, the organization's corporate objectives are important inputs to the entire process. An alignment between these aim and objectives and the reward policy is strategically important to the effectiveness of the reward policy to make a better rewarding system in the organization and thus can be applied in various contexts including the higher learning institution contexts in Tanzania.

Therefore, if supervisors boost their subordinates, motivate and give them an appreciation and recognition, these deficiencies can be reduced and will increase their job satisfaction and as a result sustainability of good and working spirit behaviour. In addition, the managers' increase semi-annually and annually salary, allowances, commissions, bonuses, fringe benefits and other indirect compensations keeps employee's morale high and makes them more motivated and hence a creation of sustainable behaviour.

Finally, the study steps in towards the development of the relationship between employee and employer in creating good working environment.

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# Homesickness and Proactive behavior: Collectivist Human Resource Management Practices as a Cross-Level Moderator

Zheng Weili

School of Management, Wuhan University of Technology, Wuhan, P.R.China, 430070

(E-mail: zhengwelli@163.com)

**Abstract:** Employees' proactive behavior is a kind of employees' free decision. It will undoubtedly promote the effectiveness of the organization, and it will benefit the development of the employees themselves. Based on the conservation of resources theory, this study selected the homesickness variable as an antecedent variable of employees' proactive behavior. Through the investigation and analysis of the 160 employees in 32 organizations, it was found that: (1) Homesickness is negatively related to employee's proactive behavior. (2) The relationship between homesickness and proactive is related via mediation by emotional exhaustion. (3) The collectivism human resource orientation moderate the relationship between the homesickness and the employees' proactive behavior. This article enriches the research on the antecedents of employees' proactive behavior from the perspective of emotional perception, and confirms that employees' homesickness emotions will have a series of effects on employees and reduce employees' proactive behaviors.

**Key words:** Proactive behavior; Homesickness; Emotional exhaustion; Collectivism human resource Management Practices

## 1 Introduction

How can we improve employees' proactive behavior? What factors influence employees' proactive behavior? At present, most scholars' research on antecedents of employees' proactive behavior mainly focuses on leadership style and personal characteristics of employees, such as abusive management, narcissism. Neglect the concern of personal emotional factors of employees. Emotion is a kind of strong emotion, which directly points to people or things and refers to the reaction to the object. Including anger, sadness, missing, etc. Existing studies have confirmed that employees' emotions at work directly affect employees' work behavior.

Dan (Dan, 2017) explained that homesickness weakens the positive impact of work resources on

work performance through the work-family resource model. Based on this, this paper will build a research model of the relationship between homesickness, emotional exhaustion, collectivist human resource management practice and employee's proactive behavior, explore the mechanism of homesickness's influence on employee's proactive behavior, and study the mechanism of emotional exhaustion in homesickness. The mediating role between the proactive behavior of employees' and the moderating role of collectivism orientation between homesickness and the proactive behavior of employees.

## **2 Theory and Hypothesis**

### **2.1 Homesickness and proactive behavior**

Employee's proactive behavior plays a vital role in the organization (Schmitt et al., 2016), but it is a kind of spontaneous behavior of employees, which is affected by many factors. This study considers that homesickness is the emotional appeal of employees who have left home, often accompanied by negative emotions (Rekšć, Magdalena, 2015). It will affect the physical and mental health of employees, personal performance and organizational performance to a certain extent. On the one hand, from the perspective of resource preservation theory, employee's homesickness will consume emotional resources of employees and make them face enormous psychological and physical pressure. From the perspective of resource preservation, employees will reduce the occurrence of their proactive behavior, because employees' proactive behavior needs to consume personal resources such as time and energy. On the other hand, homesickness, as an indicator of people's mental health, is likely to lead to a decline in physical function and the efficiency of resource utilization (Beal et al., 2005). Therefore, we believe that homesickness accompanied by negative emotions will reduce the probability of employees' proactive behavior in work. Based on this, this paper proposes the following assumptions:

Hypothesis 1: Homesickness has a negative impact on employees' proactive behavior.

### **2.2 Mediating effect of emotional exhaustion**

First, resources are not inexhaustible; there will always be a day of exhaustion. According to the classification of resources according to the theory of resource preservation, emotional resources are defined as an energy resource (De et al., 2008). Generally speaking, it is difficult for employees who work outside their hometown alone to communicate effectively with their relatives and friends who are far away from their hometown (Thurber, Walton, 2012). Missing home, relatives and friends and not adapting to unfamiliar working environment will consume employees' emotional resources. That is to say, homesickness will consume the emotional resources of employees. Employees invest emotional

resources but get no return. They cannot make up for the loss of resources, and then the continuous loss of resources will eventually lead to emotional exhaustion.

Secondly, emotional exhaustion can effectively predict employees' proactive behavior. The degree of emotional exhaustion will affect employees' enthusiasm for work. Previous studies have shown that emotional exhaustion is related to job burnout, which not only affects the physical and mental health of employees, but also is detrimental to personal and organizational performance. According to the theory of resource preservation, we know that when the individual's resources are lost or the investment of resources fails to get the corresponding return, they will have the motivation to protect the existing resources and make up for the lost resources (Kilroy S, 2016). As we said before, homesickness consumes employees' emotions and eventually leads to emotional exhaustion. After this happens, employees need to consume more resources than usual to maintain normal work and emotions, and they will lack resources to do other activities that are beneficial to the organization. Therefore, this study believes that employees will reduce their proactive behavior in the case of emotional exhaustion caused by homesickness. Accordingly, the following assumptions are made:

Hypothesis 2: Homesickness has a positive effect on emotional exhaustion

Hypothesis 3: Emotional exhaustion has a negative impact on employees' proactive behavior

Based on the conservation of resources theory, resources are limited and very important to the activity process. Homesickness brings about negative emotional experience, which consumes resources to a certain extent and causes emotional exhaustion of employees. Furthermore, exhaustion leads to a shortage of individual resources. Furthermore, exhaustion leads to a shortage of individual resources. Because of their desire to conserve resources and obtain more resources, it is difficult for them to engage in active behavior, that is, homesickness causes emotional exhaustion of employees and affects their practice of active behavior. The following assumptions are made:

Hypothesis 4: Emotional exhaustion plays a mediating role in the process of homesickness affecting employees' proactive behavior

### **2.3 Collectivist human resource management practices as a cross-level moderator**

In this study, we also pay attention to the interaction between homesickness and collectivism human resource management practices (Zhang, 2015). If employees fall into homesickness, they will reduce the occurrence of proactive behavior in order to preserve their existing resources, but one thing cannot be ignored. Collectivist human resources practice may also have an impact on employees' proactive behavior. Emphasizing collectivism in human resources management, employees will have a strong sense of collectivism. Even if there are emotional thoughts, they will take the overall view of the

primary task and put more resources to control their negative emotions, to minimize unnecessary negative impact on the organization. However, organizations that do not emphasize collectivism in human resources work have a relatively weak sense of collectivism, and their own emotional resources are losing because of homesickness, resulting in a lower willingness to take initiative in favor of the organization. Based on this, this study proposes the following hypotheses:

Hypothesis 5: Collectivist human resources practice has a cross-level regulating effect on the relationship between homesickness and employee's proactive behavior. When the collectivist atmosphere in organizational human resources management is stronger, the negative correlation between homesickness and employee's proactive behavior is weaker.

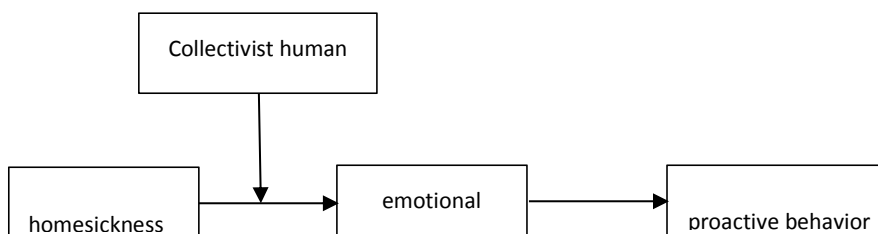


Figure 1 Research Model

### 3 Methods

#### 3.1 Sample and procedures

The participants in this study were all from organizations in southwest China. In March 2019, they were distributed through QQ, WeChat, Weibo, Questionnaire Star and E-File Questionnaire, involving 32 organizations and 200 people. After sorting out and matching, 200 questionnaires were distributed and 174 questionnaires were recovered, of which 14 were invalid and 160 were valid, with an effective recovery rate of 92%. Among them, 44.4% were male and 55.6% were female, with an average age of 27.6 years, and 79.1% were bachelor degree or above.

#### 3.2 Measures

In order to ensure the reliability and validity of each scale, the scale used in this paper has been verified by scholars and widely used in academic circles. All measures used a 5-point Likert-type scale.

Homesickness: This study used a scale developed by Margaret et al. in 2002 to assess the degree

of homesickness of employees in the past month. The scale includes five dimensions, such as "missing family" and "loneliness". The Cronbach's alpha coefficient was .89.

**Emotional exhaustion:** This study used emotional exhaustion subscales developed by Maslach (2001) to measure employee emotional exhaustion. The Cronbach's coefficient is 0.89.

**Collectivist Human Resource Practice:** This study chooses the Collectivist Human Resource Practice Scale developed by House (2004), which includes six items with Cronbach's coefficient of 0.8.

**Proactive behavior:** The scale was translated from three dimensions of the Active Performance Measurement Scale developed by Griffin (2007). The Cronbach's coefficient of the scale is 0.893.

**Controlling variables:** In the course of the research, this study controlled the characteristic variables that may influence employees' proactive behavior, such as age, gender, tenure, education level, position level, role breadth self-efficacy. The role breadth self-efficacy scale developed by Carolyn (2003) et al. in 1998 was used to measure the role breadth self-efficacy. The Cronbach's alpha coefficient was .89.

## **4 Result Analysis**

### **4.1 Preliminary analysis**

Using Mplus 7.0, 160 samples were analyzed by confirmatory factor analysis (Table 1), and several competition models were compared. The results show that the fitting degree of three-factor model, two-factor model and single-factor model is not as good as that of four-factor model, which shows that the model in this paper can well reflect the factor structure of variables, and the discriminatory validity between variables has been verified. Descriptive statistics and correlation analysis are shown in Table 1.

### **4.2 Hypothesis tests**

As shown in Table 3, we tested our hypothesis with SPSS23.0. The results showed that homesickness significantly negatively affected employees' proactive behavior ( $\gamma = 461, P < .001$ ) and significantly positively affected emotional exhaustion ( $\gamma = 76, P < .001$ ), H1 and H2 were validated. Meanwhile, emotional exhaustion significantly negatively affected employees' proactive behavior ( $\gamma = 614, P < .001$ ), H3 was validated in combination with model 2 and model 4, after adding emotional exhaustion, the effect of homesickness on proactive behavior becomes insignificant ( $\gamma = 013$ ), while emotional exhaustion on proactive behavior is still significant ( $\gamma = 625, P < .001$ ), indicating that emotional exhaustion plays a completely mediating role between homesickness and employees'

proactive behavior, and H4 has been verified. We tested Moderated Mediation with Mplus7.0. The results showed that the 95% confidence interval of the moderate variable did not contain 0 (CI= [0.105, 0.392]), and H5 was verified.

**Table 1 Confirmatory Factory Results for Model Comparison**

Model	X <sup>2</sup> /Df	RMSEA	TLI	CFI
Four-factor model	2.43	0.095	0.691	0.910
Three-factor model	2.64	0.101	0.646	0.667
Two-factor model	3.04	0.113	0.561	0.584
One-factor model	3.35	0.121	0.494	0.521

Notes: Three-factor model: Homesickness+Emotional exhaustion; Collectivism human resource management; employees' proactive behavior

Two-factor model: Homesickness+Emotional exhaustion+collectivism human resource management; employees' proactive behavior

One-factor model: Homesickness+Emotional exhaustion+collectivism human resource management+employees' proactive behavior

**Table 2 Mean, Standard Deviations, and Intercorrelations among Study Variables**

Variable	M (SD)	1	2	3	4	5	6	7	8
Level 1 Variable									
1 Age	.62(.49)								
2 Gender	32.77(9.4)	.19							
3 Education	3.31(1.41)	.32	.31*						
4 Tenure	5.58(1.2)	.35	.23	.12					
5 Position hierarchy	2.3(0.6)	.02	.32	.22	.18				
6 Role Width Self-efficacy	3.2(0.49)	.12	.02	.10*	.15	.12**			
7 Homesickness	3.13(0.56)	.13	.11	.23**	.15*	.55*	.22		
8 Emotional exhaustion	2.88(0.74)	.03	-.12	.12	.23	.06	.13	.576**	
9 proactive	3.48(0.31)	.30*	.11	.01	.14*	.03	.32	-.498**	-.642**

\*p<.05 \*\*p<.01

**Table 3 Hierarchical Regression Analysis of Variables**

Variable	Proactive behavior				Emotional exhaustion
	Model 1	Model2	Model3	Model4	Model 5
Constant	2.304***	3.455***	3.478***	3.465***	0.025
1 Age	-.016	-.009	-.020	-.020	-.018
2 Gender	.059	.132	.201	.202	.111
3 Education	-.008	-.034	.009	.010	.070
4 Tenure	-.155	-.175	-.188	-.188	-.021
5 Position hierarchy	.046	-.006	-.093	-.093	-.140*
6 Role Width Self-efficacy	.380***	.327***	.301***	.301***	-.042
7 Homesickness		-.461***		.013	.760***
8 Emotional exhaustion			-.614***	-.625***	
R <sup>2</sup>	.141	.347	.494	.494	.623

## 5 Conclusion

In this paper, we use the conservation of resources theory to explain the impact of homesickness on employees' proactive behavior. Data from 160 employees in 32 organizations show that homesickness increases emotional exhaustion, which in turn leads to a decrease in employees' proactive behavior. Collectivist human resources practice weakens the negative impact of homesickness on employees' proactive behavior. Our research also gives managers some practical inspiration:

(1) Enterprises should emphasize collectivism in the process of human resource management. On the one hand, it can improve the relationship between employees and other members of the organization, thereby reducing the negative emotions caused by homesickness perception. On the other hand, it is helpful for employees to put their organizational goals above their personal wishes and make them more willing to take out their own resources and work actively.

(2) As far as employees are concerned, they should control their emotions reasonably and face



homesickness positively. Take effective measures to reduce their emotional exhaustion. For example, keep in touch with relatives and friends, learn to get along with strangers, improve their ability to adapt to the environment and so on. Employees should also enhance their sense of collectivism and closely link their personal and corporate goals in order to enhance their willingness to take initiative.

### **5.1 Research limitations and future research directions**

Firstly, this paper uses the same time point and single data source to conduct a questionnaire survey. Although it simplifies the process of the questionnaire survey, it has not effectively avoided the homologous variance, nor has it conducted a longitudinal survey. It is suggested that a multi-time data survey should be conducted in future research, and other evaluation methods should be adopted to measure employees' proactive behavior.

Secondly, this paper fails to test the causality between variables. For example, this paper studies that homesickness may have a negative impact on employee's proactive behavior, so will employee's proactive behavior have an impact on employee's homesickness perception? What is the impact mechanism? All of these need to be further studied.

Thirdly, emotional perception is transient and dynamic. It is suggested that follow-up studies use log method to capture more delicate emotional changes within individuals

### **Acknowledgement**

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# Research on Relationship Marketing Framework and Implementation Path of Railway Freight Oriented by Customer Value

Xu Fengwei, Zhang Zhenfang

School of Economics and Management, Dalian Jiaotong University, Dalian, P.R.China, 116028

(E-mail: xu\_fengwei@163.com, zzfxsz@163.com)

**Abstract:** With the increasingly fierce competition in freight market, relationship marketing has become one of the most important aspects of railway freight marketing. And the key to relationship marketing lies in whether enterprises can create more customer value. Therefore, this paper discusses the concept of railway freight relationship marketing oriented by customer value, constructs the theoretical framework of railway freight relationship marketing oriented by customer value and further designs the relationship marketing implementation path from the perspective of customer value so as to provide enlightenment for the theoretical construction of railway freight relationship marketing and improve the core competitiveness of railway transport enterprises.

**Keywords:** Customer value; Railway freight; Relationship marketing; Framework

## 1 Introduction

With the rapid development of highway, waterway, air transport and other transportation modes as well as the continuous improvement of the overall service level in transportation market, the competition in which is increasingly fierce and the share of railway transportation in freight market shows a descending trend. The changes of transportation market environment and consumption concept make the focus of market competition from meeting the material needs of customers to meeting the service needs of customers so as to make customers satisfied and maintain loyalty. While the formation of freight service runs through the whole process of freight enterprises' service, that is to say the development of freight service depends on the maintenance of stakeholder relationship. It is certainly the focus of relationship marketing theory. And because of this, relationship marketing is also one of the most important aspects of railway freight marketing. Therefore, how to build a perfect relationship marketing system has become an essential issue for China's railway transport enterprises to obtain comparative advantages and enhance their core competitiveness in the transportation market competition.

Meanwhile, with the intensification of market competition and the deepening of economic globalization, the role of customers is gradually changing from a single consumer to multiple roles such as consumer, co-operator, value co-creator, knowledge and ability co-creator, etc. And the status of customers is becoming more and more important. In practice, enterprises have realized the importance of customer value for relationship marketing and have gradually focused on the creation and transmission of customer value. Therefore, with the theory of customer value to understand and grasp the value demand and value orientation of customers for freight service, to create and deliver excellent value for customers so as to improve customer satisfaction and loyalty, which is inevitably the core and key to build relationship marketing system of railway freight.

In practice, railway freight relationship marketing is widely used in foreign countries, but there are few theoretical studies. For example, Bodmer M. and Martins J. analyzed the role of customer relationship marketing in transportation marketing from the aspects of transportation service level and social responsibility (Bodmer M., et al., 2005). Domestic research on relationship marketing of railway freight mainly focuses on railway customer segmentation, customer relationship selection, customer relationship management, optimization of value chain and other aspects. For example, Huang Guiqun, et al. put forward the railway freight marketing model based on customer relationship management, and the corresponding countermeasures based on the difficulties in its implementation (Huang Guiqun, et al., 2003). Yang Jinhua et al. interpreted the classification and orientation of customers, the selection of customer relationship from the perspective of customer relationship management and proposed the measures for the establishment of railway customers with examples (Yang Jinhua, et al., 2008). Wang qian et al. classified customers and put forward different marketing strategies based on the customer relationship life cycle theory (Wang qian, et al., 2012). Zheng Pingbiao et al. classified railway customers by establishing customer value evaluation index system, and proposed corresponding marketing strategies for different groups (Zheng Pingbiao, et al., 2014).

To sum up, there is a lack of systematic research on railway freight relationship marketing from the perspective of customer value at home and abroad. As relationship marketing attaches great importance on the long-term relationship between enterprises and customers, so we must emphasize the creation of customer value to keep customers satisfied and loyal so as to increase and expand market share. Therefore, constructing the theoretical framework of railway freight relationship marketing from the perspective of customer value is very important and necessary for the improvement of customer satisfaction and loyalty and further enhances the core competitiveness of railway freight enterprises.

## **2 The Concept of Railway Freight Relationship Marketing Oriented by Customer Value**

### **2.1 The connotation of customer value**

At present, the academic circles have different interpretations on customer value from customer perspective. For example, Zaithaml pointed out that customer value is the overall evaluation on the utility of a product or service after weighing the perceived benefits of customer against the costs acquiring for products or service (Zaithaml V., 1988). Woodruff believed that customer value is the preference and evaluation perceived by customers on product attributes, attribute performance, application and the application result (Woodruff R.B., 1997). Among them, Gronroos' research achievements provide more valuable references for this paper. He believes that customer perceived value is a self-evaluation process of customers for service, product, information, contact, service remedy and other elements when customers consume products or service in the process of relationship development. The equations go as follows:

$$\text{Customer perceived Value} = (\text{Core product} + \text{Additional service}) / (\text{Price} + \text{Relational cost}) \quad (1)$$

$$\text{Customer perceived value} = (\text{Long-term benefits} - \text{Support costs}) / (\text{Price} + \text{Relational cost}) \quad (2)$$

In relationship marketing, customer value is perceived with the development of time. In formula (1), price is a short-term concept, relationship cost occurs with the development of relationship, and marginal cost witnesses a diminishing trend. Besides, core product and additional service are also reflected with the development of relationship. Formula (2) is similar to formula (1), which explains the comparison between the economic benefits and the costs of the enterprise. Accordingly, the duty of an enterprise is to use resources and interact with customers to support the generation of customer value (Wei Fuxiang, 2009).

### **2.2 The meaning of relationship marketing**

Relationship marketing theory was first put forward by European scholars on the basis of studying service market and industrial product market in the 1980s. However, the concept of "relationship marketing" was first proposed by Berry, an American scholar, who believed that "relationship marketing is to attract, maintain and enhance the relationship with customers". At present, there are three opinions interpreting relationship marketing. A relatively common view holds that relationship marketing is to maintain a good cooperative relationship between buyers and sellers in transaction activities. Meanwhile, some scholars believe that relationship marketing refers to the establishment of a good relationship between the trading parties in the previous trading activities, so that more trading activities will be carried out through such a good cooperative relationship in future. Some other scholars believe that relationship marketing is that all parties involved in the transaction shall abide by

the trading principles of honesty, good faith and timely fulfill the trading commitments so that the interests of all participants are realized in the relationship marketing activities (Yuan Guohua, 2004). In a word, relationship marketing is a new marketing theory, which takes the establishment, maintenance and promotion, improvement as well as adjustment of relationship as the core and innovates the traditional marketing.

### **2.3 The connotation of railway freight relationship marketing oriented by customer value**

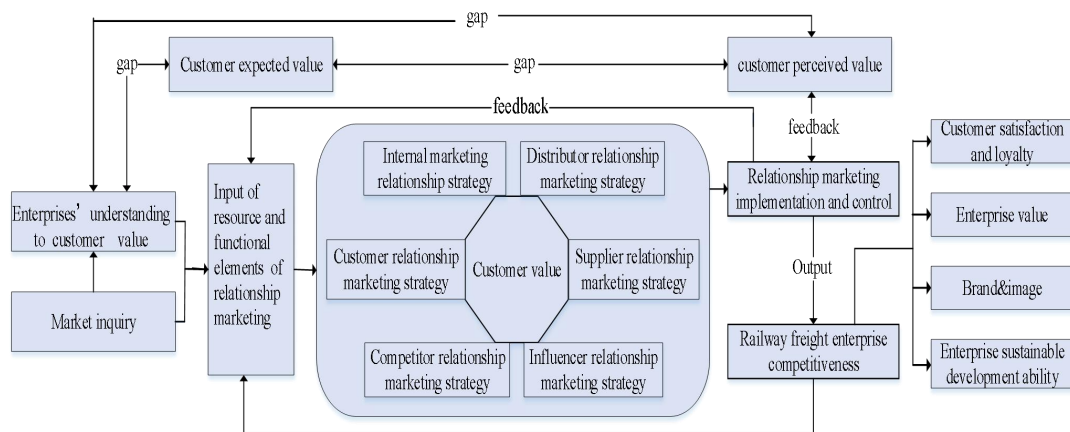
Goods transportation is the movement of goods in space with the help of transportation capacity, and goods transportation products are transportation services for transportation demanders. Transportation marketing is a comprehensive marketing process in the transportation market to meet the actual or potential needs of transportation demanders through the exchange of transportation products (Liu Zuoyi et al., 2008). It starts before the transportation production and runs through the whole process of the transportation production.

By drawing lessons from the meaning of transport marketing, relationship marketing and combining the actual conditions of railway freight, railway freight relationship marketing refers to the realization of the interests for all parties under the guidance of relationship marketing. Railway freight enterprises adopt measures to motivate railway workers and internal organization, establishing competitive and cooperative relations with external competitors. And the external competitors refer to third-party logistics enterprises, highway, aviation, shipping and other enterprises. Before providing transportation services, railway freight enterprises should analyze the market demands and opportunities, determine the target market and design transportation service scope and quantity accordingly; in the process of transportation organization, the railway freight enterprises combine and use the related marketing strategies as well as the public relations means to complete the organization processes of the transportation service; after completing transportation service, the information feedback should be completed to provide the basis for analyzing the changes of market demand, improvement and innovation of the transportation service or products. This progress goes around and round and eventually forms a virtuous cycle to constantly meet the needs of shippers and create value for them so as to better play the role of relationship marketing.

It is obviously that the enterprises can't meet the needs of modern market competition if they are only limited to develop good relations with customers. Besides, establishing, maintaining and developing a good relationship with all stakeholders is an inevitable choice for an enterprise to achieve its goals in the new marketing environment. Railway freight relationship marketing oriented by customer value aims to create maximum value for customers, which is based on the common development of win-win relationships with relevant stakeholders and finally achieves the goal of improving the competitive ability for railway freight business.

### 3 The Theoretical Framework of Railway Freight Relationship Marketing Oriented by Customer Value

Modern marketing framework is a basic theoretical framework of marketing theory(Guo Yuhua, 2011). Although emphasizing the importance of customer and customer relationship, it still passively adapts to customers and fails to actively create higher customer value beyond competitors as well as fails to solve the problems of marketing strategy combination and implementation of customer value creation. Therefore, on the basis of theoretical framework of modern marketing and the six-market model of relationship marketing, this paper puts forward the theoretical framework of railway freight relationship marketing oriented by customer value, which includes the contents, functions and targets of railway freight relationship marketing. Besides, relationship marketing strategy contains customer, internal market, distributor, supplier, influencer and competitor relationship marketing strategy. This framework centers on customer value with an outer layer around the relationship marketing strategies. Each part of the framework clearly defines customer, demand identification and strategy formulation, strategy selection, implementation evaluation as well as feedback based on customer value. Figure 1 clearly represents more details about this theoretical framework.



**Figure1 Theoretical Framework of Railway Freight Relationship Marketing Oriented by Customer Value**

As can be seen from figure 1, railway freight relationship marketing oriented by customer value consists of six parts. The first part is market exploration, which includes not only market research and prediction, market segmentation, target market selection and market positioning, but also important contents related to strategic planning. The second part is the relationship marketing resources and corporate functional elements on the basis of market research and enterprises' understanding of customer value. And the resource elements of railway freight relationship marketing are an organic combination of personnel, capital, entity, technology, equipment and information. At the same time,

these resources and functional elements must be planned and executed to achieve the output function of creating value for customers. All resource elements should follow the guidance of relationship marketing oriented by customer value. The third part is the relationship marketing strategy oriented by customer value. This part considers the particularity of railway freight products and services as well as six markets model of relationship marketing theory. Besides, this strategy contains six aspects and the key point of railway freight relationship marketing is just to be developed from these six aspects. The fourth part is the implementation and control of relationship marketing strategy. In the implementation process, it not only should implement the input of relationship marketing resources, but also strengthen the risk control and crisis management of relationship marketing. Besides, more attention should be paid to the identification and evaluation of customer value driving factors to guide and control the implementation of relationship marketing strategy. The fifth part is the customer value driving factors identification and evaluation, this is the core of the theoretical framework of railway freight relationship marketing oriented by customer value. It runs through the whole process of implementing the theoretical framework of railway freight relationship marketing and plays a decisive role in the effective input of relationship marketing resources as well as effective implementation of relationship marketing strategy. The sixth part is the target level of railway freight relationship marketing, namely the promotion of the core competitiveness of railway freight enterprises. The goal of relationship marketing for railway freight should be to coordinate the balance of enterprise's own interests, customers' interests and social interests. Therefore, the goals of railway freight relationship marketing oriented by customer value must consider the different interest orientation and demand from subject and object of relationship marketing which realizes mainly from the aspects of customer loyalty and value, enterprise value, enterprise brand and image as well as sustainable development ability.

#### **4 The Implementation Path of Railway Freight Relationship Marketing Oriented by Customer Value**

Feasible plans and implementation path maps are the key to any theoretical framework being translated into actionable plans and guidelines. Therefore, the design of the implementation path of railway freight relationship marketing oriented by customer value becomes the key to the implementation and control of railway freight relationship marketing.

##### **4.1 Identify and analyze customers' freight demands through market exploration**

Due to universality of freight service demands and limited resources of freight enterprises, railway freight enterprise must find the key customers of enterprise through market exploration, analyze their demands for freight products and the dynamic changes of demand to create higher customer value, which is the key to railway freight relationship marketing oriented by customer value.



#### **4.2 Identify the driving factors of customer value**

For different freight products, the driving factors of customer value are different, and it changes dynamically in different time periods. Therefore, analyzing the driving factors of customer value is the premise for railway freight relationship marketing and it is also the necessary link for enterprises to reasonably locate customer value so as to invest resources and provide freight service.

To identify and evaluate the driving factors of customer value, first of all, we need to look for possible drivers of perceived customer value for railway freight business owners based on the literature research on marketing, relationship marketing, consumer behaviors, consumer psychology and logistics and then obtain the relevant variables through qualitative methods such as group interview so as to generate the measurement items driving factors of customer value; After that, the stage of formal questionnaire design was carried out to obtain the perceived value data of railway freight enterprises' shippers on railway freight services; Finally, through relevant statistical analysis to find the perceptual gaps of customer value between the freight enterprises and shippers and conclude the factors that should be paid attention to and the areas that need to be improved.

#### **4.3 Develop railway freight relationship marketing strategies oriented by customer value**

After identifying the key driving factors of customer value, we can develop the relationship marketing strategies of railway freight by combining the capabilities and resources of the enterprise.

#### **4.4 Implement and control of railway freight relationship marketing oriented by customer value**

After making good relationship marketing strategies, the enterprise will implement these strategies through the corresponding organization, planning and implementation of activities. In the process of implementation, as the dynamic changes of the customer value driving factors and the gaps of perceived value between enterprise and the customer, thus the enterprise needs to set up customer value driving factors of the dynamic measurement system, analyzes the gaps of customer value perception and enterprise's understanding of customer value as well as customer expectation value at any time to adjust the relationship in time.

### **5 Conclusion**

The theoretical core of relationship marketing is to maintain and enhance customer relationship, while the development of freight service lies in maintaining the relationship among stakeholders. Therefore, railway freight marketing should not only stay in the customer market, but also integrate the distributor market, competitor market, influencer market and internal market in a systematic way to highlight the core position of customer value in railway freight relationship marketing. Railway freight relationship marketing oriented by customer value is the reform and innovation of railway

freight marketing theory and practice brought by the changes of freight market environment and consumption concept. Besides, it is the development of railway freight marketing based on customer value and relationship marketing theory. Clarifying the theoretical framework on railway freight relationship marketing oriented by customer value, which helps railway freight enterprises to clarify the full path of the implementation on freight relationship marketing, create more satisfactory value experience for customers and enhance customer loyalty so as to build the unique competitive advantages of railway freight enterprises and improve their core competitiveness.

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# A Study on Enterprise Life Cycle, Executive Compensation and Earnings Management

Du Wanxin

School of Management, Wuhan University of Technology, Wuhan, P.R. China, 430070  
(E-mail: 17839219707@163.com)

**Abstract:** With the method of empirical research, this paper puts forward the issue that the executive compensation will have an impact on the earnings management behavior, and believes that the impact of the enterprise in different life cycles is different. This paper constructs relevant models to verify this hypothesis. The conclusion of this paper is as follows: the greater difference in executive compensation, the greater degree of earnings management, and the life cycle of an enterprise will affect the relationship between the two. Compared with the mature stage, the salary comparison psychology of the management in the growth stage has a greater impact on earnings management.

**Keywords:** Life cycle; Executive compensation; Earnings management; Corporate governance

## 1 Introduction

Earnings management has always been one of the key research areas of modern financial accounting. Executive compensation is related to corporate efficiency and social equity, and a reasonable executive compensation contract can effectively alleviate the agency conflict between shareholders and managers, and achieve incentive compatibility between principals and agents. As a result, a large number of domestic and foreign literatures have conducted normative and empirical studies on such issues as whether there is correlation between executive compensation and earnings management, and whether higher PPS salary contract will lead to more serious earnings management. Foreign scholars mostly studied executive compensation, earnings management and enterprise life cycle, and found that the compensation contract of managers was the direct cause of the earnings management behavior of enterprises (Watts & Zimmerman, 1986; Armstrong, C.S., A.D. Jagolinzer, 2010; Sun, 2014). During the growth period, the manipulative accruals of enterprises tended to be positive, while during the decline period, the manipulative accruals tended to be negative (Liu, C.C. and S.G. Ryan, 2006). Domestic scholars combined the three factors and found that industry characteristics would have a moderating effect on the relationship between salary comparison and salary manipulation (Luo Hong, Zeng Yongliang and Wan Lingyu, 2016). Li Lanyun and Ren Guohui found that with the advance of enterprise life cycle, the monetary compensation incentive effect of senior executives presented a "u-shaped" distribution. Zhang Zenan and Ma Yongqiang found that the strength of the marketization process would also lead to the heterogeneity of earnings management implemented by executives induced by the compensation gap of companies with different property rights. However, based on the literature at home and abroad, the life cycle characteristics of enterprises are rarely considered in the research of this field, and most of the research starts from the perspective of equity incentive. Therefore, this paper will study the relationship between executive compensation and earnings management from the perspective of enterprise life cycle, so as to enrich the research on earnings management.

## **2 Theoretical Analysis and Hypothesis Development**

### **2.1 Executive compensation and earnings management**

Based on the analysis of agency theory, in order to obtain greater private benefits, the management is more likely to realize its own private interests by manipulating enterprise accruals, choosing accounting policies and changing accounting estimates, etc. (Luo Hong, Zeng Yongliang and Wan Lingyu, 2016). Equity theory holds that the perceived fairness and reasonableness of compensation will directly affect the effort level and behavior choice of executives (Li Yanxi et al, 2007). Social comparison theory points out that people tend to compare their efforts and returns with others (Wu Liansheng, Lin Jingyi, Wang Yaping, 2010). In the absence of reference system, general executives will choose to compare their remuneration with that of executives of similar enterprises in the same industry and employees of the same enterprises, so as to evaluate the rationality and fairness of their remuneration. When larger pay gap, executive level of perceived pay unfairness is bigger, to conduct self-compensate the lack of this kind of satisfaction, it is more likely to through other ways to get more compensation, at the same time also reduces its degree of positive work hard, and surplus management is closely related to total compensation, therefore, the compensation for the larger gap, salary gap present positive correlation relationship between earnings management (Bergstresser, D. and T. Philippon, 2006; Bo, S., 2014; Li Yanxi et al, 2007). Based on this, this paper put forward the research hypothesis:

H1: executive compensation gap is positively correlated with earnings management, that is, the higher the degree of compensation gap, the higher the degree of earnings management of the management

### **2.2 Enterprise life cycle, executive compensation and earnings management**

Different companies have different life cycles. Each life cycle has different goals, strategies, development direction, market share, profitability, sales pressure, business risks, agency problems, etc. (Chen Chen et al. 2016). Due to the small market share and certain resistance to product sales in the growth stage, the management personnel may not be able to achieve the purpose of obtaining considerable remuneration solely on the basis of product sales performance, which will prompt the management personnel to use the earnings management method to send a good signal to the enterprise and the outside world. Manipulation of performance for high pay. On the contrary, mature enterprises occupy a large share of the market, have a stable source of customers, and have considerable sales profits. Management personnel can improve their performance through normal sales profits of products, so as to improve their salary level. These mean that the managers of mature enterprises will have less incentive to take risks to carry out more costly earnings management after being discovered. Compared with mature enterprises, the external market competition faced by enterprises in the recession period is more brutal, and even there is a risk of bankruptcy. Management's performance could be hit hard, and lower performance could further affect executive compensation. At this time, the management, in order to stabilize and improve the salary, the management will choose the method of earnings management to maintain or improve performance (Wang Yun et al, 2016; Chen Chen, Li Zhe and Wang lei, 2017; Wu Liansheng, Lin Jingyi and Wang Yaping, 2010). Therefore, this paper proposes the second hypothesis:

H2: Compared with mature enterprises, the salary level of management staff in the growth period and decline period has a greater impact on earnings management.

### 3 Research Design

#### 3.1 Sample

In this paper, a-share listed companies from 2012 to 2015 were selected as the initial samples and screened according to the following criteria : (1) ST and \*ST companies were excluded; (2) financial and insurance industries were excluded; (3) samples with missing financial data and corporate governance projects were excluded. In this paper, Winsorize method is adopted to conduct 1% and 99% indentation processing for continuous variables, and finally 3741 research samples are obtained. All data in this paper are from Wind database and CSMAR database.

#### 3.2 Variable definitions

##### 3.2.1 Accrued earnings management

In this paper, the modified Jones model based on industry and annual classification, Dechow et al., is used to estimate the manipulable profit as an indicator of earnings management. The specific formula is as follows:

$$\frac{TA_{it}}{A_{it-1}} = \frac{\hat{a}_1}{A_{it-1}} + \frac{\hat{a}_2 \Delta REV_{it}}{A_{it-1}} + \frac{\hat{a}_3 PPE_{it}}{A_{it-1}} + \varepsilon_{it} \quad (1)$$

$$NDA_{it} = \frac{a_1}{A_{it-1}} + \frac{a_2(\Delta REV_{it} - \Delta REC_{it})}{A_{it-1}} + \frac{a_3 PPE_{it}}{A_{it-1}} \quad (2)$$

$$DA_{it} = \frac{TA}{A_{it-1}} - NDA_{it} \quad (3)$$

DA<sub>it</sub> refers to the total accrued profit of a company in period , which is the difference between the net profit of the company and the net cash flow from operating activities. A<sub>it-1</sub> is the total assets of the company at the beginning of period t. REV<sub>it</sub> represents the difference between t period operating income and t-1 period operating income, and REC<sub>it</sub> represents the difference between t period and t-1 period receivables. PPE<sub>it</sub> means the original value of fixed assets at the end of period t. When studying earnings management, this paper referred to the research of li yanxi et al., namely, executive compensation was only positively correlated with positive earnings management. Therefore, this paper only considered the samples of earnings management DA<sub>it</sub> greater than 0, totaling 3,741 samples.

##### 3.2.2 Enterprise life cycle

In this paper, based on the research of DICKINSON and the research of Chen Chen and wang yun, the research samples are divided into three stages: growth stage, maturity stage and decline stage. See table 1 for details.

**Table 1 Symbol of Net Cash Flow of Enterprises in Different Life Cycles**

Symbol of net cash flow	Introduction period	Growth period	Maturity period	Recession period1	Recession period2	Recession period3	Recession period4	Recession period5
Operating activities	-	+	+	+	+	-	-	-

Investment activities	-	-	-	+	+	-	+	+
Financing activities	+	+	-	+	-	-	+	-

### 3.2.3 Control variables

Based on previous studies, this paper selected audit quality, return on equity, equity nature and financial leverage as control variables. In addition, it controlled the industry and year.

**Table 2 Variable Definitions**

Variables	Variable Symbol	Variable Declaration
Explained Variable	DA	Accrued Earnings Management
Explanatory Variables	Gap	AVGTOP3/AVGEMP=Average compensation for the top three executives /Average salary of ordinary employees
	Lifel	Growth
Explanatory Variables	Life2	Mature
	Life3	Degenerating
Control Variables	Qlt	Audit quality, if the accounting firm hired by the enterprise belongs to the "big four" international accounting firm, the value is 1, otherwise it is 0
	ROE	Return on equity ratio of net profit to average net assets
	Nature	If the enterprise is a state-owned enterprise, the value is 1, otherwise it is 0
Control Variables	Lev	Financial leverage is equal to total liabilities divided by total assets
	Year	Annual factor, annual dummy variable
	Industry	Industry factors, industry dummy variables

### 3.3 Model

Model 1: Test the relationship between the comparison psychology of management personnel and earnings management

$$DA_{it} = \beta_1 + \beta_2 Gap + \beta_i \Sigma control + \beta_j \Sigma year + \beta_k \Sigma industry \quad (4)$$

$$EM = \beta_1 + \beta_2 Gap + \beta_i \Sigma control + \beta_j \Sigma year + \beta_k \Sigma industry \quad (5)$$

Model 2: examine the relationship between enterprise life cycle, competitive psychology and earnings management

$$DA_{it} = \theta_1 + \theta_2 Gap + \theta_3 life1 + \theta_4 life2 + \theta_5 Gap * life1 + \theta_6 Gap * life2 + \theta_i \Sigma control + \theta_j \Sigma year + \theta_k \Sigma industry \quad (6)$$

$$EM = \theta_1 + \theta_2 Gap + \theta_3 life1 + \theta_4 life2 + \theta_5 Gap * life1 + \theta_6 Gap * life2 + \theta_i \Sigma control + \theta_j \Sigma year + \theta_k \Sigma industry \quad (7)$$

Model 1 is used to test hypothesis 1: the smaller the compensation comparison coefficient is, the larger the compensation gap between the executive compensation and the employees of comparable companies in the same industry will be, and the higher the executive's comparison psychology will be, and the greater the degree of earnings management conducted by the management. If 2 is significantly negative, it means that the smaller the comparison coefficient is, and in turn, the larger the comparison psychology is, the greater the degree of earnings management of the enterprise will be. In model (2), the life cycle of the enterprise and the interaction between the comparison coefficient and the life cycle of the enterprise are added to verify whether the life cycle of the enterprise will have an impact on the relationship between the salary comparison psychology and earnings management. In model (2), the introduction of interaction terms usually requires the centralization of independent variables and regulating variables. Therefore, this paper centralizes Gap, life1 and life2 variables in model (2). To avoid multicollinearity, this paper studies to mature companies as a benchmark, regression results are compared with the mature of the results. The 6 are significantly negative, then compared with the mature period, growth and decline enterprise management comparing coefficient is smaller, the greater the peer, can lead to greater earnings management executives.

## 4 Empirical Results

### 4.1 Descriptive statistics and correlation analysis

Table 3 shows the descriptive statistical results of the main variables in this paper. Where, the average of earnings management DA is 0.0634, which is basically similar to the results of existing studies (Liu Qiliang, 2009). The mean and median of the comparison coefficient are both greater than 1, which indicates that there is a comparison phenomenon in the formulation of executive compensation in China's listed companies. In addition, the standard deviation of the comparison coefficient is 0.8396, the minimum value and the maximum value are 0.1750 and 5.2480 respectively, which indicates that there is a big gap in the executive compensation of China's listed companies. When the executive compensation is lower than the median of comparable companies in the same industry, the executive's comparison mentality may be larger. This also implies that we can discuss the impact of salary comparison in different life cycles on earnings management from the perspective of the life cycle of enterprises. In addition, the Pearson correlation coefficient between variables was calculated and the variance inflation factor vif of each variable was tested. The results showed that there was no multicollinearity between variables.

**Table 3 Descriptive Statistical Results of Main Variables**

Variable	N	Mean	Median	Standard Deviation	Minimum	Maximum
DA	3741	0.0634	0.0448	0.0642	0.0000	0.5030
Gap	3741	1.2130	1.0119	0.8396	0.1750	5.2480
Life1	3741	0.5001	1.0000	0.5001	0.0000	1.0000

<b>Life2</b>	3741	0.2029	0.0000	0.4022	0.0000	1.0000
<b>Life3</b>	3741	0.2970	0.0000	0.4570	0.0000	1.0000
<b>Qlt</b>	3741	0.0591	0.0000	0.2358	0.0000	1.0000
<b>ROE</b>	3741	0.0726	0.0683	0.0909	-0.4312	0.3680
<b>Nature</b>	3741	0.3994	0.0000	0.4898	0.0000	1.0000
<b>Lev</b>	3741	0.4273	0.4143	0.2171	0.0496	0.9346

#### 4.2 Main results

To test hypothesis 1, table 4 shows the regression results of the impact of executive compensation comparison on earnings management. As can be seen from table 4, after controlling the industry and the year, the coefficient of the comparison coefficient Gap is -0.0067, and it is significantly negative at the level of 1%, which indicates that the smaller the compensation comparison coefficient is, the greater the executive's comparison psychology will be, and the management will conduct a greater degree of earnings management. This also verifies hypothesis 1.

**Table 4 Influence of Salary Comparison on Earnings Management**

<b>Variable</b>	<b>DA</b>	<b>EM</b>	<b>P values</b>
<b>Intercept</b>	0.0522	0.0613	0.0000
<b>Gap</b>	-0.0067	-0.0075	0.0000
<b>Qlt</b>	-0.0185	-0.0195	0.0000
<b>ROE</b>	0.0839	0.0840	0.0000
<b>Nature</b>	-0.0084	-0.0085	0.0000
<b>Lev</b>	0.0275	0.0277	0.0000
<b>Industry and year</b>	control	control	
<b>Adjust-R2</b>	0.0736	0.0756	
<b>N</b>	3741	3741	

In order to verify the second hypothesis, put forward in this paper, this paper studies whether the enterprise life cycle will have an impact on the relationship between the competitive psychology of executives and earnings management. On the basis of model (1), this paper introduces the life cycle of the enterprise and the interaction term of the enterprise life cycle and the comparison coefficient, mainly focusing on whether the interaction term's coefficients (5 and 6) are significant. After controlling for industry and annual impact, table 5 lists the regression results of the impact of enterprise life cycle on salary comparison psychology and earnings management. Chips can be seen from table 5, comparing coefficient and the interaction of the item \* Life1 (Gap) and comparing coefficient of interaction with the recession (Gap \* Life2) coefficient of 5 and theta. Theta 6 is respectively 0.0082 and 0.0084



respectively in 1% and 5% significance level, it shows that compared with the mature period, growth and decline of executives comparing coefficient is smaller, on behalf of executive pay and comparable industry personnel salary Gap, the greater the management cannot ascend with the results to improve the compensation, alleviate intense sentiment, which causes the executives to earnings management motivation, It verifies hypothesis 2 of this paper that the relationship between the comparison psychology of executive compensation and earnings management will be affected by the life cycle of the enterprise. The results show that compared with the mature stage, the competitive psychology of executives in the growth stage and the decline stage has a greater impact on earnings management.

**Table 5 Enterprise Life Cycle, Executive Compensation and Earnings Management**

Variable	DA	EM	P values
<b>Intercept</b>	0.0495	0.0553	0.0000
<b>Gap</b>	-0.0087	-0.0089	0.0000
<b>Life1</b>	0.0276	-0.0279	0.0000
<b>Life2</b>	0.0416	0.0516	0.0000
<b>Gap*Life1</b>	-0.0082	-0.0092	0.0020
<b>Gap*Life2</b>	-0.0084	-0.0077	0.0230
<b>Qlt</b>	-0.0150	-0.0152	0.0010
<b>ROE</b>	0.0997	0.0995	0.0000
<b>nature</b>	-0.0071	-0.0065	0.0020
<b>Lev</b>	0.0151	0.0277	0.0050
<b>Industry and year</b>	control	control	
<b>Adjust-R2</b>	0.1264	0.1365	
<b>N</b>	3741	3741	

#### 4.3 Robustness checks

In order to test the robustness of the above conclusions, the life cycle of the enterprise in the sample was regression according to the growth period and maturity period samples, to verify the impact of salary comparison psychology on earnings management in different life cycles. The grouped regression results also verify the above conclusions, indicating that the conclusions are robust. Due to space constraints, it is unnecessary to elaborate here.

## 5 Conclusion

This paper combines executive compensation and earnings management of listed companies, and applies the knowledge of behavioral economics to analyze the impact of executive compensation gap on earnings management. Through empirical analysis, the following conclusions can be drawn: when the gap in executive compensation is larger, the executive will have the psychology of comparison, and this

negative psychology will bring the executive a negative and uneasy mood. In order to alleviate the salary gap, the executives of listed companies will increase the motivation of earnings management. In addition, the different life cycle, the executives' pay gap have different influence on earnings management degree, compared with the mature period, the growth and decline enterprise executive pay gap bigger impact on earnings management degree, and he said, as a long-term and mature enterprise executive pay gap, the greater the they compare motivation, to a greater degree of earnings management. Mature enterprises can alleviate the relationship between executive compensation gap and earnings management. This also provides a certain reference for China's listed companies in salary design. However, this paper focuses on accrual earnings management in measuring earnings management, and does not carry out relevant research on real earnings management. Future research can also focus on real earnings management, so as to make this research more adequate.

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# Organization and Human Resource Transformation Based on Three-Pillar Theory

Du Ya

School of Management, Wuhan University of Technology, Wuhan, P. R. China, 430070

(E-mail: 1395497770@qq.com)

**Abstract:** Under the background of fierce market competition, the game is the competition of talents and human resources. This paper studies the organization and human resource transformation (HRT), and explores the new mode of human resource management (HRM). Taking the organization and HRT of Guangxi Geology & Mineral Huadi Industry and Trade Group (HD) as an example, through the questionnaire survey to understand the satisfaction of employees. This paper analyzes the current situation of human resources and the problems existing in the transformation, and then put forward suggestions and safeguard measures combined with the theoretical model of three pillars. The result provides new thinking for the transformation of human resources in modern enterprises.

**Key words:** Human resource management; Organization structure; Three-pillar theoretical model; HD.

## 1 Introduction

At present, China's economy is changing from the stage of high-speed growth to the stage of high-quality development, and is in the key period of changing the mode of development, optimizing the economic structure and changing the power of growth. President Xi also pointed out that in order to really gather talents from all over the world in the new era, innovating the mode of HRM and consolidate the talent base for innovative progress, which is also the inevitable requirement of change of the times, social transformation, and innovative development. In the face of the unpredictable market environment, most enterprises lack accurate strategic guidance on human resources and perfect HRM technology and system. Therefore, enterprise must change the organizational structure scientifically, and improve the existing inherent mode of HR. Organizational structure refers to how tasks are divided, grouped, and coordinated (Henry Moon, S P R D, 2008). HRM (White Buck, 1958) must be understood, maintained, developed, hired or used effectively and to make these resources an integral part of the whole work. In addition, the management of human resources performance (Dai Yuxin, 2019) can be explained as the co-ordination and control of business, business, learning, strategy, human resource delivery and personal reputation.

The current research is aimed at the macro environment of the entire industry, little attention is paid to the HRM model of an enterprise. Based on previous studies on the theory of HRM, this paper uses the theoretical model of three pillars of HRM to explore the universal model of HRT. Through the methods of questionnaire and case analysis, this paper analyzes the present situation and existing problems of human resources in HD, and puts forward the countermeasures for the transformation of HRM under the background of the Internet and big data era.

## 2 Literature Review

About performance management, this paper puts forward the combination of the performance effect of HRM and the personal work performance (Marsman, E, Bondarouk, T and Rekers, M, 2014). Studies use multiple management control and performance measurement systems to manage performance (Pešalj, B, Pavlov, A and Micheli, P, 2018). Vu, T A, Plimmer, G and Berman (Vu, T A, Plimmer, G and Berman, 2019) believe that workers can work in line with organizational goals. In addition, there is no lack of people to use the combination of complex network and human capital (Wang X, 2019) to solve the problem.

On the impact of digitization on HRM (Van Kruining, I, 2017), it can be found that HRM has become or is in the process of become more strategic because of digitization. In addition, with regard to the four main functions of HRM (Azeem, M F and Yasmin, R, 2016) is also a major innovative research on the combination of HRM and the Internet. There is also a study on effect of the intention of using e-HRM on the relationship between the determinant of e-HRM (Obeidat, S M, 2016).

Despite the fact that a more comprehensive study of HRM in all aspects of the content, whether the theory and technology can really be used in the daily operation of the enterprise is not yet known. Therefore, research on HRM also needs to combine the current situation of human resources in specific enterprises, specific problems specific analysis, under the premise of combining theory with practice, the innovative model of human resource management in the new era is proposed.

## 3 Research Methods and Theoretical Models

The most important part of HRM is performance management, which has been investigated from different perspectives. On the one hand, it starts from the performance of enterprise management and the individual performance of employees. This paper uses the method of text analysis, questionnaire and case analysis. Have a deep conversation with the employees, so as to design the employee satisfaction questionnaire of HD and distribute it to the employees. Based on the survey data, this paper analyzes the problems existing in HRT of enterprises. Then combined with the theoretical model of three pillars, this paper makes some feasible measures to solve each specific problem.

The three-pillar theory model (Devi Ulrich, 1997) is made up of the Human Resources Expert Center (COE), the Human Resources Business Partner (HRBP), and the Human Resources Sharing Service Center (HRSSC). COE's basic responsibility is intended on the formulation and optimization of various policies and processes (Yue Yang, 2018). For the HRBP, Zang Yuefan(Zang Yuefan, 2019)believes it is aimed at the different needs of human resource. HRSSC is directly oriented to customer service, dealing with numerous daily tasks of the human resources department (Zhang Suning, 2018).

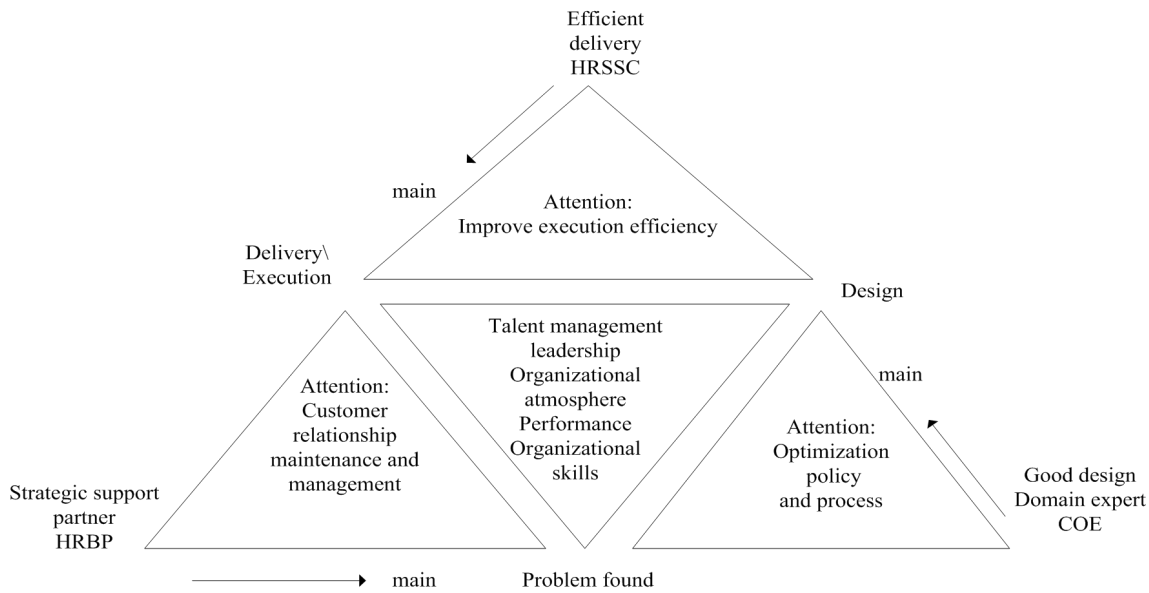


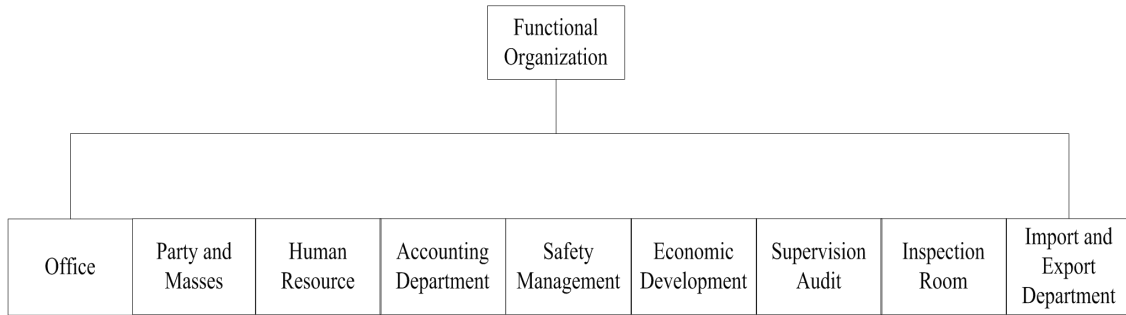
Figure 1 Three-Pillar Theory Model of Human Resource Management

## 4 Case Analysis

### 4.1 Overview of the organization and HRT of HD

Since the transformation of HD from institutions to enterprise groups in 2015, its organizational structure has modified to a certain extent. The Group divides the organizational structure into functional and operational entities (Figure 2). From the picture, we can see that the organizational structure of HD is perfect, the rights between the functions are independent of each other, but the business is closely tied. The establishment, of a separate human resources department shows that its human resources have formed a certain scale and are an indispensable part of the daily operation of the group.

The current situation of human resources is not optimistic (Table 1), with a small staff base, including staffing and hiring. The overall academic qualifications of employees are on the low side, and highly educated talents are scarce. Overall, HD's HRM level is low, the quality of staff is uneven.



**Figure 2 Functional Organization of HD**

**Table 1 Number and Quality of Staff in HD (unit: person)**

Number of employees and forms of employment	Total number of employees	249	Establishment staff	120	Employment personnel	126	\			
Educational background	Doctor	1	Graduate student	4	Undergraduate student	56	Junior college	55	Below junior college	133
Professional title situation	Senior	10	Middle	22	Primary	31	\			
Management situation	Department level	5	Middle-level cadres (at or above deputy level)			29	\			

**4.2 Research on the transformation of HD**

**4.2.1 Investigation and Analysis of employee satisfaction in HD**

HRM is a human-centered management method, so the degree of employee satisfaction is tied to the quality of HRM model. According to the Minnesota satisfaction scale (S.R. Hathaway, J.C. McKinley, 1942), this paper designs a questionnaire on worker satisfaction of HD to analyze the problems of the group's HRT after the restructuring. By checking one of the answers in "Very Disagree", "Disagree", "General", "Agree" and "Very Agree", the respondents were given a score of 1, 2, 3, 4 and 5, respectively. At the same time, the basis of the survey was added. This information, such as job type, gender, position, age, education level, etc. A total of 78 valid questionnaires was collected in this survey. The following is a descriptive statistical analysis of some of the questions in the questionnaire (Figure 3).

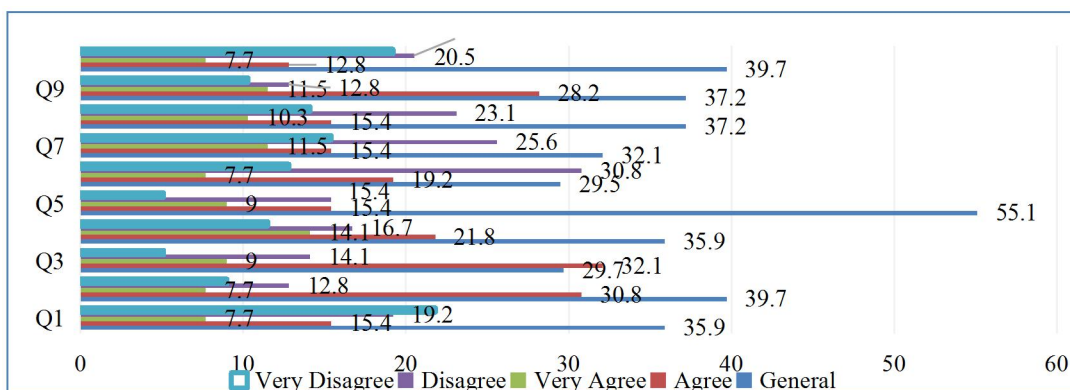


Figure 3 Survey of Employee Satisfaction in HD

According to statistics, HD employees are generally satisfied with the company's prospects and environment (Q1, Q2, Q9), this shows that the Group's economic benefits are not good, making employees less confident in the group. About performance management (Q4, Q5), most employees do not think that the group's human resource performance management is effective and fair. In terms of remuneration packages (Q8, Q10), only a few employees believe that remuneration packages are reasonable. This shows that the group has a large loophole in the remuneration system. About group system (Q6, Q7), most employees disagree with employee training, job rotation and employee career development planning. This shows that the Group's human resources system has not been improved.

#### 4.2.2 Specific issues of HRT in HD

(1) Lack of strategic planning for human resources. Through interviews with the head of the industry and trade human resources department in HD, it was learned that the group had not developed a clear strategic plan related to human resources. Compared with its human resources planning documents in the past two years, it only stays on the content of basic human resources affairs, and there is not any big change. Delete enterprises, strategic human resources planning are the overall planning and control of human resources. If there is the absence of systematic guidance, it will not be possible to form a unique HRM model. Therefore, enterprises cannot stand from a higher point of view to examine the defects and omissions in HRM, which is the biggest problem in the transformation of human resources management in the group.

(2) Dispute over compensation and benefits of employees. After the transfer of enterprises from public institutions, although some employees of HD retain their original establishment, they do not have previous benefits, especially in retirement protection, which makes them controversial about the salary system and the social security system. In the face of this situation, managers do not give specific solutions, or extend the innovative system, which indirectly increases the labor costs of enterprises, so that enterprises in the operating profits and no obvious increase in the premise, bear more economic burden. In addition, since employees have signed employment contracts with enterprises after the transfer of enterprises, many high-quality talents are more inclined to work in state-owned enterprises to protect their own economic interests, resulting in enterprises without changing the wage system. Can not recruit high-tech, superior academic experience personnel. The question of salary and



welfare benefits limits the long-term development of enterprises and the speed of improving the quality of personnel.

(3) Mismatch between the quality of staff and the development level of information technology. It is not difficult to see from Table 1 that more than 70% are college degrees and below. The distribution level of staff quality leads to the group cannot keep up with the pace of the Internet and big data era, difficult to master electronic human resource management technology, but also unable to combine online and offline business development. Today is the world of information technology, only on the basis of mastering high-end technology and introducing advanced technology and equipment, can we always catch up with the ever-changing market. The lack of high-quality talents has become the fundamental reason why HD gradually lags behind the same type of enterprises. In addition, as most of the employees are transferred from institutions to enterprises, the degree of aging of employees is also gradually improving, there are fewer young employees within the group, lack of innovative thinking, resulting in the lack of vitality of enterprises and low motivation for reform.

#### **4.3 Countermeasures for the HRT in HD based on the three pillar theory model**

(1) Establishing Shared Service Center (HRSSC) to integrate human capital. HD has numerous subsidiaries with different business contents, but the information between the parent company and the subsidiary is not shared. Establishing HRSSC can make the maximum use of the human resources of all groups. HRSSC can reduce the burden and workload of group managers, improve efficiency and the satisfaction of employees with the group.

(2) Leverage Business partner (HRBP) to improve Management. HD should formulate a performance appraisal system suitable for various departments. In addition, the service object of human resources business partners is not only enterprise customers but also enterprise employees, which regard employees as customers and can change and check the performance appraisal system. The applicable connection between HRBP and HRSSC is the focus and core of the future work of HD.

(3) Constructing human resources expert center (COE) to train high-end talents. COE can make the corresponding recruitment plan, select the recruitment method suitable through the integration of recruitment channels. The establishment of COE cannot only introduce high-end talents, but also systematically train the bottom staff and formulate corresponding self-development plans.

#### **4.4 Implementation guarantee of HRT of HD**

(1) Cultivate a good corporate culture. The group should combine the comprehensive ideas of senior managers and grass-roots employees, according to the different stages of the group, establish the group corporate culture. Through regular group enterprise culture education lectures, the distribution of the group enterprise culture propaganda manual, the production and promotion of enterprise culture propaganda video and other ways to spread and cultivate the HD enterprise culture. In a word, the basis of the implementation of the HRT in the group is to cultivate and implement a sound corporate culture.

(2) Increase the investment in personnel training. HD should carry out planned and organized staff quality training, provide various ways of foreign exchanges, so as to create a suitable environment to cultivate excellent technical talents. In addition, actively looking for prestigious and strong headhunters to recruit outstanding professionals. Professionals should be given high pay and appropriate rights, so as to deepen the loyalty and satisfaction of the staff and workers of the group.

From this point of view, increasing investment in talent cultivation is an important way to make sure the implementation of the transformation of human resources in the group.

(3) Establishing a scientific and reasonable HRM system. According to the current situation, the needs of employees and other aspects, the group should formulate an HRM system that can be implemented for a long time. On the basis of the system, we should standardize illegal behavior, abolish some unwritten provision and break the inherent mode of thinking. Through the standardized system, it is the human resources department to better perform the responsibilities of the department, improve the professional level and the quality of the department staff. Therefore, the establishment of a scientific and reasonable human resources management system can provide the guarantee and support for the implementation of the transformation of human resources in the group.

## 5 Conclusion

This paper through establishing HRSSC, training HRBP, and establishing COE, the human resources of HD will be re-integrated and the Group's human resources management model will be strengthened. On the basis of combining the electronic human resource management and service platform, it creates a human resource management method that belongs to HD. However, because the three-pillar theoretical model itself has certain limitations, and there are gaps in theoretical and practical operations, the process of introducing the three-pillar model into enterprise needs to be more cautious.

## Acknowledgement

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# Research on the Cultivation Status and Measures of Innovative Talents of Marketing Major

Ma Ying, Chen Long

School of Management, Wuhan University of Technology

mying331@163.com, 498733358@qq.com

**Abstract:** In order to cultivate talents that serve the construction of an innovative country, it is necessary for higher education institutions to actively explore innovative talent training models in the context of the new era. Based on the investigation and analysis of the current situation of the cultivation of innovative talents in marketing major in colleges and universities, this paper summarizes the achievements and shortcomings, reconstructs the training objectives of talents, reforms the training program and curriculum system, and proposes measures for the cultivation of innovative talents in marketing major based on industry-university-research cooperation.

**Keywords:** Cultivation mode; Innovative talents; Marketing major; Industry-university-research cooperation

## 1 Introduction

Innovation is the theme of The Times and the inexhaustible source of development. High-quality talents with innovative spirit and ability are the promoters of enterprise development, the leaders of economic prosperity, and the guarantee of social progress.

The cultivation of innovative talents has become one of the important goals of college teaching.

Throughout China's college education, special measures have been taken to cultivate innovative talents, and some results have been achieved.

However, it is worth noting that China's higher education has not formed a perfect system in the cultivation of innovative talents, training programs and social needs are not fully matched, innovative talents training is not particularly outstanding. The cultivation of innovative talents should not only allow the campus and teachers to play a role, but also integrate enterprises into the

cultivation system, connect all links of production, study, research and use, and realize the effective cultivation of innovative talents.

In the research on the cultivation mode of innovative talents of marketing specialty, American universities attach great importance to the individualized education of students and adhere to the diversified talent cultivation model (Zhang, 2006). German universities hold that the purpose of university education is to cultivate a "perfect person" with all-round development (Huang, 2008). Japanese universities put forward the training model of "industry-university-government cooperation", attach importance to students' national education (Xie, 2004).

In the exploration of the cultivation mode of innovative talents of marketing major in China, researchers put forward some different cultivation modes. For example, Wang et al (2018) propose that the so-called "order-type" training is to determine the enrollment number and professional talent training program based on the "order" of enterprises. Gao et al (2019) believes that the modern apprenticeship training model can connect apprentices, training institutions and employers, and enable students to integrate theoretical knowledge with practice. Zhu & Wu (2014) puts forward that the cultivation of innovative talents in marketing majors should adhere to the results-oriented, focus on students, provide more learning resources for students.

It can be found that the training mode of practical teaching and industry-university-research cooperation has been unanimously recognized by the researchers. However, there are two deficiencies in the existing research. First, the research lacks targeted investigate and practical guidance. Secondly, the cultivation mode of Chinese universities is still the imitation and copy of foreign universities, lacking of innovation and feasibility.

## **2 Investigation of Innovative Talents of Marketing Major**

### **2.1 The existing mode**

In the first investigation, the students majoring in marketing in several universities in Wuhan were surveyed through the Internet. A total of 100 questionnaires were sent out and 87 were collected. In terms of teaching methods, (Figure 1) Case teaching and students' self-discussion method are widely used. And teachers will adopt different teaching methods according to the teaching content.

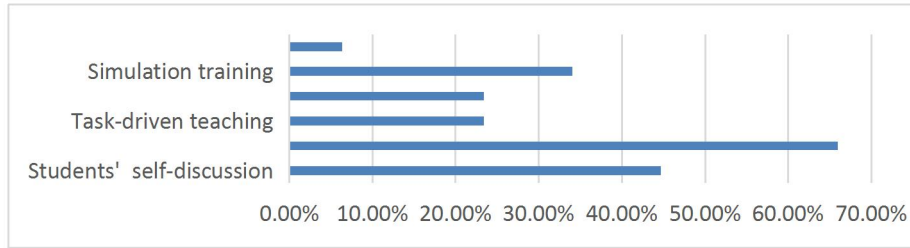


Figure 1 Teaching Method of Marketing Major

In addition, students from several universities in Wuhan are not satisfied with the course setting of marketing major. As shown in figure 2, the main reason why students are not satisfied with the curriculum is that the curriculum pays too much attention to the theory but ignores the practice, and their comprehensive ability is not well explored and exercised, which leads to their insufficient practical ability.

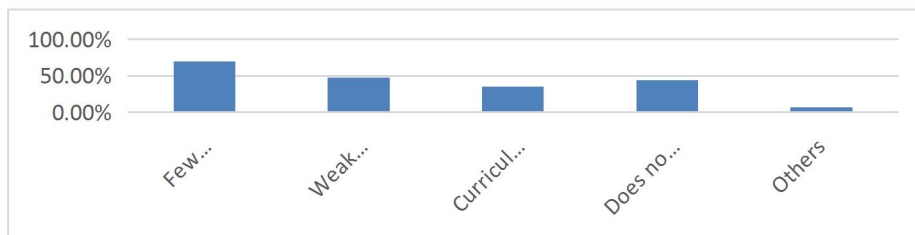


Figure 2 Problems in the Curriculum Setting of Marketing Majors

## 2.2 Social benefits

In order to know the social demand for innovative talents of marketing major in China's universities, and the social satisfaction on students' knowledge level, learning ability and social ability. In the second investigation, the marketing managers of enterprises of different economic types were investigated through network survey. 150 questionnaires were sent out and 116 were recovered. The research results are as follows:

From the perspective of enterprise demand, most enterprises are in urgent need of recruiting innovative talents of marketing majors. In terms of vocational skills, market development, market research and prediction, and marketing planning have gradually become the focus of enterprise needs and concerns.

On the basis of constructing the evaluation index system of social benefits for innovative talents

of marketing specialty, this study uses the fuzzy AHP comprehensive evaluation method to evaluate their social benefits, as shown in Table 1.

**Table 1 Evaluation Results of Social Benefits**

Primary index	Weight	Score	Secondary index	Weight	Score
Levels of knowledge (U <sub>1</sub> )	0.0906	69.39	U <sub>11</sub>	0.5278	67.8
			U <sub>12</sub>	0.1397	66.8
			U <sub>13</sub>	0.3325	73.0
Ability to learn (U <sub>2</sub> )	0.1578	71.98	U <sub>21</sub>	0.1551	72.0
			U <sub>22</sub>	0.1178	71.0
			U <sub>23</sub>	0.2886	76.6
			U <sub>24</sub>	0.4385	69.2
			U <sub>31</sub>	0.3137	68.8
Social ability (U <sub>3</sub> )	0.1041	69.09	U <sub>32</sub>	0.0873	71.2
			U <sub>33</sub>	0.1552	72.4
			U <sub>34</sub>	0.2612	65.0
			U <sub>35</sub>	0.1826	71.6
			U <sub>41</sub>	0.3108	68.0
Ability to work (U <sub>4</sub> )	0.4026	73.00	U <sub>42</sub>	0.1958	75.4
			U <sub>43</sub>	0.4934	75.2
			U <sub>51</sub>	0.0988	67.2
The innovation ability (U <sub>5</sub> )	0.2449	71.05	U <sub>52</sub>	0.5369	72.6
			U <sub>53</sub>	0.3643	69.8

The comprehensive score of enterprises on social benefits of innovative talents majoring in marketing is as follows:

$$\text{Social benefit score} = (0.0906, 0.1578, 0.1041, 0.4026, 0.2449) * \begin{pmatrix} 69.39 \\ 71.98 \\ 69.09 \\ 73.00 \\ 71.05 \end{pmatrix} = 71.63$$

From the point of view of score, enterprises are quite satisfied with the social benefits of innovative talents of marketing specialty, which fully shows that the cultivation of innovative talents of marketing specialty in Colleges and universities can meet the basic requirements of the development of enterprises in China.

### 2.3 Cooperative resources for cultivating

The third investigation is mainly to survey the marketing teachers of several universities in Wuhan by means of network survey. 150 questionnaires were sent out and 92 were recovered. The results are as follows:

In terms of the form and content of cooperation, as shown in Figure 4, there are three main modes of school enterprise cooperation: Internship provided by the enterprise, School-enterprise order-type training, School-enterprise guidance project or competition. It can be seen from the data that the cooperation between modern enterprises and universities is increasingly frequent and diversified in content and form, and students can get more exercise in cooperation opportunities, and gradually meet the requirements of enterprises for compound talents.

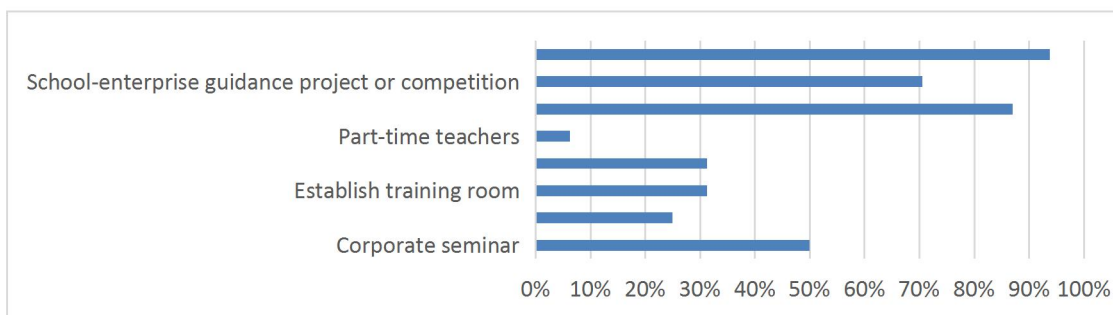


Figure 4 Content and Form of School-enterprise Cooperation

From the perspective of the motivation of cooperation between universities and enterprises, for universities, enterprise financial support and the conversion rate of scientific research achievements are the main factors to be considered. For enterprises, the uncertainty of cooperation income, the economic loss of personnel training and the lack of government preferential policies will affect the enthusiasm of enterprises to carry out school enterprise cooperation.

### 2.4 The main problems of Innovative Talents of Marketing Major

According to the survey, the following problems exist in the training of marketing innovation talents in colleges and universities:



First, the training target is not accurate. Under the condition of market economy in China, there is a large demand for practical talents, so most colleges and universities should focus on practical talents. Secondly, colleges and universities should combine their own reality and external environment to make the destination of marketing graduates.

Second, the curriculum is not reasonable. On the one hand, the content of the course is not closely related to practice, and there is no local development practice in China, so the theory cannot be applied to practice. On the other hand, the relevance of the curriculum is not strong, most of which are simply stacked, which do not take into account the relevance between courses, nor design the curriculum according to the professional characteristics and teaching expertise of school.

Third, the practical teaching link is weak. On the one hand, many universities do not regulate the management of training bases, therefore the number of training bases outside universities is small and the quality is not high. On the other hand, most of the teachers are not strong in practice and lack of knowledge of enterprise marketing management. In addition, universities have not established a complete evaluation system of practical teaching, and there is not enough emphasis on practical teaching evaluation.

### **3 Measures for Cultivating Innovative Talents**

#### **3.1 Cultivating the "reverse" concept of talent cultivation**

##### **3.1.1 "Order-type" talent training**

"Order-type" talent training mode is a cooperative school-running mode in which both the school and the enterprise jointly formulate the talent training target, sign the employment agreement. In this process, the school formulates the talent training program according to the requirements of different posts, and the enterprise evaluates students and takes up employment according to the agreement. Colleges and universities should do a good job in market research, actively seek "orders" from enterprise units, actively seek partners, and strive to train talents in positions, and at the same time establish a teaching management system that is appropriate to them.

##### **3.1.2 School-enterprise cooperation training**

According to the practice of colleges and universities in China, many problems of cooperative education are caused by the lack of close cooperation between schools and enterprises. Enhance the level of industry-university-research cooperation from the following three aspects: On the one hand, schools and enterprises need to jointly develop application-oriented talent training plans, such as

curriculum setting, practical teaching, and teacher management; On the other hand, schools and enterprises jointly build laboratories, simulation training bases and off-campus training bases. In addition, through the establishment of the industry-university-research cooperation committee, more social forces can directly participate in the management of cooperative education, and promote the education comprehensive and lasting.

### 3.1.3 Optimize the subject knowledge structure and curriculum system

The training of marketing talents under the mode of industry-university-research cooperation should integrate all disciplines as a whole knowledge. On the one hand, under the premise of following the discipline and specialty rules, the discipline and specialty structure should be optimized to achieve the close connection between theory and practice. On the other hand, the education concept of cultivating students' innovative thinking should focus on the cultivation of post ability and build a multi-disciplinary integration curriculum system.

## 3.2 Reforming the "open" teaching

### 3.2.1 Treat the company as a second class.

On the one hand, teachers can participate in marketing practice under the guidance of enterprise experts, and become a window for teachers to lead to society, research society and transition to "double-qualified" teachers. On the one hand, On the other hand, students can walk out of the classroom and participate in organizing marketing activities, planning, promotion and other practical activities to enhance their practical and logical thinking skills.

### 3.2.2 Strengthen the campus practice construction.

First, build simulation training room. The marketing training room is the main place to implement the practical teaching link. The students' basic operation skills training and simulation operation training are mainly carried out in the training room. Second, operate the "second-hand market" and "plaid supermarket". Establish a business base, operate in accordance with the business model of a limited liability company, and employ professional teacher as manager for business management, conduct daily professional guidance for students, and rotate student-related marketing practice.

### 3.2.3 Expand the training base outside the school

In order to enhance students' practical operation ability, it is difficult to meet the needs of practical training only by the on-campus training base. It is necessary to expand the off-campus training base and establish internship and training bases in enterprises or related industries, which not only can cultivate students' ability to solve problems. And it can cultivate the spirit of students'

dedication and dedication.

### **3.3 Optimizing the "double-qualified" teams**

At present, there is a relative shortage of "double-qualified" teachers in marketing major in colleges and universities. Most of the teachers are "from school to school", who have a good grasp of professional theoretical knowledge, but they are quite short of application ability and practical operation experience of knowledge and technology. To build a high-quality "double-qualified" teacher team with both professional knowledge and practical skills, the following three aspects should be carried out.

#### **3.3.1 "Introducing part-time teachers" and "teacher training"**

Employ enterprise experts, social celebrities, department managers, or managers with many years of work experience in the company as part-time teachers outside the school. There are two ways for teachers to pursue further education. One is to arrange teachers to go to business operations for internships and technical consulting services; the other is to select some young teachers with potential or teachers with practical experience to go to famous universities in China for training.

#### **3.3.2 Develop a reasonable teacher evaluation system**

Formulating a reasonable performance appraisal system will help mobilize the enthusiasm of teachers and motivate teachers to fully engage in their work. Therefore, it is necessary to clearly define the duties of the post, and the experts should evaluate the comprehensive ability of the young teachers' teaching ability, practical application ability and scientific research analysis ability. The assessment follows the principle of superiority and inferiority, and the method of rebuilding is adopted for those who fail to pass the examination. Moreover, it is necessary to carry out spot checks on the performance of "double-qualified" teachers from time to time to ensure the quality of the "double-qualified" team.

### **3.4 Establishing the "sustainability" evaluation mechanism**

On the basis of exploring the new mechanism of school-enterprise cooperation and deepening the new connotation of school-enterprise cooperation, colleges and universities should improve and optimize the "double-certificate" mechanism, reform the course teaching and evaluating mechanism. Furthermore, colleges and universities should explore and practice the enterprise-led in-post internship mechanism, and finally form the "enterprise-oriented" talent training evaluation model and build its supporting system. The construction idea is shown in figure 5.

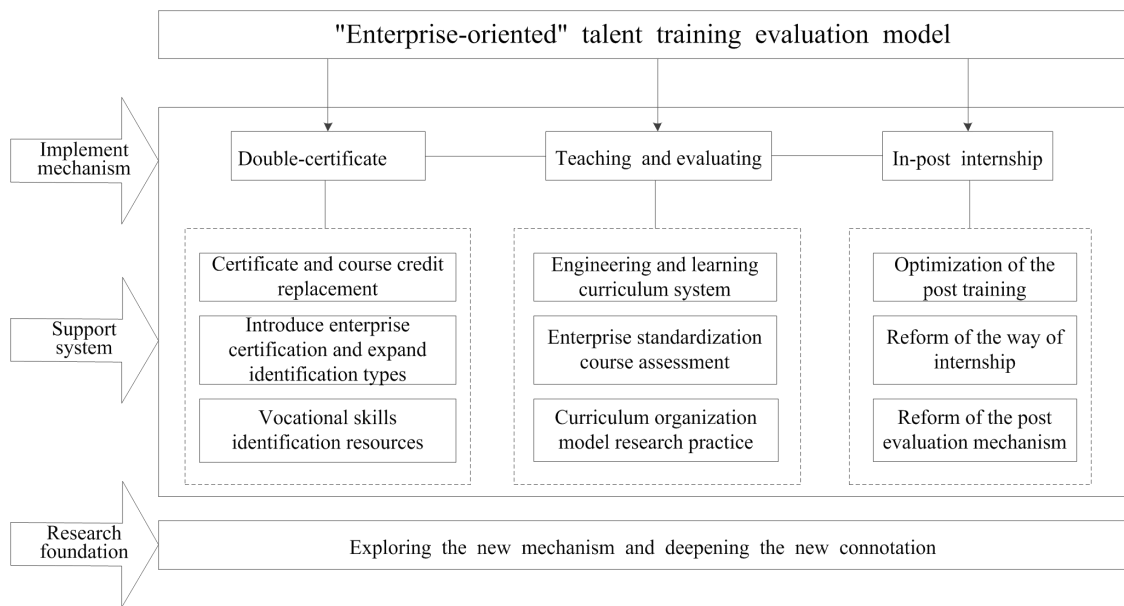


Figure 5 Thoughts on the Construction of Talent Cultivation Evaluation System

#### 4 Conclusion

This paper focuses on the cultivation of innovative talents, researches the cooperation model of industry-university-research on the cultivation of innovative talents, and takes the marketing profession as an example.

Based on the investigation of well-known universities and a large number of enterprises in Wuhan, this paper investigates the cultivation mode, social benefits and cooperative resources of innovative talents in marketing majors in universities. The results show that there are some problems in the cultivation of innovative talents, such as inaccurate orientation, unreasonable curriculum and weak practical teaching. In view of these problems, this study proposes measures to cultivate innovative talents in marketing majors based on industry-university-research cooperation, such as cultivating the "reverse" concept, reforming the "open" teaching, optimizing the "double-qualified" teams, and establishing the "sustainability" evaluation system.

This study integrated theoretical analysis and practical investigation, combined with experience summary and put forward the innovation model, has important theoretical and practical value. Moreover, the specific mode and measures proposed in this study can make up for the deficiencies in the existing training system and effectively promote the cultivation of innovative talents

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## Evolutionary Game Analysis on Credit Behavior of Three Parties in Logistics Finance

Xu Fengwei, Zhang Zhenfang, Yu Bowen

School of Economics and Management, Dalian Jiaotong University, Dalian, P.R.China, 116028

(E-mail: xu\_fengwei@163.com, zzfxsz@163.com, 875956854@qq.com)

**Abstract:** In view of dynamic evolution of three parties' credit behavior in logistics finance, this paper constructs evolutionary game model on credit behavior of three parties in logistics finance, and analyzes the evolution dynamic stability of their behavior choices. The results show that: whether logistics enterprises choosing "to supervise" strategy and financing enterprises choosing "not cheating" strategy depend on normal cost, penalty, cheating cost, additional benefit after successful default and the size of performance cost under financial institutions' supervision as well as the interaction among those factors; whether financial institutions choosing "to supervise" strategy depends on supervision cost, penalty, the size of fraud losses and the interaction among those factors.

**Key words:** Logistics finance; Credit behavior; Risk; Evolutionary game

### 1 Introduction

Financing difficulty has always been the bottleneck for development of small and medium-sized enterprises, therefore logistics finance serving as an innovative financial service comes into being. It has effectively solved the problems of insufficient credit standing, pledged goods and other problems in traditional credit and also alleviates the financing predicament of small and medium-sized enterprises to some extent. However, though logistics finance eases the default risk of financing enterprises in traditional credit, it also expands the risk from two parties (financial institutions, financing enterprises) of traditional credit to three parties (financial institutions, financing enterprises and logistics enterprises) in logistics finance because of special third-party principal-agent relationship of its business. Besides, risk in logistics finance is more complex and unpreventable. Therefore, identification and prevention of logistics financial risk are essential to healthy development of logistics financial business.

In recent years, scholars at home and abroad have gradually shifted their focus from objective risk to subjective credit risk concerning the logistics finance risk. For example, Cossin and Hficko thought that pledged goods with price risk has a complex impact on pricing of credit risk after we established a model and analyzed the valuation of credit risk with pledged goods in different situations (Cossin and Hficko, 2003). Suo i subjective credit risk faced by logistics enterprises, financial institutions and financing enterprises in logistics financial services, and proposed corresponding preventive measures (Suo Na, 2013). Xu Mingchuan made a game analysis on related subjects in logistics finance business, which provided a new method for credit risk control of logistics finance (Xu Mingchuan, 2006). Wu Hao made a game analysis on logistics finance subjects of China Guangfa Bank, and put forward suggestions on credit risk control of logistics finance (Wu Hao, 2012). He Juan et al. established a three-party stackelberg dynamic game model of logistics enterprises priority decision based on the business of inventory pledge financing, and results show that logistics enterprises and banks have comparative advantages in "bilateral market" (He Juan et al., 2012). Guo Chunxiang and Shi Ruili established a tripartite subject signal game model based on incomplete information hypothesis, and results show

that financing enterprises are more likely to send information beneficial to themselves or attract logistics enterprises and banks to participate with high remuneration and interest rate. Besides, logistics enterprises and banks are more willing to take risk to participate in logistics finance (Guo Chunxiang and Shi Ruili, 2013). Tao Zhengxu and Zhou Gengui made evolutionary game analysis between logistics enterprises and financing enterprises based on the unified credit model, identified the influencing factors of credit risk, and proposed management countermeasures (Tao Zhengxu and Zhou Gengui, 2016).

From what has been discussed above, current researches on the game analysis of logistics finance subjective credit risk are mostly based on traditional static, dynamic and repeated game analysis, or simple two-party evolutionary game analysis. In view of this, this paper applies evolutionary game theory to study the motivation and dynamic evolution on credit behavior of three parties in logistics finance, and analyses the fundamental reasons of credit behavior between logistics enterprises and financing enterprises so as to provide theoretical basis and practical references for preventing credit risk of logistics finance.

## 2 Basic Assumptions and Model Building

For simplicity, this paper mainly studies the game relationship among logistics enterprises, financing enterprises and financial institutions. And strategy set of logistics enterprises  $A = \{ \text{to supervise, not to supervise} \} = \{ A_1, A_2 \}$ , strategy set of financing enterprises  $B = \{ \text{not to cheat, to cheat} \} = \{ B_1, B_2 \}$ , strategy set of financial institutions  $C = \{ \text{to supervise, not to supervise} \} = \{ C_1, C_2 \}$ .

Assumption 1: Under the condition that both financing enterprises and logistics enterprises are integrity compliance, we assume that  $I_1, I_2, I_3$  respectively represents normal revenue of logistics enterprises, financing enterprises and financial institutions. Meanwhile,  $C_1$  represents supervision cost of logistics enterprises avoiding risk,  $C_2$  represents management expense of financing enterprises' normal projects,  $C_3$  represents supervision cost of financial institutions.

Assumption 2: When financing enterprises choose cheating or logistics enterprises choose non-supervision, financing enterprises need to pay  $Y_2$  for whitewashing their credit information for obtaining loans, logistics enterprises also need to pay  $Y_1$  for their failing of supervising financing enterprises. Meanwhile,  $R_2$  and  $R_1$  represent respectively additional benefits obtained by financing enterprises' cheating successfully and logistics enterprises' non-supervision but are not detected by financial institutions. On the other hand, financial institutions will suffer losses  $S_2, S_1$  caused by financing enterprises' cheating and logistics enterprises' non-supervision.

Assumption 3:  $F_2$  and  $F_1$  respectively represent penalty imposed by financial institutions because of financing enterprises' cheating and logistics enterprises' non-supervision. In addition, logistics enterprises also need to pay  $H_1$  for new overheads to conduct supervision due to the original commitment and financing enterprises will also generate new management expense  $H_2$  because of cheating.

Based on above assumptions, the payoff matrix on credit behavior of three parties in logistics finance is shown in table 1.

**Table 1 Payoff Matrix of Tripartite Game**

Strategy Set	Logistics Enterprises	Financing Enterprises	Financial Institutions
(A <sub>1</sub> ,B <sub>1</sub> ,C <sub>1</sub> )	$I_1 - C_1$	$I_2 - C_2$	$I_3 - C_3$
(A <sub>1</sub> ,B <sub>1</sub> ,C <sub>2</sub> )	$I_1 - C_1$	$I_2 - C_2$	$I_3$
(A <sub>1</sub> ,B <sub>2</sub> ,C <sub>1</sub> )	$I_1 - C_1$	$I_2 - F_2 - H_2 - Y_2$	$I_3 + F_2 - C_3$
(A <sub>1</sub> ,B <sub>2</sub> ,C <sub>2</sub> )	$I_1 - C_1$	$I_2 + R_2 - Y_2$	$I_3 - S_2$
(A <sub>2</sub> ,B <sub>1</sub> ,C <sub>1</sub> )	$I_1 - F_1 - H_1 - Y_1$	$I_2 - C_2$	$I_3 + F_1 - C_3$
(A <sub>2</sub> ,B <sub>1</sub> ,C <sub>2</sub> )	$I_1 + R_1 - Y_1$	$I_2 - C_2$	$I_3 - S_1$
(A <sub>2</sub> ,B <sub>2</sub> ,C <sub>1</sub> )	$I_1 - F_1 - H_1 - Y_1$	$I_2 - F_2 - H_2 - Y_2$	$I_3 + F_1 + F_2 - C_3$
(A <sub>2</sub> ,B <sub>2</sub> ,C <sub>2</sub> )	$I_1 + R_1 - Y_1$	$I_2 + R_2 - Y_2$	$I_3 - S_1 - S_2$

### 3 Equilibrium Analysis of Tripartite Evolutionary Game

Suppose that logistics enterprises choose “to supervise” strategy with a proportion  $x$ , and choose “not to supervise” strategy with a proportion  $1-x$ ; financing enterprises choose “not to cheat” strategy with a proportion  $y$ , and choose “to cheat” strategy with a proportion  $1-y$ ; financial institutions choose “to supervise” strategy with a proportion  $z$ , and choose “not to supervise” strategy with a proportion  $1-z$ .

Based on table 1, the expected revenue  $E_{11}$ ,  $E_{12}$  and average revenue  $E_1$  of logistics enterprises choosing “to supervise” strategy or “not to supervise” strategy is as follow:

$$E_{11} = (I_1 - C_1)zy + (I_1 - C_1)y(1 - z) + (I_1 - C_1)(1 - y)z + (I_1 - C_1)(1 - y)(1 - z)$$

$$E_{12} = (I_1 - F_1 - H_1 - Y_1)yz + (I_1 + R_1 - Y_1)y(1 - z) + (I_1 - F_1 - H_1 - Y_1)(1 - y)z + (I_1 + R_1 - Y_1)(1 - y)(1 - z)$$

$$E_1 = E_{11}x + E_{12}(1 - x)$$

The expected revenue  $E_{21}$ ,  $E_{22}$  and average revenue  $E_2$  of financing enterprises choosing “not to cheat” strategy and “to cheat” strategy is as follow:

$$E_{21} = I_2 - C_2$$

$$E_{22} = -(F_2 + H_2 + R_2)z + (I_2 + R_2 - Y_2)$$

$$E_2 = E_{21}y + E_{22}(1 - y)$$



The expected revenue  $E_{31}$ ,  $E_{32}$  and average revenue  $E_3$  of financial institutions choosing “to supervise” strategy or “not to supervise” strategy is as follow:

$$E_{31} = (I_3 - C_3)xy + (I_3 + F_2 - C_3)x(1 - y) + (I_3 + F_1 - C_3)(1 - x)y + (I_3 + F_1 + F_2 - C_3)(1 - x)(1 - y)$$

$$E_{32} = xyI_3 + x(1 - y)(I_3 - S_2) + (1 - x)y(I_3 - S_1) + (1 - x)(1 - y)(I_3 - S_1 - S_2)$$

$$E_3 = E_{31}z + E_{32}(1 - z)$$

### 3.1 Replication dynamic analysis of logistics enterprises choosing “to supervise” strategy

Replication dynamic analysis is a dynamic differential analysis method to study the degree of adaptability of a strategy within population in evolutionary game(Xu Jianzhong and Lu Xichen,2014). The replicator dynamics equation of logistics enterprises choosing “to supervise” strategy is as follow:

$$F(x) = dx/dt = (E_{11} - E_1)x = [-(C_1 + R_1 - Y_1) + (F_1 + H_1 + R_1)z]x(1 - x) \quad (1)$$

(1) When  $z = C_1 + R_1 - Y_1 / F_1 + H_1 + R_1$ , we let  $F(x) \equiv 0$ , then for  $x \in [0,1]$  is evolutionary stability point. That means any proportion of logistics enterprises choosing “to supervise” strategy will not change over time.

(2) When  $z \neq C_1 + R_1 - Y_1 / F_1 + H_1 + R_1$ , we let  $F(x) = 0$ , then  $x = 0$  and  $x = 1$  are evolutionary stability points. And we take the derivative with respect to  $F(x)$ , the result thereby is as follow:  
 $F'(x) = [-(C_1 + R_1 - Y_1) + (F_1 + H_1 + R_1)z](1 - 2x)$ . And under this circumstance, we can analyze it in two cases:

Case 1: If  $z < C_1 + R_1 - Y_1 / F_1 + H_1 + R_1$ , for  $F'(x)|_{x=0} < 0$ ,  $F'(x)|_{x=1} > 0$ , so  $x = 0$  is evolutionary stability point; Case 2: If  $z > C_1 + R_1 - Y_1 / F_1 + H_1 + R_1$ , for  $F'(x)|_{x=0} > 0$ ,  $F'(x)|_{x=1} < 0$ , so  $x = 1$  is evolutionary stability point. It suggests that logistics enterprises choosing “to supervise” strategy is closely related to the proportion of financial institutions choosing “to supervise” strategy. When proportion of financial institutions choosing “to supervise” strategy is higher than  $C_1 + R_1 - Y_1 / F_1 + H_1 + R_1$ , logistics enterprises are willing to supervise considering penalty imposed by financial institutions and cost saving; when the proportion is lower than  $C_1 + R_1 - Y_1 / F_1 + H_1 + R_1$ , logistics enterprises will not to supervise.

### 3.2 Replication dynamic analysis of financing enterprises choosing “not to cheat” strategy

The replicator dynamics equation of financing enterprises choosing “not to cheat” strategy is as follow:

$$F(y) = dy/dt = (E_{21} - E_2)y = [-(C_2 + R_2 - Y_2) + (F_2 + H_2 + R_2)z]y(1 - y) \quad (2)$$

(1) When  $z = C_2 + R_2 - Y_2 / F_2 + H_2 + R_2$ , we let  $F(y) \equiv 0$ , then for  $y \in [0,1]$  is evolutionary stability point. This means any proportion of financing enterprises choosing “not to cheat” strategy will not change over time.

(2) When  $z \neq C_2 + R_2 - Y_2 / F_2 + H_2 + R_2$ , we let  $F(y) = 0$ , then  $y = 0$  and  $y = 1$  are evolutionary stability point. And we take the derivative with respect to  $F(y)$ , the result thereby is as follow:

$F'(y) = [-(C_2 + R_2 - Y_2) + (F_2 + H_2 + R_2)z](1 - 2y)$ . And under this circumstance, we can analyze it in two cases:

Case 1: If  $z < C_2 + R_2 - Y_2 / F_2 + H_2 + R_2$ , then  $F'(y)|_{y=0} < 0$ ,  $F'(y)|_{y=1} > 0$ , so  $y = 0$  is evolutionary stability point; Case 2: If  $z > C_2 + R_2 - Y_2 / F_2 + H_2 + R_2$ , then  $F'(y)|_{y=0} > 0$ ,  $F'(y)|_{y=1} < 0$ , so  $y = 1$  is evolutionary stability point. It suggests that the behavioral choice of financing enterprises is closely related to proportion of financial institutions choosing "to supervise" strategy. When the proportion of financial institutions choosing "to supervise" strategy is higher than  $C_2 + R_2 - Y_2 / F_2 + H_2 + R_2$ , financing enterprises are willing to choose "not to cheat" strategy considering penalty and cost saving; when the proportion is lower than  $C_2 + R_2 - Y_2 / F_2 + H_2 + R_2$ , financing enterprises tend to cheat because of poor supervision of financial institutions.

### 3.3 Replication dynamic analysis of financial institutions choosing "to supervise" strategy

The replicator dynamics equation of financial institutions choosing "to supervise" strategy is as follow:

$$F(z) = dz/dt = (E_{31} - E_3)z = [(F_1 + S_1 + F_2 + S_2 - C_3) - x(F_1 + S_1) - y(F_2 + S_2)]z(1 - z) \quad (3)$$

(1) When  $y = -(F_1 + S_1)x + (F_1 + S_1 + F_2 + S_2 - C_3) / F_2 + S_2$ , we let  $F(z) \equiv 0$ , then for  $z \in [0, 1]$  is evolutionary stability point. This means any proportion of financial institutions choosing "to supervise" strategy will not change over time

(2) When  $y \neq -(F_1 + S_1)x + (F_1 + S_1 + F_2 + S_2 - C_3) / F_2 + S_2$ , we let  $F(z) = 0$ , then for  $z = 0$  and  $z = 1$  are evolutionary stability point; And we take the derivative with respect to  $F(z)$ , the result thereby is as follow:

$F'(z) = [(F_1 + S_1 + F_2 + S_2 - C_3) - (F_1 + S_1)x - (F_2 + S_2)y](1 - 2z)$ . And under this circumstance, we can analyze it in two cases:

Case 1: If  $F_1 + S_1 + F_2 + S_2 < C_3$ , then  $F'(z)|_{z=0} < 0$ ,  $F'(z)|_{z=1} > 0$ , so  $z = 0$  is evolutionary stability point. It suggests if supervision cost of financial institution is higher than sum of revenue obtained through punishment between financing enterprises and logistics, losses caused by non-supervision, financial institutions are willing to supervise to avoid further losses.

Case 2: If  $(1 - x)(F_1 + S_1) + (1 - y)(F_2 + S_2) > C_3$ , then  $F'(z)|_{z=0} > 0$ ,  $F'(z)|_{z=1} < 0$ , so  $z = 1$  is evolutionary stability point. It suggests that if sum of penalty imposed by financial institutions for logistics enterprises' non-supervision and financing enterprises' cheating, losses avoided by financial institutions is higher than financial institutions' supervision cost, financial institutions are willing to supervise logistics enterprises and financing enterprises for their own benefits.

### 3.4 Evolutionary stability analysis on credit behavior of three parties

Simultaneous replicator dynamics equations (1), (2), (3), and we obtain a three-dimensional dynamic system, which describes evolutionary dynamics on credit behavior of three parties. Then let  $dx/dt = dy/dt = dz/dt = 0$ , we get equilibrium points of three-dimensional dynamical system. And if equilibrium of evolutionary game  $x$  is evolutionary stability point, so  $x$  must be the strict Nash equilibrium. Besides, strict Nash equilibrium is pure strategy Nash equilibrium (Selten R., 1980; Ritzberger K. and Weibull J. W., 1995). Besides, strict Nash equilibrium is pure strategy Nash equilibrium. Therefore, we discuss asymptotic stability of eight points, that is (0,0,0), (1,0,0), (0,1,0), (1,1,0), (0,0,1), (1,0,1), (0,1,1), (1,1,1), and obtain the stability of these points through local stability analysis of Jacobian matrix. The results of evolutionary stability are shown in table 2.

**Table 2 Stability Analysis of Equilibrium Points**

Equilibrium points	Stability condition	Result
(0,0,0)	$C_1 + R_1 > Y_1, C_2 + R_2 > Y_2, F_1 + S_1 + F_2 + S_2 < C_3$	ESS
(1,0,0)	$C_1 + R_1 < Y_1, C_2 + R_2 > Y_2, F_2 + S_2 < C_3$	ESS
(0,1,0)	$C_1 + R_1 > Y_1, C_2 + R_2 < Y_2, F_1 + S_1 < C_3$	ESS
(1,1,0)	$C_1 + R_1 < Y_1, C_2 + R_2 < Y_2$	ESS
(0,0,1)	$C_1 - Y_1 > F_1 + H_1, C_2 - Y_2 > F_2 + H_2, F_1 + S_1 + F_2 + S_2 > C_3$	ESS
(1,0,1)	$C_1 - Y_1 < F_1 + H_1, C_2 - Y_2 > F_2 + H_2, F_2 + S_2 > C_3$	ESS
(0,1,1)	$C_1 - Y_1 > F_1 + H_1, C_2 - Y_2 < F_2 + H_2, F_1 + S_1 > C_3$	ESS
(1,1,1)	—	Unstable

As can be seen from table 2, there are seven evolutionary stability strategies for game system under certain conditions, that is (0,0,0), (1,0,0), (0,1,0), (1,1,0), (0,0,1), (1,0,1), (0,1,1). The analysis results show that: when supervision cost of logistics enterprises is higher than difference between cost of whitewash for choosing “not to supervise” and additional benefits, which is net fees of non-supervision or higher than sum of penalty imposed by financial institutions for logistics enterprises’ non-supervision, new supervision fee, expense of concealment, then logistics enterprises tend to “not to supervise” strategy, otherwise they are willing to supervise. Similarly, the same goes for financing enterprises. If supervision cost of financial institutions is relatively higher than sum of penalty paid by both parties for their nonperformance of normal credit, losses avoided by financial institutions because of their supervision; or higher than sum of penalty paid by one party for their non-performance of normal credit and losses avoided by financial institutions due to their supervision, financial institutions eventually tend to choose “not to supervise” strategy, otherwise they are willing to supervise.

### 4 Conclusion

Identifying reasons and nature of participants’ credit behavior is fundamental to control credit

risk of logistics finance. Therefore, this paper constructs evolutionary game model on credit behavior of three parties among logistics enterprises, financing enterprises and financial institutions, and analyzes evolutionary process of their credit behavior selection over time. The results show that normal expenses between logistics enterprises and financing enterprises, additional benefit after successful default or concealment of unsupervised behavior are smaller, and cost of cheating or concealment, the performance fee and penalty after being supervised by financial institutions are relatively larger to a certain extent, logistics enterprises and financing enterprises will observe the contract, otherwise they will breach the contract. Besides, financial institutions will choose "to supervise" strategy when penalty, fraud losses are larger and supervision cost is smaller to a certain extent, otherwise they will choose "not to supervise" strategy. Lastly, financial institutions' behavior choice has a significant impact on credit behavior selection of logistics enterprises and financing enterprises. If financial institutions strengthen supervision, logistics enterprises and financing enterprises are willing to keep the contract, which suggests that supervision of financial institutions is an important guarantee to prevent credit risk of logistics finance.

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# **An Integrated BWM and MOORA Method for Engineering Quality Evaluation in Project Management**

Gang Jun<sup>1</sup>, Tu Yan<sup>2</sup>, Wei Ying<sup>1</sup>

1 Sichuan Institute of Building Research, Chengdu, P. R. China, 610081

2 School of Safety Science and Emergency Management, Wuhan University of Technology,

Wuhan, P. R. China, 430070

(E-mail: gangjun@aliyun.com, tuyan1988@whut.edu.cn, indigo712003@aliyun.com)

**Abstract:** With the development of rapid economy, construction industry has been the focal point among the public, especially in quality management. Quality evaluation model, as a significant aspect of quality management, has been paid more attention by construction industry. In this paper, we first establish a complete and systematic quality evaluation system based on the rules of comprehensiveness, operability and hierarchy. Then an integrated BWM and MOORA method for engineering quality evaluation is developed, which has higher consistency and less computation complexity. Therefore, it is easy to be implemented for practical evaluation situation. Finally, a case study is carried out to verify the effectiveness of the proposed model.

**Key words:** Best worst method; MOORA method; Quality evaluation; Project management

## **1 Introduction**

Project management involves three key goals, cost management, quality management and progress management, which are mutual restriction and interaction in the process of a project. Quality management, as a crucial link, is related to the life of the project and the safety of personnel. Compared with general projects, quality management of construction projects is more complicated owing to mobile construction process. But with the development of economy, construction quality was improving as a decreasing rate (Yung and Yip, 2010). Therefore, it is necessary to establish a quality evaluation model and propose a quality evaluation method.

Existing researches focus on the following several aspects. Yung and Yip (2010) reviewed some literatures concerning on the construction quality in China, where proper management was emphasized to improve the construction quality. From the perspective of contractor quality performance, Xiao and Proverbs (2002) made a comparison among contractors in Japan, the UK and the USA in terms of construction quality. They discovered the deep-rooted quality consciousness in Japan is beneficial to better quality performance. Gransberg and Molenaar (2004) explored and analyzed existing approaches to evaluating quality in design/build proposals, and they identified the six methods to articulating design/build quality requirements. With the development of modern technology, building information model (BIM) as a new management mode, has been paid more attention by a great deal of scholars. Chen and Luo (2014) developed a BIM-based quality model

integrating organization and process model and it was applied into the quality control during the construction phase of the Wuhan International EXPO Center. Kim et al. (2016) proposed a new dimensional quality assurance technique for full-scale precast concrete elements, denoted as a BIM-based practical method for dimensional quality assurance data storage and management. Besides, based on the same idea, Sacks et al. (2010) applied BIM technology to improve work effectiveness by visualization, which is beneficial to quality management. Although these researches have great contribution to quality management in engineering management, it has some limitation in establishing the quality evaluation system and evaluating the quality of project. Therefore, we first establish a quality evaluation system for engineering management based on a series of rules. And then an integrated best worst method (BWM) and multi-objective optimization based on ratio analysis (MOORA) method is developed.

The method is proposed based on two reasons. For one thing, BWM has better consistency and lower computation complexity compared with some criteria determination method, such as analytic hierarchy process and analytic network process (Rezaei, 2015; 2016). It has been extended into multiple different environments, such as fuzzy environment (Guo and Zhao, 2017), intuitionistic fuzzy environment (Mou et al., 2016) and interval-valued fuzzy-rough environment (Pamučar, et al., 2018). For another, MOORA method was developed in the light of multi-objective optimization with discrete alternatives (Brauers and Zavadskas, 2006), which was applied into multiple fields such as manufacturing environment (Chakraborty, 2011), materials selection (Karande and Chakraborty, 2012a) and ERP system selection (Karande and Chakraborty, 2012b). Therefore, to exploit the advantages of BWM and MOORA, we integrate these two methods named as BWM-MOORA method and it is applied to the quality evaluation in engineering management.

This paper is organized as follows. In section 2, we first introduce the rules of establishing a quality evaluation system in project management including comprehensiveness, feasibility and hierarchy, and then a quality evaluation system is constructed. In section 3, an integrated BWM and MOORA method is put forward for engineering quality evaluation. Section 4 provides a case study concerning on the construction engineering quality evaluation is implemented in virtue of the proposed method in section 3. Finally, conclusions and future research direction are given in section 5.

## **2 A Quality Evaluation System in Project Management**

In this section, we mainly introduce the rules of establishing quality evaluation system and the context of the quality evaluation system.

### **2.1 Rules of establishing quality evaluation system**

The indicators need to be hierarchically decomposed and classified to make them an organic whole. At the same time, it is necessary to ensure that the quality evaluation system should meet the principles of comprehensiveness, feasibility and hierarchy.

#### **Comprehensiveness**

Construction projects often involves the participation of owners, surveying, design, construction and supervision companies. Therefore, quality evaluation system should be established by considering the impact of the various participants, which makes the quality evaluation system enormous.

Evaluators need to pay attention to the influencing factors in an all-round and meticulous way.

**Feasibility**

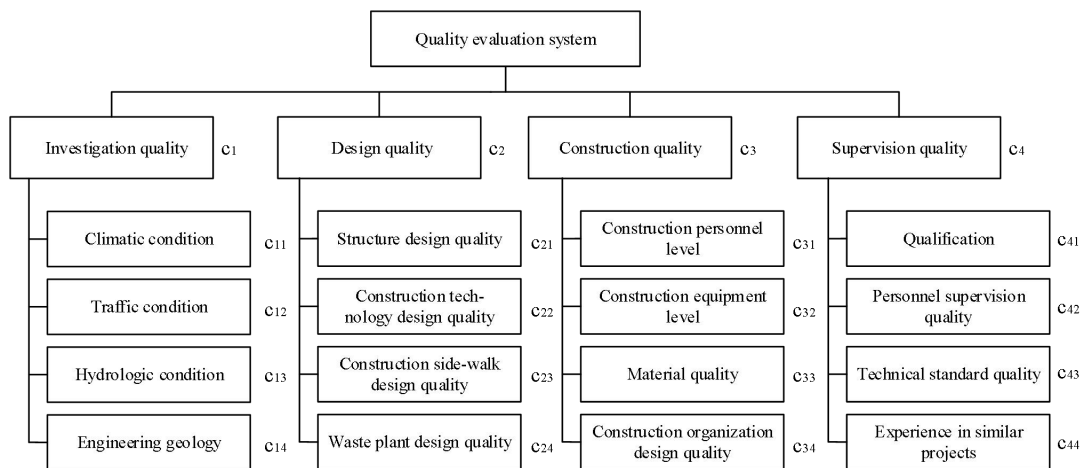
The establishment of quality evaluation system should be feasible, that is, easy to operate and implement. The selected factors should be easy to collect and be consistent with the actual situation. The number of evaluation indicators should not be too large, where human, material and financial resources should be considered comprehensively. Owing that the knowledge and experience level of evaluators are not uniform, a readable, understandable and applicable quality evaluation system is required to be established.

**Hierarchy**

The established evaluation system should be clearly structured and organized, where the adjacent two layers should be closely linked, and the lower layer should be logically consistent with the upper layer. The same level factors must be independent of each other, no overlap and inclusion.

**2.2 Establishment for a quality evaluation system**

Based on the above rules shown in section 2.1, we establish a quality evaluation system shown in Fig. 1. It is comprised of four parts, investigation quality, design quality, construction quality and supervision quality, which integrates exploration, design, building and supervision corporations. In detail, investigation quality is comprised of climatic condition, traffic condition, hydrologic condition, and engineering geology. In terms of design quality, there are four elements, structure design quality, construction technology design quality, construction sidewalk design quality and waste plant design quality. For construction quality, we select construction personnel level, construction equipment level, material quality and construction organization design quality as basic components. Besides, supervision quality includes qualification, personnel supervision quality, technical standard quality and experience in similar projects.



**Figure 1 Construction Engineering Quality Evaluation System**

### 3 An Integrated BWM and MOORA Method for Engineering Quality Evaluation

In this part, we first introduce an integrated BWM and MOORA method. The advantages of this method lie in the following two aspects. On one hand, BWM has the merits in consistency level and computation complexity. On the other hand, MOORA method is easy to understand to decision makers. Therefore, we develop an integrated BWM and MOORA method, and the procedures are depicted as follows:

**Step 1.** Select the best criterion and the worst criterion respectively as  $C_B$  and  $C_W$ .

**Step 2.** Provide pairwise comparison relationships among the best and worst criterion and other criteria using number 1-9.

**Step 3.** Construct an optimization model to minimize the maximum the difference  $\{|w_B - a_{Bj}w_j|\}$  and  $\{|w_j - a_{jW}w_W|\}$  as follows:

$$\begin{aligned} & \min \max_j \{|w_B - a_{Bj}w_j|\} \text{ and } \{|w_j - a_{jW}w_W|\} \\ & \text{s.t.} \begin{cases} \sum_j w_j = 1 \\ w_j \geq 0, j = 1, 2, \dots, n \end{cases} \end{aligned} \quad (1)$$

Then Eq. (1) can be equivalently transformed into the following optimization model:

$$\begin{aligned} & \min \zeta \\ & \text{s.t.} \begin{cases} |w_B - a_{Bj}w_j| \leq \zeta, j = 1, 2, \dots, n; \\ |w_j - a_{jW}w_W| \leq \zeta, j = 1, 2, \dots, n; \\ \sum_j w_j = 1; \\ w_j \geq 0, j = 1, 2, \dots, n \end{cases} \end{aligned} \quad (2)$$

Solving the above model, we can obtain the optimal weight  $w_j = (w_1, w_2, \dots, w_n)^T$  and  $\zeta$ . The bigger  $\zeta$  means the higher consistency ratio, and consistency ratio is derived by using Eq. (3).

$$\text{Consistency ratio} = \frac{\zeta}{\max \zeta} = \frac{\zeta}{\text{Consistency index}} \quad (3)$$

where the  $\max \zeta$  can be calculated based on  $(a_{BW} - \zeta) \times (a_{BW} - \zeta) = (a_{BW} + \zeta)$  and  $a_{BW} \in \{1, 2, \dots, 9\}$ . The consistency index is listed in Table 1.

**Table 1 Consistency Index**

$a_{BW}$	1	2	3	4	5	6	7	8	9
Consistency Index	0.00	0.44	1.00	1.63	2.30	3.00	3.73	4.47	5.23



**Step 4.** Provide the evaluation matrix, denoted as  $X = (x_{ij})_{m \times n}$ .

**Step 5.** Normalize the evaluation matrix, denoted as  $R = (r_{ij})_{m \times n}$  using Eq. (4).

$$r_{ij} = \frac{x_{ij}}{\sum_{j=1}^n x_{ij}^2} \quad (4)$$

**Step 6.** Obtain the weighted normalized matrix using Eq. (5).

$$v_{ij} = r_{ij} \cdot w_j \quad (5)$$

**Step 7.** Drive the overall rating of benefit criteria using Eq. (6) and cost criteria using Eq. (7) for all alternatives.

$$S_i^+ = \sum_{j=1}^n v_{ij}, \text{ if } i \in J^{Max} \quad (6)$$

$$S_i^- = \sum_{j=1}^n v_{ij}, \text{ if } i \in J^{Min} \quad (7)$$

where  $J^{Max}$  and  $J^{Min}$  represents the benefit criteria and cost criteria.

**Step 8.** Determine the overall performance index by integrating overall ratings for benefit and cost criteria using Eq. (8).

$$S_i = S_i^+ - S_i^- \quad (8)$$

**Step 9.** Rank the alternatives in virtue of  $S_i$ . The ranking rule is that the bigger  $S_i$  is, the better the alternative  $a_i$  is.

#### 4 A Case Study for Quality Evaluation in Construction Project Management

In this section, the proposed method is applied into the quality evaluation in construction project management. Government want to evaluate and select the best quality's project so as to award a China Construction Engineering Luban Prize. Five projects  $\{a_1, a_2, a_3, a_4, a_5\}$  pass preliminary review. Next, we assess the performance of these projects.

**Step 1.** In the quality evaluation system, the first level, investigation quality  $c_1$ , design quality  $c_2$ , construction quality  $c_3$  and supervision quality  $c_4$ , are of equal importance provided by experts.

**Step 2.** The best criterion, the worst criterion with regard to each first level criteria and the corresponding comparisons relationships are shown in Table 2.

**Table 2 The Comparisons Relationships under Each Criterion  $c_j$**

Comparisons relationships	$c_{j1}$	$c_{j2}$	$c_{j3}$	$c_{j4}$	
The best criterion under $c_1$	$c_{12}$	3	1	5	7
The worst criterion under $c_1$	$c_{14}$	6	7	3	1
The best criterion under $c_2$	$c_{21}$	1	3	8	4
The worst criterion under $c_2$	$c_{23}$	8	6	1	3
The best criterion under $c_3$	$c_{33}$	5	2	1	7
The worst criterion under $c_3$	$c_{34}$	3	6	7	1
The best criterion under $c_4$	$c_{44}$	2	6	3	1
The worst criterion under $c_4$	$c_{22}$	5	1	3	6

**Step 3.** Establish the optimization model to obtain the importance of each criterion. Taking  $c_1$  for an example, we establish the optimization model as follows:

$$\begin{aligned}
 & \min \zeta_1 & \min \zeta_2 \\
 & \left\{ \begin{array}{l} |w_{12} - 3w_{11}| \leq \zeta_1; |w_{12} - 5w_{13}| \leq \zeta_1; \\ |w_{12} - 7w_{14}| \leq \zeta_1; |w_{11} - 6w_{14}| \leq \zeta_1; \\ |w_{13} - 6w_{14}| \leq \zeta_1; \\ \sum_{j=1}^5 w_{1j} = 1; \\ w_{1j} \geq 0, j = 1, 2, \dots, 5 \end{array} \right. & (9) \quad \left\{ \begin{array}{l} |w_{21} - 3w_{22}| \leq \zeta_2; |w_{21} - 8w_{23}| \leq \zeta_2; \\ |w_{21} - 4w_{24}| \leq \zeta_2; |w_{22} - 6w_{23}| \leq \zeta_2; \\ |w_{24} - 3w_{23}| \leq \zeta_2; \\ \sum_{j=1}^5 w_{2j} = 1; \\ w_{2j} \geq 0, j = 1, 2, \dots, 5 \end{array} \right. & (10)
 \end{aligned}$$

$$\begin{aligned}
 & \min \zeta_3 & \min \zeta_4 \\
 & \left\{ \begin{array}{l} |w_{33} - 5w_{31}| \leq \zeta_3; |w_{33} - 2w_{32}| \leq \zeta_3; \\ |w_{33} - 7w_{34}| \leq \zeta_3; |w_{31} - 3w_{34}| \leq \zeta_3; \\ |w_{32} - 6w_{34}| \leq \zeta_3; \\ \sum_{j=1}^5 w_{3j} = 1; \\ w_{3j} \geq 0, j = 1, 2, \dots, 5 \end{array} \right. & (11) & \left\{ \begin{array}{l} |w_{44} - 5w_{41}| \leq \zeta_4; |w_{44} - 2w_{42}| \leq \zeta_4; \\ |w_{44} - 7w_{43}| \leq \zeta_4; |w_{41} - 3w_{42}| \leq \zeta_4; \\ |w_{43} - 6w_{42}| \leq \zeta_4; \\ \sum_{j=1}^5 w_{4j} = 1; \\ w_{4j} \geq 0, j = 1, 2, \dots, 5 \end{array} \right. & (12)
 \end{aligned}$$

Solving all established optimization models, the weights of all criteria are derived in Table 3, where the first level criteria have the same importance.

**Table 3 The Comparisons Relationships under Each Criterion  $c_j$**

Weight	$c_{1j}$	$c_{2j}$	$c_{3j}$	$c_{4j}$
$w_{j1}$	0.0584	0.1389	0.0299	0.0682
$w_{j2}$	0.1413	0.0556	0.0747	0.0170
$w_{j3}$	0.0350	0.0139	0.1297	0.0455
$w_{j4}$	0.0154	0.0417	0.0157	0.1193
$\zeta_j$	0.0584	0.1389	0.0299	0.0682

From Table 3, we can see that all computation results satisfy the consistency level.

**Step 4.** Experts provide the evaluation matrix in Table 4.

**Table 4 The Initial Evaluation Matrix  $X$**

$X$	$c_{11}$	$c_{12}$	$c_{13}$	$c_{14}$	$c_{21}$	$c_{22}$	$c_{23}$	$c_{24}$
$a_1$	0.3	0.2	0.5	0.3	0.4	0.5	0.3	0.4
$a_2$	0.4	0.4	0.5	0.5	0.2	0.1	0.4	0.3
$a_3$	0.6	0.4	0.4	0.6	0.4	0.3	0.3	0.2
$a_4$	0.6	0.6	0.3	0.4	0.3	0.4	0.2	0.3
$a_5$	0.5	0.3	0.2	0.5	0.6	0.5	0.3	0.4
	$c_{31}$	$c_{32}$	$c_{33}$	$c_{34}$	$c_{41}$	$c_{42}$	$c_{43}$	$c_{44}$
$a_1$	0.2	0.4	0.5	0.4	0.5	0.6	0.3	0.6
$a_2$	0.4	0.3	0.6	0.6	0.3	0.4	0.7	0.2
$a_3$	0.5	0.4	0.3	0.4	0.7	0.6	0.6	0.3
$a_4$	0.6	0.2	0.4	0.7	0.4	0.7	0.4	0.3
$a_5$	0.8	0.5	0.5	0.5	0.6	0.3	0.5	0.4

**Step 5.** Normalize the evaluation matrix using Eq. (4) shown in Table 5.

**Table 5 The Normalization Initial Evaluation Matrix  $R$**

$R$	$c_{11}$	$c_{12}$	$c_{13}$	$c_{14}$	$c_{21}$	$c_{22}$	$c_{23}$	$c_{24}$
$a_1$	0.07	0.05	0.32	0.08	0.20	0.33	0.19	0.30
$a_2$	0.13	0.20	0.32	0.23	0.05	0.01	0.34	0.17
$a_3$	0.30	0.20	0.20	0.32	0.20	0.12	0.19	0.07
$a_4$	0.30	0.44	0.11	0.14	0.11	0.21	0.09	0.17
$a_5$	0.20	0.11	0.05	0.23	0.44	0.33	0.19	0.30
$a_1$	$c_{31}$	$c_{32}$	$c_{33}$	$c_{34}$	$c_{41}$	$c_{42}$	$c_{43}$	$c_{44}$
$a_2$	0.03	0.23	0.23	0.11	0.19	0.25	0.07	0.49
$a_3$	0.11	0.13	0.32	0.25	0.07	0.11	0.36	0.05
$a_4$	0.17	0.23	0.08	0.11	0.36	0.25	0.27	0.12
$a_5$	0.25	0.06	0.14	0.35	0.12	0.34	0.12	0.12
$a_1$	0.44	0.36	0.23	0.18	0.27	0.06	0.19	0.22

**Step 6.** Obtain the weighted normalized matrix using Eq. (5) shown in Table 6.

**Table 6 The Normalization Initial Evaluation Matrix  $V$**

$V$	$c_{11}$	$c_{12}$	$c_{13}$	$c_{14}$	$c_{21}$	$c_{22}$	$c_{23}$	$c_{24}$
$a_1$	0.0043	0.0070	0.0111	0.0012	0.0274	0.0183	0.0027	0.0123
$a_2$	0.0077	0.0279	0.0111	0.0035	0.0069	0.0007	0.0047	0.0069
$a_3$	0.0172	0.0279	0.0071	0.0050	0.0274	0.0066	0.0027	0.0031
$a_4$	0.0172	0.0628	0.0040	0.0022	0.0154	0.0117	0.0012	0.0069
$a_5$	0.0120	0.0157	0.0018	0.0035	0.0617	0.0183	0.0027	0.0123
$a_1$	$c_{31}$	$c_{32}$	$c_{33}$	$c_{34}$	$c_{41}$	$c_{42}$	$c_{43}$	$c_{44}$
$a_1$	0.0008	0.0171	0.0292	0.0018	0.0126	0.0042	0.0030	0.0580
$a_2$	0.0033	0.0096	0.0421	0.0040	0.0045	0.0019	0.0165	0.0064
$a_3$	0.0052	0.0171	0.0105	0.0018	0.0247	0.0042	0.0121	0.0145
$a_4$	0.0074	0.0043	0.0187	0.0054	0.0081	0.0057	0.0054	0.0145
$a_5$	0.0132	0.0267	0.0292	0.0028	0.0182	0.0011	0.0084	0.0258

**Steps 7-8.** Drive the overall rating of benefit criteria using Eq. (6) and cost criteria using Eq. (7) for all projects. Owing that all criteria are benefit criteria, the overall performance index are obtained by integrating overall ratings for benefit and cost criteria using Eq. (8), i.e.  $S_i = S_i^+$  shown in Table 7.

**Table 7 The Overall Performance Index of All Projects**

$a_i$	$a_1$	$a_2$	$a_3$	$a_4$	$a_5$
$S_i$	0.2111	0.1577	0.1870	0.1910	0.2532

**Step 9.** Based on the ranking rule, we can obtain the ranking result as  $a_5 \succ a_1 \succ a_4 \succ a_3 \succ a_2$ . Therefore, project  $a_5$  has the good whole quality including investigation quality, design quality, construction quality and supervision quality.

## 5 Conclusion

In this paper, we introduce a new quality evaluation system considering investigation quality, design quality, construction quality and supervision quality, which provides a new idea in establishing construction engineering quality evaluation system. In addition, an integrated BWM and MOORA method is developed to solving the problem of quality evaluation in project management, which is easy to be understood and implemented by managers. This method is effective and applicable in terms of evaluating construction project quality. A practical case study is carried out to illustrate the effectiveness of the proposed method.

In the future, some research directions can be considered. First, BIM technology can improve the efficiency and effect of quality management. Therefore, it is worth noting that BIM technology can be integrated into the process of quality management. Moreover, some other evaluation methods can be developed considering the computational complexity and practicability, such as decision-making trial and evaluation laboratory (DEMATEL) method and complex proportional assessment (COPRAS). Also, BWM can be extended into other environments, such as hesitant fuzzy sets, hesitant fuzzy linguistic sets, probabilistic linguistic sets. Finally, some other management fields such as safety management, cost management, progress management should be discussed and analyzed, and the relationships among these management fields can be explored.

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## The Impact of China's Monetary Policy on Bank Risk-Taking

Feng Rui, Xie Xiaoping, Chen Yuchun

School of Economics and Statistics, Guangzhou University, Guangzhou, P.R. China, 510006

(E-mail: fengrui0605@hotmail.com, xiexp@gzhu.edu.cn, cyc9702@163.com)

**Abstract:** In the post-crisis era, monetary policy, as a key policy to regulate macro-economy, has an important impact on bank risk taking and the financial system. Based on data of 50 banks in China from 2012 to 2017, this paper empirically tests that monetary policy has a significant impact on bank risk-taking, and the impact of different monetary policy tools on bank risk-taking is significantly different. The research shows that: (1) under the same conditions, quantitative monetary policy instruments have more obvious influence on bank risk-taking than price-based monetary policy instruments. (2) Structural monetary policy tools have a negative impact on bank risk-taking. Therefore, the monetary policy formulated by China's monetary authorities should fully consider the changes in the risk level of Banks, implement more stable monetary policy and prevent financial crisis.

**Key words:** China's monetary policy; Bank risk-taking; Impact; GMM

### 1 Introduction

After the outbreak of the crisis, all sectors of society realized that the loose monetary policy changed banks' risk-taking willingness and behavior, stimulated banks to increase credit supply and investment, and finally triggered the financial crisis. At present, the slowdown of global economic growth continues. It is particularly important for the central bank to formulate scientific and effective monetary policies to maintain financial stability. Therefore, in the context of China's long-term loose interest rate, whether the monetary policy can effectively affect the investment and credit scale of banks by changing their risk-taking behaviors, and finally achieve the sustainable development of the real economy, is a major issue facing China's macroeconomic governance.

Foreign scholars study this aspect earlier than domestic scholars. Some domestic scholars believed that the loose monetary policy led to the decrease of interest rate and reduced the return rate of banks. In order to pursue high profits, banks allocated high-risk assets and eventually took on more risks (Rajan, R.G,2005). After the financial crisis in 2008, some scholars believed that there was a risk-taking channel and formally defined it. The so-called bank risk-taking channel is the central bank through the interest rate adjustment, thus affecting the bank's risk tolerance and risk perception, and thereby affecting the bank's investment risk position (Claudio Borio, Haibin Zhu, 2008). Other scholars believed that by

increasing the money supply with low interest rate and implementing expansionary monetary policy, the supply of variable credit increases, which will increase the number of non-performing loans and thus increase the risk (Taha Zaghoud, Samir Maktouf, 2017). Domestic scholars have also conducted in-depth research on the effect of monetary policy on bank risk-taking.

Some scholars analyze the influence of monetary policy on bank risk bearing, and find that the influence of monetary policy on bank risk bearing depends on the capital status of banks (Jiang Shuxia, Chen Yuchan, 2012). Some scholars prove that there are great differences in the influence of different factors on various risks in different corporate governance mechanisms (Kong Delan, Dong Jin, 2008). Some views argued that the bank risk-taking channel of monetary policy exists, which is comprehensively influenced by macroeconomic and bank characteristics (Li Jing, Huang Juan, 2014). Some scholars select the macro data of China from 2006 to 2014 and the microcosmic data of 16 listed banks in China, compare the risk weighted asset occupation as a measure index of commercial bank risk bearing, and empirically analyze the existence of risk bearing channels of monetary policy banks in China by using the method of differential GMM (Hong Shuang, 2016). Based on the data of 53 Banks from 2005 to 2014, Some domestic scholars took provisions coverage ratio, Non-performing loan ratio and Z-score as proxy variables of commercial banks' risk-taking, M2, DRR and other indicators as monetary policy proxy variables, and adopted GMM method to confirm the existence of banks' risk-taking channels (Wang Jinbin, Li Bo, 2017). Other scholars based on the data of 24 banks from 2013 to 2017, the empirical test shows that there is risk-taking effect of quantitative and price-based monetary policies, but there is no risk-taking effect of structural monetary policies. Banks' provisions for loan losses can mitigate the adverse effects of monetary policy on bank risk-taking (Ba Shusong, Huang Shangping, 2018). Some scholars concluded through empirical research that in the transmission process of monetary policy, there is a bank risk-taking channel, and the interaction between the two shows a significant negative correlation, which is also affected by economic development, industrial structure and individual characteristics of the bank (Guo Tianyong, He Yalan, 2019).

Scholars at home and abroad have made some progress in theory and demonstration. Firstly, from the perspective of research, foreign scholars mainly start from the perspective of macroeconomic development and competition between banks, while domestic scholars start from different monetary policy tools and monetary policy cycle. Secondly, most scholars at home and abroad use GMM method for analysis. Thirdly, scholars at home and abroad have put forward some suggestions such as optimizing the monetary policy target system and improving the monetary policy tool combination. But the foreign research is obviously earlier than the domestic research. In addition, domestic and foreign literature are not uniform in the mechanism of monetary policy's action on bank risk-taking, and there are some differences in the selection of explanatory variables and control variables. Most domestic scholars have not included structural monetary policy tools into the empirical research part. In view of the above deficiencies, this paper will take the Standing Lending Facility (SLF) as the representative of structural monetary policy tools, and include it in the empirical research part to discuss the impact of different monetary policy tools on bank risk-taking.

## **2 Theoretical Analysis**

### **2.1 The effect of income and valuation**

If a country's monetary authorities carry out loose monetary policy for a long time, it will increase M2 and lower interest rates. First of all, under the environment of low interest rate, enterprises can reduce their cost of capital use, cash flow, income and asset valuation will rise, asset price and collateral



price will rise, enabling enterprises to expand income and increase profits, which will change the bank's estimate of default probability, loss amount and future market fluctuation. As collateral valuations rise, banks' risk perception and recognition will decline, and banks will take on more risk. Second, loose monetary policy can increase people's incomes and develop the economy. Bank lending rates are lower, making it easier for businesses to borrow. It is also easier for companies to raise money. Banks will relax corporate financing requirements and improve risk tolerance, so that the overall risk of the bank's asset portfolio will increase and banks will engage in more risk businesses.

## **2.2 The effect of pursuing interests**

One is the currency illusion. Investors tend to ignore the fact that nominal interest rates are falling to compensate for low inflation, blindly increasing the proportion of risky assets and reducing the proportion of risk-free assets in the portfolio. Before the financial crisis, for example, persistently loose monetary policy in the us allowed many investors to shift money from low-risk government bond markets to riskier corporate bonds and bonds of emerging economies for higher nominal yields. The other is institutional constraints. Some financial institutions with long-term commitments, such as pension funds and insurance companies, hold nominal liabilities with long-term fixed interest rates. When interest rates are low, these institutions will turn to high-risk assets with higher returns to balance their long-term returns. Similarly, for private investors, they tend to use short-term returns to measure the competitiveness of fund managers. If short-term returns are low, private investors will withdraw their money. This will encourage fund managers to take an aggressive approach to investing at low interest rates.

## **2.3 The effect of habit formation**

The loose monetary policy improves the liquidity of the market. Influenced by the inertia of thinking, bank operators and consumers may be too optimistic and believe that the prosperity of the market will last for a long time, thus ignoring the judgment of financial market risks and reducing the degree of risk aversion. Bank operators expect the market to be prosperous and stimulate banks to take higher risks by reducing risk premium, risk levels and risk aversion. Meanwhile, consumers are blindly optimistic, and it is difficult to change the consumption habit formed under the loose monetary policy in the short term. The consumption will increase than before, but it is difficult to reduce.

## **2.4 The communication and communication effect of the Central Bank**

The effect mainly reflects in the insurance effect and the transparency effect. First, in a depressed economy, financial market participants expect monetary authorities to ease monetary policy or rescue policy, thus reducing the risk of economic downturn and the probability of bankruptcy, and risk-taking will increase this amounts to implicit central bank insurance. Secondly, the transparency of monetary policy and the predictability of monetary policy decisions affect the stability of the financial system. If a country's monetary policy is highly transparent and predictable, uncertainty about short-term interest rates and ex ante inflation will decrease, and thus about medium-and long-term interest rates and financial market prices. Thus, greater transparency in monetary policy can reduce future uncertainty, enhance banks 'pricing power and encourage banks' risk-taking.

## **3 Empirical Analysis**

### 3.1 Variable selection and model setting

This paper selects the panel data of 50 banks in China from 2012 to 2017 as the analysis sample, considering the availability and reliability of the data, the banks with less than 4 periods are excluded.

At present, Z-Score, Expected Default Rate (EDF) and Non-performing loan ratio (NPL) are the main explanatory variables used by scholars at home and abroad. Although Z-Score measures the bankruptcy risk of commercial banks, but China has formally implemented the deposit insurance system since May 1, 2015, the 21st century has not yet occurred the case of commercial bank bankruptcy. Therefore, Z-Score cannot reflect the reality of our country. At the same time, considering the availability of data, risk-weighted assets to total assets ratio (RWAR) and NPL are selected as the proxy variables of risk-taking. These figures are derived from the annual reports of the banks.

In terms of explanatory variables, China uses more quantitative monetary policy tools. Central Bank used to use the "three magic weapons" of monetary policy to regulate the economy. As one of the "weapons", the Statutory Deposit Reserve Ratio (SDRR) has a strong notice effect. Thus, it plays an important role in China's monetary policy practice. At the same time, China is still carrying out the Interest rate liberalization. Benchmark Deposit Rate (BDR) is also one of the important tools for the central bank to achieve monetary policy goals. As China's economic development has entered the new normal, China has successively launched such structural monetary policy tools as SLF and put them into use in due course. Therefore, based on the situation of China's economic development, this paper adopts SDRR, BDR and natural log of year-end balance of SLF (LnSLF) as proxy variables of China's monetary policy. These three proxy variables are respectively representative of quantitative, pricing and structural monetary policy tools. As China's depository financial institutions are large and small, this paper also divides the selected 50 banks into large and small depository financial institutions. The data at the end of each year from 2012 to 2017 were selected, which come from the Wind Database.

In terms of control variables, this paper selects Capital Adequacy Ratio (CAR), Loan-to-Deposit Ratio (LTD), bank size (SIZE) and return on assets (ROA) as control variables at the bank level. The annual growth rate of GDP (GDP) is chosen as the controlling variable at the macro-economic level. In addition, since most of China's banks with large assets are listed on the Shanghai Stock Exchange, the annual rate of return of the Shanghai Composite Index can better represent the overall development of China's Capital Market. Therefore, this paper also regards the capital market situation (STOCK) as one of the control variables at the bank level. The figures come from National bureau of statistics and Wind Database.

**Table 1 Selection of Variables**

Research variables	Variable Symbol	Variable name	Variable Definition
Explained variables	NPL	Non-Performing Loan Ratio	Non-performing loans in the bank as a proportion of the total loan balance
	RWAR	Risk-Weighted Assets to Total Assets Ratio	Total risk-weighted assets as a proportion of total assets
Explanatory variables	SDRR	Statutory deposit reserve ratio	Commercial Banks must pay the ratio of the central bank's statutory reserve to their total deposits
	BDR	Benchmark Deposit Rate	The benchmark one-year deposit rate of the

	LnSLF	Standing Lending Facility	people's bank of China The natural logarithm of the year-end standing loan facility balance
Control variables	CAR	Capital Adequacy Ratio	Net capital/total risk-weighted assets in and out of the statement at the end of the period
	LTD	Loan-To-Deposit Ratio	The ratio of total bank loans to total deposits
	SIZE	Bank size	The natural logarithm of a bank's total assets at the end of the year
	ROA	Return on assets	Net profit as a percentage of average assets
	STOCK	Capital market conditions	Annual return on the Shanghai composite index
	GDP	Macroeconomic variable	Annual growth rate of GDP

This paper adopts the following dynamic panel model:

$$risk_{it} = \alpha + \rho * risk_{i,t-1} + \beta_1 * mp_t + \beta_2 * ltd_{it} + \beta_3 * size_{it} + \beta_4 * roa_{it} + \beta_5 * stock_t + \beta_6 * gdp_t + \mu_{it} + \varepsilon_t$$

In the model,  $i$  represents the sample bank,  $t$  represents the year,  $risk_{it}$  represents bank risk-taking, which is the explained variables, the index selected in the benchmark model is RWAR.  $risk_{i,t-1}$  represents the first order lag of bank risk-taking.  $mp_t$  represents monetary policy and is the core explanatory variable.  $\mu_{it}$  represents individual effect,  $\varepsilon_t$  represents random disturbance term. The quantitative analysis software used in this paper is Stata12.0. In the measurement method, this paper adopts System GMM method.

### 3.2 Empirical Analysis

The data in this paper are the dynamic short panel data. Therefore, when processing the data, the Hausman Test is firstly used to determine whether the model uses fixed effect model or random effect model. Null hypothesis  $H_0$ : there is no fixed effect. Since the p value is 0.0000, the null hypothesis  $H_0$  is strongly rejected, and the fixed effect model should be used instead of the random effect model. The test results of the impact of China's monetary policy on bank risk-taking are shown in Table 2.

**Table 2 Test Results of the Impact of China's Monetary Policy on Bank Risk-Taking**

Explained variable		RWAR (1)	RWAR (2)	RWAR (3)
Lag variable	L.RWAR	0.562**	0.371	0.849***
		(1.97)	(1.34)	(3.25)
Explanatory variables	SDRR	-2.927***		
		(-3.12)		
			-2.801**	
	BDR		(-2.27)	

	LnSLF			-0.852*** (3.72)
Control variables	CAR	-0.828*** (-3.04)	-0.616** (-2.37)	-1.249*** (-4.29)
	LTD	0.230*** (3.16)	0.279*** (4.44)	0.106 (1.17)
	SIZE	-11.86*** (-3.75)	-8.924*** (-3.79)	-20.90*** (-3.78)
	ROA	-0.288 (0.15)	-0.264 (-0.15)	-1.325 (0.62)
	STOCK	0.0418* (1.86)	0.0105 (0.66)	0.306*** (3.52)
	GDP	6.219** (2.32)	2.452 (1.01)	-6.745* (-1.75)
	AR (1)	0.0329	0.0234	0.0198
AR (2)	0.6780	0.5099	0.9133	
Sargan Test	3.4983	2.2816	2.2816	
(P values)	(0.8354)	(0.9426)	(0.9426)	
_cons	351.6*** (3.31)	260.5*** (3.29)	614.7*** (3.52)	

Note: \*\*\*, \*\* and \* respectively mean significant at the significance level of 1%, 5% and 10%; The values in brackets are standard deviations.

As can be seen from Table 2, the coefficients of the first-order lag terms of RWAR are all positive, which indicates that the bank's risk-taking has a persistent feature and verifies that the setting of the dynamic short panel model in this paper is correct.

When RWAR is taken as the explained variable, the coefficients of the three explanatory variables are significantly negative, which to some extent verifies the bank risk-taking channels of monetary policy in China. Among them, the coefficient of SDRR is -2.927, indicating that when the central bank implements loose monetary policy, the statutory reserve ratio of banks will be reduced, which will make banks take higher risks. The coefficient of BDR is -2.801, indicating that the deposit benchmark interest rate is negatively correlated with the ratio of risk-weighted assets to total assets. The coefficient of LnSLF is -0.852, indicating that SLF and RWAR are significantly negatively correlated. But the absolute value of the coefficient is less than the absolute value of the coefficient of SDRR and BDR, this

is because in SLF, the central bank and financial institutions can implement one-to-one transactions, financial institutions can be based on their current situation actively apply to the central bank, the financial institutions in the active position, so in the face of the impact of market uncertainty, its ability to cope with risks rise, risk-taking level drops.

In terms of control variables, the coefficients of CAR are all negative, indicating that the higher CAR is, the more cautious banks will be in investment. The coefficients of LTD are all positive, which indicates that banks with good liquidity usually pay more attention to the safety of assets, are more capable to deal with the liquidity risk of banks, pay more attention to risk supervision, and have higher risk levels. The coefficients of SIZE are all negative, which indicates that banks do not assume higher risks due to their larger SIZE, but the larger the bank size, the lower the risk level. The coefficients of ROA are all negative, but not significant. This may be because banks, in order to pursue higher returns, lower their lending standards and lend to high-risk enterprises, thus resulting in higher risk levels. The coefficients on STOCK are all positive, suggesting that the better the capital markets are, the higher the risk banks will take. The coefficient of GDP is negative when the explanatory variable LnSLF is used, but positive when the explanatory variable is quantitative and price-based monetary policy tools. This indicates that when using these two types of monetary policy tools, the risk-taking behavior of Chinese banks is pro-cyclical.

### 3.3 Robustness test

In order to make the experimental results more reliable, this paper uses NPL as another explained variable to conduct robustness test, and the results are shown in Table 3.

**Table 3 Robustness Test Based on the NPL**

Explained variable		NPL (1)	NPL (2)	NPL (3)
Lag variable	L.NPL	0.165 (1.11)	-0.0938 (-0.52)	0.0958 (0.50)
	SDRR	-0.206* (1.90)		
Explanatory variables	BDR		-0.0616 (-0.96)	
	LnSLF			-0.0125 (-1.20)
Control variables	CAR	-0.00718 (-0.16)	-0.00994 (0.20)	0.00896 (0.20)
	LTD	0.00802* (1.66)	0.00859** (2.06)	0.0111** (2.51)
	SIZE	-0.301*** (-3.28)	-1.001*** (-3.12)	-0.684** (-2.50)

	ROA	-1.640*** (-2.69)	-1.494** (-2.46)	-1.391** (-2.47)
	STOCK	-0.000542 (-0.31)	0.00247** (2.29)	-0.00215 (-0.58)
	GDP	0.799*** (-3.63)	0.514*** (-3.39)	0.405** (-2.54)
<hr/>				
	AR (1)	0.0240	0.0305	0.0482
	AR (2)	0.0545	0.0646	0.0572
	Sargan Test	92.1228	88.6307	103.9624
	(P value)	(0.7640)	(0.5549)	(0.6188)
	_cons	12.75*** (4.49)	33.34*** (3.42)	23.60*** (2.93)

Note: \*\*\*, \*\* and \* respectively mean significant at the significance level of 1%, 5% and 10%; the values in brackets are standard deviations.

As can be seen from Table 3, when NPL is taken as the proxy variable of bank risk-taking, the significance of coefficient decreases, and the estimated coefficient of each variable decreases as a whole, but the coefficient sign of other control variables does not change significantly. The coefficients of SDRR, BDR and LnSLF are all negative, which once again verifies the existence of bank risk-taking channels of monetary policy. It also proves from another perspective that loose monetary policy will increase bank risk-taking. In terms of control variables, the coefficients of SIZE and ROA are both negative, while the coefficients of GDP and LTD are both positive and significant. The difference is that when NPL is the explained variable, the coefficient of LnSLF is negative, indicating that this tool has a negative impact on bank risk-taking, but its impact on bank risk-taking is not as great as that of SDRR and BDR. In addition, the significance is lower than that of the benchmark model. Due to the change of explained variables, the significance, absolute value and sign of related control variables may also be changed. However, in general, the empirical results of the benchmark model are basically consistent and pass the robustness test. And from the results of Table 2 and Table 3, the change of SDRR has a greater impact on the bank's risk-taking.

## 4 Conclusion

This article is based on the 50 bank of China in 2012-2017 panel data, using GMM method for the effect of Chinese monetary policy on bank risk-taking theory and empirical analysis, the following conclusions are drawn: one is China's monetary policy on bank risk-taking exists, the influence of China's monetary policy on bank risk-taking level was significantly negative correlation relationship, the central bank's loose monetary policy, will make the bank pay a higher risk. Second, it can be seen from the empirical results that SLF has a certain impact on bank risk-taking, but the impact is not as great as

that of the other two types, possibly because the transparency and predictability of monetary policy have been improved as China's economic development enters the new normal. Third, China's monetary policy has a variety of mechanisms for the impact of bank risk-taking, among which the effects of income and valuation effect, pursuit of interests effect and habit formation effect are more prominent.

Therefore, this paper puts forward the following policy suggestions. First, implement a more prudent monetary policy. When setting monetary policy, central bank should extend the time limit for considering monetary policy. That is, the central bank should take into account the situation of economic downturn when it implements tightening monetary policy. Second, flexible adjustment of monetary policy tools. In terms of policy tools, the central bank should broaden the scope of the use of alternative monetary policy tools and innovate the use of structural tools, such as SLF and MLF. Finally, develop risk identification and measurement models. In the process of selecting explained variables, the data of EDF is almost impossible to get, and Z-score is also excluded because it is not in line with China's reality. Therefore, it is very necessary to establish a risk identification and measurement model, which is introduced into bank management, especially risk management, and combined with bank practice.

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## Research and Design of University Student Honor System Based on Information System

Lv Zuheng, Wang Jinsong, Dou Zihan

School of Management, Wuhan University of Technology, Wuhan, P.R.China, 430070

(E-mail: 983456443@qq.com, 2290613411@qq.com, 1411558441@qq.com)

**Abstract:** Honor management is one of the routine summative work of colleges and universities. It is an important means to strengthen the construction of campus civilization. It is related to the vital interests of students, and plays an important guiding role in promoting the all-round development of college students and establishing good values. Based on the major colleges and universities, this paper aims to explore the improvement programs of college students' honor management work in the information age. It uses the literature review method, research method, experimental method, action research method and object-oriented method to analyze the honor management work of colleges and universities. At present, it summarizes the problems existing in the honor management work, builds the honor incentive system for college students, and implements it by means of management information system.

**Key words:** Honor management; University management; Management Information System; Multiple parameters

### 1 Introduction

In recent years, the concept of informationization in colleges and universities has been continuously improved, and the informationization methods for dealing with affairs have become increasingly abundant. (Jiang Hang, 2015) The network management platform of colleges and universities is more and more perfect, and the informationization construction of colleges and universities will develop in a more efficient and convenient direction. (Kong Fang, 2017) Chinese scholar Xiao Peng believes that in the basic information management of students, most universities in China have realized informationization and basically bid farewell to traditional paper documents. (Ma Zhongbao, Xiao Peng, 2017) However, in terms of student honor management, most universities in China still rely on manual operations, and few universities have their own honor management systems. (Xu Qi, 2015)

American colleges and universities are important birthplaces of contemporary information technology, and its level of informatization, information management and application are the highest in the world. Information technology has become one of the keys to the quality of personnel training and scientific research innovation in American universities. The application of information technology has penetrated into all aspects of teaching, research and management in higher education institutions. (Motta



S M,2010) At present, the "American University Informatization Research Project" is still being carried out in various universities in the United States. It has been in existence for more than 20 years and is one of the most representative university informatization research projects in the world. (Sierles F S, Kushner B D, Krause P B,1988) In terms of student honor management and teacher-related performance management, foreign formal colleges have basically achieved full coverage. Incentives for students and incentives for teachers are more advanced than domestic ones.

## 2 Survey Results and Analysis

This paper investigates the personnel who participate in the honor management of students in Wuhan universities, and issues 100 questionnaires and 91 valid questionnaires. The recovery rate is 91%. Through investigation and analysis, it is found that there are still many problems in the honor system of college students in China, which are embodied in the following two aspects.

### 2.1 Honor management method is poor in functionality

Honoring honors by praising excellence, establishing typical, and recommending experiences to motivate and motivate honor winners to make progress and to appeal to other individuals in the organization, ultimately motivating the entire organization to achieve specific goals with high enthusiasm. However, at present, most of the university's honor management, its thought-leading, commendation and motivational functions have not been well played. (Qu Shasha, Xiang Hui, Zhang Qiguang,2015)

#### 2.1.1 Honor project lacks thought leadership

Through investigations, it is found that most of the honorary projects involved in the honor management system of colleges and universities generally include scholarships, honorary titles, competition awards, etc. Basically all honor management systems are dedicated to the special interests of students, such as evaluation and evaluation. Without combining it with thought leadership, some honor projects are in the form, which reduces the incentive effect.

#### 2.1.2 Existing honor management system review methods are not universal

It can be seen from Figure 1 that there are 43 people with "honor management system but no unified standards", accounting for 47% of the total number. Therefore, it can be considered that most universities have not perfected the construction of honor management system, and the honor system is different. There are differences in meeting the different requirements of different universities and departments in the environment, and there is no universality, which makes the evaluation results unfair.

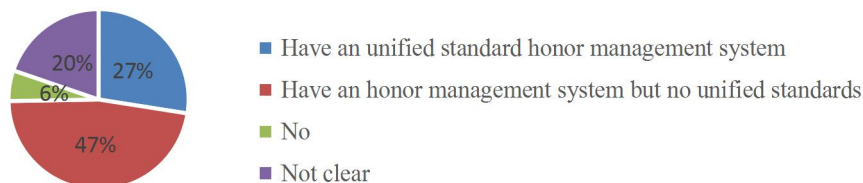
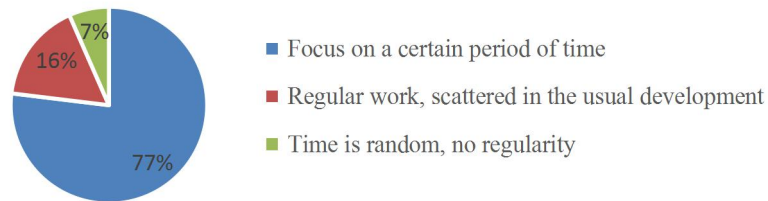


Figure 1 Status of Honor Management System

### 2.1.3 Existing honor management methods are not time-sensitive

It can be seen from Figure 2 that “70 people are concentrated in a certain period of time”, accounting for 77% of the total number. Therefore, it can be considered that the honor management methods of most universities are not time-sensitive, and real-time data update and real-time capability cannot be realized. Honor management staff did not pay attention to the continuity and procedural nature of individual student development, and did not regard the evaluation work itself as an educational process, and could not grasp the dynamic development of students well.



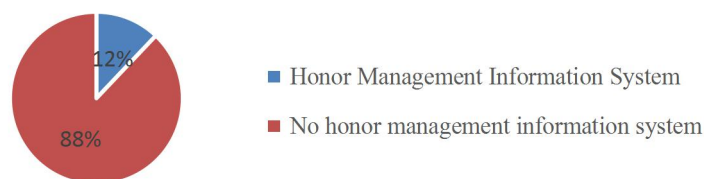
**Figure 2 Honor Management Work Time Density Type**

## 2.2 Honor management informatization needs to be strengthened

In the current era of rapid development of information technology, in the context of office automation, the development of management information systems for college students' honor management work is a powerful complement to campus office automation, and is important for improving campus office environment and improving office efficiency. However, the information construction of the honor management work is still very backward. The honor management work is mostly manual, and the data source is unreliable and the data utilization rate is low.

### 2.2.1 Manual operation with high error rate and low efficiency

As can be seen from Figure 3, there are 80 people in the “No” group, accounting for 88% of the total number. Therefore, it can be considered that the university conducts the honor management work by manual operation, and the data is manually entered into the Excel table. The data redundancy is large and docked. Problems such as complexity are widespread.

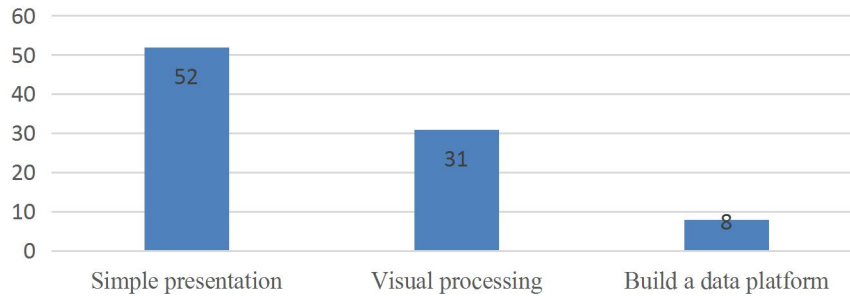


**Figure 3 The Status Quo of Honor Management Informatization Construction**

### 2.2.2 Honor data has not been deeply explored

As can be seen from Figure 4, there are 52 people in the “simple presentation”, accounting for 57% of the total number. Therefore, it can be considered that most universities do not process the data in

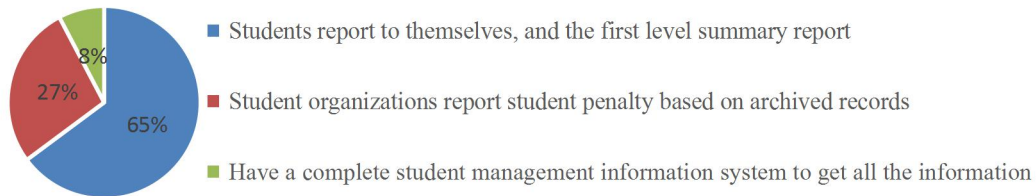
depth when processing the honor data, and the data islands and data archiving scope are chaotic. The phenomenon is widespread, the data utilization rate is low, and the honor data is not visualized.



**Figure 4 Data Utilization Status Indicator Collection Method**

### 2.2.3 Unreliable data source, lack of authenticity check

As can be seen from Figure 5, when collecting honorary information, the school uses the method of letting students report it themselves. For these data, the school has not taken effective measures to supervise the check. This easily leads to unreliable sources of underlying data, and once there is a problem with the underlying data, it will cause a series of subsequent problems.



**Figure 5 Indicator Collection Method**

## 3 System Design

### 3.1 The idea of multi-parameter honor management information system

Through the investigation and research on the honor management work of several universities in Wuhan, we found that the original working methods can no longer meet the requirements of carrying out honor management work. Based on the above problems, the soundness and reconstruction of a systematic, convenient and flexible honor management system is particularly important. Therefore, the multi-parameter honor management information system for colleges and universities is envisioned.

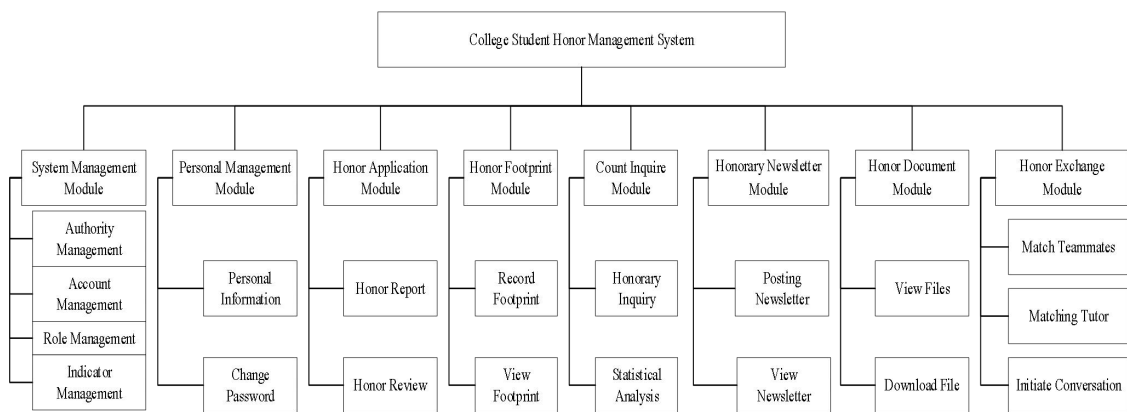
### 3.2 Design of multi-parameter honor management information system

### 3.2.1 System organization design

The overall planning and unified deployment will enable the students' honor management staff at all levels to cooperate with each other, link up and down, strengthen the organizational management system, and establish a shared data center, so that the student management can achieve the high-quality integration of resources and the normalization of core data sharing. Avoid problems with information silos, data fragmentation, and wasted data resources. (Wang Liping,2008)

### 3.2.2 System function design

The system is divided into eight functional modules, namely system management, personal management, honor application module, honor footprint module, statistical query module, honorary newsletter module, honor file module, honor exchange module and so on. Each module is interconnected, and the honor application is the basis of all modules.



**Figure 6 Functional Design of the Honor Management Information System for College Students**

#### 1) Flexible setting of indicators and weights of each indicator

When conducting student honor management, the ratios of indicators and indicators selected for each category may be different. Based on the above analysis, the indicator management in the system management module adopts the multi-parameter setting method. The honor management staff can independently design the index system such as honor type and honor diversion according to the actual situation of the college, so that the diversified talents training objectives of different institutions The needs of the university are met, so that the university student honor management system can adapt to various environments. This part of the function shows the flexibility and operability of the entire system.

#### 2) Establish a student data platform for automatic screening

The honor report of the system honor application module can realize integration and integration of a large number of scattered and diverse data resources. When the user determines the selection conditions, the system can automatically filter and meet the required student information, thereby directly Synchronize to a database of statistics for award-winning students. At the same time, the use of database related knowledge to reduce data redundancy (Wang Hu, Zhang Jun,2007), if there is a data modification, other data associated with it will be modified to prevent data inconsistency or modification between the manual operation stage and the table, so that the data is consistent and accurate from the source.

3) Relevant personnel upload and review student honor information in real time

The system honor application module can realize the real-time application of honorary items by relevant personnel, and a special group set up by each school to conduct real-time review of the honor information of students. Optimize the work from short-term high-intensity to regular work, real-time data viewing management, reduce manpower consumption, and at the same time structure is rigorous, trustworthiness and execution are strong.

4) Labeled record growth footprint, modular management honor record

The System Honor Footprint module enables you to record your honor footprint on the calendar in terms of time, or you can design your own labels and manage your personal honors modularly. At the same time, when adding and modifying personal honors, you can upload relevant honorary documents. The system can systematically store and maintain honor information and honor related files, and support batch download.

5) Long-term storage of honor data and deep exploration of data potential

The system can store all honorary information for each student's university during the long term. (Rong Rong, Yang Xianmin, Chen Yaohua, Zhao Qiujin,2014)The system statistical query module can implement functions such as multi-condition query and data visualization, and analyze and process data from different angles. Using the algorithm to analyze the student's honor text co-words, drawing on the students' advantages and disadvantages, students can develop according to their own advantages and disadvantages. The system provides the honor management personnel with the inquiry of the students in any section of the indicator. The honor management staff can determine the development target according to the plan and focus on training.

6) Building a communication platform

The system honor exchange module enables matching of qualified teammates and mentors based on input criteria, and students can initiate conversations and communicate with teammates or mentors in this module.

## 4 Conclusion

Through interviews and questionnaire surveys of honorary management staff and ordinary students in major universities in Wuhan, this paper collects and integrates the problems commonly found in the honor management of college students at the present stage, and adopts literature review, investigation and experiment methods. Analytical methods such as action research method and object-oriented method are used to deeply analyze the causes of problems. Finally, combined with the relevant work experience of major universities and the investigation and understanding of related work at home and abroad, we put forward targeted solutions and constructed " The multi-parameter honor management system is implemented by means of management information systems.

The establishment of the university student honor management information system platform enables the institutions to flexibly set evaluation indicators according to the actual application environment, which meets the needs of the university's diversified talent training objectives. In addition, the university student honor management information system is connected with the responsible

departments of honor management in major universities to realize the automatic entry and calculation of student related index information, simplify the information modification process, and realize the timeliness and incentive effect of honor management.

With the advent of the era of big data, the honor management information system will further develop into the big data platform. (Yang Yu ,2018) The university information management should also establish a big data decision-making model, and use big data to make scientific decisions to ensure that the honor assessment work is fair, just and open.

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## **Assessing Land Use and Cover Change Effects on Vegetation in Ghana from 2002 to 2018: a Case Study of New Juaben Municipality**

Isaac Kuma Yeboah<sup>1</sup>, Emmanuel Yeboah<sup>2</sup>, Emmanuel Kojo Gyamfi<sup>1</sup>, Henrritta Suapim<sup>3</sup>

1 School of Information Engineering, Wuhan University of Technology, Wuhan, P.R. China, 430070

2 Department of Geography and Resource Development (Remote Sensing and GIS Lab), University of Ghana, Accra, Ghana.

3 Pipelines and Stations Department, Ghana National Gas Company, Ghana

(E-mail: isaackyeboah77@gmail.com, emmayeb77@gmail.com, emmakojogh@gmail.com, giftysuapim@yahoo.co.uk)

**Abstract:** Rapid satellite data streams in operational application was studied and have clear benefits for monitoring land cover. Information examined help in the fast changing surface conditions using Landsat satellite imagery from 2002 to 2018. The study examined how remote sensing as a key tool for monitoring and predicting environmental variables by using land surface monitoring and land cover mapping to vegetation decrease. The data use for the study was from Ghana and case of New Juaben municipality. We found out that dense vegetation lost was 13344 square Kilometers between 2002 and 2013. This means that, the area covered by dense vegetation are now covered by other features as at 2013. Also an area of 55375 square Kilometers to other features between 2013 and 2018. This means that, areas covered by dense vegetation in 2013 are now covered by other features as at 2018. The NDVI value range for 2002 was 0.09 – 0.66 which means that the health of vegetation was high. The health of vegetation decreased in 2013 with NDVI range value of 0.07 – 0.62 and further decreased to 0.65 - 0.10 in 2018. Hence the consequences of climate change on the territory in our opinion, should be divided and classified. Mainly - on the positive and negative consequences directly and indirectly affecting the nature of public life for socially unprotected segments of the population of countries.

**Key words:** NDVI range; Landsat satellite; Vegetation in Ghana; Land use

### **1 Introduction**

The decrease in the health of vegetation is increasing dramatically in most developing nations. In Africa and in the New Juaben municipality of Ghana, in particular, expansion of farmlands and buildups in particularly settlements (urbanization), roads, industries, shops among others have contributed to the high rate of decrease in the health of vegetation in the municipality. The municipality falls into the semi-lit climate zone of the rainforest with a bi-modal rainy season of between 1200 mm and 1700 mm and reaches its maximum during the

two peak periods of May to June and September to October (Attua E.M. & Fisher J.B., 2011). The dry season was relatively short and experienced between November and February (Attua E.M. & Fisher J.B., 2011). Humidity and temperatures are generally high ranging between 20 °C and 32 °C. The mild temperatures have an important influence on making the municipality an important tourist destination. The vegetation is characterized by tall trees with evergreen undergrowth and rich in economic trees including *Chlorohorae excelsa* (Odum), *Ceiba pentandra* (Onyina), *Antaris Africana* (Kyenkyen), *Triplochinton scleroxylon* (Wawa) (Ministry of Food & Agriculture, 2019), (Chinea-Rivera J. D., 1990). These species largely support the activities of logging and estate development. However, logging, agriculture, and construction activities have contributed to the degradation of the original vegetation.

## **2 Land Change Prediction Mapping Technique**

Various spatial modeling techniques have been used within an RS-GIS environment to clarify and predict land change processes. These models described consist of three main components: multitemporal land cover maps, a transitional function that modifies the values and spatial planning of the initial land cover maps, which makes a definitive prediction map of land changes. An important advantage of the Markov modeling technique is its operational simplicity and the ability to project land use change with minimal data requirements. This was particularly relevant in each study area where there was a lack of historical data on land use or land cover. Once a transition matrix has been constructed, only the current land cover information and not the previous one needs to project the future distribution of the land cover. In the absence of reliable and accurate historical data from the study area, we considered the Markov chain application to be the most suitable for studying the historical and future changes in the land area of the study area. The study area was the New Juaben municipality in Ghana, West Africa, which is wedged between 5.55826.158N and 0.10820.248W and forms part of the southern boundaries of the semiprecious forest-agro-ecological zone of the country (Ghana Statistical Service, 2005).

## **3 Data and Methodology**

### **3.1 Method one**

Landsat images of the study area were downloaded from the United States Geological Survey (USGS) web site (United States Geological Survey, 2018). Selection had to be made from the available free download satellite images to exclude those that were more than 10% cloud covered and 10% scene cloud cover respectively. This made it impossible to use much more recent image scenes. However, the images of the New Municipality acquired was Landsat 7 ETM+ (Enhanced Thematic Mapper) 2002, 2013, and 2018. We removed the scan lines and calibrated the images 7, 4 and 2 using the ENVI (Environment for Visualizing Images) Remote Sensing Software.

#### **3.1.1 Discussing about method one**



We however choose the layer stack combination 7-4-2, since that gives a natural color and suitable for this study. We went ahead to subset using Region of Interest (ROI) by overlaying the Ghana district shape file on the layer stack 7-4-2 image. After that we took note of the district code, converted vector to ROI, selected the specific attribute query, changed the option to Dist\_code, entered the New Juaben district code derived the attribute table and extracted the New Juaben municipality out of the layer stacked image. The assessed land cover types were vegetation, farmland and buildups. Figures 1,2 and 3 show maps of historical changes in land cover for 2002, 2013 and 2018. Normalized Difference Vegetation Index (NDVI) quantifies vegetation by measuring the difference between near-infrared which vegetation strongly reflects and red light which vegetation absorbs (GISGeography, 2018). NDVI always ranges from -1 to +1. But there isn't a distinct boundary for each type of land cover (Jinru X and Baofeng S., 2017). For example, when you have negative values, it's highly likely that it's water. On the other hand, if you have a NDVI value close to +1, there's a high possibility that its dense green leaves (Jinru X and Baofeng S., 2017). But when NDVI is close to zero, there isn't green leaves and it could even be an urbanized area. As shown below, Normalized Difference Vegetation Index (NDVI) uses the near-infrared (NIR) and red channels in its formula.

$$NDVI = \frac{(NIR - Red)}{(NIR + Red)} \quad (1)$$

Healthy vegetation (chlorophyll) reflects more near-infrared (NIR) and green light compared to other wavelengths, but it absorbs more red and blue light. This is why our eyes see vegetation as the color green (Bramhe, V. S., 2018). If you could see near-infrared, then it would be strong for vegetation too (Kooti. Sh, Naseri. A, Boroomand Nasab. S., 2017). Satellite sensors like Landsat and Sentinel-2 both have the necessary bands with NIR and red (Oleson, K.W., et al, 2010). The band 4 represents the Near-Infrared and band 3 represents Red respectively. Figures 1,2 and 3 show the NDVI range for the years, 2002, 2013 and 2018.

### 3.2 Method two

The changes in the area over time associated with individual PFT's are prescribed through a forcing dataset, referred to here as the dynpft dataset. The dynpft dataset consists of an annual time series of global grids, where each annual time slice describes the fractional area occupied by all PFT's within each grid cell. Interpolation of PFT weights between annual time slices in the dynpft dataset uses a simple linear algorithm, based on the conversion of the current time step information into a floating-point value for the number of calendar days since January 1 of the current model year (cday). The interpolation weight for the current time step  $tw_{cday}$  is shown in the equation below (Oleson, K.W., et al, 2010).

$$tw_{cday} = \frac{366 - cday}{365} \quad (2)$$

Where the numerator is 366 instead of 365 because the time manager function returns a value of cday =1.0 for a time of OZ on January 1. The weights  $w_p(nt_1)$  and  $w_p(nt_2)$  obtained from the dynpft dataset for PFT p at the bracketing annual time slices  $nt_1$  and  $nt_2$ , the

interpolated PFT weight for the current time step ( $w_{p,t}$ ) is shown in the equation below (Oleson, K.W., et al, 2010).

$$w_{p,t} = tw_{cday} [w_p(nt_1) - w_p(nt_2)] + w_p(nt_2) \quad (3)$$

The change in weight for a PFT between the current and previous time steps ( $\Delta w_p$ ) is shown in the equation below (Oleson, K.W., et al, 2010).

$$\Delta w_p = w_p^n - w_p^{n-1} \quad (4)$$

Where n denotes the current time step and the area of a given PFT increases for  $\Delta w_p > 0$ , decreases  $\Delta w_p < 0$ . The above equations 2, 3 and 4 was used to plot the graphs in figures 12 and 13 which shows the inter- annual time series averages of NDVI Jan 2008 to Dec 2011 and Jan 2012 to Dec 2015 respectively.

## 4 Results and Discussion

### Patterns of Land Cover and Change

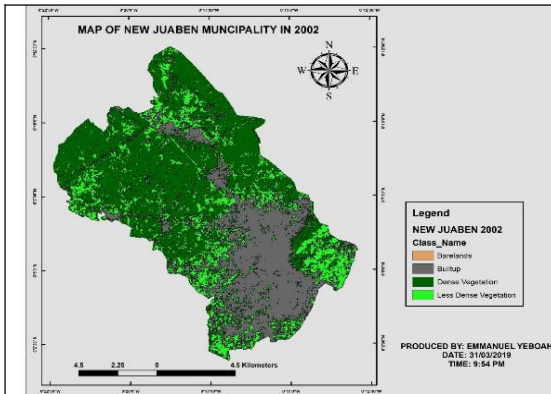


Figure 1 Range Value of 0.09-0.66 for the Year 2002

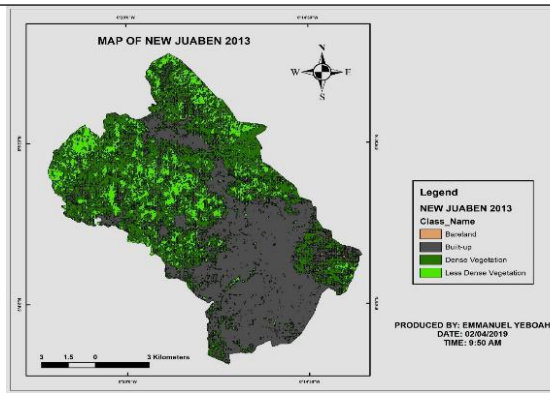
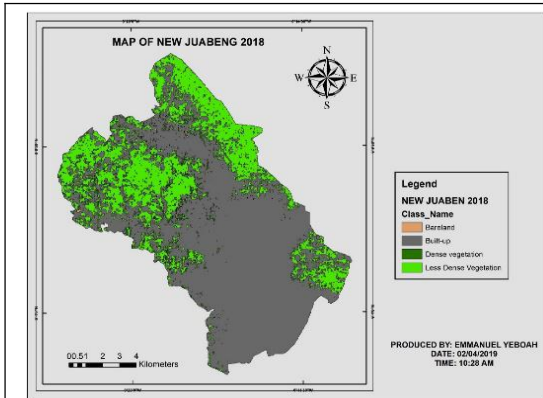
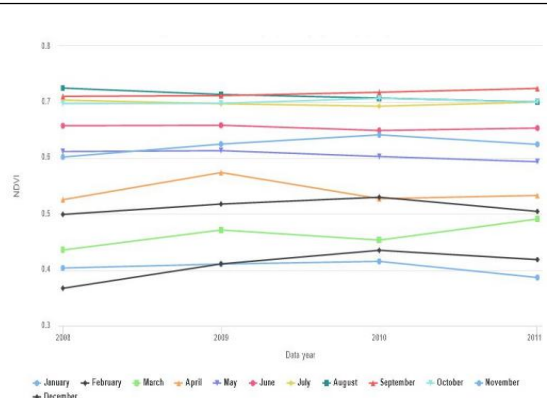


Figure 2 Range Value of 0.07-0.62 for the Year 2013



**Figure 3 Range Value of 0.10-0.65 for the Year 2018**



**Figure 4 Inter-annual time series average NDVI for Jan 2008 to Dec 2011.**

From the images and maps above figures 1,2 and 3, it was observed that there was a continuous decrease in Dense Vegetation the deep green color across the years. However Less Dense Vegetation light green, Bare lands Orange and build-up houses, Industries, roads, market places, schools, churches, among others continue to increase across the years. The tables below show the change detection statistics of land use and land cover change of the New Juaben Municipality in 2002, 2013 and 2018 in terms Area in square kilometers for the initial stage 2002, 2013 and the final stage 2018.

**Table 1 Change Detection Statistic Showing Land Use and Land Cover Change Between 2002 and 2013**

Class	Sq. Km (2002)	Sq. Km (2013)	Difference (2002 - 2013)
Bare lands	334	1496	1162
Less Dense Vegetation	40415	31758	-8657
Built-up	47048	67887	20839
Dense Vegetation	72275	58931	-13344

The change detection statistics in table 1 above, dense vegetation lost 13344 square Kilometers to the other Classes between 2002 and 2013. This means that, the area covered by dense vegetation are now covered by other features as at 2013. However less dense vegetation also lost 8657 square kilometers to other Features. This means that, 8657 square kilometers of the areas covered by less dense vegetation in 2002 are covered by other features as at 2013. However, Built-up gained and area cover of 20839 square Kilometers between 2002 and 2013 respectively. This means that, areas covered by other features such as dense vegetation and less dense vegetation in 2002 are now areas covered with built-up as at 2013. Also, bare lands gained an area of 1162 Square Kilometers between 2002 and 2013.

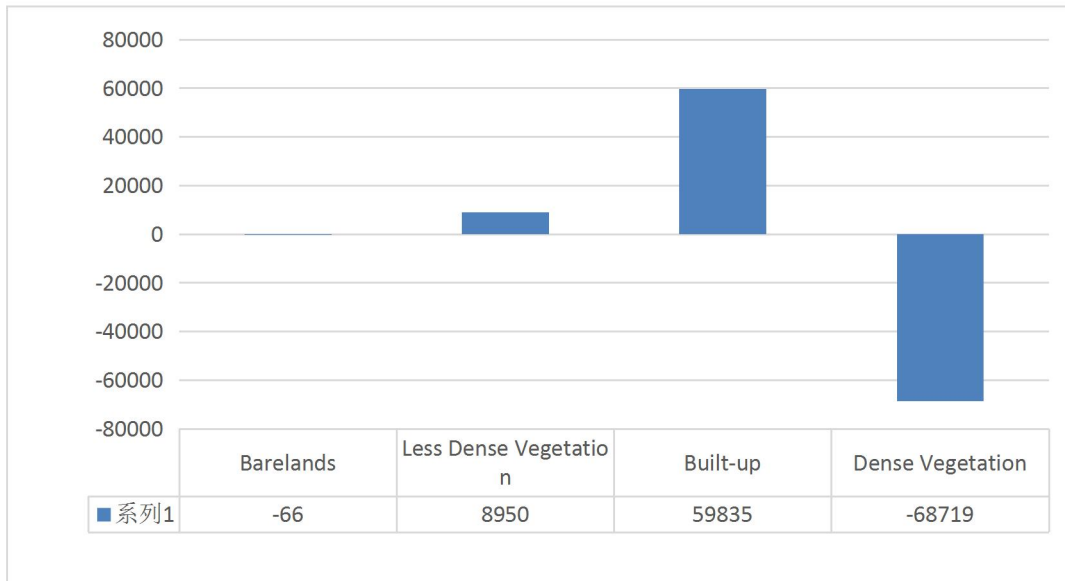
**Table 2 Change Detection Statistic Showing Land Use and Land Cover Change Between 2013 and 2018**

Class	Sq. Km (2013)	Sq. Km (2018)	Difference (2013 - 2018)
Bare lands	1496	268	-1228
Less Dense Vegetation	31758	49365	17607
Built-up	67887	106883	38996
Dense Vegetation	58931	3556	-55375

The change detection statistics in table 2 above, dense vegetation lost an area of 55375 square Kilometers to other features between 2013 and 2018. This means that, areas covered by dense vegetation in 2013 are now covered by other features as at 2018. However, less dense vegetation gained an area of 17607 square kilometers. This means that, areas covered by other features in 2008 are now covered by less dense vegetation as at 2018. Buildups gained an area of 38996 square Kilometers between 2013 and 2018 respectively. This means that, areas covered by other features such as dense vegetation, bare lands and less dense vegetation in 2013 are now areas covered with built-up as at 2018. Also, bare lands lost an area of 1228 Square Kilometers between 2013 and 2018.

**Table 3 Change Detection Statistic Showing Land Use and Land Cover Change Between 2002 and 2018**

Class	Sq. Km (2002)	Sq. Km (2018)	Difference (2002 - 2018)
Bare lands	334	268	-66
Less dense vegetation	40415	49365	8950
Built-up	47048	106883	59835
Dense vegetation	72275	3556	-68719



**Figure 5 Shows Change Detection Statistics Bar Chart of 2002 and 2018.**

The change detection statistics table 3 and figure 5 above, dense vegetation lost a total area of 68719 square Kilometers to other features between 2002 and 2018. This means that, areas covered by dense vegetation in 2002 are now covered by other features as at 2018. However, less dense vegetation gained an area of 8950 square kilometers.

## 5 Conclusion

In conclusion, areas covered by other features in 2002 are now covered by less dense vegetation as at 2018. Build-up gained an area of 59835 square Kilometers between 2002 and 2018 respectively. This means that, areas covered by other features such as dense vegetation, bare lands and less dense vegetation in 2002 are now areas covered with build-up as at 2018. Also, bare lands lost an area of 66 Square Kilometers between 2002 and 2018. The NDVI value range for 2002 was 0.09 – 0.66 which means the health of vegetation was high. The health of vegetation decreased in 2013 with NDVI range value of 0.07 – 0.62 and further more decreased to 0.65 - 0.10 in 2018. Implications from figure 4 shows that, the entire Ghana health of vegetation decreased in monthly inter-annual time series average NDVI using the MODIS-Terra MOD13C2 for 2008-2011. From the graph, it is evident that there are fluctuations in the Normalized Difference Vegetation Index (NDVI) across the respective month. The NDVI value is high during the rainy season from the following months April, May, June, July, August, September and November, as evident in the graph above. This was because, during the rainy season the leaves of plants reflects more greens so the satellite is able to detect high reflectance from vegetation. During the dry season from the following months January, February, March and December the NDVI values are relatively low and this is because during the dry season, the leaves are generally dry and therefore they reflect less green so the satellite is able to detect very low reflectance from vegetation during the dry season. Hence

consequences of climate change on the territory in our opinion, should be divided and classified. These should be based mainly on the positive and negative consequences directly and indirectly affecting the nature of public life for socially unprotected vegetation and segments of the population of countries.

### **Acknowledgement**

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## Research on Governance Effect of Equity Structure: The Perspective of Mixed Ownership Reform in State-owned Enterprises

Deng de Yu<sup>1</sup>, Hong Hong<sup>1</sup>, Xiang Shouren<sup>2</sup>

<sup>1</sup> School of Management, Wuhan University of Technology, Wuhan, P.R. China, 430070

<sup>2</sup> Zhuzhou CRRC Times Electric Co., Ltd., Zhuzhou, P.R. China, 412000

(E-mail: 271348851@qq.com, whhw02@163.com, 2725326421@qq.com)

**Abstract:** This paper takes the A-share listed state-owned enterprises in China from 2013 to 2017 as research samples, and applies empirical approach to study the influence of the equity structure in the mixed ownership of state-owned enterprises on the agency cost. The study found that there is a significant negative correlation between the diversification of the number of shareholder categories and the nature of shareholdings and excess management costs; there is a significant positive correlation between the diversification of the number of shareholder categories and the nature of shareholdings and the quality of internal control. In addition, this paper studies the mechanism of path effect from the perspective of the quality of internal control and the structure of the board of directors, from which it is found that the quality of internal control and the structure of the board of directors are both intermediary variables that the equity structure plays a role in the corporate governance effect.

**Key words:** Mixed Ownership Reform; State-owned Enterprises; Equity Structure; Governance Effect; Agency cost.

### 1 Introduction

At present, in a large number of state-owned enterprises, there are many systemic problems, such as excessive interference of government administration, serious administration of internal management, serious "insider control" and inexpensive control of management. These problems have seriously restricted the long-term development of state-owned enterprises, and have great influence on corporate governance of state-owned enterprises. Effectiveness has had a serious impact. An important reason for these problems is the unreasonable ownership structure of state-owned enterprises, the existence of state-owned capital "dominated by one share", the softening of debt constraints, the lack of equity of human capital and other issues. The Third Plenary Session of the Eighteenth Central Committee of the Communist Party of China has proposed and implemented major strategic measures for the reform and adjustment of state-owned enterprises. By introducing non-public economic elements, the public economy and non-public economy can be integrated and infiltrated into each other, the phenomenon of "one share is dominant" of state-owned capital can be changed, and diversified mixed ownership economy can gradually replace single ownership. First, establish and improve the modern enterprise system in the public ownership economy. Therefore, it is of great practical significance to study the governance effect of ownership structure in the reform of state-owned mixed ownership.

Previous research found the effect of mixed ownership reform of state-owned enterprises from different angles. Such as, Liu Shaojia, et al. (Liu Shaojia, et al., 2003) pointed out that mixed ownership reform can significantly improve the performance of state-owned enterprises, and the effect of eastern region is significantly higher than that of the western region. Xue et al. (Xue et al., 2018) found that the mixed ownership reform of state-owned enterprises can improve the technological innovation ability and efficiency of enterprises. Sun Yongxiang (Sun Yongxiang, 2001) found that the mixed ownership reform can effectively improve the innovation efficiency of enterprises and compared with other ownership enterprises, the innovation efficiency of state-owned enterprises after the mixed ownership reform is higher than that of foreign-funded enterprises, private enterprises and Hong Kong, Macao and Taiwan enterprises. These research results have played a theoretical guiding role in the mixed ownership

reform of state-owned enterprises. However, there is little research on the impact of the mixed ownership reform of state-owned enterprises on corporate governance from the perspective of equity structure. The essence of mixed ownership reform is the main form to make joint-stock system become the public sector of the economy, which makes state-owned capital, private capital, collective capital and foreign-funded capital integrate with each other. Therefore, the mixed ownership reform is to re-optimize and combine the equity structure of enterprises. It can be seen from this that there is an inevitable connection between the mixed ownership reform and the selection of the enterprise's equity structure. This paper applies property rights theory, corporate governance theory and capital structure theory, takes listed companies in Shanghai and Shenzhen A-share markets from 2013 to 2016 as research samples to study the governance effect of equity structure. Its contents include two aspects: the governance effect of the equity structure and the intermediary influence path in the mixed ownership reform. And the robustness test guarantees the reliability of the results.

The contribution of this paper is manifested on following aspects: firstly, the paper integrates the mixed ownership reform of state-owned enterprises with the selection of ownership structure. The existing research has no research on the mechanism of the governance effect of the mixed ownership reform equity institutions. However, this paper studies the intermediary path of the governance effect of the equity structure in the mixed ownership reform. It is found that the quality of internal control and the structure of the board of directors are intermediary paths for the governance effect of the equity structure in the mixed ownership reform, which is of great significance for deepening the understanding of the reform of state-owned enterprises and enriching the research on the reform of state-owned enterprises. Secondly, the paper enriches the research contents of relevant capital structure theories. The western capital structure theory mainly studies the public companies, but this paper takes the state-owned enterprises in China as the research objects. The state-owned enterprises in China have the special status and the management way in the market economy, their capital structure constitution also has certain particularity, so taking the state-owned enterprises in China as the research objects has the very vital significance to deepen the research of capital structure theory.

## **2 Research Assumptions**

The mixed reform of state-owned enterprises is a reform of the stock price structure. From the perspective of theoretical research, the mixed ownership reform is essentially a reorganization of the stock ownership structure of the enterprise (Yuan, 2019). According to the relevant decisions of the Third Plenary Session of the 18th Central Committee of the CPC, China's mixed ownership reform at current stage is to combine public ownership capital with other non-public ownership capital to form cross-holdings, which is essentially an organizational form of enterprise capital and a re-selection of the equity structure of enterprises. From the realistic point of view, the mixed ownership reform in China is to introduce different economic components such as private economy, foreign-funded economy and private economy into the state-owned economy to form a diversified ownership structure, activate the vitality of the state-owned economy and enhance the economic competitiveness of the state-owned enterprises. Therefore, the mixed ownership reform is also a selection of equity structure (Yang and Tong, 2015; Yang et al., 2015).

At present, the ownership of the state-owned enterprises in China is state-owned, which will lead to a serious phenomenon of the omission of ownership and will make the government as the ownership of the enterprise unable to effectively exercise its rights (Bebchuk et al., 2009). Therefore, in order to better manage the state-owned enterprises, the government will choose to give the management rights of the enterprises to the management of the enterprises. However, because the government does not have a clear organization and system to effectively supervise and manage the management of the state-owned enterprises, the management of the state-owned enterprises has absolute rights in the process of enterprise management. As a rational economic person, they inevitably seek personal gain for themselves, such as excessive investment and on-the-job consumption, which will lead to serious problems of insider control and thus serious principal-agent problems (Core et al., 1999).

By introducing non-public sector of the economy, the mixed ownership reform allows the public



and non-public sectors of the economy to merge and penetrate into each other, changes the phenomenon of dominant state-owned capital, and gradually allows the single public ownership system to be replaced by the multiple property rights system of mixed ownership, allowing the public and non-public sectors of the economy to merge with each other, and realizing the diversification of the equity of state-owned enterprises (Chen and Liu, 2019). On the one hand, although the introduction of non-public sector of the economy in state-owned enterprises leads to the decline of state-owned enterprises' equity and the dispersion of enterprise equity, the increase in the number of shareholders can restrain the problem of insider control caused by the phenomenon of ownership vacancy in state-owned enterprises, clarify the company's property rights, form multiple supervision by multiple management levels, and restrain the excessive investment and on-the-job consumption of management (Gui et al., 2019). On the other hand, private capital, collective capital and foreign-funded capital have clear main bodies and have stronger characteristics of "economic man". Unlike the holders of tradable shares, they pursue the growth of long-term value of enterprises and attach more importance to the improvement of long-term performance of enterprises and the discovery of enterprise growth (Qi et al., 2015). Compared with state-owned capital, private capital, collective capital and foreign-funded capital have stronger supervision power and ability. Therefore, based on the above analysis, this paper proposes the following research hypothesis 1:

H<sub>1</sub>: The equity structure has a governance effect on the mixed ownership reform of state-owned enterprises.

Based on the principal-agent theory and the equity structure theory, this paper analyzes and finds that the equity structure in the mixed ownership reform has a good governance effect, but the mechanism behind this is still unclear. What kind of transmission channels are used to form the governance effect of the equity structure in the mixed ownership reform? Therefore, this paper will analyze how the equity structure in the mixed ownership reform affects the corporate governance effect from the following two ways.

Effective internal control can restrain the principal-agent problem between management and shareholders, and equity structure is the fundamental reason for the principal-agent problem between management and shareholders (Zhang and Li, 2018). Therefore, there is a certain correlation between internal control and equity structure. A large number of empirical studies have also proved this point. Fan, et al. (2002) have found that there is a significant positive correlation between the shareholding ratio of the largest shareholder of the enterprise and the effectiveness of the internal control of the enterprise. Based on the data analysis of listed companies in China, Wang and Chen (2004) found that only the moderately centralized equity structure can have a positive effect on the internal control of enterprises and highly centralized and highly dispersed equity structure may have a certain negative impact on the internal control. From the perspective of internal control and corporate governance effect, an important content of internal control is the control of the board of directors and management. Internal control and corporate governance are interrelated and interactive. Effective implementation of internal control is based on a good corporate governance environment (Liu, 2018). Therefore, internal control and corporate governance effect are closely related. Based on the above analysis, this paper proposes research hypothesis 2:

H<sub>2</sub>: The quality of internal control is the intermediary path for the equity structure to affect the governance effect of state-owned enterprises in the mixed ownership reform.

In addition to the internal control path, the governance effect of the change of equity structure on the enterprise in the mixed ownership reform can also be achieved through the board structure path. According to the requirements of the Third Plenary Session of the 18th Central Committee of the CPC that the market plays a decisive role in the allocation of resources, enterprises must become the real main market players. Then, the legal status of the board of directors will be finally confirmed and it will become the most important decision-making body of the enterprise. In this way, the composition of the board of directors is crucial. The board of directors is an important organization that connects the shareholders and the management of an enterprise and plays an important role in the management of an enterprise. Its work and governance efficiency are related to the legitimate rights and interests of shareholders and the operating performance of the company. The establishment of an efficient board of

directors can help realize the interests of shareholders (Harris and Raviv, 2016). The board of directors is elected by all shareholders, which is mainly responsible for the strategic system and its implementation of the enterprise and employs management to be responsible for the daily operation and management of the enterprise and the implementation of the strategy. It is an important joint between management and shareholders. Before the mixed ownership reform, the main shareholders of our state-owned enterprises were the government, the members of the board of directors of the enterprises mainly came from administrative appointment, and their independence and professional management level were relatively low (Xie et al., 2019). After the mixed ownership reform, the phenomenon of dominated state-owned capital can be changed and the results of state-owned enterprises' equity can be diversified. Therefore, it is necessary to change the previous recruitment and selection method of the board of directors, and to add directors' representatives of the shareholders of collective shares, private shares and foreign-funded shares in the board of directors. These directors' representatives are generally selected through the market mechanism (Core et al., 2017). They have the ability to effectively supervise the management while they are representatives of collective shares, private shares and foreign-funded shares, and they have the power to ensure that the interests of non-public capital are not damaged. Therefore, the mixed ownership reform and the diversification of corporate equity structure can have an impact on the structure of the company's board of directors, thus affecting the corporate governance level. Based on the above analysis, this paper proposes research hypothesis 3:

H<sub>3</sub>: The structure of the board of directors is the intermediary path for the equity structure to affect the governance effect of state-owned enterprises in the mixed ownership reform.

### 3 Research and Design

#### 3.1 Sample selection and data source

This paper selects the data of China's A-share listed state-owned enterprises from 2013 to 2017 as research samples. In order to ensure the authenticity and validity of the data, this paper screens the data according to the following rules: companies whose net assets are negative and whose stock code is ST forced by the stock exchange are excluded and financial listed companies are excluded. In order to eliminate the influence of extreme values on the empirical results, this paper carries out Winsorize processing on each variable according to the 1% of the front and back ends, and finally 3,546 data are obtained.

#### 3.2 Variable and model design

We construct the model (1) to test the impact of the mixed ownership reform on the company's principal-agent cost to prove Hypothesis 1.

$$Agent_{i,t} = \beta_0 + \beta_1 MC_{i,t} + \gamma \sum ControlVar_{i,t} + \varepsilon_{i,t} \quad (1)$$

In the formula,  $Agent_{i,t}$  refers to the principal-agent cost,  $MC$  refers to the equity structure in mixed ownership reform,  $i$  refers to the individual enterprise, and  $t$  refers to the year mark.

According to the research of Liu et al. (2015), the excess management fee is used to measure the principal-agent cost between the management and shareholders. The specific measurement adopts the following two formulas. Firstly, each coefficient is calculated according to (2), then the observed value is brought into (2) again according to the calculated coefficient to calculate the management fee  $\overline{CE}_{it}$ , finally, it is brought into (3) by subtracting the expected management fee from the actual management fee to obtain the principal-agent cost.

$$CE_{it} = \sigma_0 + \sigma_1 sale_{it} + \sigma_2 lev_{it} + \sigma_3 grow_{it} + \sigma_4 dsh_{it} + \sigma_5 sj_{it} + \sigma_6 age_{it} + \sigma_7 roa + \sigma_8 first + \sigma_9 industry + \sigma_{10} year + l \quad (2)$$

$$Agent = CE_{it} - \overline{CE}_{it} \quad (3)$$

In the formula,  $CE$  represents the current management expenses divided by operating income,  $\ln$  refers to the natural logarithm of operating income,  $lev$  refers to the asset-liability ratio,  $dsh$  represents the size of the board of directors,  $sj$  refers to a virtual variable, whose value is 1 if it is the top ten accounting firms, and whose value is 0 otherwise,  $age$  refers to the natural logarithm of the company's age,  $roa$  refers to the rate of return on assets,  $first$  represents the shareholding ratio of the largest shareholder, and controls the industry and annual influence.

The ownership categories of mixed ownership and the nature of shareholder ownership are diversified (Feng, 2016). For the diversification of shareholder categories  $MC1(4)$ , this paper according to Li et al. (2012). Firstly, the collective nature, foreign-funded nature, state-owned nature and private nature are assigned to 1, 2, 3 and 4, and the proportion and number of shares of different natures are summed up, so as to obtain the shareholding ratio and the number of shareholders of each kind of shares in each company in each year; secondly, it is measured by Herfindal coefficient, and we constructs the model(4)as follows:

$$MC1 = 1 - \sum p_i^2 \quad (4)$$

Where,  $p_i$  indicates the proportion of type I shareholders in the top ten shareholders.

In view of the diversification of the nature of shareholder ownership  $MC2(5)$ , this paper uses the research of Jensen et al. (2016) for reference and adopts entropy index as its measurement standard. Firstly, it assigns values to shareholders of different natures as above and calculates the number and shareholding ratio of shareholders of different natures, and then uses entropy index. We construct the model (5)as follows:

$$MC2 = \sum X_i * Ln\left(\frac{1}{X_i}\right) \quad (5)$$

Where,  $x_i$  indicates the proportion of the number of shares of type I shareholders in the number of shares held by the top ten shareholders.

Meanwhile, in order to test the intermediary path to prove Hypothesis 2 and 3,, according to Sobel intermediary factor test, the test is conducted in accordance with the following test procedures: step 1, the governance effect of equity structure in the mixed ownership reform is tested; step 2, the effect of the equity structure in the mixed ownership reform on the structure of the board of directors (the quality of internal control) is tested; step 3, According to model (7) , the effect of equity structure and the structure of the board of directors in the mixed ownership reform on the company's principal-agent cost is tested.

$$ETR_{i,t}(Borad_{i,t}) = \alpha_0 + \alpha_1 MC_{i,t} + \gamma \sum ControlVar_{i,t} + \varepsilon_{i,t} \quad (6)$$

$$Agent_{i,t} = \chi_0 + \chi_1 MO_{i,t} + \chi_2 ETR_{i,t}(Borad_{i,t}) + \chi \sum ControlVar_{i,t} + \varepsilon_{i,t} \quad (7)$$

According to model (6),  $ETR$  refers to the internal control, Board refers to the structure of the board of directors,  $i$  refers to the individual enterprise,  $t$  refers to the year mark,  $\beta_1$  coefficient refers to the impact of the equity structure in mixed ownership reform on the principal-agent cost of state-owned enterprises, and  $\alpha_1$  and  $\chi_2$  coefficients refer to whether the board structure and the quality of internal control have intermediary effects between the equity structure and the principal-agent cost of state-owned enterprises in mixed ownership reform.

Internal Control ( $ETR$ ). This paper uses Dib Internal Control Index as a substitute variable of internal control quality. Dib Internal Control Index is based on the five basic indexes (financial report, internal control standardization, enterprise operation and management, enterprise asset safety and enterprise strategy) combined with the current situation of internal control of listed enterprises in China. Structure of the board of directors ( $Board$ ). According to Ye et al. (2011), we use the board size as a substitute variable for the structure of the board of directors. The calculation method is the total number of directors included in the board of directors.



ROA	-	0.015*	0.049**	0.109*	1														
		*	**	*															
First	0.369**	0.075**	0.423*	0.060*	1														
	**	**	*	*															
Lev	-	0.062**	-	0.135*	-	-	1												
		**	0.037*	*	0.004**	0.149**													
ΔCF	0.59**	*	0.0130	0.024	0.108*	0.0030	0	0.0200	1										
	**	*			*	0													
EPS	-	0.047**	0.023*	0.89**	0.78**	0.032*	0.133*	0.675*	1										
		**	*	*	*	**	*	*											
INS	0.043*	**	-	0.186**	0.95**	0.106*	-	0.156*	0.708*	0.979*	1								
	**	**	**	**	*	*	0.029*	*	*	**									
Size	-	0.0150	0.005	0.223*	0.0180	0.414**	-	-	-	-	1								
		*		*		**	0.024*	0.0130	0.0110	0.0130									
Deviation	0.040*	**	0.022*	0.0170	0.133**	0.090**	0.025*	0.298**	-	0.047**	0.482**	0.325**	1						
	*	**	*		**	**	*	**	0.047**	**	**	**							
ICT	-	0.357**	-	0.020*	0.035*	0.018*	0.063**	0.017*	-	0.414**	0.225*	0.117*	0.023*	1					
		**	0.020*	*	*	*	**	**	0.019*	**	*	**	*						
Board	-	0.348**	0.993**	0.460**	-	0.030**	0.036*	0.347*	0.119**	0.009*	0.535**	0.011**	0.082**	0.256**	1				
		**	**	**	0.030**	**	*	*	**	*	**	**	**	**					
ERT	-	0.021*	0.0170	0.087**	0.047*	0.100**	0.532**	0.281**	0.123**	0.041*	-	0.167**	0.173**	1					
		*		**	*	**	**	**	**	*	0.040**	0.035*	**						

## 5 Regression Analysis

### 5.1 Basic analysis of the governance effect of the equity structure in the mixed ownership reform

Table 3 show the regression results of equity structure in the mixed ownership reform on the principal-agent problem between management and shareholders. Model (1) is the regression result of the diversification of the number of shareholder categories. Its regression coefficient is -0.088 and it is significant at the level of 1%, which reflects that there is a significant negative correlation between the diversification of the number of shareholder categories and the excess management cost of the enterprise. This indicates that the higher the degree of diversification of the number of shareholder categories is, the lower the principal-agent cost between the management and the shareholders of the state-owned enterprises is, and increasing the diversification of the number of shareholder categories can effectively inhibit the principal-agent problem between the management and the shareholders. Model (2) is the regression result of the diversification of the nature of shareholders' holdings. Its regression coefficient is -0.056, which is significant at the level of 5%, which reflects the significant negative correlation between the diversification of the nature of shareholdings and the excess management cost of the enterprise. This indicates that the higher the diversification of the nature of shareholdings is, the lower

the principal-agent cost between the management and shareholders of the state-owned enterprises is, and increasing the diversification of shareholdings can effectively inhibit the principal-agent problem between the management and shareholders. Therefore, Hypothesis 1 is verified. Meanwhile, through the comparison of the two regression results, we can see that the diversification of the number of shareholders' categories has better inhibitory effect on the principal-agent problem between management and shareholders than the diversification of the nature of shareholdings, which has guiding significance for the mixed ownership reform of state-owned enterprises.

**Table 3 Regression Results of Equity Structure in Mixed Ownership Reform on the Principal-agent Problem between Management and Shareholders**

	Agent	
	(1)	(2)
MC1	-0.088*** (-2.86)	
MC2		-0.056** (-2.00)
Control variables	YES	YES
YEAR	YES	YES
IND	YES	YES
Dual	YES	YES
R2	0.330	0.350
N	3546	3546

Note: (1) \* refers to the significance level of 10%, \*\* refers to the significance level of 5%, and \*\*\* refers to the significance level of 1%. (2) The statistics of T value after Cluster correction are shown in brackets.

## 5.2 Path analysis of the governance effect of the equity structure in the mixed ownership reform

### 5.2.1 Quality of internal control

Table 4 the column 1 shows the regression results of the influence of the quality of internal control as the intermediary path of the governance effect of the equity structure in the mixed ownership reform. Models (1) and (2) test whether the ownership structure in the mixed ownership reform will affect the quality of internal control governance. We find that the regression coefficients of the diversification of the number of shareholders' categories and the diversification of the nature of shareholdings in models (1) and (2) are 0.554 and 0.352, respectively, and both are significantly correlated at the level of distribution of 1% and 10%, which indicates that the equity structure in the mixed ownership reform can have a positive impact on the quality of internal control. Models (3) and (4) test the influence of equity structure and the quality of internal control on the company's principal-agent cost in the mixed ownership reform. We can find that the regression coefficient of the diversification of shareholder's categories in model (3) is -0.233 and is significantly correlated at the level of 5%, and the regression coefficient of the quality of internal control is 0.434, which is significantly correlated at the level of 5%. Meanwhile, in model (4), the regression coefficient of the diversification of shareholdings is -0.122, and is significantly correlated at the level of 10%, and the regression coefficient of the quality of internal control is 0.532 and is significantly correlated at the level of 5%. The above regression results show that the structure of the board of directors is the full intermediary path for the governance effect of equity structure in the mixed ownership reform. It supports Hypothesis 2.

### 5.2.2 Structure of the board of directors

Table 4 the column II shows the regression results of the influence of the structure of the board of directors as the intermediary path of the governance effect of the equity structure in the mixed ownership reform. Models (1) and (2) test whether the ownership structure in the mixed ownership reform will affect the structure of the board of directors. We find that the regression coefficients of the diversification of the number of shareholders' categories and the diversification of the nature of shareholdings in models (1) and (2) are 0.663 and 0.231, respectively, and both are significantly correlated at the level of distribution of 1%, which indicates that the equity structure in the mixed ownership reform can have an impact on the structure of the board of directors. Models (3) and (4) test the influence of equity structure and the structure of the board of directors on the company's principal-agent cost in the mixed ownership reform. We find that the regression coefficient of the diversification of shareholder's categories in model (3) is -0.712 and is significantly correlated at the level of 5%, and the regression coefficient of the structure of the board of directors is -0.012, which is significantly correlated at the level of 5%. Meanwhile, in model (4), the regression coefficient of the diversification of shareholdings is 0.063, and is significantly correlated at the level of 1%, and the regression coefficient of the structure of the board of directors is -0.022 and is significantly correlated at the level of 1%. The above regression results show that the structure of the board of directors is the intermediary path for the effect of principal-agent cost between management and shareholders in the mixed ownership reform. It supports Hypothesis 3.

### 5.3 Robustness test

This paper conducts the robustness test for the empirical results, mainly from the following two aspects: (1) Substitution of variables. This paper uses the method of Li (2007) for reference and uses the turnover rate of total assets as a substitute variable of agency cost between management and shareholders. this is mostly due to agent cost produced by the low service efficiency of enterprise capital caused by opportunism such as decision-making mistakes or laziness in enterprise economic management. (2) Endogenous problems. According to econometric theory, there may be endogenous problems caused by the measurement deviation of variables, thus affecting the robustness of research results. In order to reduce the endogenous problem caused by variable measurement errors, this paper applies the method of eliminating industry differences to improve the robustness of the conclusion. Firstly, in view of the impact of industry differences on mixed ownership reform and principal-agent costs, this paper utilizes annual industry mean to adjust mixed ownership reform and principal-agent costs to eliminate the impact of industry fixed effect differences on regression results.

**Table 4 Regression Results of Intermediary Path of the Governance Effect of the Equity Structure in the Mixed Ownership Reform**

	I				II			
	Board		Agent		ERT		Agent	
	(1)	(2)	(3)	(4)	(1)	(2)	(3)	(4)
MC1	0.554*** (2.38)		-0.233** (-1.92)		0.663*** (2.35)		-0.712** (-2.18)	
MC2		0.352* (1.81)		-0.122** (-1.95)		0.231*** (3.92)		- 0.063*** (-4.04)
Board			0.434** (2.01)	0.532* (1.84)				

ERT							-0.012**	0.022***
							(-2.42)	(-2.64)
Control variables	YES	YES	YES	YES	YES	YES	YES	YES
YEAR	YES	YES	YES	YES	YES	YES	YES	YES
IND	YES	YES	YES	YES	YES	YES	YES	YES
Dual	YES	YES	YES	YES	YES	YES	YES	YES
R2	0.367	0.345	0.256	0.321	0.307	0.390	0.234	0.322
N	3546	3546	3546	3546	3546	3546	3546	3546

Note: (1) \* refers to the significance level of 10%, \*\* refers to the significance level of 5%, and \*\*\* refers to the significance level of 1%. (2) The statistics of T value after Cluster correction are shown in brackets.

## 6 Conclusion

Based on the data of A-share listed state-owned enterprises in China from 2013 to 2017, this paper empirically studies the influence of equity structure on the agency cost between shareholders and management in mixed ownership of enterprises, and studies the mechanism of path effect from the perspective of the quality of internal control and the structure of the board of directors, and obtains the following conclusions: there is a significantly negative correlation between the diversification of the number of categories of shareholders and the diversification of the nature of the shareholdings and the excess management costs, which shows that the equity structure in the mixed ownership reform can effectively reduce the principal-agent cost between the management and shareholders, protect the legitimate rights and interests of shareholders and reduce the infringement of the management on the legitimate rights and interests of shareholders. There is a significantly positive correlation between the diversification of the number of shareholders and the diversification of the nature of shareholdings and the quality of internal control, while there is a significantly positive correlation between the quality of internal control and excess management costs, which suggests that the quality of internal control is the intermediary path through which the equity structure affects the principal-agent problem between management and shareholders in the mixed ownership reform. There is a significantly negative correlation between the diversification of the number of shareholders and the nature of shareholdings and the structure of the board of directors, while there is a significantly positive correlation between the structure of the board of directors and excess management fees, which indicates that increasing the size of the board of directors is an intermediary path through which the equity structure produces effects on the principal-agent problem between management and shareholders in the mixed ownership reform.

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# A Study on Earnings Management, Analyst Forecasts and Equity Liquidity

Fu Keke

School of Management, Wuhan University of Technology, Wuhan, P.R.China, 430070

(E-mail: 1023830171@qq.com)

**Abstract:** This paper empirically examines the impact of earnings management on stock liquidity by taking a-share listed companies in Shanghai and Shenzhen Stock Markets from 2009 to 2016 as research samples. Combined with the role of analysts in the market and enterprises, this paper further tests the moderating role of analyst forecasts in the relationship between earnings management and stock liquidity, and reveals the mechanism of earnings management on stock liquidity. The main conclusions of this paper are as follows: (1) earnings management behavior of enterprises will reduce stock liquidity; (2) analyst forecast can effectively reduce the negative correlation between earnings management and stock liquidity.

**Key words:** Earnings management; Analysts; Analyst forecasts; Stock liquidity

## 1 Introduction

Corporate earnings management has always been a hot topic in academic research. Earnings management refers to corporate management using accounting methods or arranging real transactions to change financial reports to mislead stakeholders' understanding of corporate performance or affect contracts based on reported earnings (Healy and Wahlen, 1999). Over the years, relevant scholars in the academic circle have been enriching the researches on earnings management, but most of them focus on the motivation, means and influencing factors of earnings management (Kothari, 2015). The research on economic consequences also focuses on the enterprise level (Chen H, 2012), and pays less attention to the impact on the capital market.

At present, many theories focus on the relationship between information disclosure quality and stock liquidity (Lambert et al., 2007), and earnings management will reduce the quality of financial reports and report disclosure. Foreign studies on the relationship between earnings management and stock liquidity found a significant negative correlation (Amihud, 2002). For the domestic stock market where the information disclosure quality of listed companies is worse, listed companies may implement earnings management strategies to a greater extent. Meanwhile, considering the intermediary role of analysts in corporate information disclosure and investors, can they regulate the relationship between earnings management and stock liquidity to some extent? This is also the issue discussed in this paper.

This paper from the perspective of analysts, examine the analysts' estimates on earnings management and the role of relationship between stock liquidity, with abundant liquidity surplus management and research of the theory and empirical evidence, and to further strengthen the company's earnings management governance, improve the quality of information disclosure of listed companies, perfect our country capital market to provide experience and theoretical basis.

## **2 Theoretical Analysis and Research Hypotheses**

### **2.1 Earnings management and stock liquidity**

At present, some scholars study the relationship between earnings management and stock liquidity from the perspective of information disclosure quality. Amihud took the illiquidity index as the measure index of stock liquidity (Amihud,2002), and studied the relationship between earnings management and stock liquidity based on comprehensive consideration of accrual item earnings management and real activity earnings management of enterprises, and found that there was a significant negative correlation between them. The result of earnings management is that the company's external disclosure information is distorted, the quality of information disclosure is reduced, the judgment of investors on the real enterprise value of the company is affected, and the stock liquidity of the company is finally reduced. Corporate earnings management behavior will reduce the quality of accounting information disclosure, intensify information asymmetry, and reduce stock liquidity (Ascioglu,2012). This rule is also applicable to China's capital market (Wang Xiaoliang ,2016). They believe that the earnings management behavior of a company will reduce the quality of accounting earnings information disclosed by the company, reduce enterprise value, reduce the attractiveness of the company's stock to investors, and thus reduce the liquidity of the company's stock.

Earnings management is the management of accounting earnings to manipulate the behavior, the result is that investors will mislead the real performance of the company's understanding. Based on the theory of efficient market hypothesis, capital market can reflect the earnings management behavior of enterprises to some extent, reduce the value of enterprises and ultimately reduce the stock liquidity. In view of this, this paper proposes hypothesis 1:

H1: *Ceteris paribus*, earnings management reduces stock liquidity.

### **2.2 The moderating effect of analyst forecast on earnings management and stock liquidity**

Earnings forecast is one of the core information in the research report of securities analysts, and it is also an important reference information for investors to make investment decisions. For investors, the earnings forecast of securities analysts can provide important reference basis for investors to evaluate the company value, form the company's earnings expectation and select valuable stocks (Brown, 1993). As a result, more accurate earnings forecasts are more valuable to investors.

Analysts can serve as information intermediaries to enhance the transparency of the company, but they do not have to accept the direct choice of management as auditors, so they are more independent and can play a potential supervisory role over the management (Lang&Miller,2004). Analysts can not only alleviate information asymmetry and convey more useful information to the securities market, but also play a governance role and restrain the company's earnings management behavior(Knyazeva,2007).Therefore, this paper believes that analyst's earnings forecast is binding on the earnings management behavior of the company, and the more accurate analyst's forecast is, the lower the degree of earnings management of the company will be (Yang Yulong, Yu Xiang, 2013). At the same time, the more accurate the analyst's earnings forecast is, the higher the accuracy of the information provided to investors reflecting the intrinsic value of the company will be, so that the private information may be reflected in the stock price more quickly, thus reducing the uncertainty of the asset value and improving the liquidity of the stock. Based on this, this paper proposes hypothesis H2:

H2: *Ceteris paribus*, analysts' prediction can effectively reduce the negative correlation between corporate earnings management and stock liquidity.

### 3 Data and Methodology

#### 3.1 Sample selection and data sources

This paper takes China's a-share listed companies in Shanghai and Shenzhen from 2009 to 2016 as the research sample, and selects them according to the following criteria: (1) the companies with missing relevant data during the research period were excluded; (2) excluding samples from the financial industry; (3) to avoid IPO effect, companies with less than two years of listed years are excluded; Finally, 12,320 sample observations were obtained, all of which were from CSMAR database. In order to eliminate the influence of extreme values, this paper winsorize the continuous variables at the level of 1%.

#### 3.2 Variable measurement

##### 3.2.1 Earnings management

The modified Jones model is the most powerful model for measuring accrual earnings management (Dechow, 1995), so this paper uses the modified Jones model to calculate controllable accruals:

$$TAC_{i,t} = NP_{i,t} - CFO_{i,t} \quad (1)$$

$$\frac{TAC_{i,t}}{TA_{i,t-1}} = a_0 + a_1 * \frac{1}{TA_{i,t-1}} + a_2 * \frac{\Delta REV_{i,t}}{TA_{i,t-1}} + a_3 * \frac{PPE_{i,t}}{TA_{i,t-1}} + \varepsilon_{i,t} \quad (2)$$

$$= a_0 + a_1 * \frac{1}{TA_{i,t-1}} + a_2 * \frac{\frac{NDA_{i,t}}{TA_{i,t-1}} - \Delta REC_{i,t}}{TA_{i,t-1}} + a_3 * \frac{PPE_{i,t}}{TA_{i,t-1}} + \varepsilon_{i,t} \quad (3)$$

$$|DAC_{i,t}| = \left| \frac{DA_{i,t}}{TA_{i,t}} \right| = \frac{TAC_{i,t}}{TA_{i,t-1}} - \frac{NDA_{i,t}}{TA_{i,t-1}} \quad (4)$$

where, total accruals ( $TAC_{i,t}$ ) is the difference between net profit and net cash flow from operating activities, and total accruals can be further divided into non-discretionary accruals ( $NDA_{i,t}$ ) and discretionary accruals ( $DAC_{i,t}$ ).  $TA_{i,t-1}$  is the total assets of company i at the beginning of year t.  $PPE_{i,t}$  is the net fixed asset value of company I at the end of year t;  $\Delta REV_{i,t}$  is the change in operating income of company i in the year i;  $\Delta REC_{i,t}$  is the change in receivables of company i in the year t.

##### 3.2.2 Stock liquidity

Amihud 's illiquidity index accurately measures stock liquidity and the required data is easy to obtain in practice (Goyenko et al., 2009). In this paper, Amihud was used for reference to calculate the illiquidity index as follows:

$$ILLIQ_{i,t} = \frac{1}{D_{i,t}} \sum_{d=1}^{D_{i,t}} \frac{|R_{i,t,d}|}{Vol_{i,t,d}} * 100 \quad (5)$$

where,  $|R_{i,t,d}|$  is the absolute value of the return rate of the ith stock on day d in year t.  $Vol_{i,t,d}$  is the

trading volume of the  $i$ th stock on day  $d$  of year  $t$  (in millions of dollars);  $D_{i,t}$  is the number of trading days of the  $i$ th stock in year  $t$ . This index measures the change of average price caused by the trading volume per unit. The larger the ILLIQ value is, the lower the stock liquidity level will be.

### 3.2.3 Analyst prediction accuracy

Based on the practice (Tang Songlian & Chen Wei, 2017), this paper adopts securities analyst prediction accuracy  $ACC_{i,t}$  for measurement, and the calculation formula is as follows:

$$ACC_{i,t} = \left| \frac{Feps_{i,t} - Reps_{i,t}}{Reps_{i,t}} \right| \quad (6)$$

where,  $ACC_{i,t}$  represents the accuracy of the analyst's earnings per share forecast for company  $i$  in the year  $t$ ;  $Feps_{i,t}$  represents the analyst's predicted earnings per share in company  $i$  in the year  $t$ ;  $Reps_{i,t}$  represents the real value of company  $i$ 's earnings per share in the year  $t$ ; the greater  $ACC_{i,t}$ , the lower the accuracy of the analyst's earnings forecast.

### 3.2.4 Control variables

In addition, in order to consider the influence of other factors on the stock liquidity of the company (Wang Xiaoliang and Yu Jing, 2016), this paper selected the asset-liability ratio, return on equity, growth rate of total assets, shareholding ratio of the largest shareholder and the nature of the company as control variables. The definitions of main research variables and control variables are shown in table 1.

**Table 1 Definitions of Primary Variables**

Variable	Definition
DAC	Absolute value of discretionary accruals, as shown in formula (1).
ILLIQ	Amihud's (2002) illiquidity index is shown in formula (2).
ACC	See formula (3) for the prediction accuracy of securities analysts.
Lev	Long-term debt to total assets.
Roe	Net income scaled by total assets.
Grow	Growth rate of total assets
Top1	The largest shareholder shareholding ratio
State	State-owned enterprises are 1, while private enterprises are 0

### 3.3 Regression model

In order to study the impact of accrual earnings management on stock liquidity, that is, to verify H1, this paper constructs the model (4) as follows:

$$ILLIQ_{i,t} = \alpha_0 + \alpha_1 * DAC_{i,t} + \alpha_2 * Controls_{i,t} + \sum Year + \sum Industry + \varepsilon_{i,t} \quad (4)$$

$$ILLIQ_{i,t} = \alpha_0 + \alpha_1 * DAC_{i,t} + \alpha_2 * ACC_{i,t} + \alpha_3 * DAC_{i,t} * ACC_{i,t} + \alpha_4 * Controls_{i,t} + \sum Year + \sum Industry + \varepsilon_{i,t} \quad (5)$$

Model (4) is used to verify H1. If  $\alpha_1$  is positive, it indicates that accrual earnings management will reduce the stock liquidity of the company; if  $\alpha_1$  is negative, it indicates that accrual earnings management has a promoting effect on the stock liquidity of the company, and the expected test result is positive. Model (5) is used to verify H2. If  $\alpha_3$  is negative, the higher the accuracy of securities analyst's prediction is, the weaker the relationship between the degree of accrued earnings management of listed companies and stock liquidity is. If  $\alpha_3$  is positive, it means that the higher the accuracy of securities analyst's prediction is, the stronger the relationship between the degree of accrued earnings management of listed companies and stock liquidity is, and the expected test result is negative.

## 4 Results

### 4.1 Descriptive statistics

Table 2 provides descriptive statistics for the main variables. It can be seen that the average value of accrued earnings management (DAC) is 0.165, the maximum value is 1.785, and the minimum value is 0.001, indicating that the behavior of accrued earnings management varies greatly among different listed companies in China. The average value of ILLIQ is 0.068, the maximum value is 0.618, and the minimum value is 0.003, indicating that there are differences in stock liquidity among Chinese listed companies. This conclusion is in line with the development status of China's stock market. The mean value of analysts' earnings prediction accuracy is 1.832, the maximum value is 24.080, and the minimum value is 0, indicating that analysts' forecasting behaviors vary greatly among different companies.

**Table 2 Sample Descriptive Statistics**

Variable	N	Mean	Median	SD	Min	Max
ILLIQ	12320	0.068	0.040	0.090	0.003	0.618
DAC	12320	0.165	0.065	0.290	0.001	1.785
ACC	12320	1.832	0.566	3.747	0.000	24.080
Lev	12320	0.476	0.473	0.221	0.054	1.141
Roe	12320	0.068	0.074	0.149	-0.788	0.464
Grow	12320	0.218	0.103	0.544	-0.342	4.274
Top1	12320	35.890	33.760	15.490	8.804	75.780
State	12320	0.462	0.000	0.499	0.000	1.000

## 4.2 Regression analysis

In order to test the influence of accrual earnings management on stock liquidity and verify H1 and H2, this paper conducted a regression analysis on model (4) and model (5). The specific regression results are shown in table 3.

**Table 3 Regression Results**

Var	Model (4)		Model (5)	
	coefficient	t-stat	coefficient	t-stat
DAC	<b>0.054***</b>	19.92	0.057***	18.84
ACC			-0.000	-0.17
DAC*ACC			<b>-0.001**</b>	-2.90
Lev	0.047***	6.54	0.046***	6.42
Roe	-0.023***	-3.78	-0.023***	-3.76
Grow	-0.020***	-13.40	-0.020***	-13.45
Top1	-0.000*	-1.83	-0.000*	-1.87
State	0.005	0.95	0.005	1.01
_cons	0.049***	7.70	0.049***	7.74
<i>Year</i>	control		control	
<i>Industry</i>	control		control	
<i>N</i>	12320		12320	
adj. <i>R</i> <sup>2</sup>	0.0515		0.0519	

\*, \*\*, \*\*\* Indicate significance at 0.10, 0.05, and 0.01, respectively (two-tailed).

It can be seen from table 3 that the regression coefficient of accrual earnings management (DAC) in model (4) is significantly positive at the confidence level of 1%, indicating that the degree of accrual earnings management of listed companies negatively affects the stock liquidity of companies, which is consistent with H1. It can be seen that when the negative effects of earnings management behaviors of China's listed companies are transmitted to the stock market, there will be a signal feedback of stock liquidity reduction.

In the model (5), the regression coefficient of accrual earnings management significantly at the 1% confidence level is positive, analysts predict regression coefficient is negative but not significant, and accrued earnings management and analysts predict accuracy of by item (DAC \* ACC) of the regression coefficient significantly at the 5% confidence level is negative, said analysts predict negative regulation accuracy accrued earnings management and the relationship between the stock liquidity. Explain the



accuracy of analyst earnings forecast the company's earnings management behavior, to a certain extent, reduce the possibility of a management by earnings manipulation, prompted the company to offer investors reflect the company's intrinsic value information to improve accuracy, thus weakened the degree of earnings management negative impact on stock liquidity, consistent with H2.

## 5 Conclusion

This paper examines the relationship between earnings management, analyst forecasts and stock liquidity. The research results show that: (1) earnings management behavior of enterprises will reduce stock liquidity. Earnings management can reduce the value of the enterprise, send a bad signal to investors, will reduce investors' expectations of trading stocks, stock liquidity will naturally reduce. (2) analysts' prediction can effectively reduce the negative correlation between earnings management and stock liquidity. Analyst is not directly involved in the management process of accounting information, but with its own professional financial knowledge, convenient access to information channels and information dissemination channels, through long-term tracking of the listed company business process, management can effectively restrain the improper earnings management and the risk of material misstatement, improve the quality of accounting information.

This empirical result is of great value to both listed companies and investors. First of all, listed companies should be clearly aware that excessive use of earnings management will increase the illiquidity of their stocks and thus increase the cost of equity financing, which is very unfavorable for their refinancing. If listed companies want to obtain low-cost equity financing, they must reduce the level of earnings management. Secondly, relevant departments should continue to strengthen the construction of analyst industry, improve the professional quality and independence of Chinese analysts, and provide more reliable information for investors. Finally, when investors allocate their asset portfolios, they should consider the financial information disclosure of the company. If the company carries out a higher degree of earnings management, it will have a higher degree of information asymmetry, and thus a higher degree of illiquidity and greater risk.

The main prospect of this paper is that stock liquidity is a large indicator of short-term changes, which changes from day to day and even from minute to minute. However, due to the availability of data and other reasons, this paper adopts annual data for research, which will affect the accuracy of the research to a certain extent. In the future, more accurate data can be used for research.

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## Does Cost Stickiness Affect a Company's Financial Risk?

Li Yiwen

School of Management, Wuhan University of Technology, Wuhan, P.R. China, 430070

(Email: 850955998@qq.com)

**Abstract:** Based on the resource-based theory, this paper examined the relationship between cost stickiness and corporate financial risk by taking the a-share manufacturing listed companies in Shanghai and Shenzhen from 2010 to 2017 as samples. The research finds that: the increase of cost stickiness will aggravate the financial risk of the company; Further research shows that the property nature has a moderating effect on the above relations, and the relationship between the two is closer in state-owned enterprises than in non-state-owned enterprises. This result provides a new perspective for the study of the economic consequences of cost stickiness and the influencing factors of corporate financial risk.

**Key words:** Cost stickiness; Financial risk; Ownership; Resource allocation

### 1 Introduction

The development process of an enterprise is a process of dynamic allocation of various production factors and enterprise strategies, and production factors inevitably produce surplus, especially in the case of macroeconomic uncertainty. Based on the resource surplus caused by the change of business volume, foreign scholars put forward the concept of "cost stickiness" (Anderson et al., 2003). From the perspective of cost management, domestic scholars believe that the existence of cost stickiness is an adverse influence. The essence of cost stickiness is the incomplete match between business volume change and resources, that is, the existence of surplus resources. Foreign studies show that surplus resources can promote or inhibit corporate risk (Cheng J C, Kesner I F, 1997). Some scholars believe that the influence of surplus resources on corporate risk is not a simple promotion or inhibition, but a curvilinear relationship exists between them. Then, what role does the cost stickiness with the core content of surplus resources play in the financial risk of enterprises? In recent years, many scholars have studied financial risk and corporate governance environment, internal control management and other aspects (YuFusheng et al., 2008). However, there are not many researches on the influence of cost stickiness on financial risk, and the correlation between cost stickiness and financial risk under the influence of different ownership factors is rarely discussed. Therefore, the impact of cost stickiness on corporate financial risk and the differences among companies with different ownership have become a topic worth discussing. The contribution of this paper is to examine the relationship between cost stickiness and corporate financial risk from the perspective of resource-based theory, and further explore the role of cost stickiness on corporate financial risk under internal

influencing factors based on the ownership. This article has theoretical and practical significance for correctly understanding cost stickiness and enterprise financial resource allocation and reducing enterprise financial risk.

The first part of this paper briefly introduces the research status of cost stickiness and financial risk at home and abroad, leading to the research topic, that is, whether cost stickiness affects the company's financial risk. The second part first introduces the concept of cost stickiness, and then carries on the theoretical analysis to put forward the hypothesis of this paper. The third part takes Chinese listed companies from 2008 to 2015 as samples to empirically test the relationship between cost stickiness and corporate financial risk. The fourth part shows the research results of this paper. The research finds that: the increase of cost stickiness will aggravate the financial risk of enterprises; After further study, it is found that the nature of ownership has a moderating effect on the above relationship, and the relationship between the two is closer in state-owned holding companies than in non-state-owned holding companies. The conclusion is in the fifth part.

## **2 Theoretical Analysis and Research Hypotheses**

### **2.1 Concept of cost stickiness**

Cost behavior is a very important concept in management accounting. It says that changes in firm costs depend on changes in business volume, which are proportionally variable. The traditional cost-state model is proposed in an ideal state, which means that the cost only changes with a fixed proportion of the business volume, and the manager does not need to carry out active cost management. However, studies abroad show that under realistic conditions, the relationship between cost and business volume does not always change proportionally, and the total cost is often related to managerial decision-making. Through the demonstration of cost and business volume, it is found that for every 1% increase in sales revenue, sales management expenses increased by 0.55%; for every 1% decrease in sales revenue, sales management expenses decreased by 0.35% (Anderson et al., 2003). For the first time, it is confirmed that there is an asymmetry change between the company's expenses and the business volume. Quoting the price volatility of economics, the phenomenon of showing "easy to increase and hard to decrease" is called cost stickiness. Once the concept of cost stickiness has been proposed, research on cost stickiness at home and abroad has also grown rapidly. After demonstrating the existence of cost stickiness, domestic and foreign scholars began to conduct more in-depth research on cost stickiness in order to discover the characteristics, causes, impact mechanism and economic consequences of cost stickiness.

### **2.2 Impact of cost stickiness on financial risks of enterprises**

Cost stickiness is inevitable in the resource allocation process of a company, and

resource scheduling is the basic premise of cost stickiness. Domestic and foreign scholars have proved that the imbalance of resource allocation will lead to the emergence of cost stickiness and anti-cost stickiness (James n. Cannon, 2014). Sun Zheng and Liu Hao (2004) summarized the "contract view" when explaining the stickiness of cost, believing that the sustainable operation of a company comes from the stability of contract adjustment cost. The high adjustment cost of long-term contract means that the change in the short term is not enough to prompt the enterprise to make cost adjustment, resulting in the inertia of cost change, so the cost stickiness is reflected in the company's cost change. While cost occupies resources, cost stickiness will bring resistance to the adjustment of cost and make the cost deviate from the optimal resource allocation (Xie Huobao, Hui Lili, 2014). Cost stickiness will lead to the improper allocation of resources, so that resources cannot be efficiently used in projects with core competitiveness, thus affecting the economic interests of the company (Kama I, Weiss D, 2013). Cost of the influence of viscous nature is the enterprise resource allocation. As an important part of internal resources, the optimal allocation of financial resources will also be affected by cost stickiness. For listed manufacturing companies, the input of production resources is relatively large. When the macroeconomic environment changes, the change asymmetry between cost and income will increase, leading to the increase of internal risks (Xie Huobao, Hui Lili, 2017). It also increases the company's financial risk. Based on the above analysis, this paper proposes the following hypotheses:

**H1: Cost stickiness of listed companies is positively correlated with financial risks.**

### **2.3 The influence of ownership on the relationship between cost stickiness and financial risk**

Under China's unique economic environment and institutional background, will the difference in the nature of ownership have a different effect on the stickiness of expenses? Some scholars have conducted relevant researches. Weiss D (2010) believed that for enterprises with different ownership, the stickiness of expenses is different, and the effect of external audit on reducing the stickiness of expenses is also different. To be specific, compared with non-state-owned enterprises, state-owned enterprises have higher stickiness of expenses, and external audit plays a more significant role in reducing the stickiness of expenses. Under the impact of the financial crisis, the cost stickiness of state-owned holding companies increased, while that of non-state-owned holding companies decreased (Balakrishnan R, Gruca T S, 2008). Liang Shangkun (2015) pointed out that the excessive separation of the two rights in China's state-owned listed companies leads to the higher stickiness of expenses in state-owned listed companies than in non-state-owned listed companies. Jiang Wei and Hu Yuming (2011) pointed out that due to the more serious principal-agent problem in state-owned enterprises, their cost stickiness is more likely to be affected by the development level of factor market. Based on this, this paper proposes the following hypotheses:

**H2: The influence of cost stickiness of state-owned enterprises on financial risk is greater than that of non-state-owned enterprises.**

### 3 Research Design

#### 3.1 Sample selection and data sources

This paper takes the a-share manufacturing listed companies in Shanghai and Shenzhen from 2010 to 2017 as the research sample, and selects them according to the following criteria: (1) exclude the companies that are specially treated during the study period; (2) the companies with missing relevant data during the research period are excluded; (3) the samples of IPO year are removed; (4) exclude the data that do not meet the calculation conditions of the model (Sticky calculation requires that the company's revenue and cost change in the same direction in the same year), 15683 sample observations are finally obtained, all the sample data are from the CSMAR database. In order to eliminate the influence of extreme values, winsor processing is carried out on continuous variables at the level of 1%.

#### 3.2 variable definition

##### 3.2.1 Financial risk warning value

In this paper, the enterprise financial risk is calculated with reference to the z-score model proposed by Altman (1968), which uses 22 financial ratios to establish the five-variable z-score after mathematical statistical screening. The specific formula is as follows:

$$Z_{i,t} = 1.2 * X_1 + 1.4 * X_2 + 3.3 * X_3 + 0.6 * X_4 + 0.999 * X_5 \quad (1)$$

In formula (1),  $Z$  represents the financial risk warning value;  $X_1$  = working capital/total assets;  $X_2$  = retained earnings/total assets;  $X_3$  = ebit/total assets;  $X_4$  = Stockholders' equity/total liabilities;  $X_5$  = sales revenue/total assets. When  $Z < 1.8$ , the company is in the bankruptcy zone; When  $1.8 \leq Z < 2.99$ , the company is in the gray area; When  $2.99 \leq Z$ , the company belongs to safe zone. That is, the smaller  $Z$  is, the greater the financial risk of the enterprise is.

##### 3.2.2 Cost stickiness

Dan Weiss (2010) <sup>[9]</sup> proposed the formula (2) when studying the influence of cost stickiness on the earnings forecast of enterprises. This model is suitable for studying the economic consequences of cost stickiness.

$$Sticky_{i,t} = \log \frac{\Delta COST}{\Delta SALE_{i,\mu}} - \log \frac{\Delta COST}{\Delta SALE_{i,\bar{\mu}}} \quad (2)$$

Among them, the Sticky said cost stickiness,  $\mu$  for the recent sales incomes fall in quarterly revenue,  $\bar{\mu}$  as recent sales rise in quarterly revenue.  $\mu, \bar{\mu} \in \{t, \dots, t-3\}$ ,  $\Delta SALE = SALE_{i,t} - SALE_{i,t-1}$ ,  $\Delta COST_{i,t} = (SALE_{i,t} - EARNING_{i,t}) - (SALE_{i,t-1} - EARNING_{i,t-1})$ . When Sticky is negative, it means there is cost stickiness, and the smaller the value, the higher the level of stickiness.

### 3.2.3 Control variables

In order to consider the influence of other factors, this paper draws on the practice of relevant scholars(Liang Shangkun,2017<sup>[13]</sup>) and selects the return on equity (ROE), earnings per share (EPS), growth rate of net assets per share (Pbvg), growth rate of net profits (Netp) and enterprise size (Size) as control variables.

**Table 1 Variable Definition Table**

Variable Symbol	Variable Name	Definition
Z	Financial Risk Warning Value	See formula (1)
Sticky	Cost Stickiness	See formula (2)
Roe	Return on Equity	Net profit/shareholders' equity
EPS	Earnings Per Share	(net income - preferred stock dividends)/weighted average of common stock outstanding
Pbvg	Growth Rate of Net Assets Per Share	Increase of net assets per share this year/net assets per share at the beginning of the year
Netp	Growth Rate of Net Profits	Net profit increase of this year/net profit at the beginning of the year
Size	Enterprise Size	Take the natural logarithm of the company's total assets at the end of the year

### 3.3 Regression model

To verify hypothesis H1, the model (3) constructed in this paper is as follows.

$$Z_{i,t} = \alpha_0 + \alpha_1 Sticky_{i,t} + \alpha_2 ROE_{i,t} + \alpha_3 EPS_{i,t} + \alpha_4 Pbv_{i,t} + \alpha_5 Netp_{i,t} + \alpha_6 Size_{i,t} + \varepsilon_{i,t} \quad (3)$$

In model (3), if  $\alpha_1$  is positive, the existence of cost stickiness will aggravate the company's financial risk. If  $\alpha_1$  is negative, it indicates that the cost stickiness has an inhibitory effect on the company's financial risk, and the expected test result is positive.

In order to verify hypothesis H2, this paper, on the basis of model (3), divides samples into state-owned enterprise group and non-state-owned enterprise group, and then conducts grouping regression. If H2 is to be verified,  $\alpha_1$  of soe group needs to be significantly positive, while  $\alpha_1$  of non-soe group needs to be insignificant.

## 4 Test Results and Analysis

To verify H1 and H2, this paper selected the fixed-effect model for regression analysis based on the results of Hausmann test. The empirical regression results are shown in table 2.

Table 2 Regression Results

Z	Model_1	Ownership	
	(1)	Soe (2)	Non-soe (3)
Sticky	0.157*** (3.55)	0.335*** (7.20)	0.043 (0.61)
Roe	-0.445*** (-3.90)	0.138 (1.17)	-0.742*** (-3.90)
EPS	1.448*** (34.50)	0.982*** (23.93)	1.814*** (25.00)
Pbv	0.134*** (3.83)	-0.0273 (-0.63)	0.212*** (4.21)
Netp	-0.000999 (-0.93)	0.00154 (1.47)	-0.001 (-0.57)
Size	-0.339*** (-16.53)	-0.213*** (-9.07)	-0.554*** (-16.35)
_cons	9.672*** (21.54)	6.561*** (12.53)	14.515*** (19.87)



N	15683	7050	8633
Adjusted R <sup>2</sup>	0.2110	0.1629	0.1722

\*, \*\*, and \*\*\* denote significance at the 10, 5, and 1 percent levels, respectively, in two-tailed tests.

As can be seen from column (1) of table 2, the cost stickiness of an enterprise is significantly positively correlated with the value of financial risk. That is to say, the higher the value of cost stickiness, the higher the value of financial risk. It has been shown above that the smaller the value of cost stickiness, the greater the degree of cost stickiness. The smaller the value of financial risk, the greater the financial risk of the enterprise, so the degree of cost stickiness is positively correlated with the financial risk. Thus, verifying the hypothesis H1 of this paper.

As can be seen from the regression results of column (2) and column (3), in the sample group of state-owned enterprises, the coefficient of cost stickiness is significantly positive at the confidence level of 1%, indicating that state-owned enterprises have a significant positive regulating effect on the relationship between cost stickiness and financial risk. However, in the sample group of non-state-owned enterprises, the coefficient of cost stickiness is not significant, which indicates that the cost stickiness of non-state-owned enterprises has little impact on financial risk. Therefore, the hypothesis H2 in this paper is verified.

## 5 Conclusion

This paper takes the optimization of financial resource allocation as the entry point, discusses the relationship between cost stickiness and corporate financial risk, and further discusses the impact of cost stickiness on corporate financial risk under different property rights. According to the data of China's a-share manufacturing listed companies in Shanghai and Shenzhen from 2010 to 2017, it is found that :(1) there is a significant positive correlation between the cost stickiness and the company's financial risk. (2) further discussion shows that the property right nature of a company has a moderating effect on the relationship between cost stickiness and financial risk. The influence of cost stickiness of state-owned enterprises on financial risk is greater than that of non-state-owned enterprises.

The research conclusion of this paper provides an important reference basis for Chinese enterprises to effectively allocate financial resources: on the one hand, surplus resources have a negative effect, enterprises should keep a low level of cost stickiness according to their situation and current financial risks; On the other hand, Chinese enterprises need to treat cost stickiness according to different property rights. In state-owned enterprises, we should be alert to the increase of cost stickiness, while in non-state-owned enterprises, we can moderately relax the control of cost stickiness.

The contributions of this paper are as follows :(1) the relationship between cost stickiness and enterprise financial risk is studied, which makes up for the gap in relevant

literature and paves the way for future scholars to improve financial risk warning formula; (2) from the perspective of property right nature, the moderating effect of property right nature on cost stickiness and financial risk is studied.

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# The Feasibility Analysis of Popularizing Prefabricated Buildings in the Project of College Student Dormitory

Zheng Feng

Infrastructure Department of Wuhan University of Technology, Wuhan, P. R. China, 430070

(E-mail: 5102265@qq.com)

**Abstract:** Chinese government has been upholding the development of prefabricated buildings. This paper, by analyzing the research and application status at home and abroad, summarized the technical characteristics of prefabricated buildings, and concluded the applicability of prefabricated buildings in the projects of college student dormitory. Besides, based on specific cases, the fuzzy comprehensive evaluation method was used to compare the construction technology with conventional construction technologies. Accordingly, this paper verified the advance and feasibility of prefabricated concrete construction technology and laid a basis for the promotion of prefabricated buildings in the projects of student dormitory.

**Key words:** Feasibility analysis; Prefabricated buildings; Student housing; Fuzzy comprehensive evaluation method

## 1 Introduction

Student dormitory project is vital for college capital construction projects. With the continuous expansion of university scale and the gradual improvement of student accommodation conditions, both the number of students and the index of per student accommodation area have increased remarkably, making the contradiction between supply and demand of student apartments increasingly prominent. Thus, the construction of student dormitory project faces multiple challenges (e.g. large scale, shortened schedule and high standard)<sup>[1]</sup>. At present, the cast-in-situ concrete construction scheme is widely used. Though this technology is mature, problems (e.g. bad qualification of construction enterprises, prolonged construction period and large amount of engineering changes) still occur in the process of project bidding and construction. This significantly affects the security ability of the student dormitory project and does not contribute to the control and management of the construction target of the university.

Prefabricated construction refers to an industrial construction method. According to this method, some or all components of a building are prefabricated in a factory, transported to the project site, and then overlapped and assembled. According to relevant data statistics, adopting prefabricated construction technology is capable of significantly shortening the construction period and improving main performance (e.g. the surface smoothness of concrete building and structural firmness). In the meantime, because the external wall tiles, insulation, doors and windows and other components can be processed as a whole with the concrete wall, the waterproof, heat preservation performance of the building will be better than those of the cast-in-place concrete building<sup>[2]</sup>.

Based on the fuzzy comprehensive evaluation method, this paper compared the cast-in-place concrete construction scheme with the prefabricated concrete construction scheme. Then, the feasibility of the prefabricated construction scheme in the college student dormitory project was analyzed and verified, and some suggestions on the promotion and application were proposed based on the comparison results.

## 2 Features of Prefabricated Technology

### 2.1 Advantages of fabricated technology

Compared with the conventional construction method, the prefabricated construction technology has the following advantages:

#### (1) Short construction period

In the factory, standardized components are prefabricated following standard procedures and then installed in an integrated manner. Thus, a large number of manual operations on the construction site can be converted into production line operations, significantly enhancing production efficiency, reducing the time delay caused by weather, technology and other reasons, and saving the time consumed by cast-in-place. According to the existing research at home and abroad, using prefabricated technology can shorten the construction period by 20%-30%.

#### (2) High engineering quality

The factory and mass production of building components can enhance dimensional accuracy of components and reduce the defects in structural stability, sealing and waterproofing caused by dimensional errors. In the meantime, because exterior wall decoration materials, insulation materials and doors and windows and other attachments can be produced together with wall body, assembly-type technology can to the greatest extent avoid the quality problems (e.g., tile falling off, insulation stripping and leakage of door and window joints) after the project is put into use, thereby improving the project safety, durability and amenity and reducing maintenance costs.

#### (3) Saving energy and protecting environment

In the implementation stage of the project, through component prefabrication, the noise, dust, waste water and other pollutants in the construction process and the nighttime construction workload are greatly reduced. On the other hand, mass production can improve labor productivity, reduce the input of raw materials (e.g. cement and template), and save resources (e.g. labor and materials); Due to the consistent size of prefabricated components, the mass production and prefabrication of furniture can be achieved during the decoration construction to improve the space utilization rate, reduce the waste caused by "secondary decoration" and save the cost of furniture purchase and depreciation<sup>[3]</sup>.

#### (4) High controllability

From the perspective of the owner's project management, prefabricated technology can reduce the time delay and cost changes caused by policy changes, material price changes, technical defects of construction personnel or adverse construction site environment during the construction period; In the meantime, the general contracting mode of integrated design, component production, construction and procurement is adopted in the current implementation of assembly-type projects, thereby raising the technical requirements for general contracting enterprises, and reducing the owner's bidding risk and contract management workload. Thus, it is conducive to achieving project management objectives<sup>[4]</sup>.

#### (5) Strong support from government

With the rapid development of the construction industry, construction technology is also constantly improving and updating. In recent years, the country and provinces and cities have issued relevant opinions and measures in succession, in an attempt to boost the development of prefabricated building and improve the overall level of the construction industry.

In September 2016, the general office of the state council issued and implemented the Guideline on Vigorously Developing Prefabricated Buildings (no. [2016]71). It is stressed that we should, in accordance with the requirements of applicability, economy, safety, green and beauty, press ahead the market leading, government promotion, regional promotion and gradual promotion, adhere to the top-level design and coordinated development, promote the innovation of construction methods, and constantly improve the proportion of prefabricated buildings in new buildings.

From January to March 2017, the ministry of housing and urban-rural development issued national standards, including the Technical Standards for Prefabricated Wooden Structures (GB/T 51233-2016), Technical Standards for Prefabricated Steel Structures (GB/T 51232-2016), Technical Standards for Prefabricated Concrete Buildings (GB/T 51231-2016), and Action Plan for Prefabricated Buildings during the 13th Five-year Plan. The prefabricated building standard system covering the whole process of design, production, construction and use and maintenance has been further improved, and the phased work objectives have been defined.

With the deepening of the deployment of national strategies, various provinces and cities actively uphold and support the development of prefabricated buildings by means of floor area award, capital subsidy, tax preference and interest rate reduction<sup>[5]</sup>.

## **2.2 Defects of assembly technology**

### **(1) Poor flexibility**

Though the industrialized prefabrication of prefabricated buildings enhances production efficiency, it reduces the flexibility and diversity of architectural design, making it difficult to meet the personalized needs of users in building facades, apartment types and other aspects, which is also one of the difficulties facing the promotion process of prefabricated buildings.

### **(2) High construction cost**

The calculation of the cost of completed prefabricated buildings reveals that because the prefabricated technology remains in the early stage of application and development, and there is no reasonable valuation standard for prefabricated buildings in China. At present, the cost of mono-project of most prefabricated building projects is generally higher than that of traditional similar buildings, and the increased cost primarily originates from the prefabrication, transportation and installation of components.

### **(3) Lack of experience**

The development of prefabricated buildings in China lags behind that of Germany, Japan, the United States and other developed countries with a higher degree of industrialization. Various technical standards and management norms are still being established and improved. There is a lack of experience in the design of prefabricated buildings and the production of components. Besides, general contracting enterprises, which can coordinate the implementation of the design, production, construction and installation of prefabricated buildings, are lacked. These factors hinder the overall promotion of prefabricated buildings.

## **3 An Applicability Analysis of Prefabricated Buildings in College Student Dormitory Project**

### **3.1 Structural adaptability**

The structure of the student dormitory project is characterized by simple design and consistent apartment type. The construction area, internal structure, reserved openings, doors and windows, and decoration of each dormitory are exactly the same. Adopting prefabricated technology to the student dormitory project, the lack of flexibility of this technology is circumvented. This accordingly reflects the applicability of assembly technology and student dormitory project in structural design.

### **3.2 Applicability regarding schedule**

Compared with residential and commercial buildings, university infrastructure projects are built on campus. The shorter the construction period, the smaller the study and life of teachers and students will be affected, and the smaller the campus environment and security will be affected; At the same time, due to the expansion of college enrollment and the adjustment of college building area index, most of the current colleges and universities face problems (e.g. poor student accommodation, inadequate accommodation area, and unreasonable allocation of teaching resources). It is urgent to build new student apartments to improve the living environment and re-plan the functions of the campus<sup>[6]</sup>. Adopting the prefabricated technology can significantly expedite the project construction progress and shorten the construction cycle; it is more suitable for the student dormitory project in terms of progress control than the conventional construction method.

### **3.3 Applicability regarding quality**

The quality level of the student dormitory project is linked to the vital interests of every student studying in the university, reflecting the infrastructure management and logistics ability of the university, which has always been highlighted in the university infrastructure work. The construction quality of traditional student dormitory project is primarily determined by the technical level of the successful construction enterprise, and the owner is in a relatively passive position in quality control<sup>[7]</sup>. On the one hand, in the process of public bidding, bidding enterprises may have poor qualification or non-standard bidding behaviors, which may affect the impartiality of construction enterprises. On the other hand, project managers and construction teams selected by successful construction enterprises have various technical levels, affecting the quality of project construction as well. The main components of the prefabricated building are produced in the factory. The manufacturing environment of the components is more standardized than that of the construction site, and it is not easy to be affected by the external environment. Accordingly, the quality of the components is more guaranteed. In the meantime, since most enterprises that can undertake the prefabricated construction projects are large-scale enterprises with leading scale and technology industries, the backward construction technology and enterprises lacking competitiveness are eliminated naturally.

### **3.4 Environment applicability**

The construction of infrastructure projects in colleges and universities will inevitably occupy the public resources (e.g. roads and green spaces), which have been put into use. Adopting assembly-type technology can effectively reduce the noise, dust and other pollution during the construction, and further shorten the time occupied campus resources; At the same time, since the work of external wall decoration, door and window installation, furniture procurement can be advanced to the component manufacturing stage, adopting assembly technology can also reduce the air pollution caused by decoration and installation work, to provide students with a more environmentally friendly and healthy accommodation environment.

### **3.5 Applicability regarding administration**

There are many problems in the management of university capital construction, including heavy

construction task, tight construction period, scattered projects and few management personnel. Adopting the general contracting model of assembly construction integrating design, component manufacturing, construction and procurement can effectively reduce the workload of bidding and contract management of infrastructure management departments and decrease the probability of engineering changes. This can not only reduce the workload of project managers, but also facilitate the control of project management objectives, so that project functions can be better achieved<sup>[8]</sup>.

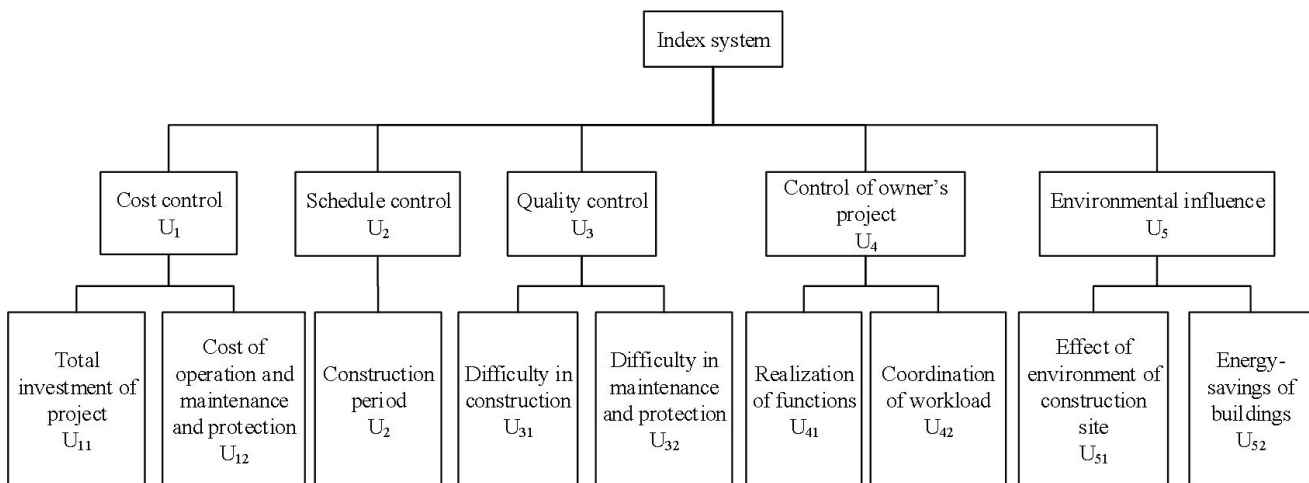
#### 4 A Comparative Analysis of Construction Scheme of Student Dormitory Project Based on Fuzzy Comprehensive Evaluation Method

Through the above analysis, it can be seen that the prefabricated building has strong applicability in the college student dormitory project. To compare the technical and economic benefits of prefabricated buildings and conventional construction schemes more intuitively, this paper examined the feasibility of promoting prefabricated buildings in the projects of student dormitory. This paper took the newly built student dormitory project of a university in Wuhan as an example. The fuzzy comprehensive evaluation model was used to compare the prefabricated concrete with the cast-in-place concrete<sup>[9]</sup>.

The total construction area of a new student dormitory project in a university in Wuhan is 74,684 square meters, including 7 student dormitories with 6 floors, 1,288 planned rooms. Besides, the single building area and indoor structure are basically the same. This paper applies fuzzy comprehensive evaluation method. Twenty judges, including teachers, students and industry experts, were invited to judge the cast-in-situ concrete construction scheme and the prefabricated concrete construction scheme respectively.

##### 4.1 Index selection

According to the characteristics of the student dormitory project, in the selection of indicators, besides considering the three basic objectives of cost, schedule and quality, the project management of the owner and the realization of environmental impact objectives were also emphasized. A target set was created, containing the above 5 items. Subsequently, the index system affecting the realization of the



goal and the evaluation of the scheme was analyzed and established<sup>[10]</sup>.

Figure 1 Establishment of Index System

#### 4.2 Weight definition

The following evaluation results were obtained by calculating the evaluation results of the weight of indicators.

**Table 1 Result of Index Weight Evaluation**

Target Set	Target Weight $A_i$	Factor Set	Factor Weight $A_{ij}$
cost control $U_1$	0.20	Total investment of projects $U_{11}$	0.68
		Cost of operation and maintenance $U_{12}$	0.32
schedule control $U_2$	0.30	construction period	1
quality control $U_3$	0.22	difficulty in construction $U_{31}$	0.64
		difficulty in maintenance and protection $U_{32}$	0.36
control of owner's project $U_4$	0.17	realization of functions $U_{41}$	0.80
		coordination of workload $U_{42}$	0.20
environmental influence $U_5$	0.11	effect of environment of construction site $U_{51}$	0.57
		energy-savings of buildings $U_{52}$	0.43

The target set of the project  $A = \{0.20, 0.30, 0.22, 0.17, 0.11\}$ , where the weight set of the cost control target  $A_1 = \{0.68, 0.32\}$ ; likewise,  $A_2, A_3, A_4$  and  $A_5$  can be yielded.

#### 4.3 Membership calculation

In order to facilitate the evaluation by the judges, this paper divided the 9 evaluation factors into two categories: functional factors and wastage factors. Among them, functional factors include function realization and building energy conservation. The greater the effect of such factors, the better the evaluation will be. The other 7 items are loss factors. The larger the value or effect of such factors is, the worse the evaluation will be. According to the above evaluation methods, the judges evaluated the advantages and disadvantages of each factor of the two technical schemes.



**Table 2 Evaluation Results of the Technical Scheme by the Judges**

Target set	Factor set	Evaluation rating							
		cast-in-situ concrete				Prefabricated concrete			
		Best	Good	Moderate	Worst	Best	Good	Moderate	Worst
cost control U1	Factor set	12	6	2	0	4	9	4	3
	Total investment of projects U <sub>11</sub>	4	8	4	4	6	6	6	2
schedule control U <sub>2</sub>	construction period	1	6	9	4	6	8	4	2
	difficulty in construction U <sub>31</sub>	7	2	5	6	9	5	3	3
quality control U <sub>3</sub>	difficulty in maintenance and protection U <sub>32</sub>	3	4	10	3	8	5	5	1
	realization of functions U <sub>41</sub>	11	4	3	2	10	5	4	1
control of owner's project U <sub>4</sub>	coordination of workload U <sub>42</sub>	2	2	9	7	9	6	3	2
	effect of environment of construction site U <sub>51</sub>	0	3	11	6	13	3	4	0
environmental influence U <sub>5</sub>	energy-savings of buildings U <sub>52</sub>	3	3	6	8	4	9	5	2

According to the evaluation of the factor set by 20 judges, the votes of each grade were summarized to obtain the above evaluation results. Taking the cast-in-place concrete scheme as an

example, the membership matrix of the cost control objective was obtained  $R_1 = \begin{bmatrix} 0.6 & 0.3 & 0.1 & 0.0 \\ 0.2 & 0.4 & 0.2 & 0.2 \end{bmatrix}$ .

Each target membership matrix can be obtained R<sub>2</sub>, R<sub>3</sub>, R<sub>4</sub> and R<sub>5</sub> successively.

#### 4.4 Fuzzy synthetic evaluation model

The fuzzy comprehensive evaluation set of each target  $W_i = A_i \times R_i$ . Then, the objective fuzzy comprehensive evaluation matrix is established.

$$W_{\text{prefabricated}} = \begin{bmatrix} 0.472 & 0.332 & 0.132 & 0.064 \\ 0.050 & 0.300 & 0.450 & 0.200 \\ 0.278 & 0.136 & 0.340 & 0.246 \\ 0.460 & 0.180 & 0.210 & 0.150 \\ 0.065 & 0.150 & 0.442 & 0.343 \end{bmatrix}$$

Likewise, the objective fuzzy comprehensive evaluation matrix of prefabricated concrete scheme can be calculated.

$$W_{\text{prefabricated}} = \begin{pmatrix} 0.232 & 0.402 & 0.232 & 0.134 \\ 0.300 & 0.400 & 0.200 & 0.100 \\ 0.432 & 0.250 & 0.186 & 0.132 \\ 0.490 & 0.260 & 0.190 & 0.060 \\ 0.457 & 0.279 & 0.221 & 0.043 \end{pmatrix}$$

The evaluated results of each target  $B = A \times W$ . The fuzzy comprehensive evaluation results of the two schemes are obtained.

$$B_{\text{cast-in-place}} = \{0.25586, 0.23342, 0.32058, 0.19015\}$$

$$B_{\text{prefabricated}} = \{0.364955, 0.33029, 0.203985, 0.10077\}$$

In order to compare the evaluation results more intuitively, this paper assigned values to the evaluation grades of the judges, and made the excellent, good, medium and poor represent 90, 70, 50 and 30 points, respectively. Assigned matrix  $F = \{90, 70, 50, 30\}^T$ , the quantitative evaluation score of each scheme can be obtained  $S = B \times F$ , Score for in-situ concrete schemes  $S_{\text{prefabricated}} = 61.10$ , prefabricated concrete project scores  $S_{\text{prefabricated}} = 69.19$  (reserve two decimal places),  $S_{\text{cast-in place}} < S_{\text{prefabricated}}$ . In other words, based on the above evaluation and taking into account the project's cost, schedule, quality, owner's project management and environmental impact objectives, the prefabricated concrete scheme has a higher score than the cast-in-place concrete scheme.

## 5 Conclusions

This paper analyzed the feasibility of the prefabricated building in the student dormitory project through the applicability analysis and program comparison, and drew the following conclusions and suggestions

(1) The prefabricated building itself is highly matched with the characteristics of the student dormitory project in terms of structural design, progress control and quality control. The application of the prefabricated construction technology to the student dormitory project can effectively shorten the construction period, improve the construction quality and improve the construction environment<sup>[11]</sup>. At the same time, compared with the traditional cast-in-place concrete construction scheme, the prefabricated construction scheme is more conducive to the university's control of project cost, quality, schedule, owner's project management, environment and other objectives in the case of student dormitory project, and has the feasibility of promotion and application.

(2) In the early stage of the promotion of prefabricated building, there are still some problems, such as high cost, imperfect technical specifications and few construction enterprises with the ability to implement, which restrict the wide application of prefabricated building technology. Component processing enterprises can gradually reduce the unit cost of prefabricated components by innovating process and expanding production scale, and construction enterprises can accelerate the transformation to assembly-type industry by improving technical capacity and changing management mode. The government and the construction industry can also promote the development of prefabricated buildings by issuing incentive policies, implementing standards and other means, and providing cost compensation and technical support for projects adopting prefabricated technologies.

(3) On the basis of prefabricated student dormitory project construction, colleges and universities can also explore the construction mode of integration of decoration and main structure, modularization of interior design and furniture, etc. We should give full play to the knowledge-intensive advantages of institutions of higher learning and strengthen the application of building informatization and industrialization<sup>[12]</sup>. We are required to innovate the design standard, construction specification and project management mode of prefabricated buildings, and build a number of demonstration projects with advanced management and advanced technology.

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# Optimization Design of Wuhan Riverside Landscape Regulatory Plan

Peng Yuhao

Wuhan University of Technology, Wuhan, P.R.China,430070

(E-mail: 1138362753@qq.com)

**Abstract:** Rapid urbanization and industrialization have caused serious damage to the natural ecological environment, and people attach great importance to the optimization design of Wuhan riverside landscape regulatory plan. At the same time, the rapid development of city also highlights the ecological, economic and cultural sustainability issues of Wuhan riverside landscape regulatory plan. In this context, under the guidance of sustainable development theory, this paper conducts research on optimization design of Wuhan riverside landscape regulatory plan. By analyzing the current status of existing riverside landscape facilities, this paper summarizes three riverside landscape regulatory plan management strategies from adaptive design and development, appropriate intervention and coordination, cultural inheritance and protection. Based on the management strategies of sustainable development of riverside landscape, the optimization design of Wuhan riverside landscape regulatory plan is explored from five aspects: landscape axis combing, landscape node integration, landscape facade planning, green landscape implantation and service landscape setting.

**Key words:** Regulatory plan; Optimization design; Management strategy; Riverside landscape

## 1 Introduction

Optimization design of regulatory plan is an important part of urban riverside landscape design. In the 1950s and 1960s, western developed countries began to redevelop the riverside space. At that time, many optimization design of riverside landscape were born.<sup>75</sup>After that, Canada, Japan, and the United States began to research systematic management of riverside design, and deepened relevant<sup>76</sup>theories from the material, economic, and social levels. In the 21st century, riverside design management began to focus on the ecological environment. With the practice of China's sustainable development theory, the optimization design of riverside landscape regulatory plan has gradually received attention. At the ecological level, the optimization design of riverside landscape regulatory plan enables people to live in harmony with the environment; at the economic level, the optimization design of riverside landscape regulatory plan covers high-quality commercial resources and cultural connotations; at the social level, the optimization design of riverside landscape regulatory plan can enhance the livability of the city to provide space for various social activities.

The riverside landscapes in American are mostly distributed in the economically developed areas of the rivers and estuaries. The riverside landscape has many nodes and the landscape layout is compact.

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<sup>75</sup>Breen A. and Rigby D. 1996

<sup>76</sup>Ali Madanipour. 1996

The design focuses on optimizing the daily activities and public gatherings of the citizens. The riverside landscape in Europe are mostly distributed on both sides of the alluvial plains of the rivers. The terrain is wide and the riverside has a long history. The design emphasizes the urban characteristics and emphasizes the harmonious coexistence between man and nature. The riverside landscape of Japan and South Korea are mostly located in large-scale cities with dense populations. The water body spans narrowly, and the design focuses on enriching people's waterfront leisure activities. Although China's riverside landscape design started late, after the Economic Reform and Open Up, relevant research results have developed rapidly. The related design of China's riverside landscape has a strong tendency, focusing on commercial development and the driving role of the surrounding service industry, but lack of ecological The overall consideration of the environment and the riverside green belt. The theory of sustainable development requires that the natural environment, social history, and human activities be organically integrated in the optimization design of riverside landscape regulatory plan. The regulatory plan design of the riverside landscape must take into account the ecological effects, aesthetic effects, commercial effects, and the sustainability of social effects so as to let people, city and natural environment live in harmony.

## **2 Issues of Wuhan Riverside Landscape Regulatory Plan**

However, Wuhan City, which is located in the middle of the Yangtze River, started late in the urban riverside landscape regulatory plan. In the initial construction of the city, the importance of the development and construction of the riverside landscape were not fully understood, and there was no professional design management theory guidance, the construction conditions were also not complete enough. The riverside landscape design in Wuhan is more likely to ignore the connection between the historical context of the city and the river without comprehensive consideration of the natural environment, which is also the shortcoming in the regulatory plan of the riverside landscape in Wuhan. In today's Wuhan riverside landscape regulatory plan, on the one hand, the problems of paying much attention to economy and exploitation while ignoring ecology and protection in urban construction are ubiquitous, which make the natural environment and regional context of Wuhan riverside landscape greatly damaged. Moreover, the riverside landscape once became the gray area in the city. On the other hand, the old riverside landscape facilities can no longer meet the needs of the increasingly demand of residents. Many of the existing facilities are overloaded and suffer serious losses. In the face of the unreasonableness of the original design, it is necessary to rethink the Wuhan riverside landscape and regulatory plan optimization design issues.

Wuhan Riverside landscape is relatively simple, with no change and depth, and the overall sustainability is not strong. The existing design focuses on flood protection and practical functions, making the near water area less aesthetic sense. Wuhan is hot in summer, with strong sunshine intensity and long time. The lack of shade facilities in the riverside landscape makes the use in summer is low and lacks rationality. Fitness facilities are located in open areas and lack maintenance, resulting in higher scrap rates. The landscape type of riverside landscape in Wuhan is relatively simple, and the utilization of aquatic plants is lacking in the greening of landscape vegetation, resulting in a large number of near-water wetlands being wasted. Grassland and shrub vegetation are less, and rainwater flows directly into the Yangtze River along the slope, lacking natural infiltration and filtration purification. Wuhan existing riverside landscape has problems such as unreasonable landscape configuration, single landscape function, less recreational facilities, and space planning that do not meet the needs of use. Optimization design of riverside landscape regulatory plan improves urban ecology through landscape vegetation and greening, supporting the construction of service-oriented landscape facilities, enriching the way of life and leisure of citizens, rationally planning the layout of the space, highlighting the characteristics of the

urban landscape, and ultimately aiming at designing the urban riverside landscape that in line with the slogan “Core City of the Yangtze River Economic Belt and the Central City of Wuhan”.

### 3 Current Situation Analysis of Wuhan Riverside Landscape Regulatory Plan

First of all, the adaptive design of the riverside landscape functional configuration is one of the important management strategy of riverside landscape regulatory plan. The landscape regulatory plan of riverside area does not adapt to the development of the city, which will inevitably lead to chaos and disorder in the area and natural coordination is harder to talk about.<sup>77</sup>The original riverside landscape design lacks a unified plan for the green landscape. The riverside landscape has a rigid slope protection, and the space lacks change and flexibility, resulting in the overall function that not adapting well to the development of the city. Some repetitive and underlying industries occupy good resources in the riverside area. The riverside area is mixed, messy without overall coordination, and the characteristics of the riverside landscape are gradually disappearing. Wuhan riverside landscape regulatory plan should move towards an adaptive design management model of “coordination between people and nature”. It is the key direction of Wuhan riverside landscape regulatory plan optimization design.

Secondly, the rational allocation of land resources in the riverside landscape also faces many problems, and the government is in urgent need of appropriate intervention and coordination. It is necessary to follow the management strategy of appropriate intervention and coordination so as to protect the natural landscape of riverside district and control the commercial development of land.<sup>78</sup>At the same time, the excessive density of industrial land and civil buildings has led to an extremely scarce open space such as riverside square and landscape greening, and the imbalance in spatial scale is very serious. Therefore, in order to realize the harmony of Wuhan riverside landscape between people and nature, it is necessary to coordinate and intervene in urban construction activities and protect natural resources through government intervention, and adopt a compact and efficient land use model for land resource management strategy in riverside district.

Optimization design of Wuhan riverside landscape regulatory plan emphasizes the management strategy of cultural inheritance and protection of urban cultural background. The riverside landscape in Wuhan has a long history. It blends the architectural styles and landscapes of various countries during the old lease period, reflecting the wisdom of Wuhan people. Today's Wuhan riverside landscape develops rapidly, while the riverside landscape design management does not show the traditional Wuhan riverside culture. Many designs are pursuing modernization, seeking new forms of landscape expression while ignoring local differences, which lead to the lack of using traditionally excellent landscapes. Today's landscape construction design cannot adopt the extensive mode of “large-scale demolition and construction”. The riverside landscape should be updated and replaced step by step, respecting the urban memories, the urban environment, the local spirit. The specific performance is highlighted by the characteristics of the human environment, the functional replacement of buildings, the expression of design forms, and the application of appropriate techniques and measures.<sup>79</sup>

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<sup>77</sup>Breen A, Rigby D. 1996

<sup>78</sup>Nickels G. 2002

<sup>79</sup>St-Denis Benard and Jacobs Peter.2005

#### **4 Optimization Design Methods of Wuhan Riverside Landscape Regulatory Plan**

To create comfortable and livable environment under people-oriented concept is an important method to achieve the Wuhan riverside landscape regulatory plan. In the optimization design of Wuhan riverside landscape regulatory plan, only focusing on economic development will lead to a decline in the ecological vitality of the riverside region. To fully exert the economic potential and human settlement value of the riverside region, it is necessary to create comfortable and livable environment under people-oriented concept. In the “Blue Ribbon Network” of the Thames in London, the government advocates protective restoration and constructive renovation of the water system, adding greening, shops and sightseeing facilities on both sides of the Thames, and actively organizing social activities to enhance the vitality of the city and highlight the livable characteristic. The city's riverside area has a long history of development, various social ecology, diverse living content and scenes are part of the characteristics and charm of the city's riverside region. The urban riverside area has a complex composition of migrant workers, as well as indigenous people and new citizens in the old city. They are responsible for social relations and diverse living needs. Optimization design of regulatory plan should improve the infrastructure and facilitate the diversification of Wuhan riverside landscape regulatory plan through the method of livable transformation.

Optimization design of Wuhan riverside landscape regulatory plan should rely on ecological regulation and various methods to shape the characteristics of Wuhan riverside landscape, form a distinctive landscape different from other regions, and then combine with the artificial landscape to form an overall riverside ecological landscape. Ecological regulation can be understood as the protection and restoration of the ecology, combined with the local climate, vegetation, hydrology characteristics and etc., showing their ability to highlight the characteristics and individuality of the landscape as a whole ecological balance and stability. For example, in the near-water environment of the riverside landscape, the landscape vegetation enhances the penetration of groundwater and strengthens the natural purification ability of the water flow. At the same time, it can promote the ecological restoration ability of the riverside landscape and achieve self-regulation. A good riverside landscape ecology can promote the integration of city and nature. Paying attention to protecting, repairing and reshaping the natural ecological environment such as water bodies and vegetation in the riverside area, and recreating the ecological regulation and vitality of the riverside interface has become the top priority of urban riverside landscape design.

According to the traditional urban characteristics of Wuhan riverside district, optimizing and protecting the historical context of riverside, adopting the humanistic linkage design methods is the key to realize the optimization design of Wuhan riverside landscape regulatory plan. People form an abstract subjective feeling through various elements and contents in the landscape, such as regions, roads, borders, nodes, markers, reflecting the linkage process between landscape and people. Take the Royal Theatre in Copenhagen, Denmark as the example, the port was an important naval base during World War II and the riverside landscape has a long history. Under the condition of changing the landscape axis of the original Royal Opera House, new buildings are laid out, forming new and old echoes. In the process of transformation, humanities linkages will be realized, highlighting public services and regional cultural characteristics. The road arrangement and architectural pattern of Wuhan City are closely related to the Yangtze River and have a strong riverside landscape. Landscape elements such as bridges, piers and old leased buildings form a riverside landscape with humanistic features. In the process of riverside landscape renewal in Wuhan, the humanistic linkage method was adopted to show the urban humanities in Wuhan, emphasizing the characteristics of the riverside landscape, and vividly presenting the historical accumulation and cultural connotation of urban development.

## **5 Optimization Design Practice of Wuhan Riverside Landscape Regulatory Plan**

The main axis is the spatial link of the entire riverside landscape, which plays the role of combing the interior space of the landscape and conveying the flow of people. Optimization design of Wuhan riverside landscape regulatory plan, it is necessary to analyze the current situation of landscape use and decide what design form to adopt. When conducting the main landscape axis combing, it is necessary to fully consider the traffic flow elements. In the design, we must first ensure the accessibility of the walking system, and implement the diversion of people and vehicles to reduce mutual interference between tourists and motor vehicles or non-motor vehicles. When designing, try to ensure that the main road is smooth and convenient for people with disabilities. The boundaries of the road are indicated by changes in the paving. In addition, it is necessary to set up rest facilities such as seats along the axis of the landscape, which can weaken the flow speed of the tourists in the linear space and enable the tourists to continue to play after a short stay.

The Wuhan riverside landscape has a mature and perfect human landscape. It promotes the development of the surrounding commercial service industry through high-quality human landscapes, and the focus of sustainable development of Wuhan riverside landscape design management. Through optimization design of Wuhan riverside landscape regulatory plan, the landscape nodes in the entire riverside landscape are evenly distributed, the utilization rate of the riverside landscape in different time periods is improved, and the flow of personnel in various regions is promoted. The Wuhan riverside landscape regulatory plan enhances the leisure service capacity of the Wuhan riverside landscape by adding convenience service facilities, riverside cultural districts, consumer dining venues, and leisure sports venues.

Due to the lack of maintenance and extensive management, the Wuhan riverside landscape has undergone many alterations, expansions, constructions, and renovations, resulting in different styles of the facades. The riverside landscape facade with landscapes, shops and docks has gradually formed, and some landscapes have even been partially deformed and damaged. It has reached the point where repairs must be rectified and redesigned. Optimization design of Wuhan riverside landscape regulatory plan combines the architectural style and color of the riverside facade with the landscape greening and lighting effects, and combines with the city skyline of riverside to become a beautiful riverside landscape. The design of the riverside facade needs to consider the unification of the landscape facilities with the surrounding buildings and natural topography. The boundary between the buildings and the natural topography in the landscape view is the background of the riverside facade. Therefore, in order to make the riverside landscape facade cooperate with the surrounding buildings and topography, it must be integrated with the natural boundary line, and attention should be paid to the change of elevation and distance.

Optimization design of Wuhan riverside landscape regulatory plan highlights the interaction between people and nature, enabling citizens and tourists to fully appreciate nature during leisure visits. Vegetation is the ecological basis in the design of waterfront landscapes, including herbs, shrubs and various large and small trees. The implantation of interactive landscape can be roughly divided into revetment landscape implantation, platform landscape implantation and green lane landscape implantation. Most of the revetment landscapes are near water areas. Considering the tidal fluctuations, most of them are aquatic plants. The green vegetation can be planted with reeds and other plants for easy maintenance. Most of the green lane plants are mainly herbaceous plants and shrub plants. Through the landscaping, they will guide the flow of people and beautify the environment without affecting the sight of the tour.

The landscape service facilities mainly include the functions of rest, protection and display, such as



fences, seats, signs, garbage bins, etc. They not only provide practical functions and values such as rest and protection, but also embellish the landscape, render the atmosphere, and beautify the role of the environment. The so-called pleasantness of the landscape is that the scale of the landscape is within the scope of the human senses. At the same time, the humanized barrier-free design is equally important for the optimization design of Wuhan riverside landscape regulatory plan. Therefore, it is necessary to consider the basic considerations of many aspects such as the configuration and size of the landscape facilities.

## **6 Optimization Evaluation of Wuhan Riverside Landscape design**

The functionality of the riverside landscape reflects the role of landscape optimization design in sustainable theory. Compared with the landscape itself, the function needs to change rapidly from time to time, so the sustainability of service functions is particularly important. Riverside scenery will inevitably lead to the function that does not meet the needs of people's life because of the changes of the times. This requires that the design of the riverside landscape needs to consider the functional status of its service facilities. The evaluation of landscape quality is based on three types of data: service type, service intensity and service area. When the service area of the landscape is larger, it can be considered that it can carry more users, and its functionality is better. Service intensity refers to the frequency of use within a certain service time. The higher the frequency used, the better the functionality of the landscape. If the variety of services that a landscape can provide is diverse, the more types of visitors the landscape can attract, the better the functionality.

Starting from the establishment of the relationship between people and nature, the degree of pleasantness of the landscape is an important factor in the sustainable riverside landscape optimization design. By observing people's participation in the riverside activities, it can directly reflect the livability of the riverside region and the pleasantness of the landscape. It determines the quality of the riverside landscape optimization design. The evaluation of the landscape's pleasantness includes six main indicators: the number of tourists, road conditions, vegetation coverage, number of service facilities, public space and safety. The six indicators were scored and the rankings were evaluated by the scores. The greater the number of visitors to the landscape, the more people are covered by the landscape, the more livable it is. The better the road conditions, the better the accessibility of the landscape. The higher the vegetation coverage, the higher the environmental quality from the side. The greater the number of service facilities, the larger the area of public space, the more people can be accommodated. The higher the security, the better the protection of the people in use.

The relationship between human activities and natural landscapes is interdependent with common evolution and symbiosis coordination, which is the fundamental reason why the riverside landscape can flourish. It reflects that the riverside landscape optimization design cannot be separated from human activities. The evaluation of landscape sustainability includes four main aspects: the type of flora and fauna of the landscape, the proportion of the original flora and fauna, the adaptability of the artificial landscape and the natural landscape, the self-purification of the landscape and the waste treatment capacity. The more types of flora and fauna in the landscape, the stronger the risk resistance to the natural environment. The higher the ratio of the original flora and fauna, the stronger the continuity of the landscape. The better the adaptability of artificial landscapes and natural landscapes, the smaller the impact of artificial landscapes on natural landscapes. The more self-cleaning and waste treatment capacity of the landscape, the better the landscape ecological cycle.

## 7 Conclusion

The original Wuhan riverside landscape is worthy of affirmation and learning for the improvement of urban infrastructure. However, due to the lack of consideration of regulatory plan design in early urban development, the landscape style of Wuhan riverside is relatively unchanged, the layout of landscape facilities is unreasonable, the elevation level of the riverside is monotonous and short of alterations and the overall landscape lacks recognition. It can be said that Wuhan riverside landscape design has great potential for development. In order to achieve healthy and sustainable development of Wuhan riverside landscape control planning and design, more attention should be paid to the designer as an intermediary, the transformation and innovation of Wuhan riverside landscape should be realized by designers' professional knowledge.

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## **The Analysis of Effectiveness of Cost Control Strategy on the Profitability of Coca-Cola Company from 2015 to 2017**

Xiao Zhiqi, Zhang Jingxian

School of International Education, Wuhan University of Technology, Wuhan, Hubei, P.R. China,  
430070

(Email: 2143898477@qq.com, zhangjx@whut.edu.cn)

**Abstract:** This paper is aiming to evaluate the effect of cost control strategy on the profitability of Coca-Cola Company from year 2015 to 2017 by using the ratio analysis and offer essential recommendations for the company. This paper is divided into three parts. First part is to introduce the current business operation activities and basic background information. This paper adopts desk research as data collection method. The major sources of information are the annual report of Coca-Cola Company, the database of World Health Organization and other scholastic websites such as Wan Fang Database. Second, financial statements analysis and profitability analysis. This part contains three data analysis methods that are horizontal analysis and ratio analysis. Third part is the conclusion which is from year 2015 to 2017, Coca-Cola Company has strengthened its profitability through cost control strategy but there are fatal hazards in the profitability of Coca-Cola Company that is the worse utilization of its assets to generate profit and dispute with IRS. The recommendations are also provided based on the conclusion which could be referenced by other companies to some extent.

**Key words:** Horizontal Analysis; Ratio Analysis; Profitability Ratio; Financial Statement Analysis; Coca-Cola Company

### **1 Introduction**

Although Coca-Cola Company is the world's largest beverage company who owns and markets four of the world's top five non-alcoholic sparkling soft drink brands and was recognized as the number one global brand in 2010; however, as the awaken of people's awareness toward healthy diet, the soft-drink industry is facing a great recession, which has caused the revenue of Coca-Cola Company to decrease consecutively since 2015. According to the annual reports of Coca-Cola Company, the net operating revenue for Coca-Cola Company in 2015 amounted to about \$44,294 million; however, in 2017, the Coca-Cola Company's net operating revenues worldwide amounted to about \$35,410 million. The continuous decrease in revenue, as well as the market share and profits took a hit on the financial position of Coca-Cola Company. Therefore, it is crucial to analyze the financial report of Coca-Cola Company to detect the reasons for the recessions, moreover, to propose appropriate remedies or recommendations for its financial risks, in order to regain its financial stronghold and business success.

In 20<sup>th</sup> century, as the development of second Industrial Revolution, the owners' right and the management right has been separated, which lead the stakeholders to concern the profitability of their companies. The growing concerns of the profitability has led the study of profitability analysis to begin and develop rapidly. Charumathi has proved that the main factors of the profitability are the asset scale, management effectiveness and the loss ratio (Charumathi, 2012). Bisbe and Malagueno has also detected that the effectiveness of the cost management is the most important factor to influence the

change in profitability of a company (Bisbe and Malagueno, 2012).

Through studying the dissertation of the foreign and domestic scholars, the system of profitability analysis is fully fledged. Wang has created a comprehensive profitability analysis system by dividing the measurement standard into the gross profit analysis and the quality analysis of profitability analysis (Wang, 2006); Zhang has combined the gross profit analysis and the cash flow analysis with the profitability analysis as the standard to measure the profitability (Zhang, 2007). Meanwhile, Huang has proved that the gross profit ratio and loss ratio could also be the standard to measure the profitability of a company (Huang, 2013).

## **2 Financial Statement Analysis**

### **2.1 Method data collection and analysis**

This paper has adopted desk research to obtain secondary sources of data. In order to obtain reliable and verifiable financial data, the most frequent used secondary source of data is annual reports on the official website of Coca-Cola Company. Scholastic databases including China National Knowledge Infrastructure, Wanfang Database, and Google Scholar are used to attain data that might contribute to gain a better understanding of the financial position and business operation of Coca-Cola Company. Papers published by professional analysts that related to the financial aspect are used as secondary sources of data as well. The data gained from secondary resource provides annual financial reports of Coca-Cola Company in last three years and the recent finance and investment activities it engaged in. It demonstrates the financial position and business operation strategy of Coca-Cola Company from 2015 to 2017.

The main financial data analysis tools adopted in this paper are horizontal analysis and ratio analysis. Horizontal analysis is used to compare the historical data over a number of accounting periods that presents the changes in the amounts of corresponding financial statement account over a period of time, which is useful to determine trends of change for Coca-Cola Company from year 2015 to 2017 and future trends of change in financial position for Coca-Cola Company. Ratio analysis is a quantitative analysis used to obtain indications of a firm's financial performance in critical accounting areas (Goel, 2015). Profitability ratios are essential tools to evaluate the profitability of Coca-Cola Company through year 2015 to 2017. Profitability ratio involves gross profit ratio and operating profit ratio that measures and evaluates the ability of Coca-Cola Company to generate profit relative to revenue, which is more meaningful than just comparing the revenue or profit generated by Coca-Cola Company, since it presents how well Coca-Cola Company utilizes its assets to generate profit with concerns of cost of sales and other costs.

### **2.2 Horizontal analysis**

In the Income Statement, there are some changes in the accounts from 2015 to 2017 that should be noticed. As shown in the Table 1, from 2015 to 2017, both Net Operating Revenue, Cost of Goods Sold, Gross Profit, Operating Expenses and Operating Income have decreased continuously; moreover, both accounts have worsened more seriously in 2017 than 2016. Net Operating Revenue has decreased by 5% and 15%. Cost of Goods Sold has decreased by 6% and 19%. As a result of decrease in the Net Operating Revenue, Gross Profit has decreased by 5% and 13% respectively. The Operating Expenses has decreased by 9.27% and 8.74%. As a result of decrease in Gross Profit and Operating Expenses, Operating Income has decreased by 1% and 13% respectively. The Interest Cost for Coca-Cola Company has decreased by 14% from 2015 to 2016, however, it has increased by 15% in 2017. The consecutive decreases of Gross Profit and the Operating Income are due to the large decrease in Net Operating Revenue by 5% and 15% respectively. The reasons given for the consecutively decreases in 2017 Coca-Cola Company Annual Report are "currency fluctuation and acquisitions and divestitures". It

specifies that the currency fluctuation is responsible for 1% decrease in Net Operating Revenue in 2017 and 3% decrease in 2016. This means that the 2% decrease in 2016 and 14% decrease in 2017 are due to the acquisition and divestitures. The reason for the decrease in the acquisition and divestitures in 2017 is due to the deconsolidated of German bottling operations in December 31, 2016. The end of partnership with German bottling operations greatly decreases the revenue of acquisition and divestitures for Coca-Cola Company. Another reason for the decrease in the Net Operating Revenue in 2017 is an article of World Health Organizations (WHO) named 'Effect of Nutrition in Coke to Diabetes in Ecuador' that disclosed the unhealthiness of Coca-Cola Company which raised widely concern toward sparkling soft-drinks.

**Table 1 Main Financial Data in Consolidated Statements for Coca-Cola Company.**

<i>(Amounts in millions, except per share data)</i>	Fiscal Years Ended January 31,		
	2017	2016	2015
Net Operating Revenue	\$35,410	\$41,863	\$44,294
Cost of Goods Sold	13,256	16,465	17,482
Operating expenses	14,653	16,772	18,084
Gross Profit	22,154	25,398	26,812
Operating income	7,501	8,626	8,728
Cash and Cash Equivalents	6,006	8,555	7,309
Trade Account Receivables	3,667	3,856	3,941
Short-term Investments	9,352	9,595	8,322
Asset Held for Sale-Discontinued Operations	7,329	-	-
Total Asset	87,896	87,270	89,996
Total Current Liabilities	27,194	26,532	26,929

*Source: Data comes from Consolidated Financial Statements for Coca-Cola Company, from 2015 to 2017.*

There are some alternations in the Statement of Financial Position that has led to changes in the financial position of Coca-Cola Company. Referring to the Table 1, Cash and Cash Equivalents in 2017 is 30% less than 2016, but 13% more than 2015. From 2015 to 2017, the Short-term Investments increased by 15% in 2016, however, it decreased by 3% in 2017. The Trade Account Receivables from 2015 to 2017 has decreased consecutively by 2%, and 5% respectively. The Marketable Securities decreased by 5% in 2016, however, it increased by 31% in 2017. As a result, the Total Assets decreased by 3.12% in 2016, but increased by 0.71% in 2017. Total Current Liabilities decreased by 1.50% in 2016 and increased by 2.43% in 2017.

### **3 Implications for Profitability Ratio Analysis**

#### **3.1 Profitability ratios**

Profitability ratios are a class of financial metrics to assess a business's ability to generate earnings

relative to its associated expenses by means of a series of ratios (Williams and Carcello, 2008). The data and calculation of profitability ratios are presented numerically in table 2 and graphically in figure 1.

### 3.2 Gross profit ratio

Gross profit ratio is a profitability ratio that shows the relationship between gross profit and total net revenue. It is used to evaluate the operational performance of the business. The ratio is computed by dividing the gross profit figure by net revenue (Groppelli, 2006). The Gross Profit Ratios of Coca-Cola Company in 2015, 2016 and 2017 are shown in Table 2 and their trend is shown in figure 1.

From 2015 to 2017, the trend for the Gross Profit Ratio has been steady with a slight increase. In 2016, the Gross Profit Ratio has increased by 0.14%, which is due to the decrease in both cost of sales and net revenue. As a result of the deduction of \$1,017 million in cost of sales and deduction of \$2,431 million in revenue, the decrease in gross profit of \$1,414 million has been outweighed. In 2017, the increase of 1.89% in the Gross Profit Ratio is due to the same reason. Although the gross profit in 2017 is \$3,244 million less than it is in 2016, the reduction of \$3,209 million in cost of sales and reduction of \$6,453 million in revenue ensures the elevation in Gross Profit Ratio.

Based on the 2016 annual report and 2017 annual report of the Coca-Cola Company, the result of the decrease in net revenue is due to the global arising of concerns on the health issues and the deconsolidated of German bottling operations in December 31, 2016. In 2016, the partnership between Coca-Cola Company and its German bottling operations has been terminated, which caused the revenue that generated from bottling business to decrease and the consolidated revenue to decline by \$2,431 million. Moreover, in 2017, the World Health Organizations (WHO) has published an article written by nutrition specialists that indicates the ingredient of Coke produced by Coca-Cola Company could largely increase the possibility of diabetes (Carpio et al, 2017). Although Coca-Cola Company has responded to adapt the recommendations by WHO, it still suffered a decrease of \$6,453 million in revenue and a decrease of \$3,244 million in profit. However, Coca-Cola is able to reduce its manufacturing cost and material cost in both 2016 and 2017. There are main reasons for the decrease in cost of goods sold that are currency fluctuation and backward integration. In 2016, the currency fluctuation has led a 2 percent decrease in the cost of goods sold for Coca-Cola Company and 1 percent decrease in 2017. Another important factor is the backward integration strategy adopted by Coca-Cola Company. The divestitures of Coca-Cola Company such as bottling company saved the distribution and production cost greatly that allows it to reduce cost of sales by \$1,017 million in 2016 and \$3,209 million in 2017, which elevate the Gross Profit Ratio consecutively.

### 3.3 Operating profit ratio

Operating profit ratio calculates the percentage of profit a company produces from its operations, prior to subtracting taxes and interest charges. It is calculated by dividing the operating profit by total revenue and expressed as a percentage (Pizzey, 2001). The Operating Profit Ratios for Coca-Cola Company from year 2015 to 2017 are shown in Table 2 and the graph of the trend is shown in figure 1.

From 2015 to 2017, the trend for operating profit ratio is increasing steadily and slowly. The Operating Profit Ratio has increased by 0.91% due to the decrease in the operating cost of \$1,312 million and the decrease in revenue of \$2,431 million which outweighed the decrease in operating profit of \$102 million. Although the operating profit in 2017 is \$1,125 million less than it is in 2016, the reduction of \$2,119 million in operating costs and reduction of \$6,453 million in revenue ensures the elevation in Operating Profit Ratio. The increase of 0.57% in the Operating Profit Ratio is due to the decrease in operating

costs.

According to the 2016 annual report and 2017 annual report of Coca-Cola Company, operating costs include the selling costs, general costs, administrative costs and other operating costs. The decrease in the operating cost is due to the large reduction in advertising costs and shipping and handling costs. In 2016, the divestitures of Coca-Cola Company have saved \$1,312 million for Coca-Cola Company which is benefited from the back-ward integration strategy. In 2017, Coca-Cola Company adopts strategy that allocates estimated full year marketing expenditures that benefit multiple interim periods to each of our interim reporting periods, then use the proportion of each interim period's actual unit case volume to the estimated full year unit case volume as the basis for the allocation. This methodology results in its marketing expenditures being recognized at a standard rate per unit case. As a result, the marketing costs reduced by \$627million. The backward integration strategy also benefits the reduction of shipping and handling Costs for Coca-Cola Company. The holding distribution companies and distribution partners reduced the distribution costs by \$0.9 billion in 2017, which elevates the Operating Profit Ratio by 0.57%.

**Table 2 Profitability Ratio for Coca-Cola Company**

	Fiscal Years Ended January 31		
<i>(Amounts in millions, except per share data)</i>	2017	2016	2015
Gross Profit	\$22,154	\$25,398	\$26,812
Net Operating Revenue	35,410	41,863	44,294
<b>Gross Profit Ratio</b>	62.56%	60.67%	60.53%
Operating profit	7,501	8,626	8,728
Net Operating Revenue	35,410	41,863	44,294
<b>Operating Profit Ratio</b>	21.18%	20.61%	19.70%
Operating Profit	7,501	8,626	8,728
Employed Capital	60,702	60,738	63,067
<b>Return on Capital Employed</b>	12.36%	14.20%	13.84%
Net Income Attributable to Shareowners	1,248	6,527	7,351
Number of Ordinary Share	4,303	4,322	4,350
<b>Earnings per Share</b>	\$0.29	\$1.51	\$1.69

*Source: Data comes from Consolidated Financial Statements for Coca-Cola Company, from 2015 to 2017.*

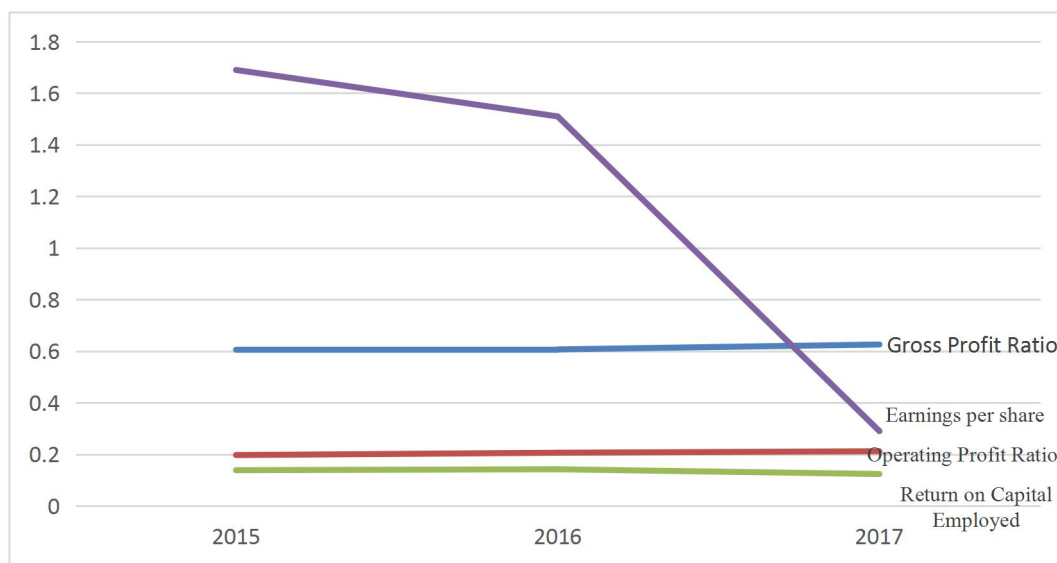


Figure 1 Graph for Profitability Ratio from 2015 to 2017

### 3.4 Return on capital employed (ROCE)

Return on capital employed (ROCE) is a profitability ratio which detects the efficiency of a company generating profit from utilization of its capital (Lee, 2009). ROCE is an indication of how much profit that one dollar of capital employed could generate. The ROCE for Coca-Cola Company from 2015 to 2017 are shown numerically in the Table 2 and graphically in Figure 1.

From 2015 to 2017, the trend for ROCE for Coca-Cola Company increases first, but decreases rapidly to the lowest rate among the three years. The increase from 2015 to 2016 is due to the decrease of \$2,329 million in employed capital. Since there are less capital employed, the profit generated from each dollar employed increases, which means that Coca-Cola Company is more efficient in utilization of its assets. However, from 2016 to 2017, the operating profit decreases by 15%, which exceeds the decrease in the capital employed of less than 0.01%.

On the basis of the 2016 annual report and 2017 annual report of Coca-Cola Company, the capital employed is composed by total assets and total current liabilities. The main reason for the decrease in the capital employed in 2016 is the decrease of \$2,324 million in the 'Bottler's Franchise Rights with Indefinite Lives', which is caused by the decomposition of the German bottling partner in 2016. Another main factor for the decrease in capital employed is the decrease of \$2,481 million in the 'Other Investments'. Available-for-sale securities is the major factor for decrease in the 'Other Investments', this is due to the periodic recession in economy, which reduced the estimated fair value for the securities investment of Coca-Cola Company. From 2016 to 2017, the capital employed is stable, however, the operating profit decreases dramatically. The decrease in operating profit of 15% is due to the decrease in the revenue as analyzed in the operating profit ratio, which leads the ROCE to recess by 1.84%.

### 3.5 Earnings per share (EPS)

Earnings per share (EPS) identifies how much money that each ordinary share could receive from the attribution of company's profit (Lee, 2009). The EPS for Coca-Cola Company from 2015 to 2017 are shown numerically in the Table 2 and graphically in Figure 1.



From 2015 to 2017, the EPS for Coca-Cola Company decreases steadily and rapidly from \$1.69 to \$0.29. On the basis of financial statements of Coca-Cola Company, the number of ordinary share is steady with a little decrease that is too meager to make an impact. The major factor for the decrease in EPS is the decrease of \$6,103 million in 'Net Income Attributable to Shareowners' in 2017. As per the 2017 annual report of Coca-Cola company, the major reason for the decrease in the 'Net Income Attributable to Shareowners' is due to the increase in the 'Income Taxes'. In 2015, Internal Revenue Service (IRS) has sent a Statutory Notice of Deficiency to Coca-Cola Company claiming that the Company's US taxable income should be increased. In 2017, IRS created a potential federal income tax liability of approximately \$3,300 million for the period plus interest. Moreover, IRS also filed an amended answer to the Company's petition in U.S. Tax Court in which it is increased its penalties by \$523 million. As a result, the "Net Income Attributable to Shareowners" decreases rapidly in 2017, which leads to a dramatic decline in EPS.

#### **4 Conclusion**

This paper aims to evaluate the effect of cost control strategy on the profitability of Coca-Cola Company from year 2015 to 2017 and offer essential financial recommendations. The profitability of Coca-Cola Company has been strengthened from 2015 to 2017, which is done by reducing cost of sales and operating costs. The gross profit ratio indicates that Coca-Cola Company has a 2.03% increase and the operating profit ratio indicates that it has a 1.48% increase. However, both the revenue, the gross profit and the operating profit have decreased, which leads to the decrease of 1.84% in the Return on Capital Employed and \$1.4 in the Earnings per Share. In order to remain the advantage in profitability when the market is recessing and avoid any future financial crisis, there are some possible ways that Coca-Cola Company could consider. First, Coca-Cola Company should remain its cost reduction strategy by executing its backward integration strategy to reduce the material cost and the marketing costs calculation methodology to reduce its marketing costs. Second, Coca-Cola Company should insist its foreign currency fluctuation control strategy to ensure that company would be beneficial in currency fluctuations. Moreover, Coca-Cola Company should adopt the recommendations by World Health Organization to adapt its syrup ingredients in accordance with the health to restore the confidence of the customer and boost the revenue. Besides, Coca-Cola Company should reconstruct relationship with IRS in order to avoid filing more lawsuit and penalties.

From this paper, the influence of various costs on the profitability and the relationship between the effectiveness of cost control strategy and the profitability has been revealed. The theory that cost control strategy is the most efficient way to ensure the stability of profitability for a company when the market recesses and revenue declines is drawn based on the horizontal analysis and ratio analysis. This paper could be valuable for scholars to review and develop future study on the profitability analysis. Companies and organizations who seek to improve their profitability could also reference to this dissertation to find solution that is to advance its cost control strategy.

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## Competency Management, Knowledge Management and Corporate Education: A Study on Brazilian Companies

Fernando José Lopes<sup>1</sup>, Vivian Gava Malta de Abreu<sup>2</sup>, Roberto Shizuo Kumasaka<sup>3</sup>,  
Alessandro Marco Rosini<sup>4</sup>, Arnaldo José de Hoyos Guevara<sup>5</sup>

<sup>1</sup> Flamingo, Campos Sales, São Paulo, Brazil,

<sup>1,3</sup> Faculdade FIA de Administração e Negócios, São Paulo, Brazil,

<sup>4</sup> UNIAN, UNIVAG, São Paulo, Várzea Grande, Brazil

<sup>5</sup> Pontifical Catholic University of São Paulo, Brazil

(E.mail: lopesfj2008@gmail.com, vivianmalt@gmail.com, shiz@terra.com.br,  
alessandro.rossini@yahoo.com, arnoldodehoyos@yahoo.com.br)

**Abstract:** Competence is responsible and recognized act of knowing, that involves mobilizing, integrating, transferring knowledge, resources, skills, that adds economic value to the organization and social value to the individual. Knowledge management is the systematic and deliberated coordination of people, technologies, processes and organizational structure of the company with the purpose of adding value through use, reuse and innovation. The relationship between the two practices increases the organization's competitiveness potential. In order to understand this relationship, this research analyzed data on the practices related to knowledge management and corporate education and management by competences of Brazilian organizations through the database of the survey 'Best Places to Work' - using a quantitative approach. The data analysis allows us to infer a positive relationship between the practices that can demonstrate a human resources area more active next to the business strategy and seeking to raise the competitiveness of the organization.

**Keywords:** Management by competence; Knowledge management; Corporate education; Organization

### 1 Introduction

Knowledge is the most precious asset of a company and their contributors. That one that know how to use and share properly in a organization reach better results in productivity, information flow and end customer service (BARNEY, 199 *apud* DUTRA, 2017).

Fleury and Fleury (2001) remember that, for long decades, prevailed Taylorist and Fordist models of work organization, based on the production line and on the task fragmentation process. Discussions about competences mobilized in Europe, mainly in France, took in account the employee delivery for the execution of a work, or a task, using their knowledge to improve not only their work capacity, but also the productivity with its knowledge, aligning theory and practical applicability, that is: the attitude of doing different and bring improvements.

For Zarifian (1999 *apud* Fleury and Fleury, 2001), competence is the practice intelligence for situations that are supported by acquired knowledge and transform they harder, how much more grows complexity. Le Boter (1995 *apud* Fleury and Fleury), presents competence as a knowledge about knowing how and the way that is recognized by the others. It implies knowing how to mobilize, integrate and transfer the knowledge, resources and abilities, in a certain professional determined context.

Eboli (2008) promotes reflection about corporate education, as a development system of person, based on competence management and presents researches that evidence the strategic role about it, in Brazil, as well as their alignment with organizational competences.

Fischer and Amorim (2010) emphasize that, although they are interconnected, knowledge management and corporate education have some different elements, such as the character of learning and the production subject process of knowledge.

As a way of searching comprehension of in what way competence management and that one of knowledge coexist in the Brazilian organizational environment, this research analyzed data of large organizations by the research 'Best companies to work' [MEPT], annually published, since 1997.

## 1.1 Objectives

This research has as its general objective identifying knowledge management practices and education, together with Brazilian organizations and verify if they are together with a competence management by competencies.

Specific objectives are:

- (1) List which companies have knowledge management practices and corporate education; and,
- (2) Identify if there is a relationship between companies that have a competence management system.

## 1.2 Justification

Understanding possible relationship between systems of competence and knowledge management, and current relevance of these practices for organizations differ in a competitive environment, postulates the importance of identifying if there is relationship between practices of knowledge management and management competence and management system, as well as how it happens, in a Brazilian context of organizations.

MEPT research is on its third decade of existence, and since 2006 works in partnership with the Program of Studies in Management of People of Administration Institute Foundation [PROGEP-FIA] and Abril Publishing Company responsible for *Você S/A* magazine publication, whose research is linked. By academic viewpoint, this scientific work looks for support studies, where data are processed products to the professional public active in human resources (FISCHER, AMORIM, FEVORINI, & SILVA 2018)

## 2 Theoretical Foundation

### 2.1. Competence management

Fleury and Fleury (2000) define competence as “know how to act responsible and recognized, that involves mobilizing, integrate and transfer knowledge, resources, skills that add economic value to the organization and social value to individual.

The debate about competence management permeates some chains. Mirabile (1997 apud Fleury and Fleury, 2001) remembers that Mc Clelland started up the debate about competence between psychologists and administrators in the USA. It, according to this author, was one of the characteristics underlying a person, casually related to the superior performance in carrying out a task, or in a given situation. It made a difference, in this way, aptness competence: natural talent of the person that may be improved, from skills, demonstration of a particular talent in practice and knowledge, what people need know to perform a task.

For Fleury and Fleury (2001), while prevailed Taylor’s and Ford’s model of work organization and business strategy definition, the concept of qualification provided the necessary reference to work the individual-organization professional relationship. Qualification is, usually, defined by requirements associated with the position, or position, or knowledge, knowledge stock of the person that can be classified and certificated by educational system.

The French debate on competence was born in the 1970s, precisely the questioning of the concept of qualification and the process of professional training, mainly technical. Unsatisfied with the gap between the needs of the world of work (mainly industry), they sought to bring education closer to the real needs of enterprises, with a view to increasing the skills of workers and their chances of employment. It was sought to establish the relationship between skills and knowledge - the know-how - in the framework of diploma and employment (FLEURY and FLEURY, 2001).

According to Dutra (2001), in the last decades, there was a change in the profile of the people required by the companies. To the obedient and disciplined profile, one prefers an autonomous and enterprising profile. The change, in the demand pattern, generated the need for an organizational culture that stimulated and supported individual initiative, creativity and the autonomous search for results for the company or business.

Le Boterf (1995 apud Fleury and Fleury, 2001) situates competence at a crossroads, with three axes formed by the person (his biography, socialization), his educational background and his professional experience.

Competence is the set of social and communicational learning nurtured upstream by learning and training and, downstream, by the evaluation system. According to Le Boterf (1995 apud Fleury and Fleury, 2001), competence is a responsible act of knowing that is recognized by others. It involves knowing how to mobilize, integrate and transfer knowledge, resources and skills in a given professional context.

### **2.3 Knowledge management and corporate education**

According to Dutra (2001), knowledge plays an important role in economic processes, and investments in intangible goods grow faster than those in physical goods. Countries, companies and people with a higher degree of knowledge are more successful, productive and recognized.

Knowledge originates from a set of experiences, information and values that allow to evaluate and to incorporate new data in a simultaneously fluid and structured way, allowing to subsidize the making of better decisions, which translate into actions more aligned to the reality of a company and of their objectives (DAVENPORT & PRUSAK, 2003).

The creation of knowledge in the organization is subjected to the context in which it is inserted, and focused on the dialectic of thought and action that opposes and integrates contrasting elements, to transcend its original contradictions and meanings, while exercising and receiving influences from the environment with which relates (Nonaka & Toyama, 2003). In companies, the information cycle and its positioning in the market means that there is the exercise and accommodation of viable information for the creation of knowledge; companies are influenced by external variables, which means that knowledge strategies are adapted and modified to their needs to exist and grow in a market.

Such organizations generate and use knowledge and therefore must manage them, although knowledge is more a process than an object (Davenport, 1998). The generation of knowledge, mentioned by Davenport, occurs in a conscious and intentional way, and not necessarily unprecedented, only new to the organization itself.

Knowledge management is defined by Dalkir (2005) as the systematic and deliberate coordination of people, technologies, processes and organizational structure of the company, with the purpose of adding value through use, reuse and innovation. Such coordination is carried out thanks to the actions of creation, sharing and application of knowledge, besides feeding from lessons learned, best practices and important elements for corporate memory, directed to continuous organizational learning.

Barroso and Gomes (1999), in their studies, directly relate the importance of knowledge management to the growth of intangible assets of companies in relation to tangible assets, and defines knowledge management as: the transformation of intangible assets into values, through analysis, development and use of processes related to such knowledge.

In research with technology companies, Kuniyoshi and Santos (2005) identified practices and management initiatives, such as:

- (1) Declared knowledge management strategies and policies;
- (2) Corporate portals; repositories of lessons learned and best practices;
- (3) Recognition and award of best practices;
- (4) Taxonomy and ontology as facilitators of content management;
- (5) Document repositories and virtual or physical corporate libraries;
- (6) Corporate education and e-learning;
- (7) Network of experts;
- (8) Innovation centers.

For Fischer and Amorim (2010), corporate education and knowledge management, as organizational innovation movements of contemporary organizations, have emerged to revolutionize the way in which organizations treat the processes of training and learning.

According to Eboli (2008), the processes of knowledge management and corporate education gain strategic character, when they come to have as reference the organizational competencies of the company. Corporate education responds to the competitiveness challenges of organizations, making the processes of behavioral, technical or theoretical qualification strongly aligned with company strategies and with the precepts of modern management.

In common with knowledge management, corporate education focuses on the organizational phenomenon, learning and the product of this: knowledge. However, there are elements that define the specificities of each system: how learning is planned and performed and who is responsible for its production and appropriation (Eboli, 2008).

### **2.3. Competence management and knowledge management**

Corporate education has played an important role in building organizational competitiveness through the development of human skills related to organizational competencies (Eboli, 2008).

In dynamic markets with dispersed resources, organizational structures must foster learning and the generation of new knowledge, to integrate the company's intangible assets and use it as a sustainable competitive advantage (Teece, 2007). Part of this knowledge must be provided by the company, using the training, the search for new knowledge in the market and adapting to the reality of the business.

According to Garvin (1993 apud Dutra, 2001), learning organizations are those able to create, acquire and transfer knowledge, as well as modify their behaviors to reflect these new insights and insights. They need to change to become competitive and, for that, they must invest in individuals who, with their knowledge, will be able to manage new forms of work and competitive models for it. Therefore, the relationship between a competency system and knowledge management becomes important, aiming at providing conditions so that employees can acquire such knowledge and, at the same time, deliver their work to improve their way of working.

For Senge (1990 apud Dutra, 2001), an organization is always expanding its capacity to create future. This ability translates into the need for flexibility and adaptability to the market where, in a globalized era, the external variables affect the internal variables of the organization, such as: human resources, machinery, equipment and product and service development areas.

According to Zarifian (1999 apud Fleury and Fleury, 2001), "competence is practical intelligence for situations that rely on acquired knowledge and transform it with more force, the more the complexity of situations increases." In this scenario, the required competencies of individuals are increasingly complex and therefore both employee and company must strategically know how to use knowledge to generate deliverables that add value to the business. Therefore, knowledge is fundamental for the creation of new competencies, that make the company modernize and be competitive in the market where it operates.

Corporate education, in turn, plays a fundamental role in breaking paradigm to seek improvements in the way it works, providing a return to the organization and its individuals.

## **3 Methodological Procedures**

A quantitative research was carried out, with data analysis of the MEPT survey for the year 2017, published by Editora Abril, which lists the companies with the best evaluations based on the proposed criteria.

Lakatos and Marconi (2010) present the definition of technique as a set of precepts or processes that serve a science or art; is the ability to use such precepts or standards, the practical part. All science uses innumerable techniques in pursuit of its purposes.

According to them, besides the specific methods of the Social Sciences, such as the approach and procedure, the qualitative and quantitative methods are also very important in scientific research.

The quantitative method is characterized mainly by the use of statistical instruments such as: percentage, mean, standard deviation, correlation coefficient, regression analysis, among others. Moreover, Lakatos and Marconi (2010) also affirm that the way of collecting and analyzing data also differ from a qualitative method:

"In the quantitative method, the researchers rely on large samples and numerical information, while in the qualitative the samples are reduced, the data are analyzed in their psychosocial and the collection instruments are not structured" (LAKATOS AND MARCONI, 2010). , P. 269).

The methodology, in general, encompasses two distinct moments: the research / data collection and the analysis / interpretation, when one tries to investigate a certain subject.

In order to make feasible the statistical analysis, dichotomous questions related to the same variable within a construct were grouped in a Likert format. The use of numerical scales from questionnaires in a quantitative approach aims to obtain analyzes that would not be immediately available through formal records or simply observation of the phenomenon to be studied (HAIR, BABIN, MONEY, & SAMOUEL, 2005).

The MEPT research database is composed of approximately 79 issues related to the theme of this article, of which 16 are related to demographic and / or identification information, while the others, to the validation and correlation between the proposed constructs.

The consultation to the MEPT database, which was accessed by the PROGEP-FIA team, returned a total of 456 respondent companies, with 33 main activities.

The authors' concern was to carry out a bibliographical survey to obtain a basis and support to the ideas explained during the text, both in the theoretical reference, as well as in the analysis of data collected by the MEPT research, seeking to satisfy the need to know, quantitatively, how the knowledge management and the corporate education collaborate to improve the competences in the analyzed companies. This provides a significant response to the importance of knowledge and the incentives provided by companies to improve their skills.

## 4 Discussion of Results

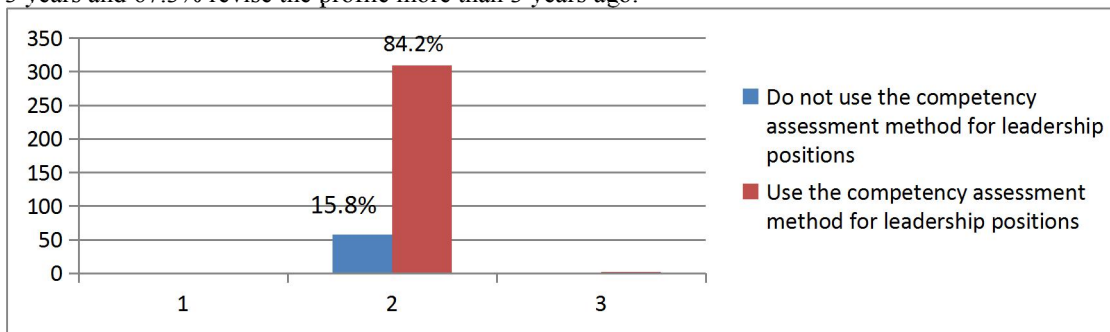
### 4.1 Characterization of companies and the role of human resources

According to MEPT data, out of a total of 456 companies surveyed, there is an average operating time of 42 years. 45% are service providers; 23.4% belongs to industry; 9.2% are from the commercial branch in general; 4.4% work with agribusiness; 3.3% belong to business and technology; 1.2% to education; 12.9% of them did not identify the branch of activity.

The data showed that the main Human Resources decisions occur in: 45%, with managers consulting the HR area; approximately 17% with the HR area, consulting managers and the same index showing HR autonomy in making decisions; 2.4% of the decisions are taken, only, by the managers. It can be inferred that, based on the data, HR is a protagonist in the decisions, or involved in it, which allows for the integration in the different areas of the organization and better dissemination of HR practices. Thus, HR is the main source of consultation of managers and, therefore, is a strategy adopted by most companies surveyed.

### 4.2 Results about competence management

Data analysis showed that 84.2% of companies adopt formal practices to define, disseminate, evaluate and internalize a competency profile for their leaders; and 15.8% reported that they did not have a defined competency profile, according to Chart 1. Of the 84.5% of them, 32.7% of the companies started to practice periodic review of the leadership profile, with the participation of managers, in up to 3 years and 67.3% revise the profile more than 3 years ago.



**Figure 1 They Adopt Formal Practices Related to Skills Assessment.**

Data is sourced from MEPT (2017) and treated statistically and interpreted by the authors.

When asked if company formally announces the leadership profile, 40,1% of organizations informed that disseminates these practices by internal communication, like on: newspapers, magazines, intranet and murals; and, 59,9% disseminates these practices on interactive activities like: meetings, lectures or formal training.

It was raised that 48.2% of companies offer training, or guidance to managers on how to disseminate the leadership profile and 30.3% of these practices started in the last 3 years. 69.7% have been guiding and training their managers for more than 3 years (table 1).

**Table 1 Percentage of Companies that Offers Training or Guidance to Disseminate Leadership Profile**

Question	Percentage
Companies that offer training or orientation to for leaders on how to disseminate the leadership profile.	48,2%
There are over 3 years	69,7%
Started in the recent 3 years	30,3%

Data source from MEPT (2017)

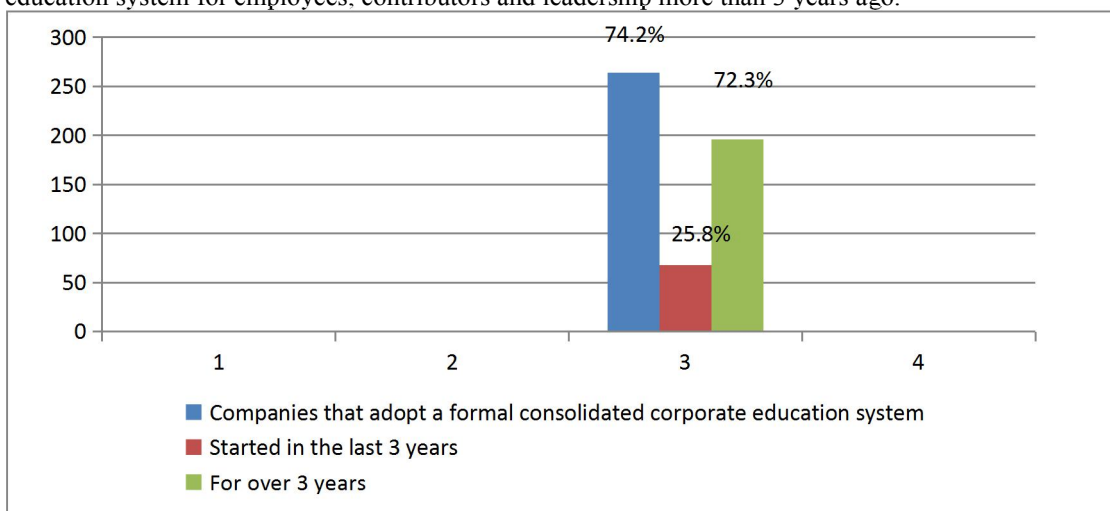
For 71.3% of the companies, the leadership profile is taken into account for the performance evaluation, whereas in 28.5% they included this consideration in the last 3 years and 71.5% have practiced it for more than 3 years, remembering that the profile can be elaborated by the company, through HR, in partnership with the managers, by the description of the positions of the company.

According to the survey, 89.1% of companies use tools for leadership appreciation, such as performance and competency assessment. The main source used for this is the immediate manager, and self-assessment, for 21% of companies. 10.9% of them do not use tools for this procedure. As verified, the evaluation is validated by a committee within the organization, composed of high and medium management, a fact quite common in companies in Brazil.

Finally, 96.2% stimulate the practice of feedback to employees; and 3.8% of them promote some stimulus action. In 85.5% of the analyzed, managers are formally oriented on how to provide feedback; in 71%, the managers are charged in this sense, in relation to their leaders; in 39.5%, non-managers are formally encouraged to provide feedback to their colleagues and managers. It is important to emphasize that this practice makes possible the subsidy for the employee, its performance and which way to improve or develop the skills required by the organization.

#### 4.3 Corporative education and knowledge management results

According to MEPT data, 72,3 companies that were searched adopt a consolidated formal system of corporative education. 25,8% started a practice of this system last 3 years and 74,2% have an education system for employees, contributors and leadership more than 3 years ago.



**Figure 2 Companies that Adopt the Formal System of Corporate Education.**

Data is sourced from MEPT (2017) and treated statistically and interpreted by the authors.

This result may indicate an evidence about importance given by Brazilian companies, nowadays, to knowledge management and the perception of this system, while competitive differential to them.

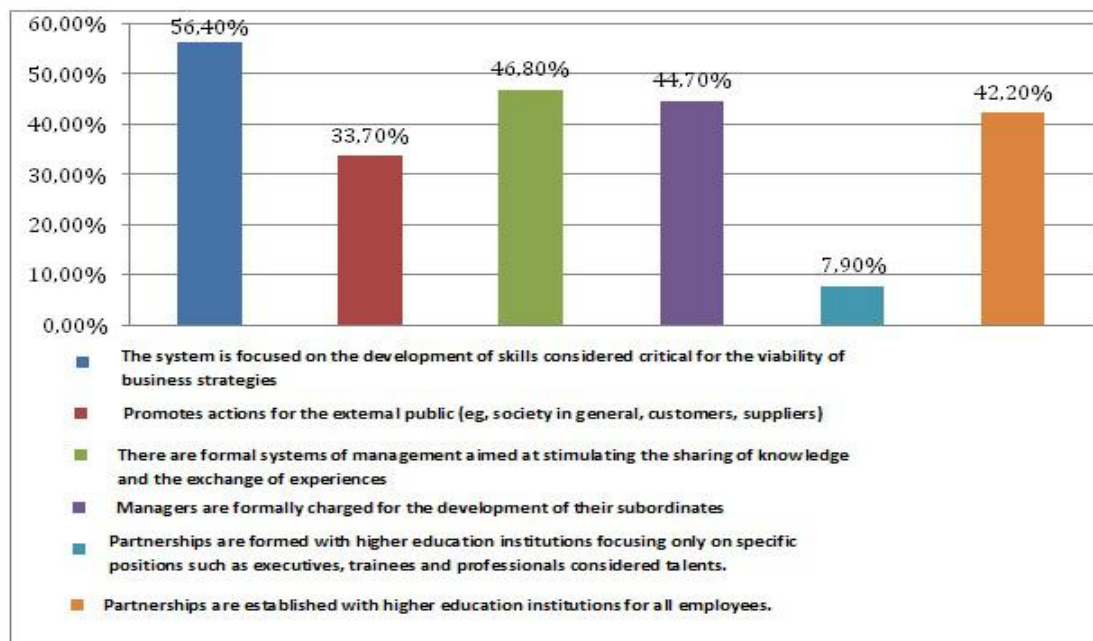
**Table 2 Percentage of Companies Surveyed Adopting a Formal Consolidated Corporate Education System**

Question	Percentage
Companies that adopt a formal consolidated corporate education system	72,3%
For over 3 years	74,2%
Started in the last 3 years	25,8%

Data source from MEPT (2017).

Of the companies that adopt a corporate education system: 56.4% of the practice is focused on the development of skills considered critical, for the viability of business strategies; and, 33.7% promote actions for the external public (eg society in general, customers, suppliers etc).





**Figure 3 Corporate Education and Skills Development**

Data is sourcee from MEPT (2017)and treated statistically and interpreted by the authors.

As one of the focal points of the present article, the data show that 46.8% of the companies have formal systems of management aimed at stimulating the sharing of knowledge and the exchange of experiences. 67.7% have done this for over 3 years, and 32.2% have begun to stimulate sharing in the last 3 years.

**Table 3 The Following Practices Related to Knowledge Management Were Identified**

Question	Percentage
The system is focused on the development of skills considered critical for the viability of business strategies	56,4%
Promotes actions for the external public (e g, society in general, customers, suppliers)	33,7%
There are formal systems of management aimed at stimulating the sharing of knowledge and exchange of experiences	46,8%
Managers are formally charged for the development of their subordinates	44,7%
Partnerships are established with higher education institutions, focusing only on specific positions, such as executives, trainees and professionals considered talents	7,9%
Partnerships are established with higher education institutions for all employees	42,2%

Data source from MEPT (2017).

In 44.7% of the companies analyzed, managers are formally charged for the development of their subordinates. When asked if there are partnerships with higher education institutions, 7.9% of companies have such partnerships focused on specific positions, such as executives, trainees and professionals considered as talents and 42.2% for all employees. Of which 73.5% have more than 3 years of service and 26.5%, up to 3 years.

86.6% of the companies carry out systematic evaluations of the training and development actions: 79.7% of the evaluations are aimed at verifying that the courses, programs and training have met the expectations of the participants. 37.9 establish a development plan, as assessed by training and development actions; finally, only 26.9% stated that they performed performance evaluations of the participants before and only after the training actions (table 4).

**Table 4 Systematic Evaluations of Training and Development Actions.**

Question	Percentage
Verify that the courses, programs and training met the participants' expectations	79,7%
Establishes development plan, as assessed by training and development actions	65%
Carry out performance appraisals of participants before and after training actions	26,9%

Data source from MEPT (2017).

59.5% adopt formal development practices specific to young employees: 34.9%, Young Apprentice Program; 30.6% have an Internship Program with a minimum duration of six months; 8.2%, Internship Program on vacation, or short-term; 15.3% Trainee Program; and, 11% Young Talent Program (table 5).

**Table 5 Facilitating Corporate Education and Knowledge Incentive Programs**

Question	Percentage
Specific formal development practices for young employees	59,9%
Young Apprentice Program	34,9%
Internship Program with a minimum duration of six months	30,6%
Short Term or Internship Program	8,2%
Trainee Program	15,3%
Youth Talent Program	11%

Data is sourced from MEPT (2017) and treated statistically and interpreted by the authors.

53.7% have a program to stimulate employees who are participating in long-term courses (equal or superior to six months, such as technologists, undergraduate and graduate). Of these, 44% provide data from their operations to set up case studies and other academic research; 33.7% offer flexible scheduling options to facilitate employee education; in 16.7%, employees can go through job rotations, in areas related to the study developed, to facilitate the practical application of the learning; and, 5.6%, the companies reward the employees who develop their conclusion work based on topics of interest to the company

## 5 Conclusion

When analyzing the use of knowledge management and corporate education in organizations, and its connection with the management by competences, this research identified evidence that allows to infer that there is an investment in managing its employees through a system of management by competencies, identified, especially when addressing the profile and management of leadership, as allocated in item 4.2 of the paper.

It is postulated that the use of knowledge management practices and corporate education make possible the implantation and institutionalization of organizational and individual competences. For this purpose, companies train, communicate, evaluate performance and establish practices to stimulate the development of individuals. It is also understood that companies work with proposals aimed at training, to generate knowledge and knowledge sharing.

Most companies have a formal corporate education system, providing knowledge management to improve the skills of employees, in order to guarantee the development of human capital and its competitive differential in the foreign market.

Some degree of maturity, or path, is observed for practices of knowledge management or corporate education and management by competencies, considering that, whenever questioned about the time that these practices were adopted, the majority was positioned indicating that they are previous the last 3 years.

The research provides us with elements capable of inferring that, in the majority, companies are concerned with the profile of the employees' competences and, to this end, they provide actions aimed at corporate education, as a way of generating and managing knowledge management in the organization, seeking to achieve, in this way, the organizational results are achieved, also being made possible by the sharing and dissemination of knowledge. It is possible to observe, and also, that the greater focus, when it comes to practices focused on the proficiency profile, is directed towards the leadership positions.

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# **Research on Development Tendency of Chinese Automobile Industry from the Perspective of International Industrial Chain**

Gu Zhiqiang, Wang Chaoyang

School of Automotive Engineering, Wuhan University of Technology, Wuhan P.R.China 430070

(Email: gxkwhut@whut.edu.cn, 252011502@qq.com)

**Abstract:** With overcapacity of major auto producing countries and declining profit ratio, automakers are no longer able to obtain the highest profits from manufacturing. After entering the Internet Plus Era, the deepening economic globalization has promoted the globalization of automobile service industry at the core of marketing globalization, after-sales service globalization and service trade globalization. The wide application of new service trade methods such as auto finance and E-commerce has accelerated the extension of international competition from manufacturing to trade and service. From the perspective of international automobile industrial chain, the development strategy of Chinese automobile industry needs to be adjusted according to new development tendency of international automobile to formulate the strategy, which matches the consumption characteristics of automobile industry.

**Keywords:** Automobile; Industrial chain; New energy automobile; Auto finance

## **1 Introduction**

At present, due to the high oil prices and the softening of consumer confidence, sales of new cars in Europe, America and Japan have declined sharply in recent years. Driven by the environment, automobile sales shrink rapidly. In addition to the cost and market competition pressures, there are also higher requirements for the safety and comfort of automobile products from users. In addition, the society pays more attention to environmental protection. Mao Zhenhua, for example, pointed out that China urgently needed to break through the technical bottleneck of the disposal of old power batteries and find an industrial path that was both environmentally friendly and economical. It was necessary to promote the promotion of new energy vehicles in China by developing viable business models (Mao, 2016).

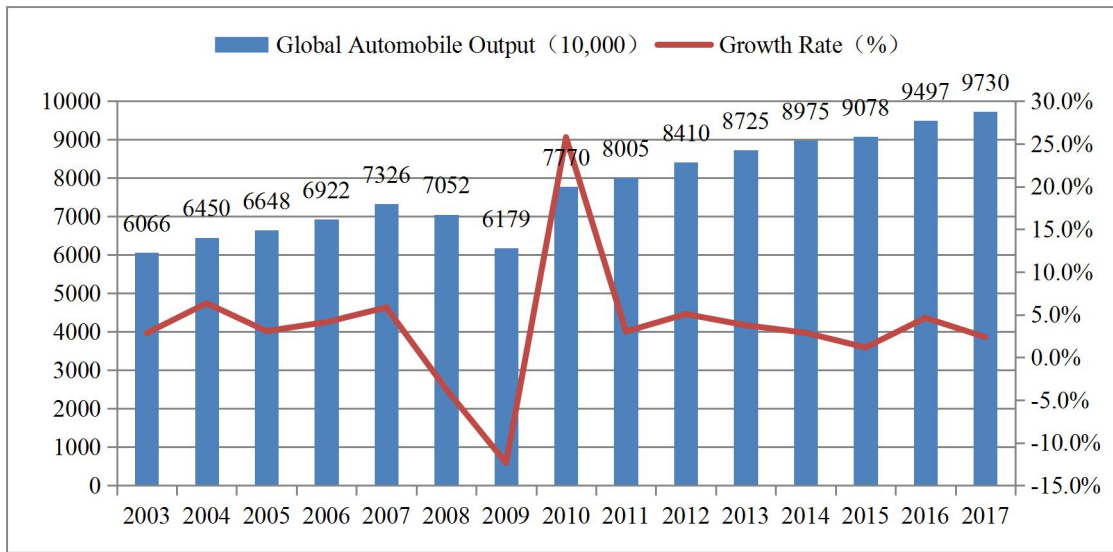
In recent years, Chinese automobile industry has made significant progress in terms of styling, interior, workmanship, quality stability, engine performance, and driving experience. It is narrowing the

gap with joint venture brands, especially in small and medium-sized SUV market with growing competitiveness. However, from the point of view of mastering the key technologies of vehicle produce, there is still a big gap between China and foreign countries, Technical problems are always closely related to the market. Xavier Richet and Joel Ruet put forward that China should strengthen independent innovation and not rely excessively on joint ventures to master technology (Xavier Richet and Joel Ruet, 2008). As Chinese economy enters New Normal era, automobile output and sales have shifted from high-speed to steady growth, and the industry has gradually stepped into a relatively steady developing phase with high base and low growth rate. Under the impetus of new energy vehicles, great changes have taken place in the form and pattern of China's automobile industry chain. For example, based on the analysis of the new energy automobile industry chain, Huo Guoqing and others concluded that the new energy automobile industry chain has the characteristics of integrating "new energy", "new material" and "new generation information technology" (Huo and Jiang, 2016). Since the "Twelfth Five-Year Plan" period, Chinese automobile output and sales have reached a new high of 20 million. In 2017, automobile output and sales broken world record and exceeded 28.8 million. It also has been ranked first place in the world for nine consecutive years. But the average growth rate is only about 6% during this period (Lv, 2017). It shifted from high-speed to steady growth, the whole industry has gradually stepped into a steady developing phase with high base and low growth rate. In particular, the development of new energy vehicles in China still lags far behind that of foreign new energy vehicles. Tang Baojun and Liu Jiangpeng proposed that the government and enterprises should make overall planning to promote the development of power batteries and the construction of related infrastructure. At the same time, they should actively introduce private capital to control the financial risks brought by subsidies (Tang and Liu, 2015). From the perspective of international automobile industrial chain, the development strategy of Chinese automobile industry needs to be adjusted according to new development tendency of world automobile to formulate strategy, which matches consumption characteristics of automobile industry.

## **2 The Development Tendency of World Automobile Industry**

### **2.1 The world automobile industry presents a pattern of “overall lower growth with differential development”**

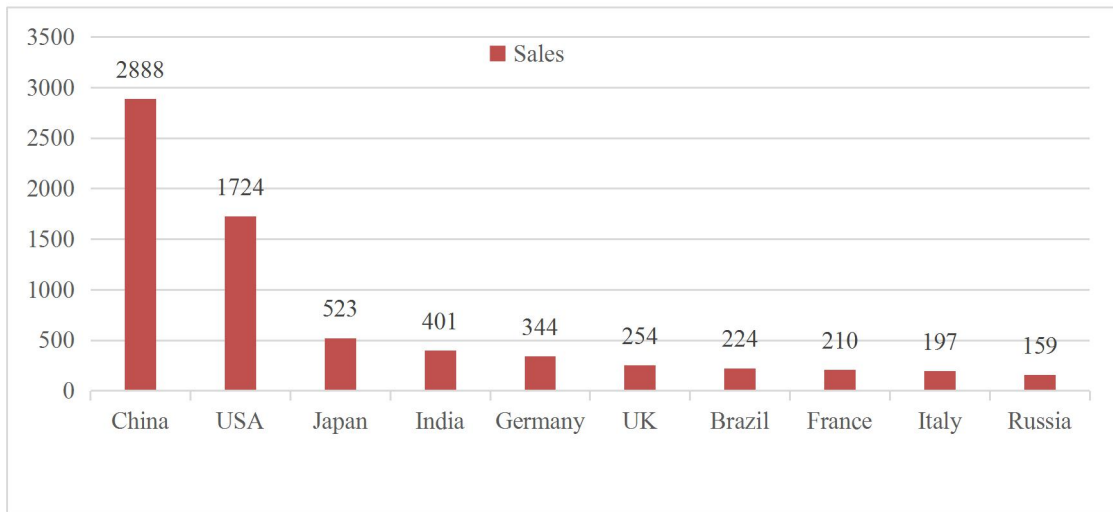
The world automobile market divides into traditional automobile market and emerging automobile market. After major developed countries finishing their industrialization, automobile, a durable consumer commodity, has entered a mature period. Over past 16 years, annual growth rate of output and sales has been mostly less than 3%.



**Figure 1 Data of Global Automobile Output from 2003 to 2017**

Data Source: The International Organization of Motor Vehicle Manufacturers (OICA)

From the perspective of market, traditional automobile powers such as the United States, Japan, and Europe countries own stable sales market. While Asia has become a new growth point in global sales market, especially countries in East and Southeast Asia (including China, India, Thailand, etc.) have become emerging automobile markets. The market has gradually shifted from developed countries to developing countries, which in turn has led to the shift of vehicle manufacturing enterprises to emerging markets. Among the top 10 automobile sales countries in 2017, four "BRIC" countries are on the list with increasing concentration. The main sales markets are basically concentrated in China and the United States.



**Figure 2 2017 Automobile Sales Statistics of Major Countries (10,000)**

Emerging markets such as China, India, Brazil, Russia and South Africa will drive global automobile sales to a record high, and the industry is expected to enter a rapid growing period in next three years, with record 120 million by 2020. With maturing automotive technology and increasing per capita income and purchasing power from emerging countries, it will inevitably lead to rapid development.

## **2.2 The globalized automobile industrial chain configuration**

The emerging markets and the cost-reducing requirements for automotive R&D have led to global transfer of automotive R&D resources to emerging countries. Its manufacturing part has been shifted to low-cost countries and regions, while the shifting scope has gradually extended to high-level R&D, designing, procurement, sales and after-sales service. China is at center of international automobile manufacturing and parts shifting process because of relatively small enterprise scale and lower manufacturing export price.





Figure 3 Map of World's Major Automobile Parts Industries

Note:

**USA:** 80 primary suppliers

**Canada:** battery; auto logos; optional parts

**Spain:** rubber seal; fixator

**Sweden:** regulator

**Germany:** seat parts; clutch; rapid charger; valve system; tire/trimming strip; glass; engine control system; vehicle information display; thermal resistor; door lock/handle; auto light; semi-axis; converter

**India:** forging component

**China:** radio; display; iron casting; auto logos/garniture; automotive electronics;

**Republic of Korea:** instrument; wiring harness

**Mexico:** safety belt; AC system; mobile headrest; loudspeaker/amplifier; antenna/cable

**Brazil:** compressor; resin

In recent years, automobile parts globalization has been further accelerated, and the matching relationship between finished vehicle and parts companies has also undergone some changes. Three



typical enterprise relationship models have been formed: parallel supply system, pagoda-shape supply system, diversified supply system represented by Germany, Japan and the United States respectively. Along with changing organizational structure of automobile parts industry, automakers tend to conduct global procurement for parts and components. Three major automobile makers General Motors (GM), Ford and Chrysler have contributed more than 300 billion dollars in global procurement process.

Growing paths of world's excellent parts enterprises can be summarized as three typical categories:

(1) System integration capability-driven enterprises: Representative enterprises are Continental, Delphi, Denso, and Visteon, etc. They have two common characteristics: firstly, the wide product series with strong system integration capability, which can provide modular products in various assembly types; secondly, they are once a part of large-scale automobile enterprises and have established close cooperative relations with world-class finished vehicle enterprises.

(2) Technological innovation-driven enterprises: representative enterprises are Bosch in Germany, Magna in Canada and Behr in the United States. They usually attach great importance to continuous investment, advanced research and development, and constantly strengthen competitive advantages with professional technical ability as the core. They can lead certain professional technologies in the world and realize continuous improvement of their products.

(3) Scale output-driven enterprises: Representative enterprises are Skoito, Yazaki in Japan. They focus on development and output of a single product, support large enterprises around the world with significant scale economy and occupy an absolute leading position in professional product market.

All these three types of enterprises became trans-regional and trans-boundary ones comprehensively implementing various business strategies such as self-expansion, mergers and acquisitions, and joint development. They can be active in vibrant automobile markets areas. Based on continuous development of quality, cost, timely supply, simultaneous development, service, technology and other basic capabilities, their effective product supply ability is formed, and then established close and stable supporting partnership with downstream enterprises. Furthermore, they have cultivated a strong endogenous ability with independent research and development capabilities as the core that based on advanced R&D investment and technological progress, thus realized the continuous innovation and development of their core competence.

Price, quality and service affect global automobile parts procurement. Chinese automobile parts enterprises own great labor cost advantages as well as improved quality and service. The global procurement strategy from multinational automobile enterprises provide favorable opportunities to Chinese enterprises. With obvious cost advantages, Chinese automobile parts manufacturers are becoming important output bases and global procurement destinations for multinational automobile

enterprises (Zhu, 2017). Within a certain period, international buyers become rational and practical in procurement in China. They intend to promote procurement process through selecting and cultivating potential core suppliers, enhancing logistics integration, strengthening communication with foreign domestic factories to promoting export, scattering procurement destinations, determining destination after comparing with other emerging markets and other ways.

### **3 Specific Manifestations of Significant Development form Changes in Automobile Industry**

Assisted by big data and cloud computing, automobile manufactures promote business model innovation and value chain reconstruction, which directly connect automobile output and consumption terminal. The product itself will no longer be the main profit point, while the customization carried on the product and its behavior information will bring major profit in future automobile ecosystem. And business model and competition and cooperation relationship of the industry will be different.

#### **3.1 Profound changes in product modality and production mode**

With continuous breakthroughs in energy revolution, new materials and information technology, automobile products move forward to new energy, light weight, and intelligent networking direction. Automobiles are transforming from communication media to large mobile intelligent terminals, energy storage units, and digital space (Sun and Jiang, 2015). Crews, vehicles, cargos, operating platforms and infrastructure can achieve intelligent interconnection and data sharing. Automobile production mode has evolved into an intelligent manufacturing system with full interconnection and cooperation. The up-downstream relation is closer, the global production resources are efficiently allocated, the R&D and manufacturing efficiency is greatly improved, and customized production mode will become a tendency.

#### **3.2 Internet Plus accelerates the emergence of newly demand and business models like diversified trip**

The deep integration of Internet and automobile fully releases safe driving demand, convenient trip, mobile officing, local service and entertainment. User experience(UE) becomes a vital factor in automobile consumption. The Internet social circle plays an increasing guiding role in consumption. The diversified consumption demands are becoming more obvious. The proportion of aging and new generation users continues to increase, while shared trip and personalized service have become main direction.

By the end of 2017, Didi platform owned more than 450 million users and covered more than 400 cities in China. International automobile giant Mercedes-Benz, domestic vehicle rental enterprises such

as Eduo Auto, Ehi, etc. Finished automobile enterprises such as BAIC, SAIC, Geely and many other brands are also actively swarming into Chinese shared trip market.

### **3.3 Traditional automobile enterprises transformed from manufacturers to manufacturers plus service providers**

In a complete mature international automobile market, 50% to 70% profits are generated from service industry, and automobile service business volume in the United States has exceeded the total sales of finished automobiles. As a major global automobile market, Chinese automobile industry owns synchronized development law with international market. In the future, automobile industrial chain will gradually shift to automobile service operators, electronic equipment suppliers, software manufacturers and communication operators from manufacturers. Moreover, enterprises those with software and hardware advantages and comprehensive solution providers for smart trip will become the center of industrial chain.

Traditional automakers have started transformation. GM is focusing on create an interconnected ecosystem of people, vehicle, and society in the future and provide intelligent transportation solutions to lead a new interconnected lifestyle of smart auto society in the future. Mercedes-Benz is transforming from an automobile manufacturer to an Internet trip service provider. BMW has turned itself into a luxury trip service provider. Volkswagen has determined to develop every vehicle into a moving smartphone by 2020. SAIC Group has proposed a strategic transformation from a traditional manufacturing enterprise to integrated suppliers that provide both product and service. Dongfeng Group has positioned itself as an excellent enterprise to provide comprehensive high-quality products and services. RI-Ring Group also has started the transformation from “product manufacturer” to “system solution provider “with the principle “product orientation” to “service orientation”.

### **3.4 Profound adjustments in industrial pattern and ecological system**

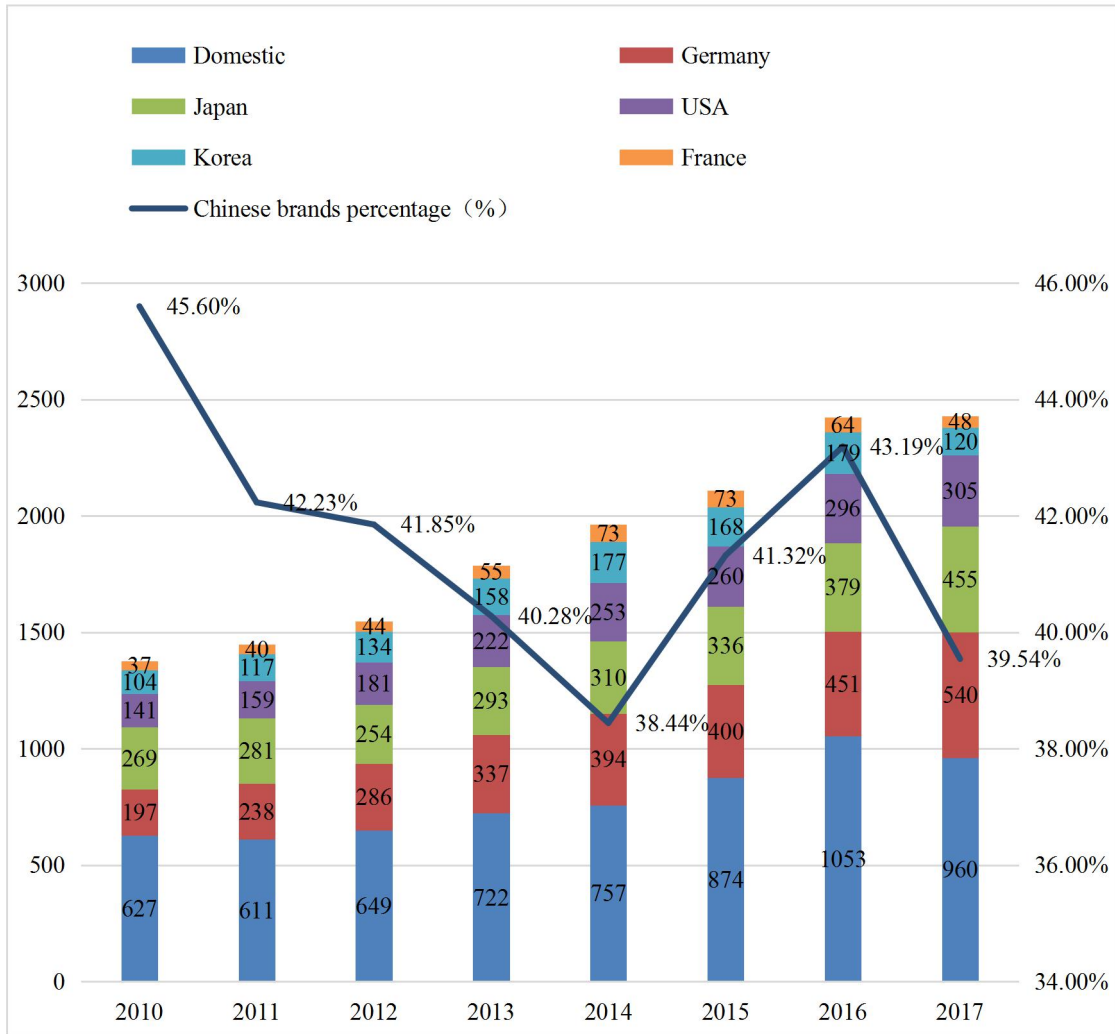
Developed automobile powers have proposed industrial upgrading strategies and accelerated industrial innovation and integrated development. While developing countries are also stepping up their efforts to take advantage of costs and markets to actively, undertake international industries and capital transfers. China is deepening reform and accelerating the internationalization of automobile industry. With increasingly blurred industrial boundaries, emerging technology enterprises from Internet are entering the automobile industry. Traditional enterprises and emerging enterprises are competing and developing with each other. Value chain, supply chain and innovation chain have undergone profound changes. Global automobile industry ecology is undergoing reshaping process. IT enterprises like Google, Apple, Tesla, and BAT have actively entered the automobile industry assisted by intelligent network. Apple entered the automobile industry through Car play vehicle-mounted system and it is currently supported by more than 200 models including Chery, MG and Roewe and other Chinese self-

owned brands. Baidu established Automated Driving Division and planned to achieve mass output by 2020. Alibaba and SAIC jointly launched YunOS vehicle-mounted system.

Interconnection between automobile and other industries has brought about tremendous changes in industrial form and business model, and created new industrial power. For instance, promoting platformization and webifying automobile electronics supply chains, managing, updating and adapting automotive electronic firmware and software. Conducting business model innovations in automotive repair and maintenance, auto insurance, used car trading, car sharing and other aspects through industry-oriented big data information service and application development. The profound integration of new information technology and traditional automobile industry is triggering far-reaching industrial revolutions and cultivating new production methods, industrial forms, business models and economic growth points.

### **3.5 The rise of Chinese finished automobile brands**

From 2010 to 2017, passenger vehicle sales volume maintained steady growth by relative slow rate. The overall sales volume of Chinese domestic passenger vehicle increased slowly. Competitions from international brands, especially Germany brands like Volkswagen and American brands like GM have resulted in a decline its market share. Since 2014, market share of Chinese passenger vehicle has increased gradually from 38.4% to 42.4% in 2016 with a total volume of exceeding 10 million. SAIC-GM-Wuling(SGMW), Great Wall Automobile and Geely Automobile are top three Chinese brands while SGMW have been sold 1.8782 million. Chinese self-owned SUV accounted for 58.2% of entire SUV market, and the top three brands are also from China. On one hand, they are benefited from 50% purchase tax cut policy. On the other hand, Chinese brands have improved their competitiveness obviously.



Data Source: China Association of Automobile Manufacturers

Figure 4 Passenger Vehicle Sales in China and Proportion of Chinese Brands

### 3.6 Consumption characteristics of Chinese automobile industry

Compared with developed countries, China has relative low automobile popularizing rate. At present, 1,000-person vehicle inventory in China is about 150, while 800 in the United States, around 600 in Japan, around 550 in Europe. The average number of the world is about 200. Judging from development law of vehicle ownership in major countries, the number in China will exceed 300 in next 15 years, and by then the annual output will be 42 million. This shows that there is still huge developing space and potential purchasing power in Chinese automobile industry.

From demand perspective, China's process of build a moderately prosperous society in all aspects

covers the consumption structure upgrading. During this process, driving effect of automobile as imitative and wave-type consumption still exists, and automobile products become increasingly prominent in individualization and diversified consumption. In addition, the current situation of Chinese automobile market is: huge demand for upgrading and repurchasing in first and second-tier cities, and market potential in third and fourth-tier cities is gradually being released, which support the development of Chinese passenger vehicle market. The demand for automobile products has brought great potential to Chinese automobile market. In period to come, automobile market will still maintain a stable and rapid growing speed. It is estimated that annual output and sales volume will reach 33 million vehicles in 2020, and will reach 40 million by 2030 with large market space.

#### Market forecast of Chinese automobile industry

The data of Chinese automobile output and sales collected from 2001 to 2016 are fitted according to exponential model  $y=3e-95e0.1119x$ , and the coefficient of determination is  $R^2=0.8758$ , which indicating well-fitting degree. The index model is used to forecast output and sales of Chinese automobile industry. The specific data are shown in the table.

**Table1 Forecast of Chinese Automobile Output and Sales Volume from 2008 to 2020**

<b>Year</b>	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
										e	e	e	e
<b>Output</b>	935	1379	1826	1842	1927	2212	2372	2450	2811	2980	3122	3280	3500
<b>Sales</b>	938	1364	1806	1850	1931	2193	2349	2460	2803	2950	3118	3275	3492

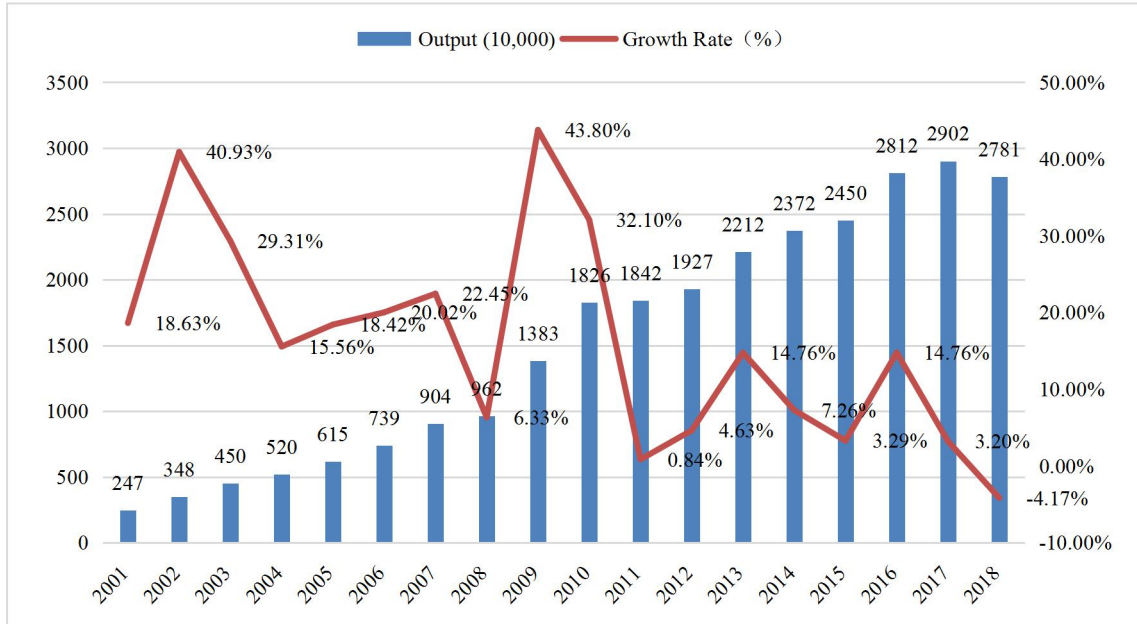
## 4 Countermeasures for Chinese Automobile Industry Development Strategy

Nowadays, although global economy has recovered to some extent, the overall situation is still complicated. The future global and Chinese economic growth will be influenced by following reasons: coordinated withdrawal of fiscal and monetary policies made by major economies, sovereign debt crisis of European highly indebted countries, global financial system reform, and global emission reduction issues at post-Kyoto Protocol.

### 4.1 Chinese automobile industry entered "Silver Decade" instead of "Golden Decade"

With long industrial chain, wide coverage, and increasing up-downstream related industries,

automobile industry has become one of the pillar industries that support and promote sustained and rapid growth of Chinese national economy with increasing significance. Since 2000, Chinese automobile market has shown rapid growth with an average 25% increase from 2001 to 2010.

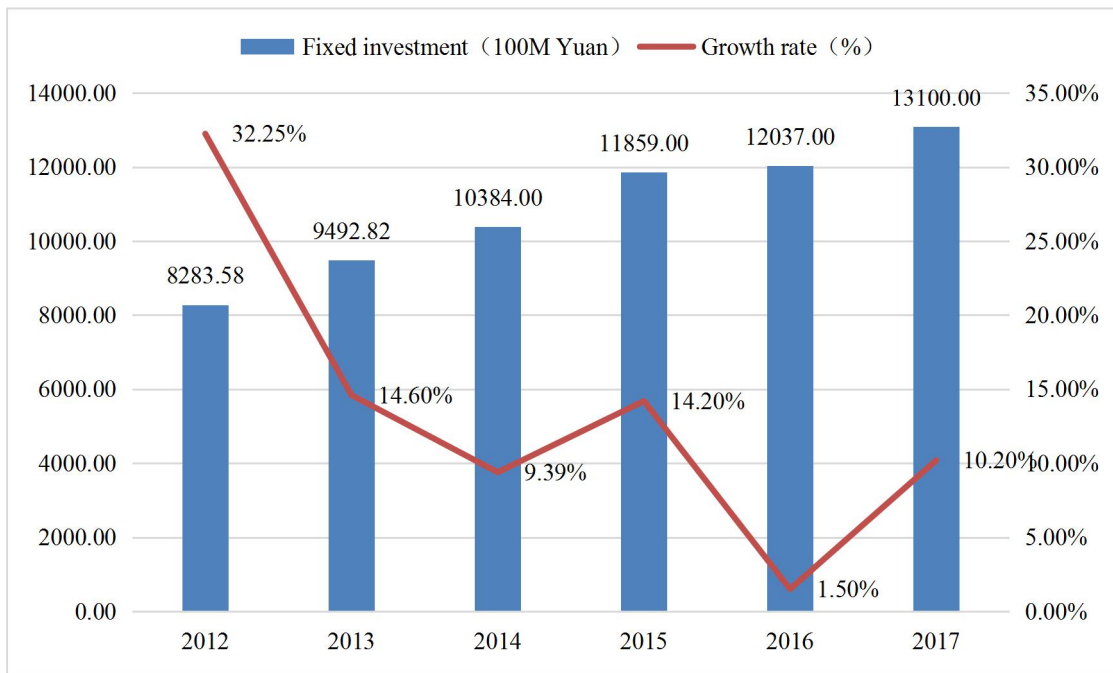


Data Source: Chinese Automobile Industry Yearbook (2011-2018)

China Association of Automobile Manufacturers

**Figure 5 Output and Growth Rate of Chinese Automobile from 2001 to 2018**

From 2012 to 2017, the industry-wide investment growth rate of Chinese automobile were 30.37%, 15.15%, 9.39%, 14.2%, 1.5% and 10.20% respectively. The declining growth rate indicating that simply relying on investment to expand production capacity cannot expand market share. Technical effect has become the focus of finished automobile manufacturers. Enterprises need to continuously increase R&D investment, improve product technology, master core technologies, form an innovation-driven development mechanism, and ultimately have technological advantages and enhance core competitiveness. Those who masters the core auto parts technology will be valued by the finished automobile enterprises. The parallel developing ability of parts enterprises similar to finished automobile enterprises has become the basic requirement for entering the complete supporting system. The development of automotive parts technology is drove by actively implementing finished automobile synchronous or advanced development with deeper involvement its development and production process. It can be judged that Chinese automobile industry will develop from "Made in China" to "Created in China."



Data Source: Chinese Automobile Industry Yearbook (2011-2017)

**Figure 6 Investment Growth Rate of Chinese Automobile Industry**

**4.2 New energy and intelligent networked automobile become mainstream when Chinese automobile industry face transformation and upgrading**

"Made in China 2025" initiative proposes to focus on "energy-saving and new-energy automobiles" and to master core automobile lightweight, information, and intelligent, technologies. Enhancing engineering and industrialization capabilities of core technologies such as intelligent control. Forming a complete industrial and innovation system from key components to finished automobile. In terms of new energy vehicle industrialization, the initiative puts emphasis on the lightweight research and application of chassis system. In the aspect of energy-saving vehicles, it promotes the application of lightweight materials and bodywork for aluminum alloy, magnesium alloy, high-strength steels, plastics and non-metal composite materials. While lightweight design should be realized in body work, chassis, power system and other core components. Since 2011, Ministry of Industry and Information Technology has successively issued "Several Opinions on Accelerating Integration of Informatization and Industrialization " (Ministry of Industry and Information Technology [2011] No.160) and "Notice on Special Funds Reporting for Development of Internet of Things in 2011" (Ministry of Industry and Information Technology ([2011] No.88) and other special projects. Intelligent networked automobile is one of key supporting areas, and technology roadmap of intelligent networked automobile also has been released. Notice issued by the ministry to implement the "Guidelines on Actively Advancing the



"Internet Plus" Initiative by the State Council (2015-2018)" to accelerate construction of industrial chain coordination by manufacturing enterprises such as automobiles and electronic information. The R&D system, which integrates various types of innovative resources, shall develop an Internet-based collaborative design model, and "develop Cyber Physical Systems (CPS) and apply it in key industries such as automobiles." Opinions on Automobile Industry Development in 13th Five-Year Plan" proposes to develop energy-saving and new-energy vehicles, and promote upgrading of advanced materials, key components, basic components, and high-end intelligent equipment. Automobile shall develop in direction of low-carbon, informatization and intelligent. As for development goals, it proposes to promote automobile intelligence and network connection, and to establish a foundation for the comprehensive promotion of intelligent networked vehicles.

In recent years, Chinese new energy vehicle adopted a technical route that focusing on pure electric vehicle (PEV), plug-in hybrid electric vehicle (PHEV), and observing and tracking hydrogen fuel cell vehicles(HFCV)(Li, Ren and Huang, 2017). PEV and PHEV are in hot sales. In 2017, the global sales of new energy vehicles were 1.2236 million with 58% year-on-year growth, of which 0.777 million were from China with 53% year-on-year growth (Dong, Xu and Pang, 2018).

At present, with rapid international intelligent automobile development, mainstream automobile manufacturers will master automatic driving technology within five years. In contrast, China has an obvious gap in terms of technology, infrastructure planning, related policies and test specifications.

#### **4.3 Chinese automobile parts industry is developing toward business globalization and technological innovation**

Chinese parts enterprises are faced with dual pressure of uncompetitive high-end products and increasing labor costs in low-end products. Automobile-related enterprises can effectively break industrial bottleneck to achieve rapid development by mastering technology from oversea mergers and acquisitions and upgrading its industrial chain. In recent years, encouraged by "self-developed core component" policy, increasing enterprises regard oversea bottom selling as the shortest path to obtain core technology. Especially after the global financial crisis in 2008, some Europe and America countries were shocked by economic crisis, and some vehicle parts enterprises were in financial crisis. This has provided favorable conditions for the acquisition of Chinese enterprises on a global scale. The domestic enterprises have increased overseas acquisitions through capital. They also have mastered the advanced technology and entered the international supporting market. For instance, Beijing Pacific Century (PCM) acquired Nexteer steering system of US General Motors, Weichai Power acquired French engine manufacturer Moteurs Baudouin and KION from Germany. China Aviation Industry Corporation (AVIC) acquired Henniges from the United States. China National Tire & Rubber Co., Ltd acquired Pirelli. Shenglong Group acquired more than 90% stock of BorgWarner's SLW Co., Ltd. in \$15.94

million. Beijing West Industry (BWI) acquired related business equipment, intellectual property, customers and product supply contracts of Delphi in less than \$90 million.

#### 4.4 Commercial vehicle market entered a “surplus in low-end and scarce in medium and high-end” stage

Commercial vehicle has always been the driving force behind Chinese automobile industry and market. From 1997 to 2004, domestic commercial vehicle market kept 10.5% annual growth rate, which higher than GDP growth rate. Among them, heavy truck sales grew at a rarely seen rate of 36.5%. Moreover, commercial vehicle made over 50% contribution to domestic market.

Since 2005, due to fundamental changes in overall demand structure of Chinese automobile market, automobiles became less commercial but more functional. Especially after 2010, Chinese commercial vehicle entered a mature stage as a whole. Slowing macroeconomic growth rate resulted in declining commercial vehicle sales, especially the heavy truck sales fell from 1 million in 2010 to 550,000 in 2015. Light truck and mini truck markets are relatively stable with small decline.

**Table 2 Output and Sales of Chinese Commercial Vehicle from 2010 to 2018**

Year	Output (10,000)	Annual growth rate	Sales (10,000)	Annual growth rate
2010	436.8	28.2%	430.4	29.9%
2011	393.4	-10.0%	403.3	-6.3%
2012	374.8	-4.7%	381.1	-5.5%
2013	404.2	7.6%	405.5	6.4%
2014	380.3	-5.7%	379.1	-6.5%
2015	342.4	-10.0%	345.1	-9.0%
2016	369.8	8.0%	365.1	9.0%
2017	420.9	13.8%	416.1	14.0%
2018	428.0	1.7%	437.1	5.0%

In the short-term, the increasing demand for raw materials like coal and steel, national overload-control management, the rise of logistics equipment has expanded the demand of heavy truck. While the rapid development of logistics and express delivery industry over past two years has driven the growth of medium and light trucks. Passenger vehicles sales were boosted by the rapid domestic tourism

industry development. Generally, demand for heavy truck and medium truck will increase because of supporting policies. The passenger vehicle market keeps steady growth. Passenger vehicles are still being competed by high-speed trains, and there is requirement space for new energy and urban buses (Li, Liu, Wang and Zhang, 2016).

In the long run, the growth rate of commercial vehicle is strongly correlated to macro economy. Fixed assets investment, road freight and passenger transportation are direct factors of commercial vehicle sales, and GDP growth rate has a strong positive correlation with future growth rate of commercial vehicles. The correlation coefficient can be above 0.9 between GDP growth rate and commercial vehicle growth rate in mature commercial vehicle countries such as the United States, Japan and Europe. In addition, industrial policy changes will lead to sale changes beside the macroeconomic impact.

The slowing Chinese macroeconomic growth has made it impossible for commercial vehicle sales to grow rapidly. The supply of domestic commercial vehicle continues to be “surplus in low-end and scarce in medium and high-end”.

#### **4.5 Automobile finance is accelerating the penetration into the entire automobile industrial chain**

Under the new normal of low demand growth in Chinese automobile market, competition is becoming more intense with declining profit. The sales of automobiles are transformed from sellers' market to buyers' market. Consumers become more rational when purchasing a car and they gradually become main buyers in diversified and personalized way. Secondly, marketing channel will shift from single 4S stores to 4S (3S, 2S) stores, large automobile stores and city exhibition halls. Extensive penetration of the Internet into post-automobile market will lead to major changes in business models in finished vehicle sales, second-hand vehicle trading, maintenance service, automotive parts supply, auto finance and auto service. It shifted from "product orientation" to "service orientation", "sales above service" to "service is priority", the transformation of business philosophy has enabled the dealers' revenue and profit structure to be continuously optimized. The proportion of new vehicle gross margin dropped sharply, while the gross profit proportion of post-market business such as auto finance and insurance, parts and maintenance services has increased significantly in Chinese automobile dealer's gross margin structure.

As the most valuable and energetic part of automobile industry value chain, auto finance service will greatly promote the industrial transformation and stimulate automobile consumption, and help manufacturers to occupy profit-bearing high point during transformation period. From perspective of market practice, automobile consumption loan from bank occupied dominant position in early developing stage. In recent years, with the relaxation of access and improvement of regulatory environment, auto finance companies have continuously expanded their asset scale. However, there are

still many bottlenecks in terms of policy, financing channels, scale development and marketization. Internet giants such as Alibaba and Tencent, as well as P2P lending companies stepped into auto finance, which also brought huge competitive pressures to commercial banks and auto finance companies. Meanwhile, continuous innovations from Internet enterprises in data accumulation, user experience, transaction payment will create more business models for auto finance market. Insurance companies, bonding companies, petty loan enterprises, and P2P online lending platforms all entered auto finance, and they competed for different target group markets by their respective advantages and differentiated positioning. Auto finance will become a new growth engine for Chinese automobile market and keep playing a key role in industry's structural adjustment.

Observing from current developing situation of Chinese auto finance market, it is urgent to develop innovative and efficient financial services in entire automobile industrial chain, and support refined and intensive mode transformation. Therefore, the future development direction of auto finance is supported by whole industrial chain to become a crucial method to resist traditional businesses decline and connect various service sections (Li, 2018).

## **5 Conclusion**

The paper studies the development tendency of Chinese automobile industry from the perspective of international industrial chain, and combines domestic and international automobile industry development to analyze specific manifestations of its development process. It proposes comprehensive, coordinated and sustainable development countermeasures based on unique development and opportunities of China. In the future, research shall be strengthened in strategy materialization and actualization, and then help the further development of Chinese automobile industry.

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# A Research on The Innovation Performance of Agricultural Science and Technology Achievements Transformation in Sichuan

Tang Ling, Wan Guochao

School of Management, Chengdu University of Information Technology, Chengdu, P.R China, 610103

(Email: tangling@cuit.edu.cn, wgc@cuit.edu.cn)

**Abstract:** This paper is based on the innovation theory, the competence theory and the sustainable competition theory. Using the method of entropy weight method combining gray comprehensive evaluation method, the performance evaluation method of agricultural science and technology transformation and innovation was established after perfecting the evaluation index system of innovation ability of agricultural science and technology transformation. It took the major agricultural science and technology conversion projects for empirical testing, and summed up the top-ranking enterprises shared experience, ranking the coexistence of enterprises after the issue, in order to provide meaningful reference and to forecast the value of agricultural enterprises for external investors.

**Keywords:** Agricultural science and technology; Achievements transformation; Innovation performance; Entropy method; Gray comprehensive evaluation method

## 1 Introduction

Under the background of the structural reform of the agricultural supply-side, it has become a consensus to "strengthen the driving force of scientific and technological innovation and lead the development of modern agriculture". Agricultural Science and Technology Achievements Transformation has greatly promoted the agricultural science and technology innovation in China (Mao Xuefeng et al., 2012). How to evaluate the technological innovation ability undertaken by projects, those problems are attracting more and more attention from the society.

At present, the research on China's Agricultural Science and Technology Achievements Transformation funds (referred to as agricultural transformation funds) can be divided into two aspects: Theoretical research and Empirical research. Theoretical research is mainly focused on the problems faced in the implementation of agricultural transformation funds, the evaluation index system on the transformation of agricultural scientific and technological achievements and other aspects (Wright, B., 2010). Empirical research is mainly focus on the evaluation of agricultural science and technology transformation funds, for example, The results of agricultural science and technology in Chengdu were studied by fuzzy comprehensive evaluation (Xu Bin, 2011). Through the questionnaire survey of 966 subjects of different types of agricultural science and technology innovation, the performance evaluation and comparative study were carried out on their patent authorization number, ability to drive farmers, and product sales income (Wang Zhidan, 2013). Based on the systematic study of the performance of the funds for the transformation of agricultural scientific and technological achievements in China, a performance evaluation system suitable for the transformation of agricultural scientific and technological achievements in China is constructed, and the performance of the national projects for the transformation of agricultural scientific and technological achievements from 2006 to 2010 is evaluated and analyzed (Zhang Li, 2014). The comprehensive evaluation method is used to evaluate the comprehensive performance of the funds for the transformation of agricultural technological achievements in different technical fields, regions and units (Liu Xiaobing, 2015). Through the inductive analysis of the existing literatures, the research on agricultural transfer funds focuses on the evaluation

of capital performance. The evaluation of scientific and technological innovation ability of agricultural transfer funds projects is still in its infancy, and the research carried out is often focused on the regional agricultural technology transformation. The evaluation is lack of comprehensive innovation ability analysis of the main enterprises of agricultural transfer funds and the research on innovation performance is even rarer.

After perfecting the agricultural science and technology achievements transformation innovation performance evaluation index system, based on the innovation theory, core competence theory and sustainable development theory, this paper establishes the agricultural science and technology performance evaluation method by combining the Entropy method with gray comprehensive evaluation method. This paper tests the major agricultural science and technology transformation projects during the “Twelfth Five-Year Plan” period in Sichuan Province and sums up the experience shared by the top companies and the problems of the coexistence of the lower ranking enterprises to find out research conclusions and implications. This paper enriches the agricultural science and technology innovation evaluation theory and has an important reference value for government departments, agricultural investors and agricultural managers.

In the evaluation of the innovation performance of agricultural science and technology transformation projects, according to the different process of transformation of scientific and technological achievements, a dynamic monitoring index system is put forward to evaluate the effect of transformation of scientific and technological achievements(Zhao Zhiyun et al.,2011).The evaluation index system of the transformation of agricultural scientific and technological achievements is constructed from five levels: policy evaluation index, economic benefit index, social benefit index, ecological benefit index and contribution rate index of scientific and technological progress(Dai Yuankun et al.,2012).The evaluation index system of applied development, soft science and basic research is constructed from three aspects of technology, benefit and risk(Jia Jingdun et al.,2015).This paper hopes to highlight the essential characteristics of agricultural science and technology innovation activities. In order to achieve the evaluation objectives, there are five basic principles must be followed in the setting of indicators: (1) Comprehensive principle. The performance of scientific and technological innovation is a multi-level, multi-dimensional complex system, covering everything from innovation investment to business performance, stressing the comprehensiveness and systematisms of evaluation indicators; (2) Scientific principle. Indicators should be selected around the essence of innovation performance in the transformation of scientific and technological achievements. The indicator system constructed can highlight the generality and particularity of agricultural science and technology innovation activities, and can also take into account the availability of data and the comparability of indicators; (3) Operational principle. The purpose of research of innovative performance evaluation methods is application. The selected indicators must be easy to obtain reliable data and accurate quantification from enterprises; (4) Prominent principle. The indicators are selected according to the evaluation aim and evaluation content, the characteristics of the scientific and technological achievements transformation project and the internal linkage between the indicators. Besides we must ensure the originality of the innovation performance evaluation method.

## **2 Construction of Innovation Performance Evaluation Model for Agricultural Science and Technology Achievements Transformation**

### **2.1 Agricultural science and technology achievements transformation innovation performance evaluation index system**

At present, scholars have proposed different indicator systems of agricultural science and

technology innovation performance. There are two main reasons for this: on the one hand, the situation involved in the transformation of agricultural science and technology is complex and diverse, the content involved in it is very specific, and the evaluation factors affecting its innovation performance are various; on the other hand, the research objects selected by scholars are different. People considers different internal and external environmental of the research subjects, which makes the screening process for the evaluation indicators of their innovation performance produce different results. Based on the basic principles of the establishment of agricultural science and technology achievements transformation innovation performance evaluation indicators, the agricultural science and technology achievements transformation innovation performance evaluation index system constructed in this paper is shown in Table 1.(1)In the aspects of agricultural science and technology achievements transformation and innovation input capacity, continuous investment in technological innovation is the endogenous driving force for sustainable growth of enterprises, and technological innovation capability is positively related to corporate performance, however, the most important factor affecting technological innovation investment is the input level of R&D, external financing amount and R&D staff density. Among them, the input level of R&D not only measures the intensity of R&D investment but also shows the importance attached to the ability of technological innovation. Selecting the density of technicians and the quantity of high-end agricultural talents not only takes into account the human capital investment but also considers the impact on the long-term development of the quantity and quality of technical labor. The amount of external financing reflects the level of external funding support for agricultural science and technology transformation projects. The R&D investment rate reflects the intensity of R&D investment and the importance of technological innovation. (2) In the aspects of agricultural scientific and technological achievements transformation into technological innovation output capacity, we should consider both technical output and economic output. From the perspective of intangible assets and fixed assets output, we need to select the number of domestic patent grants, the number of awards at the provincial and ministerial level, the number of conversion technology achievements, the number of new technology demonstration bases, and the number of new expansion and expansion lines to present technical output. Besides, we can consider the two levels of profitability and international competitiveness to measure economic output, the former uses the gross profit margin to reflect the impact of innovation on overall profitability of agricultural science and technology achievements transformation, while the latter uses export earnings to reflect the ability of agricultural scientific and technological achievements transformation enterprises to participate in international competition.(3)In the aspects of the transformation of agricultural scientific and technological achievements into sustainable development, the theory of sustainable development believes that the ability of sustainable development of enterprises is the ability to continuously obtain competitive advantage in the market. It comes from those valuable, scarce and non-replicable heterogeneous resources(Yuan Zeming et al.,2015).The sustainable development of agricultural science and technology transformation stems from the ability of serving regional economy(Zhou Mindan et al.,2017).Therefore, we can select four indexes(Industrial cross-integration, Achievement transformation area, Cultivate agricultural professionals and Cultivate new farmers) to represent the sustainability of creating excess profits and market value by companies.

**Table 1 Agricultural Science and Technology Achievements Transformation Innovation**

**Performance Evaluation Index System**

Primary Indicators	Secondary Indicators	Indicator Definition
Innovative Input	Technician Density ( $X_{11}$ )	R&D Technicians/Total Staff Number



Capability $B_1$	Talent Introduction ( $X_{12}$ )	The number of high-end agricultural science and technology talents introduced
	External Financing Amount ( $X_{13}$ )	Financial Investment, Equity Financing, Venture Capital and Bank Loan
	R&D Investment Rate ( $X_{14}$ )	R&D Spending/Operating Income
	Domestic Patent Grant Amount ( $X_{21}$ )	Patents, Invention Patents, Identification Results, New Varieties, Software Copyrights, Industry Technical Standards
	Received Higher than Provincial and Ministerial Level Awards ( $X_{22}$ )	Number of Awards at the Provincial and Ministerial Level
	Number of Conversion Technology Achievements ( $X_{23}$ )	Number of Conversion Technology Achievements
Innovative Output Capacity $B_2$	Number of New Technology Demonstration Bases ( $X_{24}$ )	Number of New Technology Demonstration Bases
	Newly Improved and Expanded Production Lines ( $X_{25}$ )	Newly Improved and Expanded Production Lines
	Gross Profit Margin ( $X_{26}$ )	New Profits and Taxes/Operating Income
	Export and foreign exchange generation earnings ( $X_{27}$ )	Export and Foreign Exchange Generation Earnings
	Industrial cross-integration ( $X_{31}$ )	Drive the Upstream and Downstream Industries to Achieve the Number of Output values
Innovative Sustainable Development Capacity $B_3$	Achievement Transformation Area ( $X_{32}$ )	Achievement Transformation Area
	Cultivate Agricultural Professionals ( $X_{33}$ )	the number of Agricultural Professionals
	Cultivate New Farmers ( $X_{34}$ )	the number of New Farmers

## 2.2 Construction of innovation performance evaluation model for agricultural science and technology achievements transformation

(1) Entropy method. The Entropy method is a method for objectively weighting data. The main steps of using the Entropy method to determine the index weight are: ① Dateless non-dimensional processing. The indicators selected in this paper are all positive indicators (that is, the numerical values change in the same direction with its reflected content), and there is no need to change direction. However, there are different magnitudes between the index values, so the data needs to be dimensionless. In this paper, the min-max method is used for standardization:  $\text{New data} = (\text{Initial Data} - \text{Minimum Value}) / (\text{Maximum} - \text{Minimum Value})$ . The data value after Min-max standardization is between 0 and 1 (closed interval). To ensure the calculation result of the Entropy method is practical, all

the data after standardization will be moved forward by 1 unit, so that the final indicator data will be obtained between 1 and 2 (closed interval). Then, according to the formula (1), we should calculate  $P_{ij}$ , the proportion of  $j$  indicator value to the sum of all  $j$  index values, by following a sequence. ② Calculate the entropy value of the  $j$  indicator according to formula (2). ③ Calculate the coefficient of variation  $G_j$  according to formula (3). ④ Calculate the weight  $W_j$  of the  $j$  indicator according to formula (4). Among them,  $\sum_{i=1}^n W_j = 1$ . The entropy weight obtained is the weight in constructing the agricultural science and technology transformation innovation index.

$$P_{ij} = r_{ij} / \sum_{i=1}^m r_{ij} \quad (m \text{ is the number of samples}) \quad (1)$$

$$E_j = - \ln(m)^{-1} \sum_{i=1}^m P_{ij} \ln P_{ij} \quad (2)$$

$$G_j = 1 - E_j \quad (3)$$

$$W_j = G_j / \sum_{i=1}^n G_j \quad (n \text{ is the number of indicators}) \quad (4)$$

(2) Gray comprehensive evaluation method. The gray comprehensive evaluation method is a method based on gray correlation analysis to compare the pros and cons of different objects. The specific calculation steps are as follows: ① Determine the optimal indicator set. An optimal value is selected from the same index of different evaluation objects, and the optimal value of each evaluation index is composed of the optimal index set. In this paper, all of the selected indicators are positive indicators, so the maximum value of each indicator is selected as the optimal indicator set, which is recorded as  $U^* = (r_{01}, r_{02}, \dots, r_{0n})$ . ② Combine the optimal indicator set with other indicator sets to form a matrix  $Z = \begin{bmatrix} r_{0j} \\ r_{ij} \end{bmatrix}$ .  $r_{ij}$  means the standardized data of the  $j$  indicator of the  $i$  evaluation object, where,  $i = 1, 2, 3, \dots, m; j = 1, 2, 3, \dots, n$ . ③ Calculation of gray correlation coefficient and determination of evaluation matrix. After the above processing, the optimal index set and the index set of evaluation objects are respectively determined as a reference sequence and a comparison sequence. The gray correlation coefficient between the  $i$  evaluation object and the  $j$  index of the optimal index set is  $\rho_{ij} = \frac{\min_i \min_j |r_{0j} - r_{ij}| + \xi \max_i \max_j |r_{0j} - r_{ij}|}{|r_{0j} - r_{ij}| + \xi \max_i \max_j |r_{0j} - r_{ij}|}$ ,  $i = 1, 2, 3, \dots, m; j = 1, 2, 3, \dots, n$ . In the formula,  $\xi \in [0, 1]$  is the resolution coefficient, it is generally taken as the value  $\xi = 0.5$ ;  $\min_i \min_j |r_{0j} - r_{ij}|$  is the minimum difference of two-level, and  $\max_i \max_j |r_{0j} - r_{ij}|$  is maximum difference of two-level, both of them are constants. The indicator  $r_{ij}$  is closer to  $r_{0j}$  of its optimal index set,  $|r_{0j} - r_{ij}|$  is smaller, and the gray correlation coefficient  $\rho_{ij}$  is bigger, indicating that the closer the evaluation object is to the optimal index, obviously,  $\rho_{ij} \in (0, 1]$ . At last, an evaluation matrix  $R = [\rho_{ij}]_{m \times n}$  will be formed.

(3) Formation of agricultural science and technology achievements transformation innovation performance evaluation model: linear integration of weight and gray correlation degree. Through the selection of evaluation indicators and the setting of index weights, the weights are linearly integrated with the gray correlation degree. The final model of agricultural science and technology achievements transformation innovation performance is as follows:

Agricultural Science and Technology Achievements Transformation Innovation Performance Evaluation Score =  $\sum$  Innovative input capability +  $\sum$  Innovative output capacity +  $\sum$  Sustainable development capability

$\sum$  Innovative input capability =  $\sum W_j \times \rho_{ij}, j=11, 12, 13, 14;$

$$\Sigma \text{ Innovative output capacity} = \Sigma W_j \times \rho_{ij}, j=21,22,23,24,25,26,27;$$

$$\Sigma \text{ Sustainable development capability} = \Sigma W_j \times \rho_{ij}; j=31,32,33,34.$$

### 3 Empirical Analysis on the Performance Evaluation of Agricultural Science and Technology Achievements Transformation Innovation

#### 3.1 Sample selection, data source and indicator processing

According to the above-mentioned agricultural science results and technology achievements transformation innovation performance evaluation index system, a questionnaire survey was conducted by 142 major agricultural scientific and technological achievements transformation projects completed since the “12th Five-Year Plan” in Sichuan Province. The questionnaire survey involved 59 super-species of agricultural and livestock specialties, 83 special agricultural specialties involve advantages and characteristics, 142 questionnaires were all recovered, 3 invalid questionnaires were eliminated, and 139 valid questionnaires were obtained. The questionnaire covers all evaluation indicators. Of course, some indicators are calculated based on the survey data. According to the dimensionless processing method mentioned above, the data is standardized, and the final index data is between 1 and 2 (closed interval).

#### 3.2 Weight calculation

According to the calculation steps and formulas of the Entropy method introduced above, the weights of each index about the index of agricultural science and technology achievements transformation innovation performance evaluation are calculated (see Table 2).

**Table 2 Determination of the Weight of Agricultural Science and Technology Achievements**

**Transformation Innovation Performance Evaluation Index System**

Primary indicators and weights	Secondary indicators	Weights
	Technician density ( $X_{11}$ )	0.160
Innovative input capability $B_1$	Talent introduction ( $X_{12}$ )	0.058
0.333	External financing amount ( $X_{13}$ )	0.075
	R&D investment rate ( $X_{14}$ )	0.041
	Domestic patent grant amount ( $X_{21}$ )	0.112
	Received higher than provincial and ministerial level awards ( $X_{22}$ )	0.109
Innovative output capacity $B_2$	Number of conversion technology achievements ( $X_{23}$ )	0.075
0.516	Number of new technology demonstration bases ( $X_{24}$ )	0.029

Innovative sustainabilityB <sub>3</sub> 0.151	Newly improved and expanded production lines (X <sub>25</sub> )	0.086
	Gross profit margin(X <sub>26</sub> )	0.029
	Export and foreign exchange generation earnings (X <sub>27</sub> )	0.075
	Industrial cross-integration (X <sub>31</sub> )	0.038
	Achievement transformation and extension area (X <sub>32</sub> )	0.034
	Cultivate agricultural professionals (X <sub>33</sub> )	0.029
	Cultivate new farmers (X <sub>34</sub> )	0.05

### 3.3 Empirical results and conclusion analysis

Through the calculation of the grey correlation coefficient and the determination of the evaluation matrix, the scores of the agricultural enterprise scientific and technological achievements transformation innovation performance evaluation of the sample enterprises are calculated and ranked according to the comprehensive innovation performance scores (see Table 3、 Table 4).

**Table 3 Sample Enterprise Agricultural Science and Technology Transformation  
Comprehensive Innovation Index Ranking (top 20)**

Item Number	Comprehensive Innovation Index	Innovation Input Index	Innovation Output Index	Sustainability Index	Item Number	Comprehensive Innovation Index	Innovation Input Index	Innovation Output Index	Sustainability Index
2012NC0022	0.315	0.326	0.327	0.252	2013NC0048	0.289	0.360	0.254	0.251
2012NC0008	0.300	0.271	0.315	0.313	2011CNZ0009	0.289	0.314	0.284	0.252
2013NC0009	0.298	0.316	0.298	0.254	2013NC0050	0.289	0.359	0.254	0.250
2013NC0047	0.296	0.371	0.261	0.250	2011CNZ0015	0.288	0.271	0.306	0.262
2013NC0046	0.295	0.371	0.259	0.250	2013NC0025	0.284	0.321	0.271	0.250
2011CNZ013	0.294	0.254	0.332	0.250	2013NC0011	0.280	0.261	0.299	0.252
2013NC0045	0.294	0.371	0.256	0.252	2013NC0034	0.279	0.260	0.300	0.250
2014NC0001	0.293	0.312	0.292	0.254	2011CNZ0003	0.279	0.255	0.302	0.252
2013NC0044	0.292	0.371	0.252	0.253	2012NC0011	0.279	0.262	0.298	0.251

2013NC0049	0.289	0.360	0.255	0.250	2011CNZ0023	0.278	0.275	0.288	0.251
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**Table 4 Sample Enterprise Agricultural Science and Technology Transformation Comprehensive Innovation Index Ranking(last 20)**

Item Number	Comprehensive Innovation Index	Innovation Input Index	Innovation Output Index	Sustainability Index	Item Number	Comprehensive Innovation Index	Innovation Input Index	Innovation Output Index	Sustainability Index
2012NC0010	0.254	0.257	0.252	0.250	2013NC0031	0.253	0.257	0.251	0.250
2014NC0029	0.254	0.256	0.253	0.250	2013NC0002	0.253	0.256	0.251	0.250
2011CNZ014	0.254	0.256	0.253	0.251	2013NC0038	0.253	0.251	0.254	0.250
2011CNZ005	0.254	0.253	0.254	0.252	2012NC0024	0.253	0.253	0.253	0.250
2011CNZ007	0.254	0.257	0.252	0.250	2014NC0022	0.253	0.254	0.253	0.250
2013NC0008	0.253	0.252	0.255	0.250	2014NC0011	0.252	0.253	0.252	0.250
2012NC0015	0.253	0.255	0.253	0.251	2014NC0006	0.252	0.253	0.251	0.250
2014NC0016	0.253	0.255	0.253	0.250	2013NC0014	0.251	0.253	0.250	0.250
2014NC0015	0.253	0.253	0.254	0.250	2014NC0019	0.251	0.252	0.251	0.250
2011CNZ001	0.253	0.255	0.252	0.250	2011CNZ0011	0.251	0.250	0.252	0.250

Through the ranking results of the sample enterprise's comprehensive innovation performance score and the analysis of the integrated innovation input capability, innovation output capability and innovation sustainability single index in the empirical analysis process, we can find:

(1) From the results of weight calculation, the innovation output capacity has the highest weight in the agricultural science and technology achievements transformation innovation performance score, indicating that the industrialization of agricultural science and technology achievements has a prominent role in agricultural science and technology achievements transformation. According to the coefficient of variation, the 15 secondary evaluation indicators can be divided into three categories: technician density, the patent authorization amount and the number of rewards at the provincial and ministerial level, and the sum of their weights reaches 38.1%; the second is the introduction of talents, the external financing amount, the number of foreign exchange earned by exports, the number of scientific and technological achievements in conversion, and the number of newly expanded production lines have a weight of nearly 37%. The weights of other indicators are no more different, and the impact on the innovation performance of agricultural scientific and technological achievements is equivalent.

(2) The experience shared by the top companies. According to the score of comprehensive

innovation performance, this paper selects the top 20 agricultural science and technology achievements transformation projects. The correlation trend of comprehensive innovation index, innovation input index, innovation output index and innovation sustainability index are shown in Figure1.

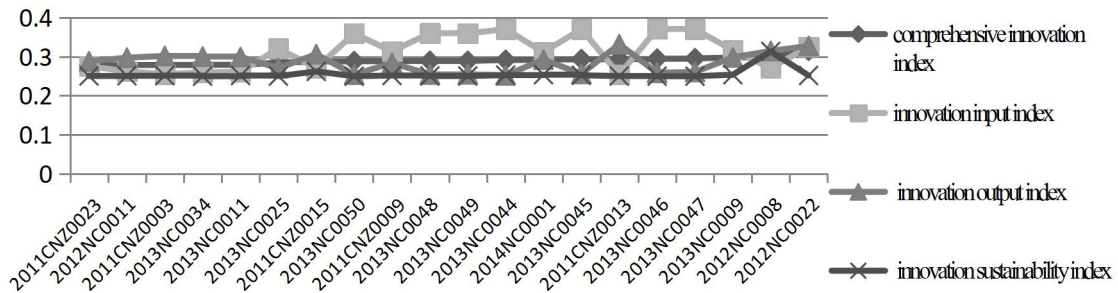
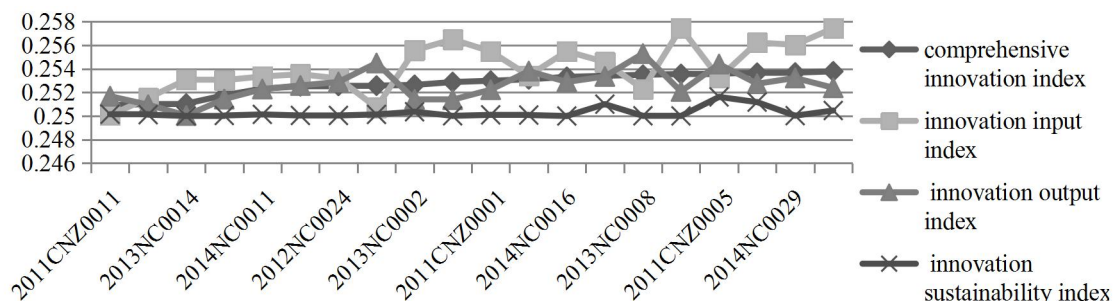


Figure1 The top 20 agricultural Science and Technology Transformation Project

### Innovation Index Correlation Degree Trend

As it can be found from Figure 1:(1) Innovation input capacity is generally higher. The average technician density of the top 20 enterprises reached to 49%, which was significantly ahead of the average technician density of 19% of the sample enterprises, and the overall quality of the employees was generally higher. The financing constraint is a little low, the average external financing amount of the top 20 enterprises reaches 45 million yuan, which is higher than the average external financing amount of 20 million of the sample enterprises, the external financing mode is diversified, the proportion of institutional investment and personal investment is generally higher than that of bank loans, and equity financing has become the main financing mode of the top 20 enterprises.(2) Innovation output capacity is generally high and balanced. The average patent authorization of the top 20 enterprises was 9.5, which was much higher than the average patent authorization amount of 3.5 items in the sample enterprises, and the average number of awards above the provincial and ministerial levels was 0.75, which was much higher than the average number of awards above and above 0.2 in the sample enterprises, and the gross margin for sales reached 34%, higher than the average gross, The profitability is higher, which reflects on the better growth.(3) From the geometric view, around the comprehensive innovation performance curve, the innovation input, innovation output and innovation Sustainable index curve of the top 20 enterprises have high convergence, which is generally in line with the trend of the innovation ability of enterprises. Moreover, the innovative sustainable index curve and the comprehensive Innovation Index curve have a higher degree of fitting, which indicates that the sustainable development ability has obvious effect on the basic optimization of agricultural science and technology innovation.(4) The Innovation ability of agricultural science and technology is in line with the development trend of regional science and Technology Service industry. Among the top 20 enterprises, the proportion of agricultural science and Technology transformation Enterprises in Chengdu is 65%, which is closely related to the importance of the development of science and technology innovation Drive strategy to the local science and Technology service industry, as well as the formulation and implementation of related policies, which promoted the development of agricultural Science and Technology Service industry in Chengdu, followed by is Meishan, which accounted for 20% Mainly the Meishan Government attaches great importance to the development of the kimchi industry, lift the strength of the city to promote, has been the Dongpo kimchi industry into a "tens of billions" of industries.

(3) The problem of the coexistence of lower ranked companies. According to the above, this paper selects the last 20 transformation projects of agricultural science and technology achievements according to the level of comprehensive Innovation index, and the correlation trend of its innovation performance is shown in Figure 2.



**Figure 2 Trend of Innovation Index Correlation Degree of the last 20 Ranking Agricultural Science and Technology Transformation Project**

As can be found from Figure2:(1) Innovation input capacity is low, lacking of technician. The average technician density of the latter 20 enterprises is only 6.5%, the overall quality of the staff is not high, and its R &D input rate is only 2.3%, which will affect the company's innovation activities. The financing constraint is higher, the average external financing amount of the latter 20 enterprises is only 4.9 million, only one enterprise obtains the investment of the institutional investors, the external financing way is mainly the financial science and technology investment and the mortgage loan, the industrialization development needs the capital quantity is extremely tight and difficult to obtain.(2) The ability of innovation output is generally poor. The average patent authorization for the last 20 enterprises was 0.45; the average number of awards above the provincial and ministerial levels was zero; the gross margin for sales was only 13%, which was lower than the average gross margin of 19% of the sample enterprises.(3) From the geometric view, around the comprehensive innovation performance curve, the innovation input, innovation output and innovation sustainable index curve of the last 20 enterprises are more dispersed, reflecting the imbalance of innovation ability. Moreover, the innovative sustainable index curve and the comprehensive innovation index curve show a low overall operation, which indicates that the sustainable development ability is poor.(4) As for the last 20 enterprises, there is only one company in Chengdu, most of which is distributed in the region where the scientific and technological service industry developed slowly.

## 4 Conclusion

This study draws the following conclusions and inspirations:(1) The density of technicians is of great significance to the improvement of agricultural science and technology achievements transformation and innovation performance. While increasing the R&D investment, senior executives of agricultural science and technology companies should vigorously improve the quality of R&D personnel, and increase the technological innovation capability of enterprises by introducing and cultivating high-quality R&D personnel to create excess profits and value. Government departments should increase support for the introduction and cultivation of high-level talents in agricultural enterprises; conduct

targeted vocational and technical training for personnel in the agricultural science and technology service industry, improve the professional quality and ability level of agricultural technicians; optimize colleges and universities. The institute's production, study and research cooperation methods encourage colleges and universities to reserve relevant talents for the agricultural science and technology service industry. (2) In terms of the number of patents, the distribution of patents among sample companies is not balanced. Most enterprises have less patent grants and weaker innovation capabilities. In terms of patent quality, the gap between invention patents representing higher technology content is even more disparity in sample companies. The average number of invention patents in the top 20 companies is 6.5 times than the average of the last 20 companies. Therefore, agricultural enterprise executives and government departments should encourage enterprises to pursue innovation in the "high-tech" field and promote the development of innovation-driven development strategies.(3) The direction of agricultural science and technology transformation and innovation should be in line with regional advantages and characteristics of agricultural industries, and improve the maturity of transformation technology. Guided by the "Belt and Road" national strategy, we will adjust the agricultural industrial structure and improve the international competitiveness of agricultural products. At the same time, it should be guided by agricultural science and technology policies, financial funds guidance, build a multifunctional synergy mechanism, and encourage agricultural enterprises, international financial institutions and other multi-field, multi-form to participate in agricultural science and technology transformation projects.(4) External investors can understand the basic situation of the company in terms of comprehensive innovation capability, market competitiveness and development potential through the transformation of agricultural science and technology achievements into innovative performance rankings, and then judge its market valuation to provide reference for investment decisions.

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## Six-Element Mode of International Science and Technology Cooperation in China

Mei Yanlan<sup>1,2</sup>, Xie Kefan<sup>3</sup>

1 School of Resource and Environmental Engineering, Wuhan University of Science and Technology, Wuhan, P.R.China, 430081

2 School of Management, Wuhan University of Science and Technology, Wuhan, P.R.China, 430065

3 School of Management, Wuhan University of Technology, Wuhan, P.R.China, 430070

(E-mail: meiyatlan@wust.edu.cn, xkf@whut.edu.cn)

**Abstract:**With the development of economy, science and technology globalization, the capacity of scientific and technological innovation in China has been enhanced. The boundary of the countries tends to dilute. It is obvious that the internationalization of science and technology innovation cooperation is very popular. The government of China adjusts the mode of international science and technology cooperation. The situation and trend of international science and technology cooperation in China are analyzed at first. And then the traditional trinity mode is analyzed. Meanwhile, the new mode of international science and technology cooperation is proposed. Finally, the conclusions and future works are summarized

**Keywords:** International science and technology cooperation; Trinity mode; Six-element mode; Cooperation mechanism;

### 1 Introduction

International cooperation is a remarkable mode of science and technology development. The science and technology involves cross-border and global cooperation among the multi-disciplinary and multi-field, and they are intersection, integration and mutual penetration. In order to promote the breakthrough of science and technology, it is necessary for scientists with different disciplines, different specialties and different cultural backgrounds to cooperate and communicate widely. Meanwhile, with the information globalization, networking and digitization, in view of this scenario of global interdependence the research methods and mode are changed which cooperate with all over the world. It provides a convenient way for the research and cooperation of science and technology.

The 21st century has been called the knowledge era, the international cooperation have been increasingly (Andrade and Carvalho, 2015), and knowledge, technology and information can easily be spread by countries (Keohane and Nye, 2001). Teemu et. al (2018) presented a novel concept of cross-border regional innovation system, which was introduced to assess the integration processes in cross-border regions. Wang and Xu (2018) believe that knowledge management ability has an indirect impact on innovation, exploratory learning ability has a significant impact on innovation, and knowledge-oriented high-level leadership can improve knowledge management ability and open innovation results (Jasimuddin and Naqshbandi, 2018). Saebi and Foss (2015) combine open innovation

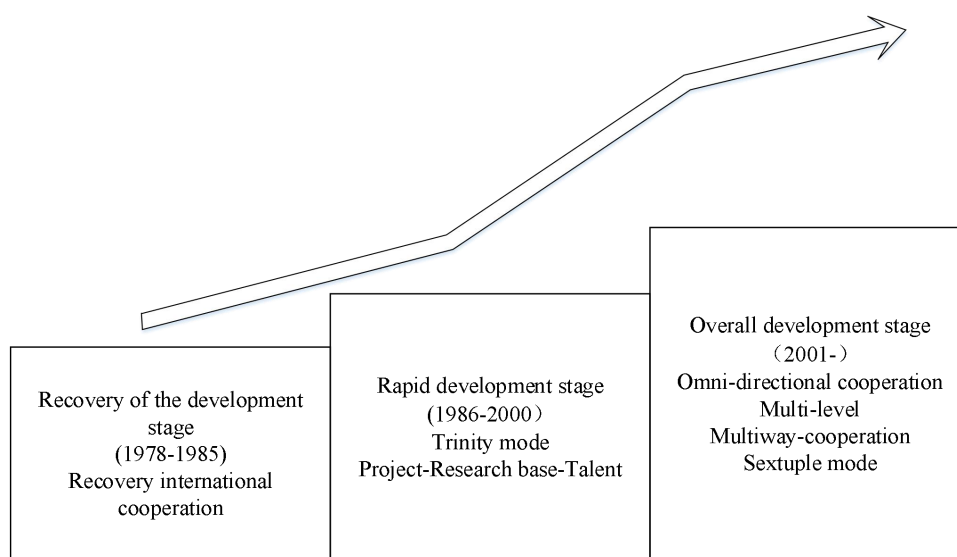
strategy with core business, and propose an open business contingency model. Zynga et al. (2018) through the investigation of 756 international organizations in the world, it is found that the standardization and organizational structure of the organization are the important influencing factors of open innovation. Calof et al. (2017) put forward the idea of open innovation in the form of innovation cooperation, and considered that the prospective performance of open innovation can effectively remove the obstacles to innovation. In the process of constructing sustainable and open scientific and technological innovation, we should pay attention to the ability of innovative value creation and value acquisition (Chesbrough et al., 2018). Chen et al. (2015) provide do pinions about the challenges and potential opportunities of German-Chinese cooperation in science and technology. However, there are fewer researches about the international science and technology cooperation mode.

Reform, opening up and innovation are the three force of China's rapid economic development (Cheng and Huizingh, 2014). Science and technology opening up and cooperation is one of most important factor for China to become second largest economy in the world. The situation of international science and technology cooperation in China is analyzed in Section 2. The trinity is analyzed, and then the new mode--six-element mode is provided in Section 3. Finally, the conclusions and future works are summarized in Section 4.

## **2 The Situation of International Science and Technology Cooperation in China**

### **2.1 Three stages**

The international science and technology cooperation in China can be divided into three stages, as shown in Fig. 1. (1) Recovery of the development stage (1978-1985). Recovering the international science and technology cooperate with international organizations such as the former USSR, Eastern Europe and the United Nations. (2) Rapid development stage (1986-2000). The trinity mode (Project-Research base-Talent) of international science and technology cooperation is effective and success. The international science and technology cooperation has developed rapidly. (3) Overall development stage (since 2001). The international science and technology cooperation presents an omni-directional, multi-level and multi-way cooperation trend.



**Figure 1 Three Stages of International Science and Technology Cooperation in China**

There has a lot of successful experience about international science and technology cooperation, and achieved a great success. China has established science and technology cooperation relations with 160 countries, signed 114 intergovernmental cooperation agreements, 346 talent exchange agreements, and participated in more than 200 international organizations and multilateral mechanisms. The construction of AIIB led by China, "The Belt and Road" and other major international strategic measures, as well as the construction of free trade zone, Guangdong-Hong Kong-Macau Greater Bay Area construction and other major actions, have expanded the geographical space and institutional space for the future opening and cooperation of international science and technology. It has been formed an international competitive advantage through integrate the international technology, such as the high-speed rail technology. There are many successful examples that gather global innovative talents and technology.

## **2.2 The trend of international science and technology cooperation**

The trend of international science and technology cooperation is shown in the following.

① The science and technology of western countries are more mature than China, which are in the dominant position. The competition of science and technology is getting fierce, especially in the strategic and strategic industries

② The new trade protectionism and environmental protection are proposed in the world. Trade war is taking place between the countries. The core technology becomes an indispensable magic weapon for the competition of international comprehensive strength.

③ International open innovation has become the main form of science and technology innovation. The international innovation cooperation has evolved from the three helix to the five helix used in political science and technology.

④It is very important that aggregate the innovation elements and technological in competition and cooperation.

⑤The structure of global technology governance and governance mechanism are undergoing profound changes. The technology groups in key areas, such as android and IOS in mobile operating system, may be concurrent technology groups.

In general, the trend of science and technology is to international cooperation and scientific and technological innovation.

### 3 The Six-element Mode of International Science and Technology Cooperation in China

#### 3.1 Traditional trinity mode

According to the condition and the stage of international science and technology cooperation in China, the trinity mode was proposed, and it has achieved certain success and experience. The trinity mode is project-base-talent, which integrate the international project, research base and talent. Project includes various forms of science and technology cooperation project, as shown in Fig.2. Base includes international science and technology cooperation bases, international cooperation laboratorie sand international joint technology centers. Based on the project and base, the talent is introduced, and share with resources and mutual benefit.The trinity mode has been adopted by many local governments and achieved success.It plays to the synergy of bases, projects and talents, and the limited financial investment in science and technology has brought into benefits.

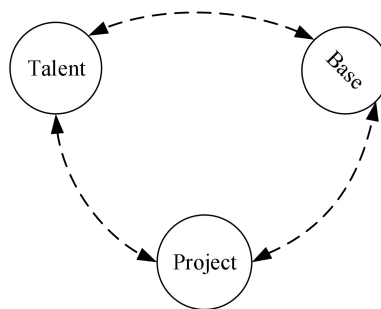
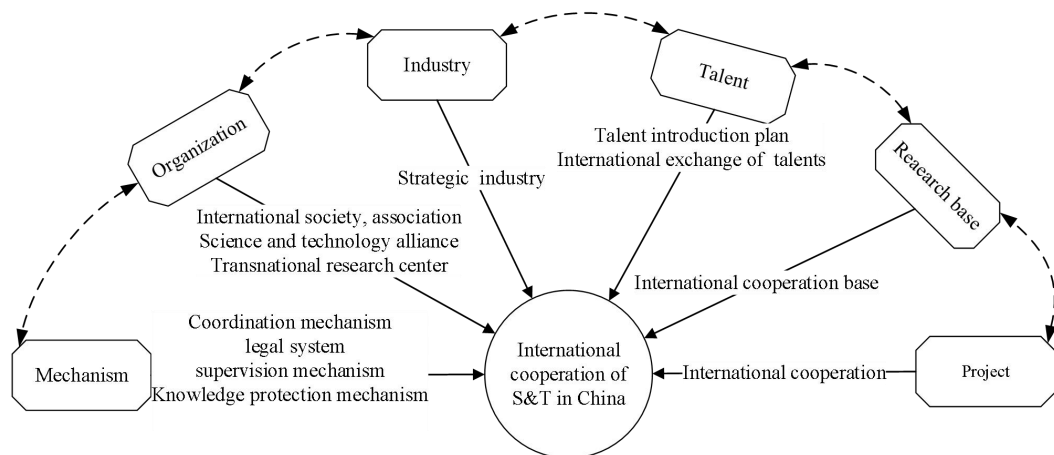


Figure 2 The Trinity Mode of International Science and Technology Cooperation in China

#### 3.2 The six-element mode

On the basis of the trinity model of project-base-talent,the six-element mode is proposed which includes project, base, talent, industry, organization and mechanism, as show in Fig.3. The six-element mode emphasizes cooperation with industries,organizations, and the advanced mechanism of science and technology cooperation. It is important to strengthen the linkage between the government, enterprises and institution, and the university-industry cooperation of universities.



**Figure 3 The Six-element Mode of International Science and Technology Cooperation in China**

About the industry, the international science and technology cooperation projects and bases supported by the state, which target key industries, especially strategic emerging industries, and should support the innovative development of key industries. In terms of the introduction of innovation elements, the talents should be introduced and emphasis on the introduction of innovation capital. We should introduce overseas public welfare science and technology funds and folk funds to China's public welfare research and basic research. Meanwhile, it is important to introduce venture capital, angel fund and private equity capital to invest in China's high-tech start-ups, which create a large number of gazelle enterprises and unicorn enterprises. Besides it, the science and technology insurance should be provided for overseas insurance companies, and suggest taking the lead in lowering the entry threshold of foreign insurance companies in the field of science and technology insurance.

About the organization, firstly, the overseas academic organizations and R&D innovation institutions are introduced. Secondly, the international societies, associations, science and technology alliances should be supported actively. Thirdly, it is a good way to encourage multinational companies to set up R&D centers or branches in China. Besides it, actively strive for Europe to set up international technology transfer stations in China, which has its own characteristics and can be connected with China's international technology transfer centers. Moreover, actively initiate, join and play a leading role in various forms of international alliances, for example, international science and technology alliance, research and development alliance, patent alliance and standard alliance and so on. Finally, it is important to join the global innovation network, or take lead in creating international innovation network in key and strength areas, and carry out in-depth cooperation and innovation by relying on it.

About the mechanism, we should actively introduce management system and operational mechanism about foreign science and technology innovation. It includes the central and local coordination mechanism, the legal system of science and technology, science and technology planning and supervisory system, promotion and protection system of the intellectual property, scientific and technical personnel evaluation system of long-term and short-term combination, scientific and technical personnel employment system of Tenure system, scientific and technical personnel salary system of annual salary system, science and technology project funds management system of contract system, academic holiday system, scientific and technical personnel flow system.

## 4 Conclusion

According to the analysis of the present situation and trend of international science and technology cooperation in China, the six-element mode was proposed based on the traditional trinity mode. The industry, organization and mechanism have been added to the six-element mode, which is more comprehensive and scientific.

However, the international science and technology cooperation of China is in the stage of overall development stage, and there are some shortcomings. In this paper, we just analyzed and studied the mode of international science and technology cooperation. The linkage of industry-university-research cooperation should be strengthening in the future.

In the further research, the introduction policy and mode of international science and technology cooperation in China be studied, and the way to learn from international cooperation. The deeply study about the industry, organization and mechanism will be researched.

## Acknowledgement

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# Research on the Development of Compound Fertilizer Industry Based on Patent Analysis

Liu Li

The Library of Wuhan University of Technology, Wuhan, P.R.China, 430070

(E-mail: lib-liuli@whut.edu.cn)

**Abstract:** Depending on Patsnap worldwide patent database and insights patent analysis platform, the development of compound fertilizer industry in China was clarified from the time and space, technology, assignee, and market value. The results showed that compound fertilizer industry increased rapidly, and mainly concentrated in the Yangtze River Economic Belt, the Pearl River and Huaihai River Basin provinces. Patents covered the formula, application, production and pack of fertilizers, but mostly focused on basic researches, lacking of core patents with uncoordinated number and quality. Enterprises became the main innovation part; whose patent applications are much higher than that of universities and institutes. Consequently, it would be considerable to promote the sustainable development of compound fertilizer industry in China, including strengthening cooperation between industrial production and scientific research, and guiding the involvement of intellectual property service agencies.

**Key words:** Patent analysis; Intellectual property; Compound fertilizer industry; Development trend

## 1 Introduction

As one of the most important forms of intellectual property, patent includes technical value, legal value and market value (Tseng et al., 2007). According to the big data mining and analyzing of patent information, the development of a certain technology or industry can be researched and tracked (Narin, 1995; Li et al., 2018). Since the middle of the 20th century, Schmookler proposed that patent information analysis could be applied to the studies of industry and related technology economy (Schmookler, 1950, 1953). Utilizing patent analysis, Sinigaglia et al (2019) mapped the development of the hydrogen fuel economy skills and Ardito et al (2018) investigated innovation dynamics of the Internet of Things domain. Additionally, the patent analysis will provide more effective and competitive information for enterprises and governments. Ribeiro and co-worker studied the patents of space debris mitigation, and noticed that the dominant spacefaring nations paid more attention to enhance the technologies of detecting and removing space debris from low Earth orbit (Ribeiro et al., 2018). Pilkington et al (2002) analyzed the assignees of the electric vehicle patents and found that car firms had formed links with competitors inside or outside the automobile industry to improve their technologies. Furthermore, promising and emerging technologies also will be monitored and forecasted through patent analysis (Kim and Bae, 2017; Joung and Kim, 2017). In summary, the comprehensive analysis of the patents in a certain field will provide suggestions and strategies for national industrial development (Li et al., 2018).

The development of the fertilizer industry is closely related to the agriculture evolution. As a new type of fertilizer industry, compound fertilizer has developed rapidly in recent years. The "No. 1 central

document" signed by the CPC Central Committee in 2007 and "Outline of the National Program for Long- and Medium-Term Scientific and Technological Development (2006-2020)" clearly pointed out that it was essential to accelerate the development of related technologies in the compound fertilizer industry and promote the structural adjustment of the fertilizer industry. Previous studies have analyzed the problems encountered by the compound fertilizer industry in China and put forward relevant countermeasures from the development status view (Zang et al., 2017; Chen and Wang, 2018). Based on the perspective of market economy, Xu showed that the transformation of commodity price, income growth rate of main operation margins, and market share of domestic high-end compound fertilizer (Xu, 2017). Moreover, the main production methods of compound fertilizer and its applications have been studied (Chen, 2000; Zhang, 2014). However, none of the above studies has studied the compound fertilizer industry from the perspective of patent information analysis. Patent is the combination of technology, law and market value, which is of great significance for the research and analysis of the industry development. Therefore, this paper takes the compound fertilizer industry as the research object, and analyzes its patent information to understand the development trends and research hotspots, to provide information support and reference for the development of China's compound fertilizer industry.

## **2 Data and Methodology**

The data were collected from the Patsnap worldwide patent database, covering more than 130 million pieces of patents information from 116 countries and providing accurate, multi-dimensional, visual intelligence in relation to patent, research and development. The patent retrieval was conducted on December 3, 2018. Key retrieval words included nitro\* and phosph\*, nitro\* and potas\*, phosph\* and potas\*, blend\*, formula, compound, mix\*, and fertilizer, and all the valid or reviewed patents were retrieved. After data deduplication and manual screening by experts of compound fertilizer field, 13,578 domestic patents were detected. Due to the time lag from application to publication, the patents in 2017 and 2018 are referenced only. The statistics mainly relied on the statistical analysis functions of Insights platform such as patent landscape and text clustering, and it made use of Excel, origin, and R Studio software to complete the data analysis and draw.

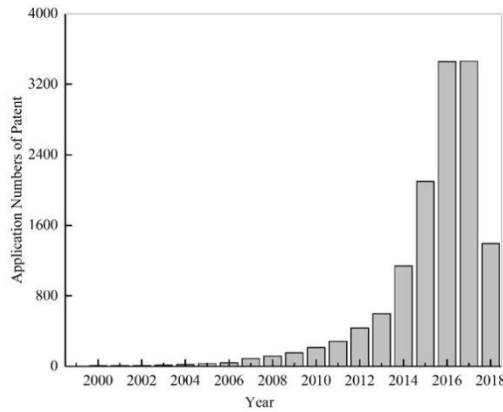
## **3 Results**

### **3.1 Time and space level**

#### **3.1.1 Development trend**

Since 1950s, blended fertilizers began to emerge in the international market, and various compound fertilizer production processes were born, opening the prelude of the compound fertilizer industry (Chen and Wang, 2018). From the Chinese patent applications of compound fertilizer (Figure 1), it revealed that the domestic patent application firstly appeared in 1999, and it developed slowly from 1999 to 2003, during which the average annual patent application was only 8 pieces per year. Starting from 2004, the patent applications had increased, with the average annual application of 80. With the development and promotion of soil testing and formula fertilization technology, the compound fertilizer industry had developed rapidly and patent applications quick increased from 2010 to 2014 at five times during the five years. The explosive growth started from 2015, and the patent applications reached 3,459 in 2016 that maintained an annual growth rate of about 150%. It is similar as the patents application of mixture fertilizer described in the previous study (Xiang, 2016). As mentioned in Chen and Wang (2018), this explosive growth is mainly due to the government's protection of intellectual property rights, the support

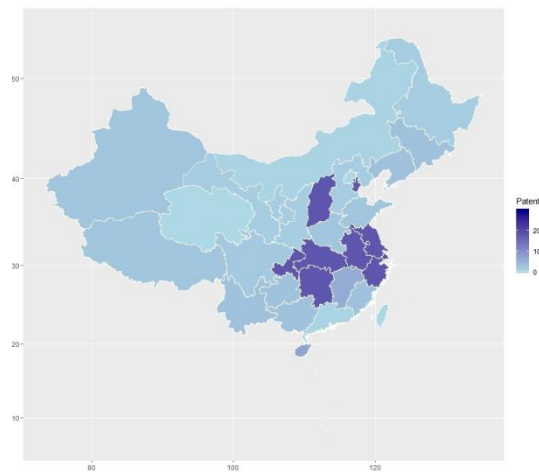
of national policies, the deepening supply-side reforms of agriculture and the structural adjustment of fertilizer industry.



**Figure 1** Development of the Patents of Compound Fertilizer Industry in China

### 3.1.2 Patent area distribution

Figure 2 shows the dominant provinces of the patent applicants of compound fertilizers. Applicants of patent in the compound fertilizer industry come from different regions and provinces, and they are mainly distributed in the Yangtze River Economic Belt and the Pearl River Basin, which accounts for 66.7% of the total domestic patent applications. Anhui and Guangxi Province rank the first and third place in patent application of compound fertilizer with nearly 3,000 and 1,400 patents respectively. In addition, the advantage of Shandong Province in the Huaihai River Basin is also obvious, which applies 1,814 applications and ranks second in all provinces. Patent applications of the northwestern provinces are relatively rare, that the total amount of Gansu, Xinjiang, Inner Mongolia, Ningxia and Qinghai provinces is only 397, which is lower than the national average of 435 pieces.



**Figure 2** Distributions of Patents of Compound Fertilizer in China

From the time and space level, the compound fertilizer industry in China started late, however, it has

dramatically developed in recent years with the national incentive and support. China has become one of the leading countries in the compound fertilizer industry. Nonetheless, regional differences in the development of compound fertilizer industry are serious, and it may relate to the regional agriculture environment and the provincial economic strength.

### 3.2 Technical level

#### 3.2.1 IPC classification

IPC is currently the only universal patent document classification tool in the world. The IPC group with a large number of patents is usually an active area for technology research and development (Liu et al., 2018). It can be seen from Figure 3 that the domestic compound fertilizer industry technology is mainly distributed in eight IPC sub-class, such as C05G (mixtures of fertilizers), C05F (organic fertilizers), and A01C (planting; sowing; fertilizing), accounting for more than 90%. Under C05G sub-class, C05G3 (mixtures of one or more fertilizers with materials not having a specifically fertilizing activity) is the most concentrated group, and C05G1 (mixtures of fertilizers covered individually by different sub-classes of class C05) is the second largest group, consistent with Xiang's research (Xiang, 2016). The C05F17 (preparation of fertilizers characterized by the composting step) is the most concentrated group in C05F sub class. Since C05C (nitrogenous fertilizers) and C05B (phosphatic fertilizers) are involved in the composition of compound fertilizers, there are a certain amount of applications. Additionally, some patents covered specific application of formula compound fertilizers, such as A01C (planting; sowing; fertilizing) sub class and A01G (horticulture; cultivation of vegetables, flowers, rice, fruit, vines, hops, or seaweed; forestry; watering) sub class.

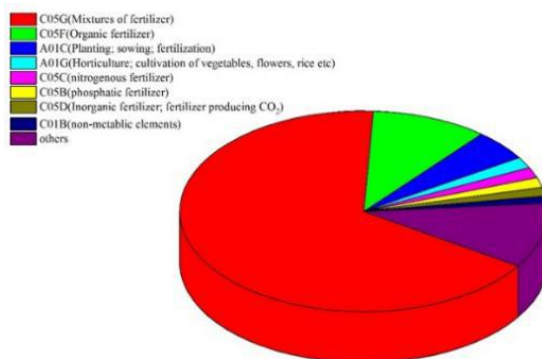


Figure 3 Main IPC of Compound Fertilizer Industry in China

#### 3.2.2 Technology topic

Using the Lingo3G text document-clustering algorithm, the most common keywords in the latest 10,000 patents of compound fertilizer field were extracted in the Insights patent analysis system, displaying the hotspots in the field. The most common 20 keywords of compound fertilizer industry are illustrated in Figure 4. There are four keywords with ultra-high frequency including phosphate amount, compound fertilizer, special fertilizer and potassium dihydrogen phosphate, which were included in more than 2000 patents. Organic matter, weight fraction, lower cost, slow release fertilizer, composite fertilizer and NPK fertilizer are also high frequency keywords that are contained in more than 450 patents. Patents containing other keywords are less than 200 pieces. Further analyzing these keywords, it could be found that phosphate amount, potassium dihydrogen phosphate, and NPK fertilizer are related to the basic composition of compound fertilizer; organic matter and composting fermentation are

inorganic-organic blending fertilizer technology; fixed connection, feeding port, dryer, and mixing tank are related to the mechanical equipment technology of compound fertilizer production.



**Figure 4 Technology Topics of Compound Fertilizer Industry in China**

Combined analysis of IPC classification and technology topic, the patents of Chinese compound fertilizer industry involve various aspects such as formulation, use, production and packaging of fertilizers. However, most of them are simple and centralized; mainly focusing on basic researches such as the fertilizer ratio of different nutrient and the improvement of formula ingredients, the research and development of industry-related technologies is still in its infancy.

### 3.3 Assignee level

The patent assignee is the owner of the patent right including law and use when the patent application is approved. From the perspective of structural composition, the assignee of Chinese compound fertilizer industry is mainly composed of enterprises, individuals and scientific research institutions. Patents of enterprises are significantly higher than that of individuals and scientific research institutions, accounting for 72%. In the top ten ranks of patent assignees of the compound fertilizer industry (Table 1), nine assignees are enterprises, and only one is research institution, namely the Guizhou University, but it ranks first with 211 patents, which are nearly 50 patents more than the Shenzhen Bartian Ecology Engineering Company as the second largest patent applicant.

Overall, the enterprises have become the most important part of technology development and promotion in the compound fertilizer industry with strong consciousness of intellectual property rights. Scientific research institutions have strong scientific research strength, but most of them have insufficient awareness of intellectual property protection and weak willingness of achievement transformation. It indirectly reflects that the cooperation between enterprises and research institutions is not close enough and further exploration and utilization should be developed.

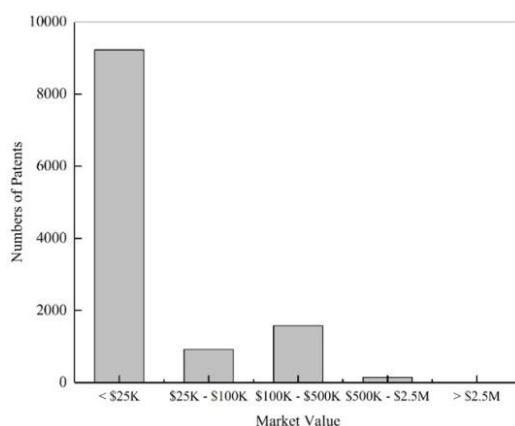
**Table 1 Top 10 Innovation Assignees of Compound Fertilizer Industry in China**

Assignee	No. of patent	Main IPC
GUIZHOU UNIV	211	C05G3; C05G1; C05F17; A01C21; C05G5
SHENZHEN BATIAN ECOTYPIC ENG	165	C05G3; C05G1; A01C21; C05G5
GUIZHOU KAILIN GRP CO LTD	130	C05G3; C05G1; C05F17
GUIZHOU KEXIN CHEMICAL CO LTD	123	C05G3; C05G1; A01C21

KINGENTA ECOLOGICAL ENG GRP	119	C05G3; C05G1; A01C21; C05G5
ANHUI SIERTE FERTILIZER IND	114	C05G3; C05G1; C05F17; A01C21; C05G5
QINGDAO HAIYICHENG MANAGEMENT TECH CO LTD	105	C05G3; C05G1
STANLEY AGRI GRP CO LTD	95	C05G3; C05G1; C05F17; A01C21; C05G5
DENGFENG LAOSHUAN FER CO LTD	82	C05G3; C05G1; A01C21
MAANSHAN KEBANG ECOLOGICAL FER CO LTD	71	C05G3; C05G1; C05F17; C05G5

### 3.4 Market value level

Patent market value analysis is one of the core functions of Patsnap, which analyses simple patent families using a set of 25 objective value indicators (e.g. forward- and backward-citations, patent family sizes, geographical coverage, patent age, legal status etc.) and visually reflects the market value of patents in the form of currency valuation (excluding design patents). Comparing with different values, it is possible to better evaluate the strength distribution of patents and help to judge the research and development focus in the technical field. Generally, the higher of patent market value, the stronger of core technology. As described in Figure 5, there are only five core patents with a patent market value higher than 2.5 million dollars, accounting for about 0.04%. In contrast, the market value of 9224 patents are less than 25,000 dollars accounting for 77.7%.



**Figure 5 Market Value Distributions of Patents of Compound Fertilizer in China**

Further analyzing the 10 highest currency valuation patents of the compound fertilizer industry (Table 2), it is found that the top ten patents owners are foreign companies, that 5 of them come from US companies, and the others are averagely distributed in Germany, Canada, Japan, the Netherlands and Israel companies. In addition to their own research capabilities, US companies have precise investment vision and improve their competitive strength by purchasing other core technologies such as CN101687720B, CN102781880B and CN100434399C. From the technical view, the top ten patents' skills are mainly concentrated in C05G and C05C, consisting with the main IPC structure of the compound fertilizer industry. In particular, the IPC classification of the highest valuation patent is C02F,

and it involves the conversion of organic sludge into inorganic-organic compound fertilizer technology, which belongs to the cross filed of wastewater treatment and compound fertilizer preparation. Moreover, CN102369171B applied by Japanese company is also a technological research in the cross-disciplinary field that mixed pesticides and chemical fertilizers.

As stated previously, there are large amounts of general patents, but lacking core patents and mismatching between the number and quality of patents would restrict the development of compound fertilizer industry in China. Nowadays, the core technology of the compound fertilizer industry is still in the hands of European and American countries, and these companies are sensitive to the market by paying great attention to the global layout. It is worth noting that cross-field research is one of new directions in compound fertilizers industry, which has higher technical requirements and greater market values.

**Table 2 Top 10 Market-valued Patents of Compound Fertilizer Industry in China**

Patent	Current assignee	Country	Value (USD)
CN101687720B	ANUVIA PLANT NUTRIENTS CORPORATION	USA	\$3,420,000
CN101945837B	FERTIVA	GERMANY	\$3,020,000
CN101287688B	ARCHER DANIELS MIDLAND	USA	\$2,800,000
CN102781880B	ANUVIA PLANT NUTRIENTS CORPORATION	USA	\$2,620,000
CN104271535B	UNITY FERTILIZER	USA	\$2,570,000
CN103547550B	SULVARIS INC	CANADA	\$2,300,000
CN102369171B	KUMIAI-CHEM IND	JAPAN	\$2,220,000
CN102300835B	ROYAL DUTCH SHELL	NETHERLANDS	\$2,130,000
CN100434399C	MOSAIC CORP.	USA	\$2,030,000
CN101400627B	ROTEM AMFERT NEGEV LTD	ISRAEL	\$1,740,000

### 3.5 Limitation

Compared with Chen and Wang's research, Kingenta, Xinyangfeng and Stanley were the top three companies of market share in the Chinese compound fertilizer industry (Chen and Wang, 2018); however, the patent applications of these three companies were less. Kingenta and Stanley were ranked in the fifth and eighth, respectively, and Xinyangfeng was not in the top ten. This inconsistency between market share and patent application is not analyzed in the research due to lacking of market data, but the further analysis will provide more comprehensive information to promote the development of compound fertilizer industry. Besides bibliometric patent analysis, patent portfolio has become one of the new approaches for distinguishing and measuring the core skills and market competitiveness of patentee. Therefore, the patent portfolio of entire compound fertilizer industry could be studied further to help Chinese enterprises to compete and control overseas market.

## 4 Conclusions

According to the analysis of the relevant patents related to the domestic compound fertilizer industry, it shows that the compound fertilizer industry has entered a rapid development stage in China with the implementation of the national fertilizer industry strategy. Until December 2018, the number of patents has reached more than 13,000. Domestic enterprises, scientific research institutions and individuals at the Yangtze River Economic Belt, Pearl River and Huai River Basin have invested a large amount of capital and human resources in the research and development of compound fertilizer industry technology. The prospect of compound fertilizer industry is increasingly promising. From technical view, it involves various aspects such as formulation, use, production and packaging of fertilizers.

However, most of them focus on basic research such as the ratio of different nutrient, which is simple and easy to be copied. From the perspective of the assignee, the enterprise is the main innovation body of the compound fertilizer industry, who plays an important role in the technology development and promotion of the industry. Although the scientific research institution has strong scientific research strength, it always neglects the protection of intellectual property rights and the transfer of the technology. From the perspective of market value, there are large amounts of patents in China, nonetheless, it lacks key patents and the number and quality of patents are obviously uncoordinated. The top ten patents with the highest valuation of compound fertilizer industry belong to the foreign companies and the cross technologies between compound fertilizer industry and other fields will have greater market value.

Therefore, the following suggestions are proposed for the patent technology innovation activities of Chinese compound fertilizer industry:

(1) Deepen the supply-side reform, formulate an industrial strategy conformed to current development needs, and lead the healthy and sustainable development of China's compound fertilizer industry;

(2) Further promote the cooperation of industry, university and research institutes, give full play to the research and development advantages of scientific research institutions and the market sensitivity of enterprises, and improve the innovation ability of the compound fertilizer industry;

(3) Emphasize cultivating compound and innovative talents, increase the research and development of core technologies, explore cross-development with other fields, strengthen patent layout, and enhance international competitiveness;

(4) Guide the involvement of intellectual property service agencies, improve intellectual property and legal awareness, enhance intellectual property protection and risk control capabilities, strengthen analysis of industrial situation and market demand, and provide information support for technological innovation of the compound fertilizer industry.

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# Research on the Improvement of Mental Health Education Ability of College Counselors Based on Knowledge Management Process

Zhu Xi

College of Automotive Engineering, Wuhan University of Technology, Wuhan, P.R.China, 430070

(E-mail: 1192282575@qq.com)

**Abstract:** In recent years, the mental health problems of college students in China have become increasingly serious, which has brought severe challenges to the educational management of colleges and universities. College counselors are the major managers of college students in school, and also the main participants in solving the psychological problems of college students. Therefore, it is necessary to improve counselors' ability in mental health education to cope with various psychological problems of college students. By adopting the methods of investigation, comparative study, literature study and qualitative analysis, this paper analyses the reasons for the insufficiency of mental health education ability(MHEA) of college counselors at present, studies the concept and process of knowledge management(KM), the concept and composition of MHEA of college counselors, and holds that knowledge is the core resource of MHEA of college counselors, and KM theory can be applied to the research of improving counselors' ability of mental health education. Based on the process of KM, the model of improving MHEA is built up. In accordance with the key points of knowledge acquisition, knowledge storage, knowledge sharing and knowledge innovation, countermeasures such as combining professional training with self-learning, knowledge platform construction with mental health archives construction, learning organization construction with multichannel communication, and the integration of incentive mechanism construction with practice and innovation are proposed. This paper provides a new research perspective and ideas for the improvement of college counselors' ability in mental health education, and enriches the research theory, which has a strong practical guiding significance for improving counselors' ability in mental health education and effectively solving the psychological problems of college students.

**Key words:** Knowledge management; Process; Colleges and universities; Counselors; Mental health education ability

## 1 Introduction

In recent years, the mental health status of college students does not look optimistic. Based on the existing research, the number of college students with psychological problems is increasing, which

brings serious challenges to the work of college education (Yu Guoliang, 2018). As an important supplementary force of mental health education in colleges and universities, counselors need to talk with students with mental distress and psychological crisis on a regular basis and offer psychological counseling and guidance. Meanwhile, they should pay close attention to students with serious psychological problems and intervene in time in order to prevent the occurrence of major mental crisis events among students. The role and orientation of counselors in guiding students determines that counselors must have good ability in mental health education.

However, it is a complicated job to carry out mental health education among college students, which requires professional knowledge and skills in psychology, pedagogy and sociology. Many counselors do not have relevant professional backgrounds, resulting in their lack of knowledge reserve. Meanwhile, most counselors are fresh graduates and postgraduates, who are insufficient in the ability and experience to find and solve problems. Worse still, since the daily work is very trivial, complex, they just cannot concentrate their energy on their work, and sometimes they even have no time to take into account the work of mental health education, which eventually leads to the failure of counselors to carry out mental health education in a timely and effective manner on many occasions. Therefore, it is necessary to improve counselors' ability in mental health education.

Knowledge management (KM) is an important management theory in the era of knowledge economy. As a typical knowledge-intensive organization, colleges and universities have the basic conditions and abundant foundation for KM. This paper tries to study the improvement of college counselors' mental health ability from the perspective of KM process, and puts forward corresponding countermeasures and suggestions. The existing research findings mainly apply KM theory to the research of counselors' team building. The research contents mostly concentrate on the team building, specialization, knowledge sharing, management of college counselors and the construction of professional competence evaluation model based on KM. However, from the perspective of KM process, the research on the improvement of counselors' ability in mental health education is scarce, and the research perspective and ideas are relatively novel, which has great theoretical and practical research value.

The modern campus mental health education originated in the United States and developed first in Britain, France and other countries, but the trend of localization in practice development is obvious (Pan Xin, 2017). Counselors are the byproduct of our country's unique education model system and an important part of our country's education system. Therefore, there are few studies abroad on the improvement of mental health education ability (MHEA) of college counselors in China based on KM process.

In China, some scholars have carried out research on the improvement of counselors' ability in

mental health education, which mainly focuses on the content analysis, factor analysis, path, measures and strategies of the improvement of college counselors' ability in mental health education. For example, Sun Yuan thinks that colleges and universities should adopt such strategies as school support and counselors' self-improvement to enhance counselors' ability in mental health education (Sun Yuan, 2012); Xue Jihong thinks that colleges and universities should build a scientific training system to improve counselors' ability in mental health education (Xue Jihong, 2009); Luo Pinchao believes that college counselors should constantly improve their core competence of mental health education by strengthening the study of psychological knowledge, participating in the practice of mental health education, setting up an online learning platform, and holding psychological salons on a regular basis, so as to meet the needs of the development of higher education (Luo Pinchao, 2008).

There are also scholars who apply KM theory to the study of counselors' team building. Their research mainly focuses on the team building, specialization, knowledge sharing, management of college counselors and construction of professional competence evaluation model based on KM. For example, Zhu Jianfei believes that to apply KM theory into practice in the construction of college counselors, it is necessary to pay attention to the top-level design, establish relevant organizations and technical platforms, build exclusive and efficient "knowledge base" and actively promote the sharing and dissemination of tacit knowledge in counselors' work field (Zhu Jianfei, 2017); Yu Jiangtao and Liu Shiyong believe that counselors should carry out KM from the aspects of strengthening the study and accumulation of knowledge on student affairs, dissemination and sharing, development and application, innovation and regeneration, etc. (Yu Jiangtao, Liu Shiyong, 2013).

At present, the research on improving counselors' ability in mental health education from the perspective of KM process is relatively scarce in China, but the existing research results still open up ideas for this study and provide experience for reference.

## **2 The Concept and Process of KM**

Knowledge is the subjective reflection of human beings, which can be divided into explicit knowledge and tacit knowledge based on its level of expression (Yan Yun, 2005). To enhance the adaptability and competitiveness of organizations and individuals, people urgently need to convert tacit knowledge into explicit knowledge, which is the key to KM (Zhu Jianfei, 2017).

KM was first put forward at the end of the 20th century. So far, there has been no unified expression of its concept. Bassi (Bassi, 1997) believes that KM is the process of creating and acquiring knowledge to enhance the performance of an organization. K. Wiig (K. Wiig, 1997) holds that KM mainly involves four aspects: top-down monitoring and promoting knowledge-related activities; creating

and maintaining knowledge infrastructure; renewing organization and transforming knowledge assets; and utilizing knowledge to improve its value(Chen Wei, 2014). The definition of KM in China mainly has the following two perspectives: first, the narrow and broad concept of KM put forward by Professor Qiu Junping. Second, Professor Zuo Meiyun proposed the division of KM definitions into the technical school, the behavioral school and the comprehensive school(Chen Wei, 2014). Although the expression of the aforementioned concepts is inconsistent, their connotations are the same. KM is a management concept that regards knowledge as an important resource and people as the core. It relies on information and network technology to collect, process, organize, sort out and disseminate knowledge, which gives full play to people's creativity, improving the accumulated value-added knowledge of individuals and organizations, so as to obtain better adaptability and competitiveness.

In terms of the division of KM process, many different methods have been proposed. Huang Yunjie and Liu Dongrong divide KM into knowledge acquisition, knowledge transfer, knowledge sharing and knowledge application based on process management(Huang Yunjie, Liu Dongrong,2010); Tian Shuo and others thought that KM can be divided into four dimensions: knowledge acquisition, sharing, use and creation, when they were doing research on KM analysis framework, which was based on the process perspective(Tian Shuo,2010). Chen Hongmei and others divided KM into four basic processes: acquisition and creation of knowledge, organization and storage of knowledge, transmission and sharing of knowledge, application and innovation of knowledge when they studied the design of training mode for business management professionals based on KM process(Chen Hongmei,2015).In view of the previous research findings and the needs of social development under the new situation, this paper attempts to divide the process of KM into four basic processes: knowledge acquisition, knowledge storage, knowledge sharing and knowledge innovation.

### **3 Definition and Composition of MHEA of Counselors**

So far, the academia has not put forward a relatively complete and unified concept of MHEA. For the time being, most scholars tend to think that MHEA is mainly that educators use the psychological knowledge and skills acquired according to the characteristics of educational objects to help them improve their mental quality, promote their mental health level, develop their psychological potential, cultivate their good psychological ability, which bestows them with the ability of overall development of personality and comprehensive quality(Pan Xin, 2017).

The role orientation of college counselors and full-time psychological teachers in mental health education is different. The role orientation of counselors is the demonstrator and nurturer of mental health(Hui Xiao,2017), the defender, discoverer, counselor, referral and tracker of mental problems. However, the orientation of full-time psychological teachers is the consultant and the therapist. The

breadth and depth of their orientation are different, so their requirements of MHEA are also different.

Through literature research and survey, combined with the orientation of counselors' mental health work and actual needs of work, the composition of counselors' MHEA is analyzed as follows:

First, it is necessary to get the hang of the basic knowledge of psychology. Dealing with psychological problems is a complex task. Counselors participating in mental health education should master basic psychological knowledge, such as general psychology, developmental psychology, personality psychology, mental health counseling, adolescent psychology and social psychology, etc.(Gu Yanqun,2017). Meanwhile, counselors should also be proficient in various skills of mental health education and apply the knowledge they have learned to practical mental health education.

Secondly, the ability of finding psychological problems of college students should be cultivated. Psychological problems often have a greater impact on college students' daily learning and life. Counselors should be good at observing students' interests, learning situation, behavior, emotions and feelings. Students with abnormal situations should be measured and analyzed by psychological methods, and counselors are supposed to communicate with students to understand the actual psychological situation of students for further confirmation.

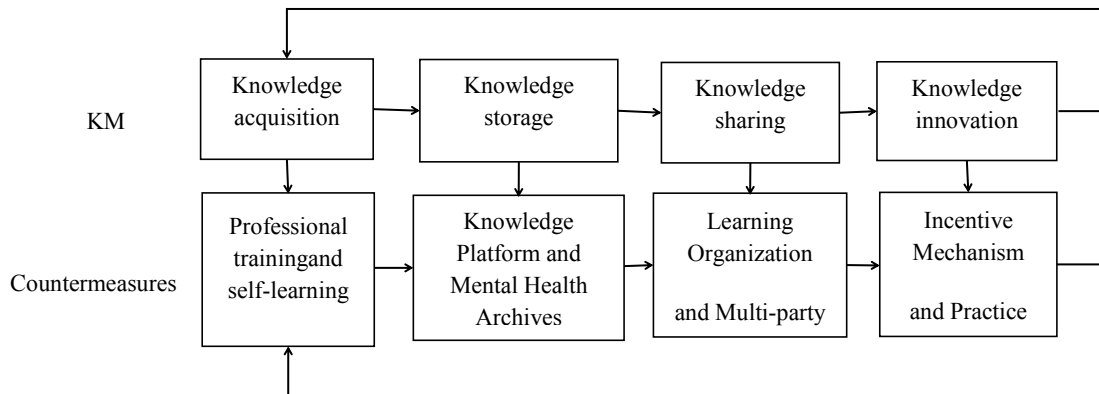
Thirdly, the evaluation ability of college students' psychological problems should be mastered. Counselors should integrate and analyze the psychological information of college students based on psychological knowledge they have learned, identify the types of psychological problems of college students, and evaluate the severity of psychological problems.

Fourth, the ability to solve psychological problems of college students should be acquired. If the psychological problems of college students are general psychological distress, counselors can actively intervene in them and apply the knowledge and skills of mental health education to solving the students' psychological confusion, offering guidance on the students' psychological mood and eliminate the psychological problems in the embryonic stage. If it is more serious mental illness and psychological crisis, counselors should provide timely referral to full-time psychological counseling teachers to cope with.

From the aforementioned analysis of the concept and composition of counselors' MHEA, counselors' MHEA is an ability, which is centered on counselors' knowledge and skills. The cultivation and improvement of counselors' MHEA cannot be separated from the development of knowledge resources, which is fully in conformity with the concept of KM. Therefore, the concept that KM is introduced into the research on the enhancement of counselors' MHEA is not only rational but also completely feasible.

#### 4 Strategies Based on KM Process to Improve MHEA of Counselors

The improvement of counselors' ability of mental health depends not only on the efforts of counselors themselves, but also on the corresponding measures taken by universities to provide better conditions for counselors. With the KM process as the key line, colleges & universities and counselors can be well integrated, with the two parties complementing each other.



Aiming at improving counselors' ability in mental health education, this paper puts forward four countermeasures in accordance with the focus of work during the four stages of KM process, and builds up a model of improving college counselors' MHEA based on KM process (Fig.1). Through the implementation of this model, the dynamic improvement of counselors' MHEA can be realized.

**Figure 1 Improvement Model of MHEA for Counselors Based on KM Process**

##### 4.1 Professional training and self-learning based on knowledge acquisition

Knowledge acquisition is the first stage of KM, the foundation of KM, and the basis of professional competence enhancement. Therefore, the key task at this stage is to enable counselors to acquire knowledge.

Colleges and universities should strengthen the training of counselors, institutionalize, and standardize it. Training is an important way to improve college counselors' MHEA. Colleges and universities should regularly organize counselors to participate in professional and systematic training, hire professors and experts in psychology to circulate their experience and skills, and systematically improve counselors' mental health education knowledge and skills.

Counselors themselves should also strengthen their self-learning. First of all, counselors should make clear their role in higher education through learning, and constantly strengthen their awareness of mental health education. Secondly, they should constantly expand their knowledge reserve. College

students' psychological problems are often comprehensive problems, which require counselors to strengthen the accumulation of knowledge in psychology, general psychology, personality psychology, mental health counseling, adolescent psychology, social psychology, etc. Thirdly, counselors should actively take the initiative in learning. College students have many kinds of psychological problems, so counselors should actively learn through the Internet, training courses online, professional papers, professional books and other ways to solve the problems in an effective manner in view of their own situation and the actual problems they encounter. Finally, counselors themselves should also strengthen the improvement of self-psychological quality and self-psychological adjustment ability in order to deal with various emergencies in psychological education more calmly and efficiently. Meanwhile, counselors also need to shape a good image of being good at solving problems, caring for students and being positive in the hearts of students, so as to set an example for college students' mental health, and stimulate students' enthusiasm and expectation for a better life.

#### **4.2 Knowledge platform of mental health education and construction of mental health archives based on knowledge storage**

Knowledge storage is the second stage of KM, in which explicit knowledge and tacit knowledge can be analyzed and systematized, and knowledge can be saved, retrieved and reused by establishing a database. Therefore, the main task of this stage is to establish a series of data resources that are beneficial to mental health education.

Colleges and universities should establish a knowledge platform for mental health education. Counselors can use the prediction function of big data to predict students' potential crisis psychology and behavior by analyzing the changes of students' relevant data, and effectively identify students with psychological crisis. Furthermore, the knowledge platform of mental health education should have a knowledge base of mental health education, a tool to support acquisition, classification, editing and storage of knowledge, an instrument to support teachers and experts to share, apply and innovate knowledge, and a function to connect with the Internet(Wang Xin, 2008). The establishment of the platform not only can help counselors and students easily achieve knowledge acquisition, storage, sharing, application and innovation, but also builds up a communication bridge between students, counselors, psychological counseling teachers and experts on the basis of the Internet, which is of great help to improve counselors' MHEA.

Counselors should establish students' mental health archives. The main purpose of establishing students' mental health archives is to understand and keep track on students' mental state, and then put forward pertinent measures and solutions. On the one hand, counselors can select students with abnormal psychological symptoms through the "Mental Health Questionnaire", and through in-depth



communication, understand the root causes of the problem, give corresponding psychological counseling, and finally establish psychological archives for follow-up observation, effective intervention in case of abnormal situation(Gao Liwei,2011). On the other hand, counselors can also dynamically record and manage students' daily learning, work, life and other information, focusing on students who have gone through major life events, timely keep track on their psychological changes and dynamics, so as to effectively target the groups that need to be mainly concerned about, carry out effective psychological intervention in advance, and enhance the effectiveness and initiative of work.

#### **4.3 Construction of learning organization and multiparty communication based on knowledge sharing**

Knowledge sharing is the third stage of KM, and an important stage to realize the transformation from tacit knowledge to explicit knowledge. Therefore, the main task of this stage is to make the tacit knowledge of counselors' mental health education explicit.

Colleges and universities should organize exchanges of psychological education skills and cases between new and old counselors. On the basis of organizing training, colleges and universities should also organize counselors to carry out experience exchange and sharing meetings between new and old counselors on a regular basis, discuss typical cases, and set up groups of psychological counseling work on some certain conditions. The counselors with longer length of service can give lectures to the new counselors about the cases of more difficult and typical psychological crisis intervention they have handled, and teach them appropriate handling methods to increase the effectiveness and scientific of counselors in dealing with psychological problems, thus passing on some experience, methods and even skills(Liang Yujia,2017).

Counselors should take the initiative to do well in many aspects of exchanges and communication. Counselors are the teachers that are closest to college students, and they are an important hub for contacts among universities, parents and students. Counselors should first establish a good relationship with students. They should be able to get close to students, help students, take the initiative to solve difficulties for students, treat every student with tolerance and equality, and gain the trust of students. Meanwhile, counselors should also pass on basic knowledge of psychology to students through various ways, such as class meetings, student activities, individual conversations, lectures, online conversation, so as to enable students to learn about mental health themselves, enhance mental health awareness, and stay away from mental illness. Secondly, counselors should play an active role in communicating with students, colleagues, leaders, counseling teachers and students' parents try to understand students' learning, life, family, emotions and other aspects, listen to colleagues, leaders, counseling teachers' opinions, and treat every student with psychological problems in the right way. Moreover, counselors need to fully utilize the resources of parents, head teachers, professional counselors, psychologists, class

cadres, etc. to form a joint force to deal with psychological crisis and serve the mental health education of college students.

#### **4.4 Incentive mechanism construction and practice innovation based on knowledge innovation**

Knowledge innovation is the fourth stage of KM, and it is also an important stage to complete the dynamic upgrading of knowledge. Therefore, the main task of this stage is to trigger the motivation of counselors and carry on the continuous innovation of mental health education.

Colleges and universities should establish incentive mechanism. So far, Chinese colleges and universities have incorporated counselors' mental health education into the assessment, and established a certain punishment mechanism. At present, most colleges and universities adopt such kind of measure: when serious psychological crisis happens to students, such as disappearing, committing suicide and other incidents, counselors are to shoulder great responsibility for the consequences, which results in huge negative impact on their future career. This punishment mechanism brings too much pressure and insufficient motivation to counselors. Many counselors have made great efforts in the field of mental health education, but because one case of a psychological crisis, their work has been totally denied; while some counselors are lucky and even though they are not hard working in their work, as long as there is no crisis among students, everything will be fine for them. That is to say, the current punishment mechanism cannot truly reflect the actual performance of counselors. Therefore, colleges and universities should also establish incentive mechanism. Motivation produces driving force, and innovation is created by the driving force. The workload of mental health education should be included in counselors' work performance, and the workload should be quantified according to the number of students with psychological crisis that are supervised by counselors and the effectiveness of assistance. Not only should the results of counselors' work be considered, but also the process of assessment should be emphasized. Counselors with outstanding performance should be praised and rewarded, and priority should be given to their career promotion and evaluation.

Counselors should place an emphasis on practice and innovation. With the development of society and the transformation of economy, many new features have emerged in the student groups. The reasons for students' psychological distress and mental illness are also quite different from those before. Counselors should combine their theoretical knowledge with specific problems in their daily work, strive to be proficient in knowledge and improve their skills in practice, and explore new methods and schemes suitable for the development of the generation and the needs of students. Meanwhile, counselors should pay attention to the innovation of work methods and carriers, making full use of such a new means as network to carry out mental health education, so as to keep pace with the times and change with the situation. For example, they should use the convenience and timeliness of the network, and use new media platforms such as QQ, WeChat, Weibo and Yiban to assist students in mental health

education. At the same time, counselors should hold up to the bottom line of online communication, actively offer positive orientation to public opinion, pay close attention to the dynamic changes of students' thoughts in real time, make timely feedback to students' online messages, dispel students' doubts, and finally guide students to establish a positive and optimistic outlook on life and values, thus obtaining the timely results.

## 5 Conclusion

Under the guidance of KM theory, it is a meaningful exploration to carry out the research on the improvement of college counselors' MHEA. Through the analysis of concepts, this paper holds that knowledge is the core resource of college counselors' MHEA, and it is feasible to utilize KM theory to conduct research on improving college counselors' ability in mental health education. The process of KM is a process of dynamic cycle. The countermeasures proposed in this paper can also realize the dynamic improvement of counselors' ability in mental health education, enable counselors' ability to keep pace with the times and constantly satisfy the needs of social development, which has certain guiding significance for the management of colleges and universities. However, this paper still has some limitations, because it only puts forward some countermeasures and suggestions for the improvement of mental health education ability of college counselors from the perspective of qualitative analysis. However, the analysis of the internal relationship between KM and the improvement of counselors' ability in mental health education is still unclear. The next step will be from the perspective of quantitative analysis, and this paper will explore the internal mechanism of applying KM to improve counselors' ability in mental health education.

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## Survey on Research-University-Industry-Based MTI Education and Suggestions on Its Sustainable Development

Yu Yanling, Ao Xinyue, Wang Danni, Zhao Jian

School of Foreign Languages, Wuhan University of Technology, Wuhan, P.R.China, 430070

(E-mail: yuyanling@whut.edu.cn, carrie32@foxmail.com,

13946796234@163.com, 1634587231@qq.com)

**Abstract:** The development of economic globalization and the implementation of the “Belt and Road Initiative” put forward new requirements for MTI education in colleges and universities in China. MTI education requires the balance between "quality" and "quantity". The paper explores curriculum designs, internship arrangements and translation studies of current MTI education through questionnaire data analysis and finds curriculum designs generally good, internship arrangements the weak link and translation studies developing smoothly but lack of innovation. Improvement on RUI-based educational model of MTI that combines practice with theory, integration of teaching and research with research facilitating teaching, cooperation between university and industry for common progress, and enhancing links between research, university and industry with regional differences considered jointly guarantee the sustainable development of RUI-based educational model of MTI.

**Key words:** Masters of translation and interpreting; Translation industry; RUI; Sustainable development

### 1 Introduction

Economic globalization and the advance of information technology contribute to more extensive and closer international cooperation. Frequent flow of international trades and the expansion of multinational companies provide opportunities for translation industry with the demand for translators and interpreters ever-increasing. Master of Translation and Interpreting, MTI for short, was approved by Academic Degrees Committee of the State Council in 2007, affiliated to Ministry of Education, to develop translation industry so as to meet the market demand. (Mu Lei et al., 2010) People of educational circles, theoretical circles and business circles all follow MTI education with interest. Scholars and experts, home and abroad, from different perspectives and positions, have various understandings, annotations and even practices of teaching model of MTI within 253 universities with MTI in the past 10 years. As a result, it is necessary to reform and optimize the training model of MTI. Cooperation between research, university and industry is considered as a vital means of linking technology, education and economy closely. Prompted by economy-technology integration, Cooperation between R-U-I in countries across the globe is becoming more innovative, larger in scale, constantly upgraded, more flexible and adaptive. It is the trend of the times and the joint demand of universities and enterprises to conduct university-enterprise cooperation. (Esther Wit-

de Vries et al., 2019) Through cooperation, enterprises can attract high-caliber future employees and increase their popularity, and universities can acquire much training resources, technology and market information which are conducive to teaching and research. (Cai Hui, Zhang Chengzhi, 2013) In abroad, Esther Wit-de Vries et als studied knowledge transfer in university-industry research partnerships which has inspired Chinese Scholars to explore more. Mu Lei has explored distinctive training mode of MTI and others including Zhong Wenming and Ping Hong have emphasized MTI quality assurance system. Scholars like Xu Jun, Fu Jingmin also showed their reflections on MTI teaching. It can be seen that this field has aroused broad attention from different perspectives in China. However, problems do exist, such as mismatch between quality and quantity; supply and demand and cooperation mode being inflexible.

## **2 Survey on the Present RUI-based MTI Education**

The improvement on RUI-based MTI education depends on the balance between “quality” and “quantity” of MTI development. Quality means level, capacity and degree; quantity means number, scale and scope. They can turn into each other under certain conditions. Too rapid expansion of quantity may lead to uneven distribution of resources and “free rides”, which will spoil the environment where MTI develops. Too slow growth of quantity may lead to inefficient use of resources and serve as a wet blanket so that the market demand cannot be met and it takes time to increase the supply. (Ping Hong, 2019; Zhong Wenming, 2018) Therefore, the sustainable development of MTI relies on the balance between Quality and Quantity. With limited resources, MTI education should show its professionalism and characteristic and take regional differences into consideration.

Therefore, the questionnaire was designed with both quality factors and quantity factors included. After surveying translation providers and universities through interviews and questionnaires, the authors acquired data about translation industries, MTI education, translation studies and RUI platforms. At first, the authors gave out 80 questionnaires in Wuhan University of Technology where they belong with 62 filled-out questionnaires handed back and collected information about MTI education, translation studies and RUI platforms through telephone interviews with lecturers and professors in Wuhan University of Technology. After that, the authors revised the design of the questionnaire to lay stress on the key points. Later, the authors gave out questionnaires in nine universities in Wuhan, Guangdong University of Foreign Studies and Chongqing University with 92 filled-out questionnaires collected and communicated with lecturers and professors in those universities. Meanwhile, the authors got information about translation industry through interviewing with renowned translation providers in Wuhan.

### **2.1 Curriculum design**

Curriculum design involves six modules - mission, faculty, teaching content, quality of online courses, teaching management and quality of teaching. In each module, 8%-18% of the respondents rate it as very good; 65%-84% of the respondents rate it as average or above average. 4% of the respondents rate quality of online courses as very bad and 1% of the respondents' rate teaching content as very bad. In each of other four modules, no respondent rates it as very bad. The mean value of each module is as follows. It can be seen that quality of online courses needs improving; teaching content should be enriched; and other modules should be kept on continuous upgrade.

**Table 1 Basic Analysis of Curriculum Design**

	Module	Mean value
1	Mission of MTI	3.78
2	Faculty of MTI	3.75
3	Teaching content of MTI	3.48
4	Quality of online courses	3.41
5	Teaching management of MTI	3.67
6	Quality of MTI teaching	3.59

Curriculum design is an important link in MTI education. But few universities invite outstanding translators, interpreters, and experts in translation industry to take part in it.

**2.2 Practice arrangements**

Practice arrangements also involve six modules - scale of local translation companies, degree of standardization of local translation companies, resources the university has for MTI practice, class periods of practice, number of students who sit for CATTI and percent of pass for CATTI, number of times a student is in charge of interpreting a major conference.

Practice arrangements are a vital link in MTI education. But privileged universities or those have geographic advantage occupy the majority of resources for MTI practice. Besides, many bases and laboratories for MTI practice terminate when in construction or shutdown due to a lack of proper management.

The survey shows that in each module of practice arrangements, 3%-10% of the respondents rate it as very good; 47%-86% of the respondents rate it as average or above average; 1%-6% of the respondents rate it as bad with 6% of the respondents rating the number of times a student is in charge of interpreting a major conference as very bad. 15% of the respondents give the fourth module a below-average; 22% of the respondents give the fifth module a below average; 44% of the respondents give the last module a below average. The mean value of each module is as follows.

**Table 2 Basic Analysis of Practice Arrangements**

	Module	Mean value
1	Scale of local translation companies	3.46
2	Degree of standardization of local translation companies	3.36
3	Resources the university has for MTI practice	3.41
4	Class periods of practice	3.29
5	Number of students who sit for CATTI and percent of pass for CATTI	3.08



6	Number of times a student is in charge of interpreting a major conference	2.59
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It can be seen that the performance of practice arrangements is worse than that of curriculum design, especially in terms of the last three modules. Therefore, MTI students should be given more chance to practice, be encouraged to sit for CATTI and work harder to pass it, and be cultivated to be good enough for posts in major conferences. Companies and universities have evident contradictions concerning practice arrangements because interns tend to have lower productivity than regular employees and companies, for profit, are reluctant to take efforts to train interns. Universities purchase professional tools to simulate the operation of enterprises but are short of guidance from professional translators and interpreters.

### 2.3 Translation studies

Translation studies involves innovation in translation technology, attention to localization, the standard of translation services and the development of translation industry. In each module, only 4% to 8% of the respondents rate it as very good; 77% to 83% of the respondents rate it as above average or average. The mean value of each module is as follows.

**Table 3 Basic Analysis of Translation Studies**

	Module	Mean value
1	Innovation in translation technology	3.10
2	Attention to localization	3.28
3	The standard of translation services	3.29
4	The development of translation industry	3.20

The “research” in RUI puts too much emphasis on translation theories but ignores the importance of the market and the application in the industry. As a result, translation studies receive little appreciation from translation industry.

### 2.4 Comprehensive analysis of different regions

**Table 4 Comprehensive Analysis of Different Regions**

Region	Curriculum design	Practice arrangements	Translation studies	Comprehensive index
Guangzhou	3.79	3.23	3.30	3.43
Wuhan	3.37	3.14	3.10	3.20
Chongqing	3.86	2.99	3.14	3.30

It can be seen that comprehensively MTI education in Guangzhou is better than that in Wuhan

and Chongqing. However, Guangzhou's curriculum design is a little behind that of Chongqing. Wuhan is much weaker in curriculum design, which leads to low comprehensive index. Chongqing performs well in curriculum design and poorly in practice arrangements. Overall, MTI education of all regions surveyed is above average with practice arrangements being the weak link. Due to limited resources for MTI practice in all three regions with no platform in the industry connecting major to career, it is hard to integrate teaching with practice. On some occasions of conference interpreting, students are only allowed to participate but not fully get involved or receive little attention or guidance. Students may feel frustrated as a result.

### **3 On Sustainable Development**

#### **3.1 Practice must be carried out.**

According to the CEO of a renowned translation company, the cooperation between universities and enterprises is superficial and unsystematic. Practice and teaching should be tightly knitted with universities putting the design of practice into the teaching plan. Practice serves as a complement to teaching as well as a test to teaching results. Special faculty should be assigned to follow the process of practice and evaluate its outcome. Currently, RUI integration is hard to carry forward due to the lack of faculty who have enough firsthand experience in translation industry. (Zhang Shidong, Peng Shuang, 2018)

#### **3.2 Innovation should be put into application.**

Innovation, both in translation courses and in translation theories, is evaluated by the way it is applied and its influence. (An Jing, 2016) Universities can outsource their courses in various ways. They can even build up their own industry chains to make RUI integration operated inside the universities by recruiting well-experienced professionals of research and management in translation industry.

#### **3.3 The ideal should be carried through with determination.**

RUI integration is generally considered as the trend of the times. However, whether it should be career-, demand-, industry- and society-oriented and how to keep its sustainability require in-depth discussion. The ideal of RUI integration is excellent yet its influence is small. Many universities may try it without determination to carry it through.

## **4 Data and Methodology**

This study intends to find the factors affecting MTI education through literature research to set up reliable indexes based on the factors, construct the framework of factors affecting MTI education, and compile the questionnaire on factors affecting MTI education. Through the questionnaire, Excel and SPSS19.0 are used to conduct the difference analysis between the survey data, descriptive statistical analysis, correlation analysis and multiple linear regression analysis, so as to test the factors. Finally, some suggestions for balancing the quality and quantity to keep MTI education sustainable are proposed based on the research results.

## **5 Suggestions on RUI-integration in MTI education**

### **5.1 Improving on RUI-integration to build a system that combines theory with practice.**

To develop various abilities in students, universities should make teaching and research integrated with research facilitating teaching; universities should cooperate with translation industry to make interactive progress together. MTI education should be based on the learning of basic theories and cultivation of all-round abilities with practical skills and innovative capacity as the focal point. Various resources should be used to improve the quality of MTI education and comprehensive strength of students. (Fu Jingmin, 2018)

### **5.2 Taking regional differences into consideration to enhance links between R-U-I.**

The links between R-U-I differ when in different regions. Universities should adjust their cooperation models with governments, translation providers, multinational companies and institutions according to the regional conditions, industries and translation demand of where they lie. They can develop cooperative projects with large multinational companies or translation companies, pay visits to language service providers to learn skills, jointly establish laboratories with institutions and introduce translation software and equipment. (Wang Hongyan, Lin Bin, 2013)

## **6 Conclusion**

The path of RUI-integration never runs smooth and requires persistence and innovative efforts. Excessive pursuit of innovation may lead to weak foundation and short life-span. Innovation, coupled with down-to-earth work, contributes to the sustainable development of RUI-integration. Online courses are an essential part of curriculum design and contribute to the integration of resources from inside universities and from outside. In internship arrangements, the practice should be closely connected to contents of paper exams. Universities should spare no efforts to put students into applying what they have learned and to keep them following the demand of society. Translation technology in translation studies is in urgent need of improvement. The innovation and continuation of translation technology lies in guidance from high-caliber translators and interpreters, introduction of translation tools and reform in teaching plans. (Chai Mingkui, 2010) Generally, Guangzhou performs better than Chongqing and Wuhan in MTI education, which indicates regional differences. To bridge the gap between regions requires platforms between regions for exchanges and communication. But building platforms is a complex and long-haul project. This paper creatively gives suggestions on the development of RUI-based MTI education: improving on RUI-integration to build a system that combines theory with practice; taking regional differences into consideration to enhance links between research, university and industry.

But, owing to limited time, there is still more room to better this research by collecting more data through different cities and ranks of the universities in a national scale to upgrade MTI education accordingly.

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## **Optimization of transformation path based on conversion rate analysis of scientific and technological achievements**

Ma Yinbo<sup>1</sup>, Lu Jing<sup>2</sup>

1 Science and Technology Cooperation and Achievement Transformation Center, Wuhan University of Technology, Wuhan, P.R.China, 430070

2 School of Management, Wuhan University of Technology, Wuhan, P.R.China, 430070

(E-mail: 2502546233@qq.com, 752374940@qq.com)

**Abstract:** The conversion path determines conversion efficiency. The paper analyzes the constituent elements of the conversion rate of scientific and technological achievements, and proposes to establish a "three categories and twelve items" evaluation index system, which provides a quantitative analysis and qualitative analysis basis for the evaluation of scientific and technological achievements conversion rate, and solves the single analysis and evaluation index of scientific and technological achievements. The problem of low fairness of evaluation conclusions; based on the internal relationship and mechanism of the conversion rate of scientific and technological achievements and the transformation path, the paper proposes a strategy to optimize the transformation path, and has practical guidance for constructing a perfect scientific and technological achievements transformation system and improving the transformation ability of scientific and technological achievements significance.

**Key words:** Scientific and technological achievements; Conversion rate of scientific and technological achievements; Evaluation index; Path optimization strategy

### **1 Introduction**

The transformation of scientific and technological achievements is a way to realize the transformation and upgrading of enterprises and the quality development of the economy. In addition, patent technology and other innovative scientific and technological achievements have become one of the important indicators to measure innovation ability (Archibugi and Pianta, 1992). Optimizing the supply of scientific and technological achievements, smoothing the transformation channels, and building a good environment are conducive to shortening the cycle of achievement transformation, improving the efficiency of transformation of scientific and technological achievements, and transforming innovation capabilities into economic development advantages.

A method of characterizing talents based on scientific and technological achievements data is disclosed, which is suitable for realizing the construction and visualization of talents'

scientific research ability portraits according to the scientific research results database, which helps to quickly and intuitively understand the research ability of talents (Xu, Zhang and Wang, 2017).

The Notice of the General Office of the State Council on Printing and Distributing the Action Plan for Promoting the Transformation of Scientific and Technological Achievements pointed out that it is necessary to establish a performance evaluation system for the transfer of scientific and technological achievements and a system for transferring scientific and technological achievements, and provide reference for supporting units. Therefore, how to correctly evaluate the transformation effect of scientific and technological achievements has become a concern of current research institutes and relevant departments.

However, when it comes to the transformation of scientific and technological achievements, most of them believe that China has a large number of scientific and technological achievements, low conversion rate, and insufficient contribution to economic and social development. It is true that due to factors such as the ability of scientific research and innovation, and the imperfect system of scientific and technological achievements, the conversion rate of scientific and technological achievements is indeed low. According to the National Intellectual Property Report of the Ministry of Education of the People's Republic of China, the conversion rate of scientific and technological achievements in China's universities is only about 10%, far lower than the level of some countries and regions (The editorial department of the journal, 2016). However, it is one-sided to take the conversion rate of scientific and technological achievements as a hard index to evaluate scientific and technological innovation and require that all scientific and technological achievements can be transformed.

The author believes that the problem of low conversion rate of scientific and technological achievements should be viewed objectively and dialectically, and the "anxiety disorder" of scientific and technological achievements should be overcome. Through the establishment of a reasonable and perfect evaluation index system for the conversion rate of scientific and technological achievements, we will explore the strategy of optimizing the transformation path of achievements and focus on promoting the effective transformation of scientific and technological achievements.

At present, the degree of informationization of scientific and technological achievements management is getting higher and higher. The scientific research management system researched and developed by colleges and universities covers information such as scientific research funds and CNKI Wan Fang DATA provided support for in-depth mining of scientific and technological data and intelligentization of scientific and technological achievements conversion rate evaluation.

In the research on the conversion rate of scientific and technological achievements, some scholars have formed a more objective understanding of the conversion rate of scientific and technological achievements. Chang Linong believes that the transformation of scientific and technological achievements is an important measure to promote the transformation of economic development mode, but it is not appropriate to emphasize the improvement of the conversion rate of scientific and technological achievements (Chang, 2013). Cai Yuezhou pointed out that there are some deviations in the understanding of the transformation of scientific and technological achievements in various sectors of society, and on the basis of combing the connotation boundaries and influencing factors of scientific and technological achievements, the paper has conducted a comprehensive discussion on the measurement and evaluation of the transformation of scientific and technological achievements (Cai, 2015).

After scholars have formed a relatively objective and comprehensive understanding of the conversion rate of scientific and technological achievements, some scholars have also strengthened the empirical research on the transformation of scientific and technological achievements, and explored the factors affecting the transformation of scientific and technological achievements by constructing models. Sun Tao based on evolutionary game theory, decision-making and scientific and technological achievements cost investment decision-making to construct the evolutionary game model between scientific research institutions and enterprises (Sun, 2019). Luo Qian take the 32 colleges and universities in Jiangsu province for example, three core concepts of impact factor including national policy factor, regional environmental factor and organizational behavior factor are extracted (Luo, 2019). Ji Chengjun based on the micro panel data of Chinese universities from 2008 to 2016, this paper measures and analyzes the conversion efficiency of scientific and technological achievements in colleges and universities through the network DEA model; Based on the innovative ecosystem perspective, the dynamic panel GMM differential model is constructed to empirically test the factors affecting the efficiency of scientific and technological achievements transformation in colleges and universities (Ji, 2019).

The deviation of people's understanding of the transformation of scientific and technological achievements often comes from the inadequate basic work such as measurement and evaluation. Foreign scholars such as Nordfors believe that traditional indicators to measure the transformation of scientific and technological achievements include patents, licensing, publications and derivative companies (Nordfors, Sandered and Wessner, 2003). Langford et al., when evaluating the transformation of scientific and technological achievements in colleges and universities, divided the evaluation indexes into three categories: input indexes, output indexes and effect indexes (Langford, Jeremy and Pete, 2006). For the research on the evaluation index system of scientific and technological

achievements, Chinese scholars also put forward different viewpoints according to different research perspectives. Zhang Mingxi and Guo Wei built a performance evaluation system for scientific and technological achievements based on the experience of international scientific and technological achievements. According to the availability and operability of the data, the data envelopment analysis method was used to study the transformation efficiency of scientific and technological achievements (Zhang and Guo, 2013). Li Xiuquan, Xuan Zhaohui explained the misunderstanding of the current research achievement conversion rate in the use of indicators from the perspective of conceptual definition, measurement and data sources of scientific and technological achievements conversion rate (Li and Xuan, 2015). Mai Weinan believes that scientific and technological achievements have not yet been fully transformed into project performance. Therefore, it is necessary to establish a sound performance evaluation index system for conversion projects, and also analyze the main mechanisms of performance formation and influencing factors. Based on this, a multidimensional evaluation index system was established (Mai, 2017).

In addition, many scholars have proposed different suggestions and directions for the research on the transformation strategy of achievement transformation. Based on the background of China's new economic normality, Zhang Wujun and Xu Ning analyzed the problems existing in the transformation of scientific and technological achievements, and combined with the advanced experience of foreign countries, proposed countermeasures for the transformation of scientific and technological achievements from the aspects of legal protection and policy support (Zhang and Xu, 2016). Cheng Xiong and Lv Jianqiu based on the survey of ten universities in eight provinces, summed up six experience suggestions for the transformation of scientific and technological achievements: stimulate the transformation of scientific and technological achievements, create a good environment for the transformation of achievements, improve the evaluation mechanism for scientific research, establish specialized institutions for the transformation of achievements, increase the conditions for the transformation of achievements, and play the role of the intermediary of science and technology (Cheng and Lv, 2018). Qi Yong, Zhu Tingting and Guo Yi divided the scientific and technological achievements into three categories: basic public welfare, common technology and proprietary technology. According to different social functions, proposed different modes and countermeasures for different types of scientific and technological achievements (Qi, Zhu and Guo, 2015).

## **2 Scientific and Technological Achievements Conversion Rate Evaluation Index System**

The evaluation index of scientific and technological achievements conversion rate has the characteristics of multi-dimensional, three-dimensional and dynamic, and can be divided into three categories and twelve indicators, as shown in Table 1.



**Table 1 Evaluation Index of Scientific and Technological Achievements Conversion Rate**

Serial number	Primary indicator (Score)	Secondary indicators (Score)
1	Scale of achievements (quantity, quality) A1 (30%)	Industrialization suitability B1 (5%)
2		R&D investment B2 (3%)
3		Research and development cycle B3 (7%)
4		Achievements attention B4 (8%)
5		Achievement innovation B5 (5%)
6		Achievement citation B6 (2%)
7		Type of achievement transformation B7 (15%)
8	Achievement transformation effect A2 (50%)	Quantity of achievement transformation B8 (20%)
9		Achievement conversion cycle B9 (8%)
10		Achievement conversion price B10 (7%)
11	Transformation of achievements into social impact A3 (20%)	Economic benefits B11 (8%)
12		Social benefits B12 (12%)

Chai Guorong et al. constructed an index system consisting of three primary indicators, seven secondary indicators and 30 third level indicators including transformation conditions, supporting capacity and transformation effects to comprehensively evaluate the transformation of regional scientific and technological achievements (Chai, Xu and Zhai, 2010). Liu et al. used the analytic hierarchy process to select the three aspects of science and technology input, output and transformation to construct a transformation of scientific and technological achievements including 35 basic indicators (Liu and Li, 2010).

1. Scale of achievements (quantity, quality) A1. Score is 30%, evaluation is dynamic, based on a model, questionnaire survey and experience analysis. This includes five indicators: First, the industrialization suitability B1, the achievements are suitable for the degree of industrialization; second, the R&D investment B2, divided into direct input, indirect investment; third, the research and development cycle B3, the longer the research time, the higher the value of the achievements; fourth, the achievements attention B4 reflects the company's interest in the achievements, and the industrialization suitability of the achievements can be obtained through network access, enterprise docking and other means; fifth is the achievement innovation B5, focusing on the practicality of the technology; sixth, the achievement citation B6, through his data analysis.

2. Achievement transformation effect A2, Score is 50%, including type B7, quantity B8, conversion cycle B9 and price B10. The evaluation is objective and quantifiable, and it is the easiest and most objective. The single item of achievements in the form of priced investment is highly converted, and the single item generally exceeds one million yuan; the single conversion price of achievements in the form of cash transfer is between 50,000 yuan and 300,000 yuan, and few can reach one million yuan, which is the ideal price pursued by the transformation of achievements; achievements in the form of license adopt "threshold price + income commission", the threshold price is relatively flexible, and the ideal income can be achieved after successful transformation. Liu Yintian points out the transformation period of setting up scientific and technological achievements of enterprises is set at 2 years. If it is more than 2 years, it is regarded as no conversion; the transformation period of scientific and technological achievements of universities and research institutes is 5 years, and it is regarded as not converting for more than 5 years (Liu, Ma, Zhang and Jiao, 2018).

3. Transformation of achievements into social impact A3. Score is 20%. The evaluation has the lag, the qualitative analysis and the quantitative analysis combine. This aspect includes two indicators: first, the economic benefit of achievement transformation B11, which can be calculated and quantified; the second is the social benefit of achievement transformation B12, which is based on qualitative analysis.

### **3 Relationship between Conversion Rate of Scientific and Technological Achievements and Optimization of Transformation Path**

The conversion rate of scientific and technological achievements is the ratio of the number of transformed achievements to the total amount of achievements. The scale of achievements A1, composition and technological innovation of scientific and technological achievements and industrialization suitability determine and influence the conversion rate of scientific and technological achievements. Scientific and technological achievements include innovative knowledge and technologies such as intellectual property rights and proprietary technologies. The number of intellectual property rights can be accurate to specific number, while proprietary technologies are not easy to be counted and quantified. Therefore, the total amount of scientific and technological achievements is a dynamic variable, and the conversion rate of scientific and technological achievements calculated with a variable as the denominator is bound to be neither comprehensive nor objective.

From the perspective of the purpose of scientific research and the composition of scientific and technological achievements, scientific and technological innovation activities cover science, engineering, medicine, management and many other disciplines, including basic research and applied research. It has both academic research achievements and applied research achievements. Some of them are high-level research papers for scientific and technological exchange, some can be used and protected by applying for intellectual property rights, and some cannot be applied for intellectual property rights. Therefore, not all the achievements can be transformed, such as the mathematical research achievements

supporting brain science and artificial intelligence. Scientific research and innovation activities can be divided into high-level and low-level activities. Low-level scientific research and innovation activities may be the "exercise" for scientific and technological workers to exercise and improve their research ability. If we all require that all scientific and technological achievements can be applied and transformed, giving all science and technology workers the task of transforming achievements, it is easy to bring the misunderstanding of one-sided performance and national cognition in performance evaluation, and it cannot accurately reflect the actual situation of the transformation of China's scientific and technological achievements. At the same time, it will dampen the innovation enthusiasm of scientific and technological personnel, and does not conform to the law and status quo of scientific and technological achievements transformation.

The transformation of scientific and technological achievements is a complex process of the game of interests between the transferor and the transferee. It is not only affected by the transferor's technology maturity, advancement and other factors, but also depends on the transferee's development strategy, carrying capacity, risk preference, financial status and other factors. In the actual work, the enterprise is very willing to accept some scientific and technological achievements of the author's work unit, and the business negotiations between the two sides are very harmonious. But in the end, limited by the size of enterprise development, carrying capacity and price concession, no deal is reached. Only in line with market demand, enterprises to undertake the achievement are suitable for transformation. Scientific and technological innovation should aim at the market, strengthen project analysis and selection, and strengthen precise docking services. However, we should not "only follow the market" and deny basic and original research, or else it is a short-term behavior eager for quick success and quick profits. We should establish a system for classifying and evaluating scientific and technological achievements, organize the evaluation of scientific, technological achievements regularly, analyze scientific, technological achievements that may be transformed, make an annual list of transformation of scientific, and technological achievements, define the task of transformation and promote it with goals and plans.

#### 4 The Strategy of Optimizing the Transformation Path of Scientific and Technological Achievements

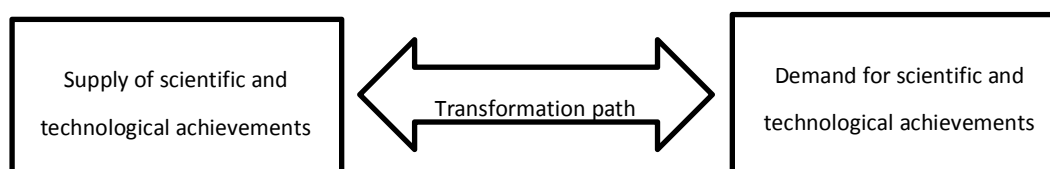


Figure 1 Matching Chart of Supply and Demand of Scientific and Technological Achievements

Ma Lisha et al. suggested that according to the transformation of scientific and technological achievements and its development rules, the scientific evaluation indicators should be selected around the industrial chain, and the existing evaluation indicators and systems should be selected to establish a normalized monitoring system covering

comprehensive data and statistical basis. Guide research and development institutions to carry out knowledge and technology transfer suitable for their nature, mission and positioning (Ma, Yu, Tia, Ma, Zhang and Guo, 2019).

To evaluate the transformation of scientific and technological achievements, it is not possible to simply look at the conversion rate, but also to examine indicators such as conversion speed and conversion efficiency ratio. Compared with the conversion rate of scientific and technological achievements, the transformation cycle and input-output ratio of scientific and technological achievements can better reflect the real level of scientific and technological achievements transformation. We should improve the diversified evaluation index system and insist that the main body of evaluation is the transferee and the scale of evaluation is the contribution to economic and social construction.

**Focus on improving the timeliness of achievements transformation.** From the perspective of time, the transformation of scientific and technological achievements starts from scientific and technological innovation activities and ends with the transferee of achievements forming new technologies and new products. The short transformation period indicates the efficiency of the transformation. On the contrary, if the transformation cycle is too long, it may be replaced by advanced technology, resulting in a waste of scientific and technological resources and missing development opportunities. We must focus on improving the timeliness of scientific and technological achievements, and adhere to the "five synchronization" : namely, scientific research projects adhere to the achievement transformation oriented, define the transformation target tasks synchronously, plan the transformation plans synchronously, the scientific research implementation shall be synchronized with the transferee, the project acceptance shall be synchronized with the assessment of conversion indicators, and the project evaluation shall be synchronized with the initiation of conversion procedures. We will provide order-oriented services for the transformation of scientific and technological achievements. For major applied scientific research projects of government departments at all levels, expected achievements can be announced, and interested enterprises may be invited to participate in the research and sign transformation agreements to accelerate the transformation of scientific and technological achievements.

**Focus on achieving effective transformation of achievements.** At home and abroad, it is generally believed that the conversion criteria include two aspects: First, the proportion of the part that has been converted accounts for the whole. If some studies believe that more than 15% of the proportions are applied when they are applied, the second is the scale of economic, ecological and social benefits. If the economic benefits generated exceed 1 million yuan, it will be converted. From the perspective of input and output, the conversion efficiency to cost ratio is the ratio between the economic benefits generated by conversion and the transfer funds and the indirect costs of conversion. If scientific and technological achievements are merely transferred without successful transformation into productive forces, they cannot be regarded as effective transformation. From the perspective of the

transformation price of scientific and technological achievements, if the price of a single transfer is less than ¥50,000, the price is equivalent to the cost of an enterprise to apply for a new invention patent. The main motivation for the enterprise to purchase is to apply for high-tech enterprises, apply for government support for scientific and technological projects, and improve the enterprise brand, but the actual implementation is not much. Therefore, we should improve the evaluation and funding methods for the transformation of scientific and technological achievements, change the "sprinkling pepper" approach, turn "universal funding" into major and targeted funding, and focus our human, material and financial resources on major projects to transform scientific and technological achievements into effective ones. For example, the "Science and Technology Achievements Transformation Project" in the 2018 Science and Technology Subsidy Project of Wuhan Science and Technology Bureau adopted a competitive distribution method to determine 20 scientific and technological achievements transformation projects through evaluation, each of which was supported by funds of RMB 3 million to 5 million.

**Focus on strengthening the management of transformation relations.** The transformation of scientific and technological achievements is a technology transfer with intellectual property rights as the carrier. It is a scientific and technological cooperation between the transferor and the transferee, not a one-time transaction, nor a simple transfer of achievements. It condenses the arduous and complex technological value of the scientific and technological personnel to re-create and re-invest. It requires a long process and painstaking post-transfer technical support and management input. In addition to the value of scientific and technological achievements, enterprises pay more attention to the scientific research and innovation ability of the team of scientific and technological achievements as well as the creativity generated by the person who gets the achievements relying on the engineering conditions provided by enterprises. From the case analysis of the transformation of scientific and technological achievements, the scientific research level of the scientific and technological achievements team and the reputation of scientific and technological personnel directly determine the transfer price of scientific and technological achievements. Therefore, the transferee hopes to take scientific and technological achievements as the link to obtain continuous and effective research and development technologies, obtain innovative scientific and technological talents, and increase the value generated by management resources, network resources and brand advantages based on the background of universities and research institutes.

**Strengthen investor relations management.** Investor relationship management is a bridge connecting scientific and technological personnel and enterprises, which is conducive to promoting the benign relationship between the transferor and the transferee of scientific and technological achievements, enhancing the transferee's further understanding of the scientific research strength of the transferor, eliminating the estrangement and misunderstanding between the transferor and the transferee in time, and establishing a long-term good strategic cooperative relationship. Before the transfer of the achievements, the transferor shall assist the transferee to fully understand the scientific and technological

achievements and conduct extensive research, understand the needs of the transferee, discuss cooperation plans, promote scientific and technological cooperation, and determine the transfer price. After the transfer of achievements, the transferor shall follow up the progress of the project, feedback the demands, suggestions and appeals of the transferee, and coordinate and guide the scientific and technical personnel to provide follow-up technical services.

**Promote the combined transformation of scientific and technological achievements.**

The benefits of single scientific and technological achievement are limited. Only the technology group, technology combination and related technology supporting single scientific and technological achievement can realize the maximum benefits of transformation. We should strengthen the coordinated supply of scientific and technological achievements and promote the cross and integrated development of various technologies.

**Limitation.** Although this paper analyzes the specific indicators of the conversion rate of scientific and technological achievements, there are many factors involved in the transformation of scientific and technological achievements, many quantitative indicators, and many qualitative influence factors. The data acquisition is difficult, the difficulty of evaluation of conversion rate is increased, and the construction of data model is difficult. Further innovation index setting is needed to verify the weight of specific indicators. Secondly, this paper studies the transformation law of the same transformation unit. Subsequent research can further expand the time span and explore the relationship between time evolution and conversion rate change. Finally, research on the relationship and function of transformation input and output in different regions, especially cross-regional comparative research, and vertical and horizontal comparison of conversion rates between regions and research institutes to further enrich the conversion rate of scientific and technological achievements. The results provide a theoretical reference for improving the ability to transform scientific and technological achievements.

## **5 Conclusion**

The paper explores the relationship between the transformation path, the conversion rate, and its mechanism of action, which has important theoretical and practical significance for improving the conversion rate. In theory, it has constructed an index system for the conversion rate of scientific and technological achievements, and linked the conversion rate with the input of scientific and technological achievements, the scale of output, the transformation effect, and the social influence. It has certain scientific and comprehensive characteristics. At the same time, this paper is transformed according to scientific and technological achievements. Data, suggesting that the lowest price of a single scientific and technological achievement is less than 300,000 yuan; it is not a successful transformation, enriching the practice of scientific and technological achievements transformation. In addition:

First, we should establish a correct value system for the transformation of scientific and

technological achievements, combat anxiety about the transformation of scientific and technological achievements, combine the transformation rate of scientific and technological achievements with the contribution to economic and social development, carry out efficient progress in a planned and step-by-step manner, and strive to optimize the effective supply of scientific and technological achievements to improve the quality and efficiency of the supply of scientific and technological achievements. Second, we will correct the motivation for transformation, carry out scientific and technological innovation in line with major needs and practical difficulties, optimize the transformation path, and build a multi-dimensional evaluation and evaluation index system to maximize the efficiency and benefits of transformation. Third, we should broaden the channels of transformation, strengthen the management of transformation process, and promote the establishment of a virtuous circle mechanism of "transformation of achievements -- enterprise development -- feeding scientific research -- promoting disciplines".

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## **Language Management on Language Choice of Chinese Singaporeans: Balance between Ethnic Identity and Utilitarian Value?**

Wang Jue, Chen Long (Corresponding Author)

School of Foreign Language, Wuhan University of Technology, Wuhan, P.R. China, 430070

(E-mail: Shirleywang\_2003@126.com, annachen03@126.com)

**Abstract:** Singapore is characterized as a multicultural and polyglot society. After decades of implementation of bilingualism, it intrigues people to know how Chinese Singaporeans define themselves in such a multi-ethnic country and how language management influences their language use in a complicate language context. By analyzing Chinese Singaporeans' language use in terms of various categories, including different domains where languages are used, social status and age of language users, the tendency of language choice among Chinese Singaporeans has indicated the language hierarchy in Chinese community is English, Chinese Mandarin and Chinese dialects if ranked from high to low. For such hierarchy, language management is a determinant to its formation. Besides, a range of other influential factors, including history, geography, personal motivation, etc. also play a large part in directing Chinese Singaporeans' language choice, and sometimes, their influence even overrides the power of language management. Therefore, the results of language management in Singapore may deviate from government's original intention of balancing between ethnic identity and utilitarian value.

**Key words:** Language management in Singapore; Chinese Singaporeans; Language choice; Ethnic identity; Utilitarian value

### **1 Introduction**

As a country composed of various ethnic groups, Singapore is a typical multi-cultural and polyglot society. Among these groups, Chinese consists of 74.2% of the whole population, Malays 13.4%, Indians 9.2%, and other ethnic origins 3.2% (Turnbull, 2016). Conditioned by factors of linguistics, history, geography, politics...etc, this peninsula witnesses English being widely accepted by the residents as lingua franca. In addition to English, Mandarin Chinese, Malay and Tamil make up other three official languages in Singapore. Bilingualism of language policy in Singapore aims at achieving among Singaporeans bilingual proficiency in English and a mother tongue that has been officially assigned to specific ethnic communities (Peter, 2016). Since language is not merely a tool of communication, but also has rich cultural connotation, Lee Hsien Loong stated language policy concerns such fundamental issues as "how we see this world, how we express ourselves culturally as people,... and have the confidence and identity to chart our future" (Li, 2014). However, language policy is not the only determinant in Chinese Singaporeans' language use in such a complicating language context.

From a bunch of researches we can generally conclude that ethnic identity, language policy& educating planning, and utilitarian value are dominating factors for linguistic behaviors of Chinese Singaporeans. Actually, those deciding factors do not only work separately, but also correlate with each other. Some researchers focus on how language attitude interacts with ethnic awareness through investigation among Chinese Singaporeans (Chai, 2010; Jacob, 2014; Peter, 2016); some scholars attempt to find how language policy and bilingual education influence the language-based ecological

balance in Singapore (Tan, 2014; Tang, 2016; Chen, 2012; Zhou, 2015); Someone else give an insight into the prospect of Chinese language in Singapore from the perspective of its economic and utilitarian value (Guo, 2008; Shang, 2016). Singapore government is always searching for a language management in expectation of a balance between maintaining ethnic identity and maximizing utilitarian value. Based on previous researches, this essay will investigate further the Chinese Singaporeans' ethnic identity through analyzing their attitude to different languages reflected from their language choice in various dimensions, and explore reasons for their language choice.

## **2 General Review of the Language Situation in the Community of Chinese Singaporeans**

Singapore's language system is diglossia. Bazaar Malay and Chinese dialects are low languages, employed in the streets and market places. English and Mandarin are high languages, used in education, government offices, and public celebrations (Turnbull, 2016).

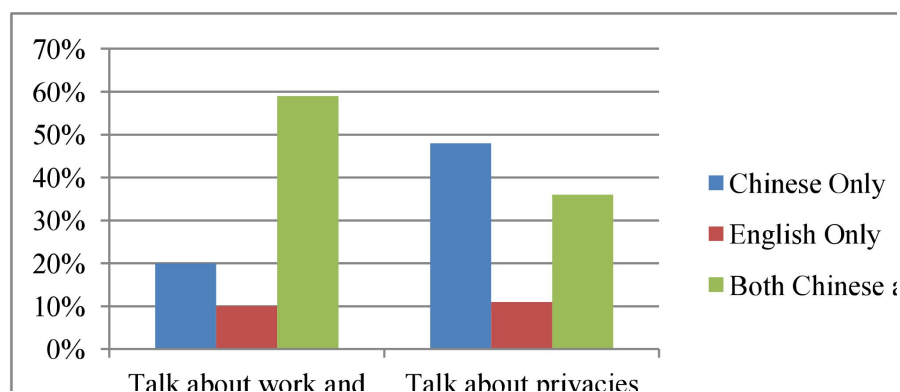
Of the Chinese Singaporeans, Hokkien, Teochews, Cantonese, and Hakkas were the four major dialects spoken by Chinese Singaporeans. In the early years of colonial period, the education needs of large part of population were mainly financed and staffed by the racial and dialect groups (Turnbull, 2016). After the Second World War, English education was greatly encouraged by colonial government. Meanwhile, Mandarin-medium schools sprang up with surge of nationalism. In 1956, the committee in Chinese education issued a report of recommending equal treatment for all schools and all four leading languages. It also promoted bilingual primary education, with a common syllabus, common textbooks, and equal grants for teachers and equal opportunities for school leavers of all language streams to enter government service. However, due to the remaining influence of colonial education policy and the superiority of English in job-market, in this period, the students enrolled into Chinese-medium school reduced sharply to 36.91% while that into English-medium school increased to 55.58% (Tan, 2014). Since the Singapore's independence proclaimed on 9 August 1965, the situation of Chinese education had even deteriorated with the implementation of the new language policy. To create a feeling of nationhood posed special problems in mixed immigrant society; the Federation precluded building up any exclusively Singapore identity and stressed the role of English as a unity language (Li, 2014). The drift towards English schooling led to another dramatic drop of students' number in Chinese schools. It was reported that in 1959, the students registering at Chinese schools was 47.4%, but the rate decreased to 9% by 1979. In 1979, with enthusiastic support from the Chinese press and the Singapore Chinese Chamber of Commerce, the government launched a Mandarin Speaking Campaign, urging all Chinese Singaporeans, including government clerks, hawkers, bus conductors and taxi drivers to use Mandarin; at the same time the Chinese traditional ideology – Confucianism was also highlighted in this Campaign. From then on, among Chinese Singaporeans the most noticeable shift has been shown from Chinese dialects to Mandarin and English (Zhou, 2015).

## **3 Language Choice in Terms of Different Categories**

According to the asymmetric principle of multilingualism, "All the languages in the repertoire of a multilingual community are not equally distributed in terms of power, prestige, vitality, or attitude" (Kachru, 1985). The language choice of Chinese Singaporeans in their everyday life is a case in point to illustrate this principle. Nearly all the members of Chinese Singaporeans speak at least two languages or codes, and their use of these languages varies in terms of different domains where the languages function differently.

Xiao (Xiao, 2010) conducted a survey concerning the Chinese Singaporeans' language choice in two kinds of domains – talking with colleagues about work and study, and talking with friends about

privacies. The general tendency of language choice demonstrated in the figure 1 is “code-mixing” (i.e. using Chinese and English at the same time) accounts for the largest proportion when talking about work and study; while “using Chinese only” dominates their language choice when talking about privacies with friends. This indicates that Chinese serves essentially as an emotional interaction tool, on the other hand, its relatively low social status considered by Chinese Singaporeans. This result is consistent with what has been found in Chen’s (Chen, 1999) investigation -- English is adopted most frequently in official occasions, which accounts for 73% of language use; while Chinese is mostly used in non-official, private occasions, which accounts for 53%.



**Figure 1 General Tendency of Language Choice among Chinese Singaporeans**

In addition, the research reveals some important variables largely affecting language choice. Among these variables, social status is the one that affects the result most.

Education status, career and salary are three main components of one’s social status. It is not difficult to figure out the model of ripple effect “higher education status—better career—higher salary—use English” from figure 2. By Contrary, the people of lower social status are more likely to use Chinese in their talk. This finding is compatible with the result of Chen & Huang’s research (2012) on students’ view about different languages in Singapore, in which 74% Chinese Singaporeans believe English is the most authoritative, influential and useful language. What’s more, people’s emotional attitude towards English varies within a decade. Chen’s investigation (Chen, 1999) shows a majority of Chinese Singaporeans think Chinese is the most elegant and friendly language despite their belief that English enjoys the highest status. However, Chen and Huang’s research (Chen and Huang, 2012) indicates that English is not only the most honorable language, but also the most elegant and melodious language. It means, English is favored by Chinese Singaporeans not only rationally, but also emotionally in recent years.

In fact, when the researcher compares the language choice in the domain of talking about privacies, he gets similar result. If the results drawn from the neutral talk can reflect more the effects of some common social factors on language choice like history, government policy, etc., the similar result gained from the intimate conversation can show more the speakers’ psychological inclination on culture and ethnic identity. In a multilingual and plural-culture society, mother tongue distinguishes itself from other languages with the function of “expressing ethnic identity, and powerful connotations of warmth and intimacy” (Benedict, 2011), and if such function of mother tongue language for a speech community has weakened so severely that even the members in this community do not use it in the personal private communication, it is dubious whether the language is still where the speaker’s emotion and ethnic value live.

Another study (Gupta, 2012) which also elicited data on how language choice related to perception of social class was carried out by a student to explore her husband's language use. Her husband, a Chinese Singaporean, was dressed in two guises -- in the middle-class professional guise he wore white shirt, trousers, and tie; while in his factory worker guise he wore a worker's overall. He looked around twenty furniture shops in each guise, the second visit being after an interval of a week. The shops were in two categories: HDB shops (in government housing estates) and up-market shops. When he was approached by an assistant, the student noted down his languages use. The results were summarized as shown in the table below:

**Table 1 Language Choice of a Chinese Singaporean in Different Guises**

Guise	Middle Class				Working Class			
	English	Mandarin	Hokkien	None	English	Mandarin	Hokkien	None
HDB	1	6	3	-	-	4	6	-
Up-market	9	1	-	-	1	4	3	2

It was found English and Mandarin were the most frequently used language in HDB and up-market store respectively when her husband was in Middle class guise; while when in working class guise, Mandarin and Hokkien were the language choices. The occasional use of Hokkien when in Middle class guise just occurred when faced with a "working class" customer. The researcher said "just as the assistants in the up-market shops tended to shift from English to Mandarin when faced with the factory workers, the assistants in the HDB shops tended to shift from Mandarin to Hokkien". In fact, those records show a very interesting implication that in Singapore, English, Mandarin and Hokkien are three levels of Languages ranked from high social status to low.

Benedict holds that "ethnic groups are formed by persons who share common cultural characteristics which are wholly learnt, typically very early in life" (Benedict, 2011). If family is the first school which builds one's initial value system, the social stratum where one is placed should be the second most important school to shape one's pre-existent value system, even change it drastically.

The second important clue revealed from both studies above is the relationship between age and language choice. The first survey discovered if taking 55 years old as the boundary to classify age groups, the difference of language choice between the older group and younger group is quite distinct. Chances of using Chinese in the older group are much greater than younger group both when talking about work and privacies. The second study also indicated quite a few irregular incidents of language use were concerned with age. For example, the sales assistants in the up-market shops who used Mandarin to the "Middle class" customers were in their fifties and it were the same assistants who switched to Hokkien when faced with the working class' customer. By contrast, the only assistant in HDB shop that spoke English was in her thirties. The close link between language choice and age, undoubtedly, can be attributed to the language policy change in history. The people above 55 years old were born before or around 1950s; their school years, if it was possible for them to go to school, were mostly spent in the Chinese-medium schools teaching in mandarin or even dialects. While the youth were born after the independence of Singapore, when English education was thriving and nearly all the students swarmed into English-medium school. Furthermore, as the younger group is far from the historical origin and susceptible to western culture, it is no wonder that their tendency to speak English is higher than the older group.

As a generation which clings to their native accent and bears stronger “root” complex, the old people always assume the responsibility of transmitting the ethnic culture from one generation to another. Obviously, mother tongue is such a powerful tool to fulfill this project. However, as there is a big difference in language use between the young and the old, the hereditary values and beliefs, conceivably, will be gradually lost owing to the increasing generation gap. One case study focusing on two Cantonese families’ language use in family reunion can reflect this problem (Xu, 2014).

The two families are Wong and Tham. They have close ties and the grandmother in the Wong Family is also the maternal grandmother in the Tham family. For Chinese, Mid-autumn day connotes “gathering” and “tightly-knitted family membership”, thus, all the members of the two families attended this gathering. All of them could speak English although the English ability of the grandparents limited them to some simple topics; only the first and second generation could speak Cantonese and Mandarin, while the grandchildren could speak no or just a little Mandarin. During the observation, the author found although the grandparents “make an effort to speak the language that their grandchildren are comfortable in”, the grandchildren “cannot do the same for them and sometimes have difficulty answering even in Mandarin.” Adult conversation due to language barrier, and “huddle off to have candle light conversation among themselves” quickly bored the grandchildren. Then the conversation between the first and second generations continued comfortably in Cantonese and on Cantonese poems of the mid-autumn festivals and Cantonese jokes were shared and laughed over. Within such an atmosphere where the elder members could communicate and express themselves fluently in Cantonese, the first generation could feel at ease. Meanwhile, the grandchildren were happily talking and laughing about boyfriends, conveying jokes, and complaining about their studies and homework. They spoke English in the whole course in spite of occasional code-switch to Mandarin.

As a matter of fact, it is not uncommon to see such a scene in Chinese Singaporean families. To a certain extent, it is the varying language policies that create the huge cultural gap between different generations, thus, lead to the difficulty in communication among family members.

#### **4 Discussion on the Tendency of Language Choice among Chinese Singaporeans**

If we review the studies above, it is not difficult to find the regulation of the language choices in Singapore Chinese community: English comes to replace the role of Chinese as a home language; English has been the dominant language held by people from higher social stratum; English has gradually been transferred into the role of native language of the new generation.

Undoubtedly, the foremost reason for this trend is the language policy. In the four official languages in Singapore – English, Mandarin Chinese, Malay and Tamil, English was promoted as a “neutral” language for inter-ethnic communication. The bilingualism education policy stipulates that all students in Malay-, Tamil-, and Mandarin-medium school should learn English as the second language. All those in English-medium schools should learn the language associated with their ethnicity as a second language (Peter, 2016). This policy eventually made English the lingual Franca of Singapore. In 1987, English was officially adopted as the first language in schools (Wikipedia, 2019). Tollefson pointed out language planning “cannot avoid the historical relationship between groups; nor can it avoid the political, ethnic, racial, social, and economical issues that are involved in defining their current relationship” (Tollefson, 1994). Singapore’s language planning is not an exception. From sociolinguists’ view, social groups seek to exercise power through their control of language and the language is also the prize in the struggle among different groups, with dominant groups gaining control over language (Fairclough, 1989). Language policy can be analyzed as the outcome of struggle as well as component in it. In such a linguistically and racially diverse country as Singapore, choosing English as the most important official language can be considered as a compromise among different racial strengths.

Although Chinese is the overwhelming majority of the whole population, the federation bears in mind this nation stands for all the races instead of the strongest. In the aim of establishing a cosmopolitan nation where all races live and work harmoniously together, choosing English is a sensible decision as the language of unity in relation to which the three major racial groups are equal.

Furthermore, geographically speaking, Singapore is surrounded by Indonesia and Malaysia – two predominantly Malay and Islamic nations, Singapore needs to carefully manage its image. “With a predominantly Chinese population, the leaders had to assure their neighbors that Singapore would not be an extension of China, but was first of all devoted to its position as a Southeast Asian nation” (Li, 2014). Therefore, choosing English as the first language is a strategy to gain a favorable international environment.

In addition, as Singapore has no natural resources of its own, its leaders were convinced that “economic survival was possible only a part of the Federation and had worked hard to bring that about” (Wee, 2003), since Singapore’s economy is largely dependent upon international export commerce, English, seen as the world language, provides this nation with access to science, technology, economic development and social mobility. Just as the former Prime Minister Lee Kuan Yew said, “without the English language, we might not have succeeded in teaching so quickly a whole generation the knowledge and skills which made them able to work the machines brought in from the industrial countries of the West” (2011).

Government policy is indeed a powerful external strength to direct the trend of language change, while people’s attitude and motivation are another determinant of language choice.

One’s attitude towards certain language is always shaped by the social context and personal experience. Due to Singapore’s colonial history, English, as the symbol of elite minority, enjoys high prestige in this society; on the other hand, “its association with currently valued domains of higher administration, science and technology, international commerce, Western culture and pop entertainment makes it perceived as all-powerful and a ticket to upward mobility” (Scridhar, 2013). Such adoration of English is likely to be transferred into an intrinsic motivation for one’s language learning and use.

What’s more, the economic value and a range of favorable conditions brought by English also stimulate Singaporeans to be proficient in English. McGroarty points out, “the position of a given language on the hierarchy is determined by very pragmatic consideration. The larger the number of desired roles a language enables its speaker to play in a given society, the higher its place is on the hierarchy” (2012). The parents may value their home dialects in certain contexts but insist that their children have ample opportunity to develop pragmatic skill in the prestige standard. Although Singapore government has ever encouraged Chinese education, as long as parents find the students who graduate from English-medium school are much more competitive nearly in all aspects, such as well-paid job, promotion etc., they would still send their children to English-medium schools. The younger generation may learn Mandarin as well in school as the bilingual policy requires that students be taught their mother tongue, but with little motivation, Chinese cannot be continuously used as English in a variety of domains outside the education system for ensuring that it flourishes. Lee Kuan Yew agreed that “while parents and students wanted emotionally to keep their mother tongue, sentimental reasons are not as strong as the economic value of the language” (Lee Kuan Yew, 2011). It’s quite possible with the motivation of economic value, the function of Chinese as a communication tool would be ignored for those young Chinese Singaporeans, along with mother tongue’s function of transmitting ethnic culture.

Nowadays, for the youngsters in Singapore Chinese community, Singapore Colloquial English, the low variety of English, plays an increasingly important role to express solidarity and nationality identity (Jacob, 2014). However, “the question is whether with the greater use of English, we may lose some

aspects of our identity. These are the traditional values of our forefathers” (Lee Kuan Yew, 2011). Although English has brought new knowledge which could support the development of a modern industrial nation, at the same time, it carries the “mindless pop culture of west” (Jacob, 2014), and it is the “gateway to decadence, liberalism, Westernization” (Bokhorst-Heng, 1999). For the sake of “re-culturalize” and “re-ethnicize” Chinese Singaporean, the government developed the “Speak Mandarin Campaign” from 1979 with the slogan “Hua Ren Hua Yu”, which means “If you are Chinese, make a statement in Chinese”. Goh Chok Tong said in his speech delivered in 1991 “Speak Mandarin Campaign”, “Values and language cannot be easily separated...A Chinese Singaporean who does not know Chinese runs the risk of losing the collectivist wisdom of the Chinese civilization” (Zhang Yue & Zhang Kun, 2015).

After so many year’s implementation of “Speak Mandarin Campaign”, the result displayed from statistics seems fall short of people’s expectation. Although the Chinese literacy has a noticeable improvement, the status of Chinese in language use is still shown to be inferior to English. Members of Chinese community concerned that merely having Mandarin as the vehicle of traditional Chinese culture and emblem of Chinese identity does not guarantee its survival, unless Mandarin has its market value (Li & Huang, 2012). The Surge of Linguistic instrumentalism in Singapore led to the “old politics of identity” being increasingly abandoned “in favor of a new pragmatic position where language and culture were valued as commonly identifiable resources” (Heller, 1999). Therefore, maybe whether Chinese can still maintain its role as a culture vehicle and ethnic value transmitter will largely depend on its economic value.

## 5 Conclusion

By analyzing Chinese Singaporeans’ language use in terms of various categories, including different domains where languages are used, social status and age of language users, the tendency of language choice among Chinese Singaporeans has reflected the language hierarchy in Chinese community is English, Chinese Mandarin and Chinese dialects if ranked from high to low. For such hierarchy, language management is a determinant to its formation. Besides, a range of other influential factors, including history, geography, personal motivation, etc also play a large part in directing Singapore Chinese language choice, and sometimes their influence even overrides the power of language management.

The declining trend of Chinese use in Chinese Singaporeans probably put them at risk of losing their culture and ethnic identity. Although Singapore government has realized the importance of remaining traditional culture to Singapore’s future prosperity, and develop the “Speak Mandarin Campaign” among Chinese Singaporean to restore the language and culture, the results seems not so satisfactory.

Therefore, how to change Chinese Singaporeans’ attitude to Chinese and strike a balance between the linguistic instrumentalism and identity orientation remains a key issue in the following researches.

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# **A Case Study of Chinese Students' Attitudes towards Flipped Classrooms**

Tang Xiaofei

School of Foreign Languages, Wuhan University of Technology, Wuhan, P.R.China, 430070

(E-mail: xiao-fei.tang@whut.edu.cn)

**Abstract:** Higher education in China has been under a significant transformation from an elite educational system to a stage of massification over the past few decades. This calls for the use of a Small Private Online Course (SPOC) embedded flipped classroom. A question raises is the proposed model perceived by students as important and effective? This study reports on the feedback of a four-month experiment using a SPOC embedded flipped classroom format for a compulsory English-major course at a public university in Wuhan. Adopting an online-based questionnaire, the study looked into the attitudes of undergraduates toward learning of English language and culture through the proposed format. Major results showed that the proposed model was partially perceived as contributing to the development of students' autonomous, active and collaborative learning skills. However, some issues remained such as the time allocation of online learning and face-to-face instruction. Pedagogical suggestions were proposed including the provision of an introductory program.

**Key words:** Student's attitude; Flipped classroom; SPOC; Blended learning

## **1 Introduction**

Higher education in Mainland China has experienced a significant transformation from an elite educational system to a stage of massification since the first decade of the 21<sup>st</sup> century. In 2007, the Department of Higher Education launched the College English Curriculum Requirements, promoting a computer-assisted and classroom-based teaching model (Department of Higher Education of Ministry of Education of P.R.C, 2007). Furthermore, the National Foreign Languages Teaching Advisory Board draw up the *Guidelines on College English Teaching*, pointing out that computer and information technology should be widely applied to college English education since they not only facilitate the reform of teaching approaches and practices but also provide a large range of innovative learning resources (Ministry of Education, 2015).

One of blended learning approaches, the Small Private Online Course (SPOC), is called for as an alternative to enhance and innovate on-campus curricular contents through the platforms, technologies, and patterns of MOOCs (Zhang, 2017). According to Fox (2013), the SPOC supplements the traditional classroom experience with free online learning materials delivered through MOOCs. In a sense, the SPOC combines the features of face-to-face and online instruction and extends the existed courses of higher education to online education.

However, an interesting issue raises: how can we distribute and arrange face-to-face and online instruction for a SPOC-embedded English as a foreign language (EFL) course in higher education? A flipped classroom approach has the potential to address this issue. Compared to the traditional knowledge-transmission teaching, the flipped classroom approach removes face-to-face lectures from class time; instead, class presentations are transferred to as home activities whilst homework and projects are shifted to in-class tasks (Abeysekera & Dawson, 2015; Sohrabi & Iraj, 2016). Since the learning process is inverted in a flipped classroom, students have more access to using English inside and outside the classroom (Bergmann & Sams, 2012). Accordingly, students watch pre-recorded instructional videos via online platforms at home and engage in homework and activities collaboratively with their classmates during the class.

Although the recent attention has been paid to the flipped classroom approach (Akçayır & Akçayır, 2018; Bishop & Verleger, 2013; Butt, 2014; Jaster, 2013; Lee, Lim, & Kim, 2017; Lee & Wallace, 2018; Shih & Tsai, 2017; Zain Uddin & Attaran, 2016), there is little empirical evidence of the real status of the SPOC embedded flipped classroom model in Chinese higher education and whether it is perceived as important and effective, particularly in EFL classrooms. The established studies focus on the design and principles of flipped classrooms in Mainland China (Jiang & Hu, 2018; Luo, 2017; Wang, 2017; Zhang, 2017; Zhang & Tao, 2017; Wang, Chen, & Zhang, 2016). Therefore, this study aims to investigate undergraduate students' perspectives on the SPOC embedded flipped learning model in an EFL course at a Chinese public university.

## **2 Methodology**

### **2.1 Informants**

This study involved a compulsory EFL course for undergraduate English majors, “*Society and Culture of Britain and America*”, collaboratively taught by three lecturers who were affiliated with the same department in the autumn semester of 2018 at a public university in Wuhan, Hubei. One hundred and fifty students enrolled in this course with six classes, and each lecturer instructed two classes. The number of students in each class was 25. A total of 122 students voluntarily participated in this survey and completed an online questionnaire at

the end of the semester. The majority of the participants were freshmen (94.26%), while the remaining consisted of six sophomores (4.92%) and one junior (0.82%). Prior to attending this course, only 13.93% had experience in online learning, while more than one-fifth (21.31%) claimed that they previously had no idea about this concept. The remaining participants (64.76%) demonstrated a limited or little understanding of online learning.

## **2.2 The SPOC embedded flipped classroom**

The course lasted for four months, throughout September to December, 2018. Each class ran twice a week for 90 minutes. The three teachers had a regular meeting every Friday to determine the topics of discussion and collaborative tasks as well as the face-to-face instruction process for the next session. All the teaching materials were developed on the basis of the course outline and curriculum requirements and then produced into a SPOC on the China Universities MOOC.

The teachers implemented the flipped classrooms through requiring students to complete self-paced online learning before class, including watching instructional videos, listening to recorded audios, reading passages, and making use of online learning resources via the SPOC platform. Additionally, students were required to undertake an online quiz each week, which was designed for evaluating the students' work and progress. The students received the results of the quizzes immediately through the online platform.

During the face-to-face sessions, the instructors facilitated the collaborative learning through leading students to engage a variety of in-class tasks and activities. Firstly, students were required to bring their own smart devices, including smart phones, tablets, or laptops, to complete homework via the SPOC platform. Each homework consisted of 10 multiple-choice questions and was created according to individual lessons. The results of homework were released instantly through the online learning system. The instructors also provided feedback to address the unclear issues proposed by students. Secondly, students were asked to participate in group discussion, concentrating on a range of pre-determined topics. The teachers offered a summary of group discussion at the end of every session. Lastly, students were told to share their questions and concerns with respect to pre-class online learning, while other classmates were encouraged to provide corresponding solutions, followed by the teachers' comments.

## **2.3 Instrument and procedures**

The researcher carried out an online survey to investigate the attitudes of students towards the proposed approach and their perceived benefits. The questionnaire comprised 10 multiple-choice questions (see Table 1-3) and 1 open-ended question. All the survey items were

designed on the basis of the nine principles for the flipped classroom developed by Kim, Kim, Khera, & Getman (Khera, & Getman, 2014) which provided a comprehensive insight into the application of flipped teaching in urban universities with computer-assisted technologies. The nine design principles for flipped teaching are listed as below (see Kim et al., 2014, pp. 43-46).

- provide an incentive for students to prepare for class;
- provide a mechanism to assess student understanding;
- provide prompt/adaptive feedback on individual or group works;
- provide enough time for students to carry out the assignments;
- provide facilitation for building a learning community;
- provide technologies familiar and easy to access;
- provide an opportunity for students to gain first exposure prior to class;
- provide clear connection between in-class and out-of-class activities;
- provide clearly defined and well-structured guidance.

For the current questionnaire, the 10 multiple-choice questions aimed to look into students' attitudes towards the SPOC and flipped classroom model, active and autonomous learning mode, and collaborative learning mode, while the open-ended question was intended for learning students' opinions of benefits or shortcomings of the flipped classroom structure. Cronbach alpha <sup>80</sup>for the five Likert scale items was conducted and revealed a value of .72, which was considered an acceptable value for reliability. To avoid misunderstanding, all the questions were presented in Chinese.

At the end of the final session, all the participants were invited to use their own smart devices to complete the online questionnaire anonymously within 20 minutes. The participants were delivered a consent form and an instruction of the online survey in advance. The researcher and the course instructors did not enter the class whilst questionnaires were being completed by consenting students and were not allowed to access any survey data until after final grades had been submitted.

The quantitative data from multiple-choice questions were analyzed through SPSSAU v16.0 Software. In order to obtain a more comprehensive picture of the students' perspectives,

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<sup>80</sup> Please check Santos (1999) for reference.

the researcher checked through the participants' responses to the open-ended question and marked the key words concerning their likes, dislikes, and suggestions to identify specific topics. The similar patterns within the topics were then generalized according to the overall features of SPOC embedded flipped classrooms, such as subtitles of the instructional videos, teaching content, homework, discussion, and peer interaction.

### 3 Results

Table 1 shows the results regarding the undergraduates' attitudes towards the SPOC and flipped classrooms through five survey items. Firstly, 60.66% of the respondents agreed or strongly agreed that they liked the online learning mode and enjoyed interacting with the instructor through flipped classrooms, and 33.61% were not sure. Secondly, 33.61% agreed or strongly agreed that they did not adapt themselves to the SPOC embedded flipped classroom very well, and over half of the informants (51.64%) held a neutral attitude. Only 14.75% showed a positive attitude about their adaptation to the proposed teaching approach. Thirdly, over a fifth of the respondents (22.13%) agreed or strongly agreed that they did not feel free while engaging with the SPOC embedded flipped classroom, while more than one-third (33.61%) indicated the opposite perspective. The rest of the participants (44.26%) were not sure. Fourthly, over two fifths of the respondents (43.45%) agreed or strongly agreed that they preferred the traditional knowledge-transmission classroom than the SPOC embedded flipped classroom, whilst less than one fifth (19.67%) held the opposite attitude. The remaining (36.89%) held a neutral position. Fifthly, 38.52% agreed or strongly agreed that the SPOC embedded flipped classroom approach was more beneficial than the traditional classroom instruction, while only 8.2% clearly opposed that. Over half of the respondents (53.28%) showed a vague attitude.

**Table 1 Attitudes toward SPOC and Flipped Classrooms**

	Strongly agree	Agree	Not sure	Disagree	Strongly disagree
I like online learning and interacting with the teacher	4.1%	56.56%	33.61%	3.28%	2.46%
I don't adapt myself to the new model very well	2.46%	31.15%	51.64%	13.93%	0.82%
I don't feel free while engaging with the new model	4.1%	18.03%	44.26%	31.97%	1.64%
I prefer traditional classrooms than flipped classrooms	9.02%	34.43%	36.89%	18.03%	1.64%
I reckon that the new model is more beneficial	0.82%	37.7%	53.28%	6.56%	1.64%

Table 2 reveals the findings of the students' attitudes towards the active and autonomous learning mode. First, over two fifths of the participants (40.99%) agreed or strongly agreed that they were able to arrange their online learning and manage their learning progress well, and approximately half of the respondents (49.18%) indicated an unsure position. Second, more than half (51.64%) agreed or strongly agreed that they had more available time to consider the relevant questions while studying the SPOC, and nearly two fifths (39.34%) were unsure about that. Last but not the least, 45.9% affirmed that the SPOC embedded flipped classroom model advanced their autonomous learning skills and enabled them to learn more actively, while almost the same amount of the respondents (45.08%) had a neutral attitude.

**Table 2 Attitudes toward Active and Autonomous Learning**

	Strongly agree	Agree	Not sure	Disagree	Strongly disagree
I can arrange online learning and manage learning progress	4.1%	36.89%	49.18%	7.38%	2.46%
I have more time to think through the questions	8.2%	43.44%	39.34%	7.38%	1.64%
It advances my autonomous and active learning skills	2.46%	43.44%	45.08%	8.2%	0.82%

As Table 3 indicates, the results of the undergraduates' attitudes regarding the collaborative learning mode are tabulated according to two survey items. First, nearly half of the informants (45.9%) showed agreement or strong agreement that they could interact better with other classmates and learn more from each other, whilst 43.44% held an unclear position. Next, over a half (53.28%) agreed or strongly agreed that their teamwork spirit and cooperative skills were advanced via the SPOC embedded flipped classroom approach, and 36.07% were not certain about their perspectives of that.

**Table 3 Attitudes toward Collaborative Learning**

	Strongly agree	Agree	Not sure	Disagree	Strongly disagree
I can interact better with and learn more from classmates	0.82%	45.08%	43.44%	9.02%	1.64%
My teamwork spirit and cooperative skills are advanced	2.46%	50.82%	36.07%	9.84%	0.82%



In addition, the open-ended comments<sup>81</sup> of the online survey were highly varied and difficult to pin down significant consistencies. The categories and keywords that were most frequently mentioned in the students' comments were that of the "online" and "time" aspects of the course. The time allocation of online learning and face-to-face instruction appears to be the most conflicting issue among the students' responses. Some students clearly indicated that they favored online-based learning and recommended further implementation of SPOCs instead of traditional in-class lectures, as exemplified in "Online learning is very interesting, and I can manage my study time. I suggest this course should be developed as 100% online instruction mode" (Student A) and "I learned a lot from online course. Hope the teacher can increase the online lessons and upload more supplementary materials to the SPOC" (Student B). However, responses to weaknesses of the proposed model tended to suggest more use of traditional in-class sessions rather than online learning, such as "The time allocation for online learning seems a bit too much, which sometimes makes me stressed" (Student C), and "More units should be delivered by in-class sessions" (Student D).

#### **4 Discussion**

First, with respect to general attitudes towards SPOC and flipped classrooms, the students showed significant consistency in favoring online learning and interacting with teachers and approximately two-fifths believed that the new teaching format was more beneficial. However, a majority of students did not feel or were hesitant that they got along well with the new model and preferred it to traditional face-to-face instruction. Most of students were open to this new attempt, but they were less satisfied with classroom structure than those in a traditional class were. This finding is relatively consistent with the result reported in Jaster (2013) which concludes that a majority of students enrolling in a first-year algebra course at an American college prefer a traditional lecture approach to a flipped classroom. A possible account for students' converse preference is that almost all the participants are first-year undergraduates and they may not get prepared for an immediate transition from a familiar instructional mode to an unfamiliar one. Those students mostly graduated from public high schools in Mainland China where traditional face-to-face lectures were exclusively employed. Thus, the lack of self-confidence might result in their conservative attitudes towards the SPOC and flipped classrooms.

In terms of active and autonomous learning mode, the students demonstrated more satisfaction with the flipped classroom structure. Approximately half of students became

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<sup>81</sup> The students' responses to the open-ended question were originally presented in Chinese. The author translated the comments quoted in Section 3.

positive towards their self-paced learning through the online platform and believed that the new model contributed to their autonomous and active learning skills and critical thinking. This result generally follows Zain Uddin & Attaran (Zain Uddin & Attaran, 2016) which finds that 78% of students favor the innovative learning mode of flipped approaches since it provides more time for them to perform individual study and practice teaching contents outside the class. However, slightly over half of students did not believe or felt uncertain that they could manage their learning progress. This may result from the fact that most of students still feel more comfortable about passively receiving knowledge from the instructor in a teacher-centered classroom and thus have not established a strong motivation for self-driven learning. Moreover, a majority of them previously had a limited or no understanding of flipped learning, so they might not be familiar with how to properly carry out autonomous and online learning.

In regard to collaborative learning mode, over half of students were positive towards their teamwork experiences and peer cooperation via the flipped classroom, whilst slightly less showed their confidence in peer learning and interaction. Similarly, 67% of students as reported in Zain Uddin & Attaran (Zain Uddin & Attaran, 2016) claim that flipped learning helped develop good virtual rapport among them outside the class. The flipped classroom model is a student-centered pedagogical approach, and thus students have more opportunities to communicate with their classmates by means of technology out of class and to actively participate in collaborative hands-on tasks or activities during the sessions. However, the result also suggests that more efforts need to be made in order to strengthen students' faiths and motivation in acquiring knowledge and skills through active helping and supporting their classmates.

In addition, the students' comments on the open-ended section draws our attention to a highlighted issue of flipped classrooms, namely, the time allocation of online learning and face-to-face sessions. Some students liked the ability to work at their own pace and time through online platforms, while others raised their concerns including more workloads from online course stressing them out and seemingly imbalance between online learning and face-to-face instruction. These concerns are similar to what have been discussed in the literature regarding criticisms of flipped learning (DeGrazia, Falconer, Nicodemus, & Medlin, 2012; Toto & Nguyen, 2009). They are possibly caused by the heterogeneity of students in class. The diversity of their English proficiency and learning demands may determine their different preferences for instructional formats.

## **5 Conclusion**

This study reports on English-major undergraduates' perspectives on a SPOC embedded flipped classroom model at a public university in China. The results revealed that, on average,

around half of students were positive about the use of the SPOC-embedded flipped classroom model in the current course, but the feedback from a few of survey items was somewhat mixed in regard to students' general attitudes toward SPOC and flipped classrooms, active and autonomous learning mode, and collaborative learning mode.

Several suggestions are proposed in order to improve the effectiveness of the current flipped classroom model. Firstly, an induction program for SPOCs and flipped classrooms needs to be established, so that students can obtain more guidance in developing their online, autonomous, and cooperative learning skills. Secondly, the instructors need to check the discussion board of the SPOC platform more regularly and address individual questions posted by students more efficiently. Regular assistance from student tutors may be an addition to practicing teaching strategies. Thirdly, a pre-course assessment may be helpful to have a better understanding of different levels of students' English proficiency. In addition, online learning materials need to be graded into fundamental and advanced materials in line with students' learning readiness.

Noteworthy, the following two limitations may influence the generalizability or interpretation of the present findings. The first issue concerns the validity of the collected data. Due to the limited scope and length of the current case study, the future research requires an appropriate quantitative data analysis approach in order to offer a better understanding of the students' attitudes toward the SPOC embedded flipped classroom model. The second issue relates to the limited range of survey items. A broader range of survey items needs to be considered in the design of questionnaire.

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## The Impact of CBI on non-English Majors' Critical Thinking Skills

Wan Zi

School of Foreign Languages, Wuhan University of Technology, Wuhan, P.R.China, 430070

(E-mail: wanzi@whut.edu.cn)

**Abstract:** Recent research on critical thinking (CT) centers on the CT facilitation model for English majors and the construction of theoretical hierarchy of CT, but there are few studies concerning the approaches and practices of the development of CT skills in College English context. In an attempt to improve non-English majors' CT skills and produce innovative international talents, content-based instruction(CBI) that features CT development is proposed, which aims at building up a questioning atmosphere in classroom context, exploring relevant themes by focusing on contents, constructing online learning platforms, and combining summative and evaluative assessment. In order to test to what extent CBI has impacted learners' CT skills in College English classroom context, a survey was conducted by issuing questionnaires to respondents (n=108) in Wuhan University of Technology. The results show that CBI is beneficial to language learners in facilitating CT skills; however, there still exist problems such as the difficulty in choosing appropriate teaching and learning materials, students' varied receptivity of the teaching strategy based on their respective levels of English and how to strike the balance between CT skills development and language skills enhancement.

**Key words:** Content-based instruction; Critical thinking; College English; Non-English majors

### 1 Introduction

It is proven by the fact that traditional pedagogy lays more emphasis on the pattern drills of language and the training of language skills, neglecting the cultivation of higher order thinking--CT skills of students, which has become the greatest barrier to fostering students' analytic, evaluating and creative abilities. Language classes in China are more like language centers aimed at improving language proficiency than places where English learners with independent and innovative thinkers are trained (Huang, 2010). Such teaching methodologies have brought about undesirable consequences in teaching objectives, curriculum setting, construction of knowledge and students' ways of learning English, which call for entire transformation in educational pedagogies.

Large quantities of overseas and domestic studies of CBI have proven the validity of CBI. The notion CBI (content-based instruction) emerged as solutions to social needs especially for immigrants who took immersion programs to cope with language problems and there emerged successful teaching prototypes (Duenas, 2004). Content-based instruction (CBI) means language learning rests upon a certain discipline or theme teaching with integration of language learning and disciplinary learning with an aim to enhance learners' language competence while improving learners' abilities of cognition and disciplinary learning. CBI teaching mode combines language forms and the meaning of learning together, eliminating the partition between language learning and disciplinary learning make by people deliberately (Mohan, 1986), which is beneficial in stimulating learners to think and learning new knowledge in the target language, thus integrating the four languages skills such as listening, speaking, reading and writing. According to Stryker & Leaver (1997), CBI should follow three major principles that feature disciplinary learning as the core, authenticity of language learning materials and fitting in

with the needs of special groups of students. Domestic studies reveal that CBI not only helps improve learners' English competence, contributes to enlarging learners' knowledge of their specialties but also generate positive effects on learners' motivation, English learning strategies, interests in learning English (Chang, 2007) and comprehensive qualities required by workplace (Yuan & Yu, 2008).

There is an increasing number of studies on critical thinking (CT), which center on the integration of the fostering of CT and foreign language skills. CT is fundamental to higher education and is presented to students as an integral part of learning at university (Moore, 2011) and it is a purposeful, self-regulatory judgment which results in interpretation, analysis, evaluation, and inference, as well as explanations of the evidential, conceptual, methodological, or contextual considerations upon which the judgment is based (Facione, 2015). Educational researchers (Halpern, 1993) find that better thinking can be "learned through instruction". Paul & Elder (2008) regard CT as the art of analyzing and evaluating thinking with a view to improving it. Abrami et al. (2008) has demonstrated that explicit teaching have better effects on CT development compared with implicit teaching and Bensely & Spero (2014) also prove that direct teaching of specific CT skills in regular course such as argument analysis and critical reading skills significantly improved college students' CT performance and metacognition. In China, researches centered on CT have gained concern from scholars recently, which mainly fall into three categories: the urgency of promoting instruction of CT skills in second language learning and approaches to cope with the status quo (Luo, 2000), the revision of the Chinese version of CT assessment tools and the establishment of theoretical framework of measuring CT abilities (Wen, 2010), and empirical studies on the CT skills of non-English majors and instructors at tertiary institutions (Li, 2011) According to Wen (2010), she proposed a theoretical hierarchy of measurement on critical thinking skills that is operational in real teaching process. The first meta-critical thinking refers to the abilities of planning, checking, adjusting and evaluating skills; the second level of critical thinking includes the skills and criteria related to cognition and affective CT qualities.

Overseas studies have tested the effectiveness of CT instruction through empirical support; however, relevant studies have not tackled the impact of CBI on English learners' critical thinking, especially under the framework of College English. This study aims to test whether CBI might be of help in improving non-English majors' critical thinking skills and attempts to demonstrate the model of applying CBI for practitioners and professionals. The lack of CT will affect people's creativity, research abilities and problem-solving abilities, therefore the problem that prevails among non-English needs to be addressed. CBI integrates language learning and disciplinary learning, thus helping language learners to think and acquire new knowledge in the target language, which might be of benefit to the cultivation of CT skills of non-English majors at the tertiary level. And this study aims to find out how CBI could facilitate language learners' CT skills and what adjustments in CBI can be made to enhance comparatively weak CT skills of the non-English majors and present a prototype for language practitioners and teachers at the tertiary level.

For this study, it will mainly focus on the correlation between the implementation of CBI and its impact on CT skills of non-English majors at the tertiary level.

## **2 An Example**

In order to implement CBI into real teaching practice with a view to cultivating language learners' CT skills, a framework has been established, featuring a classroom context that encourages questioning,

Content-based Instruction(CBI) and the combination of summative and evaluative assessment.

First, a classroom setting where students could question and cultivate their affective CT qualities is constructed. To this end, teachers should interact with students on an equal basis where teachers are the facilitator, mediator and manager instead of being an authority on the stage. For instance, in the teaching design, students are supposed to watch TED talks and summarize the main ideas, give presentations on the topic and answer questions from the audience concerning the contents they have presented. For the TED talkers, they are able to meet the challenges with full preparations that were done previously, including understating relevant concepts or definitions, training delivering skills, distinguishing facts and opinions and developing their own ideas during the process of which their questioning spirit has been enhanced.

Second, CBI is employed as the strategies that run through the completely teaching procedures. The teaching contents can centre on disciplinary knowledge and any themes in the knowledge system in the target language. Under such a teaching concept, the choice of teaching materials can create a meaningful learning context by combining language learning and disciplinary knowledge, thus challenging students' cognition. In real teaching practice, project-based teaching is implemented, which is a concrete application of CBI. Based on Stoller's research, a project is carried out in 6 procedures: choosing topics, setting schedules, carrying out projects, analyzing and summarizing data or resources they have collected, sharing their findings in presentations and evaluating their gains and room for improvements. For teachers, they should guide students to find the themes that may arouse their interests, keep up with social issues, raise their awareness of analyzing the reasons behind and ultimately form their own cognition and judgements by integrating language skills and disciplinary learning. For instance, in the study the teacher divides themes into different categories including education, environment, science and technology, economy and politics and career planning from newspapers, magazines or journals such as the Economist, New York Times or New Scientist. While helping students to broaden their cross-cultural horizons, the teacher provides timely help in training students' language skills that include topic sentence writing, distinguishing opinions and evidence, making comparison and contrast, writing summaries and group reports. Take Unit 4, College English 4 for example, one of the group project is the theme of globalization and the group members should gather data from every possible source to explore the definition of globalization, benefits and drawbacks of globalization as well as how to tackle the current problems associated with globalization under the global context of trade war between America and China by referring to relevant essays, TED talks and news reports. After the group has presented their research findings, they will defend their stance in class in response to the audience's questioning and finish self-assessment after class.

Third, online English learning platform is under construction. According to Wen (2010), she points out those cognitive skills are the major expression of CT skills including analyzing, reasoning and evaluating. Learners can regulate and adjust their cognitive process by planning, monitoring and assessing skills. One of the most effective strategy for learner training and mastering cognitive skills is learner autonomy that helps to cultivate their positive affective qualities. The construction of online learning platform that supplements classroom teaching can meet students' individualized needs, thus increasing classroom efficiency. Though the combination of off-line and online learning, learners can get access to large quantities of real-context language drills, immerse themselves in English environment with a purpose of exploring the assigned project and improve their language skills and CT skills.



Fourth, summative and evaluative assessment should be combined. Learners' profile should be made and students' classroom performance should be taken into consideration and the attributes of assessment should include learners themselves, group members and teachers. Though such dynamic evaluation, learners will be able to review, assess and revise their performance or assignments, which is one of the most important targets of self-regulation concerning CT skills.

### 3 Data and Methodology

#### 3.1 Research questions

The overarching goal of this project is to discover the impact of CBI on critical thinking skills among non-English majors at the tertiary level in China. The research questions to be addressed are as follows

- 1) Does the application of CBI in College English classroom context affect CT skills of non-English majors?
- 2) What adjustments in CBI can be made to enhance CT skills of the non-English majors while promoting their language learning?

#### 3.2 Subjects

The respondents (n=108) are non-English majors who study at Wuhan University of Technology in the second semester, their disciplines ranging from material engineering(28), business administration(24), industrial design(14), civil engineering(12), vehicle engineering and others(30). There are 61 male and 47 female freshmen.

#### 3.3 Instruments and design

An online survey in the QQ group was conducted before the end of the semester when the course was drawing to an end. During the whole semester CBI was employed as the major teaching strategies that guide through all teaching procedures. Based on the Chinese version of California Critical Thinking Skills Test (CCTST) that is the most extensively used CT skills testing instrument(Albrami et al., 2014) and Wen's (2010) framework of CT skills, a questionnaire was issued online to four classes, consisting of three parts that mainly include the evaluation of self-regulatory skills, cognitive skills and affective qualities. 108 copies of results were obtained.

Based on the data gathered from the two groups, the research will analyze to what extent CBI plays in fostering CT skills and adjustments in CBI that can be made to enhance CT skills of the non-English majors.

### 4 Results

The results can be analyzed from four angles in accordance with the theoretical hierarchy of CT. Altogether 108 responses were obtained.

**Table 1 Mean Scores of the Items for Measuring Respondents' Self-regulatory Skills**

Self-regulatory skills	Mean
I know my own strengths and weaknesses during the whole project and how to work on my weaknesses with a specific plan after adjustments.	3.82

The lower level of the theoretical hierarchy of CT concerns whether learners could regulate their own study plans and make adjustments based on their own evaluation on the previous performance. The respondents show rather positive assessment of their employment of self-regulatory skills with a mean score of 3.82, which demonstrates that they know their strengths and weaknesses in the whole project. However, they still express the problems in CBI in the semi-structural interview, such as how to distribute group work, difficulty in presenting their ideas due to lack of language competence, how to grasp the usage of new vocabulary when the explanation of words and phrases is greatly reduced and how to handle those large quantities of sources that might cause trouble in deciding the priorities of them, and etc. Therefore, relevant guidance should be given to students through different channels to cultivate their self-regulatory skills. First, teachers should let students understand the goal of CBI is not only confined to enlarging vocabulary, mastering vocabulary and understanding the superficial meaning of information but guiding them to learn how to discuss, question and evaluate different arguments, thus thinking from cross-disciplinary perspectives and raising their own ideas. For instance, social, cultural and economic issues such as climate change, whether to celebrate foreign festivals, globalization etc. might be chosen as discussion or debating topics, which requires students to follow certain research methods to get convincing evidence that could serve as support for their arguments. By doing this, language competence can be enhanced through the integrated methods.

**Table 2 Mean Scores of the Items for Measuring Respondents' Cognitive Skills**

Cognitive skills	Mean
1. I am able to choose, analyze, categorize and make comparisons among the source materials.	3.95
3. I can distinguish thesis statements and their support in TED talks or reading materials	3.82
4. In other groups' presentations, I often evaluate the plausibility of their arguments.	3.55
5. I can decide on the important concepts or definitions in the presentations accurately.	3.56
6. I am good at making a systematic plan to handle difficult problems.	3.52
7. In my group's presentation, I could explain my points clearly with appropriate support.	3.87
8. In order to finish the project, we refer to convincing newspapers, essays and website.	3.96

According to the theoretical hierarchy of measurements on CT skills presented by Wen (2009), the items in Table 2 mainly measure the cognitive skills of the respondents. Overall, the respondents' assessment of their own skills in analyzing, distinguishing opinions and support, finding out the major concepts, viewing things from a holistic point of view and being aware of providing convincing source is relatively positive, with Q 1 and Q8 ranking the highest (3.95 and 3.96). However, the figure for Q 4, Q 5 and Q 6 are comparatively low with 3.55, 3.56 and 3.52 respectively, which means the respondents tend not to easily analyze how plausible others' arguments are and might encounter troubles in finding out the important concepts or ideas that are essential as premises of their arguments; what's more, they assume that they could not give a holistic point of view of tackling difficult problems while they are preparing presentations.

Based on the results obtained from the survey, the respondents are on the preliminary stage of applying critical thinking skills, exercising analyzing, distinguishing opinions and evidence and

summarizing skills to a certain extent, which shows the application of CBI is beneficial in cultivating students' critical thinking skills. For teachers, they should know that while maintaining students' language training, they need to guide students to use English as the media for reading, thinking and language output. Besides, teachers should give students certain academic training and help them to absorb disciplinary knowledge by learning English. In real classroom settings, teachers should know how to raise questions that could provoke their critical thinking. For example, Socratic questioning can be adopted in the procedures of clarification, giving explanation, presenting viewpoints or perspectives as well as making summaries. What's more, individual and group tasks should be made explicitly so that student could know what preparations they should make, which research methods they should follow and how to tackle specific tasks more efficiently

**Table 3 Mean Scores of the Items for Measuring Affective Quality**

Affective emotions	Mean
9. My curiosity and desire for knowledge is appreciated by others	3.25
10. I respect others' different views and am willing to revise my own opinions if they are wrong.	4.27
11. I am afraid to ask questions concerning the contents, especially when others' presentations are over.	3.10

Another category that belongs to the second theoretical hierarchy of CT model is affective emotions. In this section, the degree of curiosity, openness to different views, self-confidence, integrity and perseverance is the measurement of CT skills. The mean score reaches 4.27 in Q 7, meaning the respondents are willing to listen and modify their own opinions with openness; when it comes to Q 11, the subjects generally shows uncertainty about the cause of their unwillingness to challenge other presenters by raising questions. A follow-up semi-structured interview was conducted along with the survey. The reasons behind the phenomenon are as follows. Firstly, they are too shy to raise questions for they are unable to organize their ideas in a grammatically correct way; second, they do not know how to ask questions because they are afraid the questions they raised might be meaningless; thirdly, others' presentations sometimes fail to provide them with a better understanding of the topic, causing boredom in the audience. As for Q 9, the figure is not high as expected for cultivation of curiosity is what should be enhanced in CBI. Only if the teaching contents and the group projects they undertake bear close relevance to their personal experiences and solutions to certain social issues can their curiosity be stimulated to a large extent.

The results can provide some hints for CBI teaching. The training of CT skills in college English teaching might yield negative results if an atmosphere that encourages critical thinking is not established. Teachers should work as scaffolds to offer relevant vocabulary and phrases, sentence drills, question types and discussion samples for them so that they can imitate instead of all working by themselves, thus helping them developing confidence little by little and ultimately building up open-mindedness, fairness and integrity in the thinking process.

## 5 Conclusion

The results of the survey demonstrate that CBI featuring the integration of language learning and

disciplinary learning does facilitate students' CT skills that help them to become more confident and build up a questioning mind by engaging themselves in the activities such as presentations, analyzing, interpreting, questioning and evaluating. In order to achieve the desired effect of adopting CBI, the classroom setting that promotes questioning, open-mindedness and fairness, the appropriate approaches that are combined with Socratic questioning, the online platform that works as scaffolds to offer learners relevant sources and guidance should be integrated in order to enhance learners' language competence and critical thinking skills at the same time.

The research on the impact of CBI on CT skills gives the following implications. First, language is not only the study subject but also a tool for adjusting language learning; second, language as an intermediate tool can promote the cognitive development of learners as well as language building; third, language learning is a social activity that involves many agents such as language, interactive tasks and real socio-cultural learning settings, which requires language learning to be interwoven with disciplinary learning, making learning tasks more meaningful and related to learners' needs.

The greatest hinderance to the cultivation of talents who can meet the challenges of the era of science and technology is lack of CT skills among undergraduates at the tertiary level. Innovations need those who have good language skills as well as innovative spirits that could be promoted by training students' CT in English classroom context. The teaching concepts of CBI can fit in with the requirements by combining the cultivation of language competence and disciplinary learning. However, a more specific test should be given to the respondents to get more objective results of the changes in their employment of CBI before and after the experiment, which might be revised in the future. Besides, the choice of materials that can facilitate CBI need to be reckoned with in the era of big data. Teachers should rely on the statistics of the big data to decide on the appropriate materials that might arouse students' interests and train students' competence in a more comprehensive way.

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# **Research on the Influence of Five-chain Coordination on Regional Innovation Capability**

Teng Liangwen, Zhou Jiang, Chang Yuming

School of Management, Wuhan University of Technology, Wuhan, P.R.China, 430070

(E-mail: gy\_tlw@whut.edu.cn, 376304265@qq.com, 1120105867@qq.com)

**Abstract:** With the national innovation-driven development strategy continues to advance, the coordinated development of regional innovation is becoming more and more important. This paper explores the key factors affecting regional innovation capabilities from the perspective of “five-chain co-ordination”. On the basis of the research on “industrial chain”, “innovation chain” and “financial chain”, the “talent chain” and “policy chain” are introduced: constructing a "five-chain coordination" system including "industrial chain, innovation chain, financial chain, policy chain, and talent chain". According to the panel data of the National Innovation Reform Experimental Zone, the paper studies the concept, mechanism, causes of the “Five-chain Coordination” and the concepts, dimensions of regional innovation capability, and the impact mechanism of the two, in order to provide reference and basis for the government to formulate relevant policies for regional innovation systems.

**Key words:** Five-chain coordination; Regional innovation capability; Policy balance; Regression analysis

## **1 Introduction**

In May 2016, at the National Science and Technology Innovation Conference, General Secretary Xi Jinping pointed out that “innovation is a systematic project. The innovation chain, industrial chain, financial chain, and policy chain are intertwined and mutually supportive. Deepening reform must be fully deployed and coordinated.” At the same time, talents are the mainstay of innovation. To build a world of science and technology, it is necessary to constantly inspire the innovative vitality and potential of all types of talents. Therefore, how to implement “innovation chain, industrial chain, financial chain, policy chain and talent chain” in the practice of innovation reform, analyze the influence mechanism and effectiveness of “five-chain coordination” on regional innovation, and promote innovation-driven development and regional collaborative innovation have important practical significance.

The foundation of “five-chain coordination” comes from the theory of collaborative innovation between industry, university, and research. Etzkowitz proposed the Triple Helix Model in 1995, through this model, he explained the spiral relationship between the university, enterprise and intergovernmental knowledge innovation (Etzkowitz, 1995), Leydesdof developed and systematized the triple helix theory (Leydesdof, 2011). The three main points of the market-oriented, enterprise as the main body and government-led reflect the connotation and characteristics of the industry-university-research cooperation system with Chinese characteristics at this stage (Li Jian, 2011). Based on previous research, Chen Jin and others focused on and explored the integration dimension and interaction intensity, and constructed a framework for collaborative innovation. (Chen Jing, Yang Yinjuan, 2012)

In the field of “three-chain integration” of industrial chain, innovation chain, and financial chain, Tidd and other scholars pointed out that due to the lack of systematic comprehensive considerations, many innovations have not achieved the expected results, because the interaction between the various elements in the system is neglected in the innovation process. The synergy between the elements. In 2016, Wang Xiangwang, then the director of the Wuhan Municipal Development and Reform Commission, proposed the “five-chain coordination” of scientific and technological innovation, and for the first time expounded the internal logic of “talent chain, policy chain, industrial chain, innovation chain, and financial chain”.

In summary, at present, scholars at home and abroad have already studied the basic theories and principles of “industry, university, and research” cooperation and collaborative innovation. However, there are few studies on the theoretical mechanism and the empirical test of the “five-chain coordination” of scientific and technological innovation. Therefore, the relevant results and model design of this paper are of great significance to national strategies such as innovation-driven development, the development of the Yangtze River Economic Belt and Beijing-Tianjin-Wing coordinated development.

## **2 The Definition and Principle of "Five-chain Coordination"**

Before the Wuhan Municipal Development and Reform Commission put forward the “five-chain co-ordination” in 2016, relevant research at home and abroad is mainly aimed at the research of traditional “industry, university, and research” cooperation, the research on the three-chain integration of industry chain, innovation chain and financial chain, or the collaborative innovation of the internal elements of the chain. In recent years, domestic scholars have gradually increased the research on “five-chain co-ordination”. However, the definition of “five-chain co-ordination” is still inconclusive.

By studying the relevant literature on collaborative innovation of industry, university, and research, based on the research on the integration of industry chain, innovation chain, and financial chain. In this paper, the definition of “five-chain coordination” is as follows: “five-chain coordination” refers to

promoting the coordinated development of regional innovation, deploying the innovation chain around the industrial chain, focusing on the innovation chain to improve the financial chain, and integrating three chains to build talent chain, support policy chain, to achieve high-end industrial chain, full chain of innovation chain, diversified financial chain, rationalization of talent chain, precise policy chain, and ultimately enhance the process of innovation.

The process of coordination is actually the process of interaction between the various chains. The innovation chain drives the industrial chain, which is the process of “deploying the innovation chain around the industrial chain”. In fact, the innovative approach is to improve and optimize the issues of scale, profitability, structure, and transformation in the industrial chain. The essence is to improve regional innovation capability.

The financial chain supports the innovation chain, which is to explore "focusing on the innovation chain to improve the financial chain." The process of innovation is inseparable from the support of funds. Scientific and rational allocation of funds can maximize innovation. Targeting different types of configurations for different types, different stages and different scenarios of the innovation chain, the financial chain can truly achieve the goal of supporting the innovation chain.

Finally, it is "integrating three chains to build talent chain, support policy chain " It is the important reason and ultimate goal of “five-chain coordination” to realize the integration and coordination among various innovation systems, among various chains, among various innovation entities and innovation elements through the talent chain and policy chain. The talent chain and policy chains are the guarantee and guidance for the three chains. The talent chain and policy chain must serve all links of the industrial chain, follow up the various stages of the innovation chain, and standardize the various forms of the capital chain. Realize the integration of resources and finally realize the systematic coordination between the five chains.



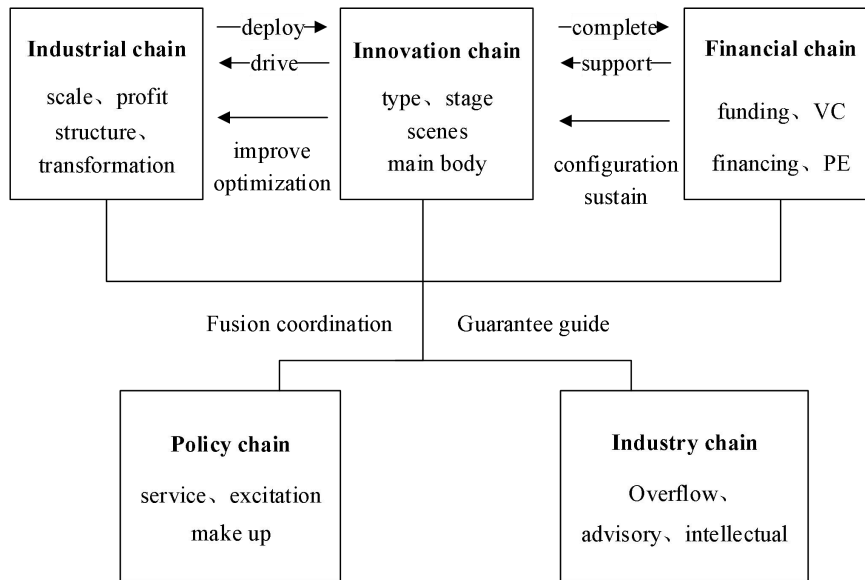


Figure 1 The Principle of "Five-chain Coordination"

### 3 Analysis and Assumptions

#### 3.1 Basic analysis

This paper starts from the macro-level of "five-chain coordination" and conducts empirical research and analysis. To further study the effects of these concepts, it is necessary to find the appropriate variables to measure. Since it is a macro level of inquiry, its variables are relatively more high-level. Therefore, in the conceptual model, this paper proposes two variables such as policy balance and regional innovation capability. Exploring the impact of "five-chain coordination" on regional innovation capabilities by exploring the relationships between these variables.

#### 3.2 Policy balance and regional innovation capability

The current problems in China's current regional innovation system mainly focus on the fragmentation of industrial innovation resources, unclear innovation subjects, and poor investment and financing channels. These problems happen in the three major segments of the industry, innovation and financial. The policy chain is needed for overall planning to guide the regional innovation system.

Table 1 Distribution of Three-chain Policies in Shanghai, Beijing, Hubei, and Heilongjiang

province	years	Industrial chain	Innovation chain	Financial chain
Shanghai	2013	58	68	65
	2014	66	86	76
	2015	112	146	127
Beijing	2013	38	43	40
	2014	33	42	33

	2015	45	59	53
	2013	66	81	87
Hubei	2014	74	84	84
	2015	83	110	107
	2013	31	27	41
Heilongjiang	2014	54	40	50
	2015	59	49	63

This paper proposes the use of policy balance as a proxy variable for measuring region for the three-chain integrated policy chain. Through the analysis of regional policies related to industry, innovation and financial in recent years, and the word frequency statistics, to measure the correlation between policies and the three major chains, the number of related policies is counted, and the calculation of Gini coefficient is used to measure the degree of uniformity of policy distribution across regions, combined with the ratio of the number of four-chain related to the total number of policies, gives the policy balance of each region.

Therefore, this study proposes the following assumption:

**Policy balance has a positive effect on regional innovation capability**

## 4 Model

### 4.1 Measurement indicators and calculations of policy balance

This paper attempts to measure the policy balance from the perspective of policy balance and the number of policies.

The Gini coefficient is an important method and tool for measuring the balance of wealth distribution. This paper proposes the policy Gini coefficient to measure the fairness of the policy chain in the industrial chain, innovation chain, and financial chain, that is, the degree of policy balance. But in addition to the degree of balance in policy distribution, the number of policies certainly plays an important role, indicating the absolute number of government-guided policies through policy. However, direct comparisons with quantities may be subject to fluctuations due to regional differences or major central decision-making. Therefore, it is more reasonable to use the number of policies related to the three chains as a percentage of the total number of policies.

According to the calculation formula of the Gini coefficient, the calculation method of the Gini coefficient is as follows:

$$G_g = \frac{1}{n} \sum_{i=2}^n \sum_{j=1}^i (P_i - P_j) = \frac{1}{nF} \sum \sum (F_i - F_j) \quad (1)$$

In the above formula,  $G_g$  is the policy Gini coefficient, and  $n$  is the number of groups. (In this study, the policy is divided into three groups: “industrial chain”, “innovation chain” and “financial chain”, so  $n=3$ ),  $P_i$  represents the proportion of the total number of documents in the  $I$  group related documents,  $F_i$  represents the total number of documents related to the  $I$  group, and  $F$  represents the total number of documents.

#### 4.2 Measurement indicators and calculations of regional innovation capability

Considering that the “five-chain co-ordination” process itself measures the process of innovation input, to avoid or reduce the problem of collinearity or endogenous impact in subsequent analysis. This paper focuses on innovation and economic benefits in selecting indicators for measuring regional innovation capabilities. Drawing on the above research results, combined with the indicators involved in various documents, and considering the availability of data, this paper constructs a regional innovation capability indicator system as shown in Table 2.

**Table 2 Regional Innovation Capability Indicator System**

	Primary indicator	code	Secondary indicators
<b>Regional innovation capability</b>	Innovation	Q1	Number of patent licenses
		Q2	Number of scientific papers included in the three systems
		Q3	Number of new product projects
	Economic benefit	Q4	New product sales revenue
		Q5	Per capita GDP
		Q6	10,000 yuan of GDP per ton of standard coal

In this paper, the entropy method is used to measure the weight of the known indicator data by using the entropy value to determine the weight. The main principle is to determine the weight by the degree of difference in indicators. The greater the degree of dispersion of the indicators, the larger the difference between the indicators and the smaller the entropy, which has a greater impact on the evaluation results. The amount of effective information provided is larger and the weight is correspondingly larger. Conversely, the smaller the degree of dispersion at this time, the entropy value is larger and the weight should be smaller. However, it is worth noting that if the value of an indicator of each evaluation index is completely consistent, the entropy value reaches the maximum at this time, which means that the indicator has no valid information and should be removed from the indicator system. According to the process of scholars applying the entropy method, the calculation method of regional innovation capability is as follows:

For a sample set with  $n$  regions and  $m$  indicators, organize them into a data matrix  $X$ :

$$X = (x_{ij})_{n \times m}, 1 \leq i \leq n; 1 \leq j \leq m; i, j \in Z$$

Where  $x'_{ij}$  represents the data value of the  $j$ th indicator of the  $i$ th region. To eliminate the influence of dimensional and data differences, the standard method is used to obtain the standardized data value  $x'_{ij}$ . And calculate the weight of the  $j$ th indicator in the  $i$ th region in turn (that is, normalize the data value matrix to normalize the column vector to obtain the weighted matrix of the data):

$$P_{ij} = \frac{x'_{ij}}{\sum_{i=1}^n x'_{ij}} \quad (2)$$

Subsequently, the information entropy value of the  $j$ th indicator is determined:

$$e_j = -k \sum_{i=1}^n P_{ij} \ln(P_{ij}) \quad (3)$$

Among them,  $k = \frac{1}{\ln(n)}$ ,  $e_j \geq 0$ .

The utility value of certain indicator information depends on the difference between the information entropy value  $e_j$  and 1 of the indicator. For the  $j$ th indicator, the greater the difference in value, the greater the impact on the comprehensive evaluation. Thus, the differential coefficient of the  $j$ th indicator is calculated:

$$g_j = \frac{1-e_j}{m-E_e} \quad (4)$$

In the middle,  $E_e = \sum_{j=1}^m e_j$ ,  $0 \leq g_j \leq 1$ ,  $\sum_{j=1}^m g_j = 1$ . Based on this, the weight of the  $j$ th indicator can be finally calculated:

$$w_j = \frac{g_j}{\sum_{j=1}^m g_j} \quad (5)$$

This is to use the information value coefficient of the indicator to calculate the comprehensive index, the higher the value coefficient reflected, indicating the greater importance to the indicator system. From this, the regional innovation capability index of the  $I$  region can be calculated.

$$s_i = \sum_{j=1}^m w_j P_{ij} \quad (6)$$

## 5 Hypothetical Test

### 5.1 Regression analysis

In order to explore the relationship between policy balance and regional innovation capability, this study uses the comprehensive energy consumption of GDP of the 10000 yuan area, energy industry

investment, natural gas consumption, and population density as control variables, with policy balance as the independent variable, with regional innovation capability as the dependent variable, linear regression analysis. The results are shown in Table 3.

**Table 3 Regression Results of Policy Balance and Regional Innovation Capability**

variable	Dependent variable: Regional Innovation	
	Model 1	Model 2
the comprehensive energy consumption of GDP of the 10000	0.415***	0.428
energy industry investment	-0.279***	-0.269
natural gas consumption	0.557***	0.512
population density	-0.078**	-0.084
Policy balance	-	0.116*
R <sup>2</sup>	0.678	0.690
R <sup>2</sup> after adjustment	0.668	0.678
F	68.521	57.386

Note: \*represent  $p < 0.05$ , \*\*represent  $p < 0.01$ , \*\*\*represent  $p < 0.001$

Model 1 tests the regression results of the control variables on the dependent variables and finds that population density has no significant effect on the dependent variables, and the other three have significant effects. Model 2 examines the impact of policy balance on regional innovation capability. It can be seen that after adding policy balance, the interpretation of policy balance to regional innovation capability is increased compared to the control variable,  $\Delta R^2 = 0.012$  ( $p < 0.05$ ), and the normalization coefficient  $\beta$  was 0.116, which was significant at the  $p < 0.05$  level, and thus the assumption was assumed that test support was obtained.

## 6 Conclusion

This paper is based on the theory of collaborative innovation and the theory of regional innovation. Exploring the mechanism and connotation of the five-chain coordination. Based on the hypothesis model, regression analysis is performed on the calculated variable values and the hypothesis is verified. Verifying the impact of “five-chain coordination” on regional innovation capability.

Since 2014, the joint research on innovation chain, industrial chain, and the financial chain has begun, focusing on basic theoretical and paradigm research, as well as its specific practices to promote the development of various chains. But there are not many introductions on how to integrate between various chains. This paper proposes the mechanism of five-chain coordination, the driving, supporting and coordinating roles between various chains, thus affecting the innovation output of the entire region, and thus affecting regional innovation capability.

Since the method used by the machine to identify text generics is only recognized from the text

classification level, there is no further semantic mining analysis of the text, so the study of policy balance needs to be further deepened. The next step is to further analyze the role of policy texts from machine learning and policy tools, to make the measurement and analysis of policy balance more precise.

Based on the comparative regression analysis of different regions, combined with the mechanism of “five-chain coordination” and the impact on regional innovation capability, this paper puts forward the following suggestions for China to promote “five-chain co-ordination” and enhance regional innovation capability:

Integrating the three chains (industrial chain, innovation chain, financial chain) to create a “talent chain” and supporting “policy chain” should pay attention to the importance of talents and consider the balance of policies. The layout of the policy should be comprehensive. At the same time, consider the coordination of the three links of industry, innovation, and capital. It is necessary to combine the characteristics of its region, timely adjust the policy for the lack of links, ensure the balance of policy release, and ensure the organic integration of the “five-chain”.

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# Research on Evaluation System of Biological and New Medicine Technology Achievements from the Perspective of Technology Transfer

Yan Jingdong<sup>1</sup>, Li Fangting<sup>1</sup>, FengCao<sup>1,2</sup>

<sup>1</sup>School of Management, Wuhan University of Technology, Wuhan, P.R. China, 430070

<sup>2</sup>RG PETRO-MACHINERY (GROUP) CO., LTD. Nanyang, P.R. China, 473000

(E-mail: yjdong02@163.com, 819316782@qq.com, fengcao66@163.com)

**Abstract:** According to the characteristics of biological and new medical technology achievements, a scientific, comprehensive and operational evaluation index system was constructed. By determining the set of factors, evaluation sets and weights of indicators at all levels of the evaluated technical achievements, the relevant experts were organized to relevant technologies. The distribution of the evaluation value of the outcome value is obtained, and the corresponding membership degree vector is obtained. On this basis, the fuzzy evaluation matrix is constructed, and the evaluation results of a certain biological and new medical technology results are finally obtained.

**Keywords:** Construction of evaluation index system; Evaluation of technical achievements; Fuzzy comprehensive evaluation; Biology and new medicine

## 1 Introduction

As a high-tech core industry in the 21st century, the biology and new pharmaceutical industry is a leading and strategic industry in the world economy. It is also one of the strategic emerging industries that China is focusing on. The State Council issued the "Twelfth Five-Year Plan" for the development of national strategic emerging industries. The Plan proposes that by 2020, the industry will be cultivated as a pillar industry of the national economy (Wang Gang, 2012). Evaluation of technical achievements as the premise and basis for the transformation of biological and new medical technology achievements (Fred D. Wood, 1997), improve its evaluation work, help optimize the allocation of resources in the field of biology and new medicine, accelerate the commercialization and industrialization of biological and new medical technology results, and promote the development of research and development personnel. Personal growth (Wang Jia, 2010). Therefore, it is of great theoretical and practical significance to construct a scientific and rational evaluation index system for biological and new medical technology achievements and to design an objective and fair evaluation process. This paper starts with the analysis of the characteristics of



biological and new medical technology achievements, builds the evaluation index system of biological and new medical technology results based on the principle of establishing evaluation index system in similar research, and proposes a fuzzy comprehensive evaluation model for evaluation. Value evaluation of the results.

## **2 Analysis of the Characteristics**

In the past 20 years, modern biotechnology represented by genetic engineering, cell engineering, enzyme engineering, and fermentation engineering has developed rapidly. At present, more than 60% of human biotechnology results are concentrated in the pharmaceutical industry to develop new specialty drugs or to improve traditional medicines. This has caused major changes in the pharmaceutical industry, and the development history of the global biological and new pharmaceutical industries. It can be summarized as a long-term, high-tech, high-input, high-risk, high-yield "one long four high" feature (Lu Xiao, 2015).

### **2.1 Long cycle**

From the beginning of development to the final conversion of biopharmaceuticals into products, there are many links: laboratory research phase, pilot production phase, clinical trial phase (I, II, III), large-scale production phase, market commercialization phase, and supervision of each link. The strict and complicated drug administration approval process of the link, and product cultivation and market development are difficult; therefore, the development of a new drug cycle is long, generally takes 8-10 years, or even more than 10 years.

### **2.2 High-tech**

The latest technologies in different periods of human society are often first applied in the military and medical fields, and cover almost all major technological achievements, such as radiology, electromagnetic technology, computer technology, laser technology, etc. The rapid development of bioengineering science and technology in recent years has also taken the lead in applications in the field of biology and new medicine and has become a strong technical support for the advanced development of the pharmaceutical industry in the future.

### **2.3 High commitment**

The high input of the biological and new pharmaceutical industries is more obvious than the general medicine. In general, generic drugs have the characteristics of simple production process, low input, low technological content of products, and large market demand. The development and production of new drugs requires a lot of investment, and the production process is complicated and the development cycle is long. It usually takes an average of \$250 million to develop a new drug, some as much as \$1 billion, and it takes 10 years from

screening to clinical use. Some famous foreign pharmaceutical companies attach great importance to the development of new drug products, and spend a lot of money to develop new drugs to improve the competitiveness of products.

## **2.4 High risk**

Biology and new pharmaceutical companies have disparate business performance and are volatile. Due to the strong specificity of the drug, the market space is mainly determined by its performance. The high technical content and good performance often have extremely broad market and right-end prices. Enterprises that develop such drugs can achieve high profits, but instead have performance. Even if the average price of a drug falls, it will not increase the market size. Once the supply increases, it means that the company's efficiency is rapidly declining. Since the selling period of a drug is generally only 3-5 years, and many pharmaceutical companies rely on one or two products, the risks can be imagined, even for some large international companies; their performance often fluctuates greatly.

## **2.5 High profitability**

The high input and high technology content of the biological and new pharmaceutical industries determine the added value characteristics. Once a new drug is successfully developed and put into use, despite the huge initial investment, the revenue generated is huge.

According to statistics, the annual sales of a successful new drug can be as much as 1.0-400 million US dollars; the profit rate of the top ten pharmaceutical companies in the world is about 30%; the patented product can monopolize the product market during the validity period of the patent, therefore, A huge monopoly profit can be obtained during the income period.

# **3 Index System Construction**

According to the comprehensive, systematic, hierarchical, qualitative and quantitative principles (Yang Sisi et al., 2013) of the evaluation index system construction, combined with the technological development characteristics of biological and new medical technology achievements, the value evaluation index system of biological and new medical technology achievements is set. The indicator system mainly examines the five aspects of technical value, benefit value, intellectual property value, team value and system risk of the technical achievements, and sets four first-level indicators such as technical value, benefit value, team value and system risk; There are a number of second-level indicators, a total of 17 secondary indicators; each of the secondary indicators has a number of third-level indicators, a total of 58 three-level indicators.

### **3.1 Technical value**

Mainly concerned with the quality of the technical achievements themselves, including the innovative, scientific and technical feasibility of the technical solutions.

(1) Innovative: Evaluate the characteristics of biological and new medical technology outcomes in improving or creating new things, methods, elements, pathways, and environments. Specifically include: Number of innovation points, Technical innovation difficulty, Technological innovation complexity.

(2) Advanced: Evaluate the excellent characteristics of biological and new medical technology outcomes relative to other outcomes. Specifically include: Level of innovation, Scope of application, Industry trends.

(3) stability: Evaluate the characteristics of biological and new medical technology results when they are stimulated by external factors. Specifically include: Reliability Reproducibility of technology, Technical life.

(4) Maturity: Evaluate the extent to which biological and new medical technology results are promoted and applied. Specifically include: Degree of industrialization, Technical radiation level.

(5) Intellectual property: Evaluate the exclusive rights enjoyed by biological and new medical technology results in accordance with the law. Specifically include: Patent authorization, Standard situation, Number of papers published, influence factor, rate of introduction, Monograph situation, Number of patent applications, New drug certificate and new varieties of animals and plants.

### **3.2 Benefit value**

Mainly concerned with the economic, social and ecological benefits that can be obtained after the application of technological results.

(1) Economic benefit: To evaluate the economic benefits of the promotion and application of biological and new medical technology results. Specifically include: Sales revenue after converted, Market share after converted.

(2) Social benefit: Evaluate the possible impact on the social development of the promotion and application of biological and new medical technology results. Specifically include: Promote the development of related industries, Degree of driving employment, Reduce patient suffering or reduce product side effects, Reduce the patient's medical burden.

(3) Ecological Benefits: Evaluate the environmental and ecological impacts that may result from the promotion and application of biological and new medical technology. Specifically include: Promote the effective use of energy resources, Benefits of energy saving

and emission reduction

### **3.3 Team value**

Mainly concerned about the role of scientific research team in scientific and technological achievements and future development potential.

(1) Scale and structure: Judging the current state of the team with the talent team structure and knowledge structure, research platform and knowledge reserve. Specifically include: Professional and technical background and tracking learning ability, Average age of professional and technical personnel, Senior and middle-level professional and technical personnel and proportion, Number of outstanding talents, Base or laboratory, Research infrastructure and experimental capabilities, Proportion of funds for horizontal research projects undertaken and completed.

(2) Technological innovation ability: Judging the scientific and technological achievements that have been achieved in the form of results to demonstrate social influence. Specifically include: Invention patents granted in the past 3 years, Published papers and monographs in the past 3 years, Nearly 3 years of research awards, Nearly 3 years of academic exchange.

(3) Internal management: Judging the execution and efficiency of the research team in an institutional form. Specifically include: Project management system, Project management system.

(4) sustainable development: Reflect the future development potential of the R&D team. Specifically include: Number of outstanding talents introduced in the past three years, Talent training in the past 3 years, Team building and future development planning, Innovation goal.

### **3.4 System risk**

The main concern is the possibility of not meeting the expected technical and economic indicators due to the uncertainty of external environmental factors. According to the purpose of evaluation, it can be divided into technical risk, market risk, policy risk and legal risk.

(1) Technical risk: Evaluate the loss or harm caused by technical know-how or defects that may exist in biological and new medical technology outcomes. Specifically include: Possibility of generating potential biosafety risks or hazards, Possibility of generating potential social ethics, Potential technological development risks or hazards, Dependence of supporting technology, Technical alternative.

(2) Market risk: Evaluate the market competition of biological and new medical technology achievements. Specifically include: Entering the market, Competitor's competitiveness.

(3) Policy risk: Evaluate the degree of matching between biological and new medical technology outcomes and policies. Specifically include: Industrial policy fit, Regional policy fit.

(4) Natural risk: Assess the natural risks that biological and new medical technology outcomes may face. Specifically include: Degree of climate factor impact, Degree of geographical influence, Factors such as pests and diseases.

(5) Legal Risk: Evaluate the legal risks that may be faced by the promotion and application of biological and new medical technology results. Specifically include: Potential equity disputes, Legal risk avoidance, Patent infringement decidability, Validity period.

## **4 Construction of Value Evaluation Model**

### **4.1 Brief introduction of fuzzy comprehensive evaluation method**

The fuzzy comprehensive evaluation method is an evaluation method proposed for the evaluation system with a large number of non-quantitative factors. On the basis of determining the evaluation index, its weight and evaluation scale, it uses the fuzzy membership degree to measure the evaluation object, and obtains the evaluation result of the technical achievement value (Shu Fuhua, 2018).

The basic idea of value evaluation of technical achievements based on fuzzy comprehensive evaluation method is to sort the evaluation index of the value of relevant technical achievements by the index system, the evaluation set and the weight of each factor to determine the value of the evaluated technical achievements. The corresponding membership degree vector (Reid N, 1988). On this basis, the fuzzy evaluation matrix is constructed, and the fuzzy evaluation matrix and the fuzzy calculation of the factor weight vector are realized by MATLAB software programming. Finally, the fuzzy comprehensive evaluation result is obtained, which is the evaluation of the value of related technical achievements.

### **4.2 Construction of value evaluation model of technical achievements based on fuzzy comprehensive evaluation method**

The fuzzy comprehensive evaluation method is used to evaluate the value of biological and new medical technology results. The factor set weight vector is the influencing factor and weight in the value evaluation system of biological and new medical technology results. The comment set is determined by consulting experts. The content of the comment collection and its corresponding analysis, after several experts (at least 7) evaluation, get the evaluation matrix  $R$ , then perform fuzzy transformation with the weight vector  $A$ , and finally multiply

with the score matrix to obtain biological and new medical technology results. Value evaluation score for value. Specific steps are as follows:

**(1) Determine the set of evaluation factors**

Through literature review and interview research, the homogenization commonality and heterogeneity of the value of technological achievements in various fields of high and new technology are clarified, and the evaluation index system of biological and new medical technology results is established, and the evaluation factors are determined.

**(2) Determine the star rating**

Star collection is the evaluation level of experts on the value of biological and new medical technology. Generally, the elements of the star collection are preferably 3 to 5, too few are not high enough, the level is too much, and the experts are not very good. . After comprehensive consideration, set 5 evaluation levels,  $V = \{V_1, V_2, V_3, V_4, V_5\}$ , the greater the number of stars, the higher the value of the technology. The corresponding comment set score:  $W = \{1, 3, 5, 7, 9\}$ , as shown in Table 1.

**Table 1 Star Rating and Corresponding Score**

Level V	Star Rating	Score W	Partition room
V <sub>1</sub>	★	1	[0,2]
V <sub>2</sub>	★★	3	(2,4]
V <sub>3</sub>	★★★	5	(4,6]
V <sub>4</sub>	★★★★	7	(6,8]
V <sub>5</sub>	★★★★★	9	(8,10]

**(3) Determine the single factor evaluation matrix.**

Using the fuzzy comprehensive evaluation method to evaluate the value of biological and new medical technology results, firstly, fuzzy evaluation is carried out from one factor, and the evaluation element of the evaluation object and evaluation set V is determined, which is called one-way evaluation. And then get a three-level indicator fuzzy evaluation matrix.

The three-level index fuzzy evaluation matrix R is based on the scores of 7 experts in the field, that is, the single-factor evaluation matrix  $R=(r_{ij})$ , wherein each row in the single-factor evaluation matrix R represents the score of each indicator.  $R_{ij}$  said the expert approval rate for each indicator under each comment.

Its matrix model is:

$$R = \begin{pmatrix} r_{11} & r_{12} & \cdots & r_{1j} \\ r_{21} & r_{22} & \cdots & r_{2j} \\ \vdots & \vdots & \ddots & \vdots \\ r_{i1} & r_{i2} & \cdots & r_{ij} \end{pmatrix}$$

**(4) Determine the weight**

Through the questionnaire survey of relevant experts, the Delphi method (Luke Georghiou, 2000) is used to determine the weights of the 1-2 indicators in the value evaluation system. The reasonable degree of expert selection determines the success or failure of research (Brown. B., 1987). The expert group is determined based on the level of knowledge and knowledge required for the value of the technological achievements in the field of biology and new medicine. The expert group shall be composed of at least 10 experts, and the same administrative unit shall be the same professional expert. In principle, the expert group shall only employ one person. The expert group includes experts in the fields of technology, management, finance, etc., with rich practical experience and a deep understanding of biology and new medicine. At the same time, the selection of experts should cover a wide range of industries, as far as possible related to industries related to biology and new medicine. Generally, after three to five rounds of opinion summarization and information feedback, the final indicator weights are obtained.

After scoring by experts, the arithmetic mean method (AlanClarke, 1999) is used to summarize the expert analysis and obtain the weights of the biological and new medical technology results. The calculation formula is as follows:

$$M_j = \frac{1}{m_j} \sum_{i=1}^{m_j} C_{ij}$$

In the formula,  $M_j$  is the arithmetic mean of the  $j$  index,  $m_j$  is the number of experts participating in the evaluation of the  $j$  index, and  $C_{ij}$  is the evaluation value of the  $j$  index by the  $i$  expert.

**(5) The fuzzy transformation**

Through the expert's classification of the value of biological and new medical technology results, the comprehensive evaluation model of fuzzy transformation is established as:  $B=A \times R$ , where  $B$  is the degree of description of each graded object, and  $A$  is the third-level indicator. Weight,  $R$  is a three-level indicator fuzzy evaluation matrix, and  $b_j$  indicates the degree to which the rated object has a comment  $v_j$ .

Its calculation model is as follows:

$$B=A \times R = (a_1, a_2, \dots, a_i) \begin{pmatrix} r_{11} & r_{12} & \cdots & r_{1j} \\ r_{21} & r_{22} & \cdots & r_{2j} \\ \vdots & \vdots & \ddots & \vdots \\ r_{i1} & r_{i2} & \cdots & r_{ij} \end{pmatrix} = (b_1, b_2, \dots, b_j)$$

In order to improve the efficiency of the evaluation process, the process of evaluating the value of biological and new medical technology results by MATLAB.

#### **(6) Obtain the second-level indicator evaluation score**

By the score value corresponding to the 3-star set element of the table 1, the corresponding score vector  $W=\{1,3,5,7,9\}$  is obtained, and the fraction vector  $W$  is multiplied by the transposition vector of the evaluation vector  $B$  to obtain two The evaluation score of the level indicator is recorded as  $V$ .

The formula for calculating:  $V=W \times B^T$

This step is also programmed using MATLAB software to obtain calculation results to improve work efficiency.

#### **(7) The final evaluation score and the corresponding star rating**

From the sixth step, the scores of all the secondary indicators  $V$  can be obtained. There are four first-level indicators in the value evaluation index of biological and new medical technology achievements, and the scores are  $T_1, T_2, \dots, T_4$ , respectively, and their weights are respectively  $S_1, S_2, \dots, S_4$ , there are  $n$  secondary indicators under the  $i$ -th level index, and the second-level index weights under each level index are  $G_{ij}$ , respectively, and the scores are respectively  $V_{ij}$  ( $i=1, 2, \dots, 4; j=1, 2, \dots, n$ ).

The formula for calculating the score of its primary indicator is:

$$T_i = \sum_{j=1}^n V_{ij} \cdot G_{ij}$$

The final evaluation score for the value of biological and new medical technology results is:

$$T = \sum_{i=1}^4 T_i \cdot S_i$$

In the end, the scores of the value scores of biological and new medical technology achievements will be between 0-10. In order to make the evaluation results of the value of technological achievements more intuitive and clear, the evaluation results of the value of technological achievements are presented in star form.

## **5 Conclusion**

### **5.1 Research results**

Based on the analysis of the characteristics of biological and new medical technology



results, this paper sets several levels of indicators from the aspects of technical value, benefit value, team value and system risk. On the one hand, the construction of the indicator system can further improve the evaluation of biological and new medical technology achievements, on the other hand, it can guide experts to conduct more reasonable, objective and fair evaluation, and improve the scientific and authoritative work of reward evaluation.

In the past, the literature found that the indicators for the evaluation of results in the field of biology and new medicine rarely considered the indicators of the value of the R&D team. In addition, the evaluation method used the Analytic Hierarchy Process and the Delphi method. This paper improved the evaluation index system of biological and new medical technology results. It can not only make an assessment of the development capability of specific technological achievements, but also collect information on technological achievements with potential for development in the fields of biology and new medicine, and lay a good foundation for the development of China's biological and new pharmaceutical industries. In addition, the use of fuzzy comprehensive evaluation method increases the scientificity and reliability of the evaluation method.

## 5.2 Limitations and future research

This paper designs the evaluation index system and model of biological and new medical technology achievements. No specific empirical research has been carried out. In the future, specific technical achievements can be evaluated through practical operation, the effectiveness and scientificity of the indicators are evaluated, and the existing indicators are guided. Adjust and screen to improve the existing evaluation index system. In addition, this study does not discuss the comprehensiveness, independence and easy accessibility of the primary indicators. Future research needs to be further explored.

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## Analysis on the Management Mode of University Library Makerspace

Xu Fang<sup>1</sup>, Su Hua<sup>2</sup>, Liu Qin<sup>2</sup>

<sup>1</sup> Library, Wuhan University of Technology, Wuhan, P. R. China, 430070

<sup>2</sup> School of Management, Wuhan University of Technology, Wuhan, P.R.China, 430070

(E-mail: 406558049@qq.com, suhua@whut.edu.cn, 47298954@qq.com)

**Abstract:** Library makerspace is a rapidly developing platform for integrating innovative and entrepreneurial resources and an important form of makerspace. How to apply the makerspace more effectively to the construction of libraries in our country has become the focus of the education department at this stage. Based on the research on the hierarchical structure, operation mode of operation platform, composition of interest subjects and their cooperative assistance mode of makerspace operation system of university libraries, this paper explores the problem of interest distribution in the makerspace innovation management system by means of game theory methods and shapely value method.

**Keywords:** University library; Makerspace; Operational management mode; Game theory; Shapley value method

### 1 Introduction

Makerspace is "a real physical place, an open communication laboratory, workshop, machining room, an innovative place where people can get together to manufacture, participate in design and study" (Mai DB et al.2017) . In recent years, with the promotion of the national innovation and entrepreneurship policy of "Mass innovation, Mass entrepreneurship", the innovation and entrepreneurship service platform mode of makerspace has also developed rapidly in China. One of the important forms is the library makerspace(Li X,et al.2014).

Library makerspace has developed rapidly both at home and abroad, and relevant theoretical and practical research has also attracted much attention. In terms of the basic operation mode of makerspace, David et al. (2017) conducted a detailed case study on typical foreign guest-creating space modes and successful elements. Sun (2016) mainly studied the development status, user needs, existing problems and corresponding countermeasures of makerspace in our country's libraries, and proposed the importance of the relationship between the interest subjects of makerspace. Ma (2017) focused on the structural construction of makerspace in university libraries, and put forward the concept of ecological system construction of makerspace. Meanwhile, the development strategy (Vanholm, 2015) and the construction of development model (Han et al., 2016) of the library makerspace have also received corresponding research attention.

As for the operating mode of makerspace, Li et al. (2015) insisted that in practice, the construction and application of community makerspace have been emphasized. All regions and communities need to consider integrating the operation of manufacturers into local development. Based on this, the driving force, function and application of American community makerspace under the library makerspace operation management system were studied and discussed. Kong et al. (2013) systematically expounded

the concept, origin, development and significance of makerspace, and discussed the significance of library makerspace operation management to makerspace from the perspective of social function, service and competitiveness by using relevant engineering cases. On the basis of analyzing the transfer value of tacit knowledge in library makerspace, Wang et al. (2017) summarized how to re-understand the effective transfer of tacit knowledge under the makerspace operation management system through the concept of makerspace.

In view of the structure of interest subjects in library space and the distribution of interest, the modeling and analysis method based on game theory provides an important and effective research tool. Zhang et al. (2016) and Dai et al. (2016) discussed the income distribution of alliance enterprises by Shapley value method, analyzed the motivation of partners to join the alliance and the important principles of income distribution from the perspective of value creation, and proposed a correction algorithm based on risk factor.

On the one hand, the existing research has already achieved some valuable research results in the development mode, system structure, service transformation and other aspects of the domestic and foreign library makerspace. On the other hand, the structure of the interest subject and the distribution of the interest need to be further studied and discussed in combination with practice, so as to promote the stable, healthy and efficient growth of the library's space system platform for makerspace. On the basis of analyzing the collaborative model of stakeholders in the library space system platform, this paper will further study the multi-party benefit distribution by Shapley value method.

## **2 Basic Structure of Library Makerspace Operation System**

### **2.1 Basic structure**

The operating system of library makerspace roughly includes three progressive levels or stages:

(1) Creative stage, that is, basic layer mode. In the basic layer model, it mainly covers capital, personnel and educational resources, innovative supporting equipment in hardware construction, horizontal cooperation in software services, such as expansion of maker activities and regulatory publicity, and vertical cooperation, such as crowd funding, introduction of external resources, professional training and government enterprise investment.

(2) Entrepreneurial phase, that is, the mode of industrial level. In the industrial layer mode, it mainly covers the preliminary industrial chain mode of customer-centered and market-oriented project construction, screening, research and development, trial operation, small batch production and sales.

(3) Commercial phase, that is, the scale layer model. In the scale layer model, the mature industrial chain model is mainly covered. The ecosystem in the scale layer is a loose network composed of suppliers, distributors and outsourcers, manufacturers of related products and services, and provision of related technologies.

### **2.2 Operation mode**

The basic principle for the construction of the library makerspace system platform is "user-centered and market-oriented". Its operation mode is divided into the following stages:

(1) Creative evaluation stage. The government and upstream and downstream enterprises mainly provide funds, infrastructure support, policies, etc. for the makerspace. Through horizontal cooperation of library makerspace, innovation resources will be integrated and cross-industry and cross-discipline

innovation will be carried out to optimize and integrate industry platforms. Makers can make full use of Internet resources and information technology to generate ideas.

(2) Development phase. Within the scope of the controllable resources of the enterprise, creative products are developed, refined and tested. After initial commercial products are formed, small-scale pilot production is put into the market. After market feedback, the professional project team of the enterprise improves the products, and then the products are tested and hatched to finally form mature products.

(3) Market stage. Market forecast is made first, then market creation (i.e. market expansion) is carried out according to the forecast situation, then mature products are produced in small batches and put into the market. Finally a commercial industrial chain is formed, and suppliers, distributors and outsourcers form a chain cooperation relationship in the industrial chain.

(4) income stage. The industrial chain income obtained through the industrial platform and trading platform serves as the income of makers, makerspaces, the government and upstream and downstream enterprises. To sum up, a closed loop is formed, and the above processes are repeated in the system platform, forming a benign and sustainable ecological circle.

### **3 Stakeholder Composition and Cooperation Mode of Library Makerspace Operation System**

The operating system of library makerspace mainly has three main stakeholders: makers, makerspace, enterprise and government.

The roles and synergic relationship of the three major stakeholders are as follows:

(1) Library makers. The creative theme of the makers on the system platform takes the library's creating space as the carrier, and carries out creativity, innovative research and development, practical operation and final innovative creative achievements through online and offline platforms.

(2) Library makerspace. Makerspace provides makers with funds, equipment, information technology and basic resources for innovation and entrepreneurship, and actively cooperates with the outside world, such as upgrading of resources, technologies and services, so as to strengthen and expand its own innovation capability, and seeks the support of the capital policy of the enterprise government. a) Library makerspace provides basic services for makers, including software and hardware equipment, internet plus technology, physical space, etc. b) The library insists on the market-oriented innovation mode in makerspace. With the participation of enterprises, the makerspace is guided by the development trend of the market and the latest development of the industry to provide innovative basic resources for enterprises that connect with the market.

(3) The government and upstream and downstream enterprises. Government enterprises provide financial policy support for makers and makerspace in the library's operating system. a) The advantages of enterprises and libraries are complementary. The enterprise's own innovation ability is deficient, while the library's advantage lies in its innovation ability, but its capital, material and hardware equipment are deficient. The cooperation between the two will make up for each other's deficiencies. b) Enterprises can gradually establish and perfect the training mechanism of innovative talents. During the docking between the enterprise and the makers, the process of training the experience and knowledge of makers by the enterprise technicians is also the process of discovering, selecting and cultivating innovative talents useful to the enterprise. c) Enterprises can strengthen enterprise publicity and

strengthen enterprise brand effect. While investing in the makerspace, enterprises also improve their reputation, gather the strength of three parties, and effectively strive for government support policies. In the final incubation results, enterprises can improve their market competitiveness and achieve fame and fortune. d) In the process of cooperation, enterprises can reduce the cost of trial and error and maximize the benefit efficiency.

There are two modes for the transformation of makers' achievements: a) makers search for matching enterprises and cooperates with them; b) Makers take makerspace as the carrier and makerspace searches for matching enterprises to cooperate with. No matter what kind of cooperation method is adopted, the main bodies of the innovation ecosystem are seeking to maximize their own interests, which will easily lead to conflicts in cooperation, inefficient transformation of innovation achievements, and even lead to the failure of cooperation.

Interest distribution is always the most critical contradiction in the operation system of library makerspace. Therefore, how to solve the problem of multi-party benefit distribution is the key to promote the construction and development of library makerspace operation system.

## 4 Benefit Distribution Mode of Library Makerspace Operation System

### 4.1 Basic assumption of benefit distribution model

In the process of building the platform of library makerspace operation system, there is a problem of benefit distribution, namely, the benefit game among makers, makerspace and the enterprise government. The rationality of benefit distribution is directly related to their cooperation. In general, makers ( $M$  for short) devote themselves to innovative research and produce innovative results in makerspace. Makerspace ( $S$  for short) firstly carries the innovation achievements of makers in the form of carrier, which is an integration of innovation achievements. Then it commercializes the innovation achievements and seeks the cooperation of enterprise government ( $F$  for short) for makers' innovation achievements. Therefore, how to distribute the benefits among the above three needs a game. All parties involved in the study are risk-neutral and stable equilibrium. The time length of any period is represented by  $\Delta$ . This paper discusses the case of continuous time, so  $\Delta \rightarrow 0$ . The discount rate is expressed by  $k\Delta$ , and  $\lambda\Delta$  is used to represent the utility loss rate of innovation achievements in each cycle. The basic model considers direct negotiations between the makers and government enterprises. Whether or not it has innovative resources in the end, makers have tacit knowledge of key value to the product development of innovative achievements. After the search phase, makers successfully match with the enterprise and obtain the support of government funding policies through lobbying. The development costs invested by both parties in the development phase are  $C_M$  and  $C_F$ . When the makers participate in the cooperative development, the probability of successful development is  $P$  and  $P_0$  respectively, and the value market generated by the innovation results is  $T$  and  $T_0$  respectively, then the expected revenue of the development activities is  $E=PT-C_F-C_M$  and  $E_0=P_0 T_0-C_F$  respectively.

The utility at the beginning of the search phase of the makers and the government enterprise is expressed by  $U_M$  and  $U_F$  respectively, and the utility at the beginning of the development phase is expressed by  $u_M$  and  $u_F$  respectively. In the process of searching for each other, due to the influence of various non-willed reasons, in each cycle, the probability that a maker searches for a matching enterprise and the enterprise searches for a matching maker is different, namely  $g_M\Delta$  and  $g_F\Delta$ . The search cost in each cycle is also different, namely  $C_M\Delta$  and  $C_F\Delta$ , and  $C_M$  and  $C_F$  are assumed to be standard convex functions. Then the expected utility  $U_M(t)$  of the creator in the  $t$  period is:

$$U_M(t) = q_M(t)\Delta u_M(t) + \frac{1}{1+k\Delta}(1-q_S(t)\Delta - \lambda\Delta)U_M(t+\Delta) - C_M(t)\Delta$$

So,

$$U_M = \frac{q_M u_M - C_M}{k + \lambda + q_M}, \quad U_F = \frac{q_F u_F - C_F}{k} \quad (1)$$

According to formula (1),  $U_M$  and  $U_F$  have basically the same molecular form, but different denominators, which is due to the different wills of makers and government enterprises. For this innovative achievement, the belief in innovation is only to advance or retreat, while government enterprises are always in the market. If this fails, they will continue to look for other innovative achievements.

#### 4.2 Bargaining game of makers' achievements independent of makerspace

According to Nash's bilateral bargaining model, this section discusses the game of profit distribution between makers and government enterprises when the creative achievements of makers are independent of makerspace. Since makers own innovation achievements, they will manage the achievements themselves. Assuming that there is always a successful match between the maker and the government enterprise after the search phase. Before entering the later development stage, benefit distribution is an important component of signing the contract. The bargaining game between the two parties takes place at this time, and their expected utilities are  $U_M$  and  $U_F$ .

First of all, the results of scientific research without the protection of makerspace operation system are analyzed. Because there are always various reasons leading to the independence of innovation achievements and the makerspace for makers to produce by themselves, it is necessary to disclose its core technical data for commercialization in cooperation with enterprises. In this case, no matter whether it can be negotiated or not, in the absence of makerspace as a carrier, the enterprise is likely to embezzle the achievement and develop it by itself after obtaining the data. The only bargaining chip of makers is their own tacit knowledge, because the intervention of these tacit knowledge can greatly enhance the value of project development. According to the scheme of this document, the bargaining result is obtained:

$$u_M^{ne} = \frac{\beta - \beta_0}{2}, \quad u_F^{ne} = \frac{\beta + \beta_0}{2} \quad (2)$$

Then the results under the protection of the operating system are analyzed. At this time, the bargaining chip for makers not only has tacit knowledge, but also has commercial and organized space for makers. In the case of makerspace as the carrier, if no talks can be reached, even if the technical secrets are involved, the enterprise cannot embezzle the achievement and can only give up with zero effectiveness, and both parties can only restart the search phase. Therefore, the prior effects of both parties in the next cycle are the same. Nash bargaining results are as follows:

$$u_M^e = \frac{\beta(k + \lambda + q_M) - C_M}{2(k + \lambda) + q_M}, \quad u_F^e = \frac{\beta(k + \lambda) + C_M}{2(k + \lambda) + q_M} \quad (3)$$

Example: Suppose there is an innovation achievement to be commercialized, and after evaluation  $\beta=100$  (unit: million, same below),  $\beta_0=40$ ,  $k=0.05$ ,  $\lambda=0.2$ ,  $q_M=0.6$ ,  $q_F=0.85$ ,  $q_S=0.8$ ,  $C_M=3$ ,  $C_F=5$ ,  $C_S=1$ . Obtained from formula (2) and formula (3),  $u_M^{ne} = 30$ ,  $u_F^{ne} = 70$ ,  $u_M^e = 14.6$ ,  $u_F^e = 5$ .

After calculation,  $E_M^{ne} = 30$ ,  $E_F^{ne} = 70$ ,  $E_S^{ne} = 0$ . The numerical results are analyzed and summarized as follows:

In the innovation management and operation system of makerspace, the actual benefit of makers will be reduced when makers search for enterprise matching successfully by themselves compared with when makerspace is used as the carrier to search for enterprise matching successfully. Therefore, when makers want to innovate, they are more willing to join in the creation space, and will be more enthusiastic to participate in the commercialization process of scientific research results and promote the transformation of results. When the innovation behavior of makers takes makerspace as the carrier, the benefit of innovation results is higher than that of makers' own search for matching enterprise protection, and the actual benefit of makerspace ranks highest among the three. Therefore, makerspace will actively search for cooperative enterprises in order to obtain higher benefits.

## 5 Conclusion

This paper mainly studies the hierarchical structure, system operation mode, stakeholder composition and its assistance mode of library makerspace operation management system. Game theory tools are used to explore the benefit distribution strategies of the three parties in the innovative operation system: makers, makerspace and government enterprises. In the collaborative relationship of makerspace operation system, makers gain more actual benefits from searching and docking enterprise resources through makerspace than from searching and docking on their own. Makerspace is used as a carrier to search for matching cooperative enterprises in the cooperative relationship of innovation operation system, accelerating the transformation of innovation achievements and obtaining maximum practical benefits. After government enterprises invest funds and resources for makerspace, although the actual income will not increase in the short term, in the long run, they inject innovative vitality into the development of enterprises and benefit from promoting the synergy of innovative operation systems. In this paper, from the perspective of the collaborative relationship of makerspace operation system, it is expected to provide valuable academic research reference for promoting the construction and improvement of makerspace for libraries in China.

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# Characteristics of R&D Teams and Innovation Performance under Different Innovation Strategies: The Mediating Effects of Organizational Climate in Joint Ventures

Li Shunjun, Peng Huatao

School of Management, Wuhan University of Technology, Wuhan, P.R.China, 430070

(E-mail: 904611892@qq.com;416295790@qq.com)

**Abstract:** The paper studies the relationships between the characteristics of R&D team and the innovation performance of joint ventures from the view of emerging countries. To do this, we apply Exploratory Factor Analysis (EFA), Confirmatory Factor Analysis (CFA) and multiple regression models based on data gathered from 375 Chinese R&D employees from three automobile JVs in China. Our main findings are: (i) Network ties of R&D teams are more positively associated with integrated innovation performance than with imitation performance. (ii) The JV's organizational climate has a partial mediating effect on the relationship between network ties of R&D teams and innovation performance. (iii) R&D team learning is more positively associated with imitation performance than with integrated innovation performance. (iv) The JV's organizational climate has a partial mediating effect on the relationship between R&D team learning and integrated innovation performance, and it has a complete mediating effect on the relationship between R&D team learning and imitation performance. Our research is helpful to guide the R&D management of joint ventures in emerging countries.

**Key words:** R&D team; Team learning; Organizational climate; Network ties; Innovation strategy

## 1 Introduction

Many scholars have explored the factors that influence JV's innovation performance at the firm level, including organizational culture (Asmawi and Mohan, 2011), upstream and downstream members (Banerjee and Lin, 2001), and R&D outputs. However, many factors at the team level, especially in the case of R&D teams, may have an important effect on innovation performance as well (Swierczek and Dhakal, 2004). R&D teams are often considered to contribute positively to innovation performance. Prior studies have linked certain characteristics of R&D team to innovation performance

with respect to certain JV innovation strategies. For example, network ties of R&D teams and R&D team learning is shown to have a positive effect on innovation performance (Nieves et al., 2006). However, the extent to which the characteristics of R&D team promote JVs' innovation performance under different innovation strategies depends on the advantages and potential barriers (Gassmann and Han, 2004). Under certain innovation strategies, different characteristics of R&D team may lead to different levels of innovation performance.

Integrated innovation and imitation are two typical JVs' innovation strategies (Massini et al., 2005). Integrated innovation integrates many potential innovation elements (Mahmood and Zheng, 2009), and imitation is based on the assimilation of imported technology. During the cooperation and learning process, the innovation strategy of the host company in JVs is usually a combination of integrated innovation and imitation. If the host company has many subsidiaries and cooperates with different foreign companies, characteristics of R&D team may have multiple effects depending on JVs' different innovation strategies. It is also unclear whether other factors have moderating effects on the relationships between characteristics of R&D team and innovation performance. Therefore, we open up the black box of firm-level literature, building on related studies that emphasize the importance of the relationship between characteristics of R&D team and innovation performance under different strategies.

The following analysis will contribute to the understanding of how network ties of R&D teams and R&D team learning influence JVs' innovation performance under integrated innovation and imitation strategies, and we will explore the mediating effects of the JV's organizational climate.

## **2 Theory and Hypotheses**

R&D team learning contributes to knowledge accumulation and an improved ability to assimilate new ideas and concepts (Nieves et al., 2006). R&D team learning has a positive effect on innovation performance. The JV R&D team has members from different firms. Thus, knowledge/resource complementarity is high (Berdrow and Lane, 2003), and the complementary knowledge/resources can be combined to create value that did not exist in either firm prior to the formation of the JV (Kim and Finkelstein, 2009); this improves integrated innovation performance.

### **2.1 Network ties of R&D teams and JVs' innovation performance under different strategies**

Network ties of R&D teams normally refer to the ties between one R&D team and other teams inside the same organization, and also the inter-organizational ties between R&D teams in one company and some other companies or research institutions. Network ties, which can both promote innovation activities and create innovation performance, are often regarded as an intangible asset (Nieves et al., 2006; Chen et al., 2008). R&D teams can exchange innovative ideas with other teams or

think tanks, leading to new products, concepts, and models (Chen et al., 2008). These then contribute to the formation of the innovation orientation, the innovation scheme, and the overall innovation strategy. Vertical network ties are ties between R&D teams and material suppliers, product manufacturers, and product development departments. Such ties can improve the overall technological innovation of JVs (Asmawi and Mohan, 2011). Vertical ties often provide key information about technological innovation. They therefore support every aspect of R&D innovation, including the orientation, cost, implementation, product launch, and profitability. Goerzen and Beamish (2005) also stressed the importance of network ties for innovation performance. They found that the higher the heterogeneity of the network ties, the greater the likelihood of strong innovation performance. This leads to the following hypothesis:

**H1: Network ties of R&D teams are positively associated with JVs' innovation performance.**

According to the research on integration mechanisms, network ties of R&D teams contribute to the collaboration of many different specialists, and their work can be integrated to create a coherent whole to realize innovation. On the other hand, imitation innovation is inclined to imitate existing technologies or products. To some extent, these technologies or product information are also from network ties of R&D teams, whereas product innovations require less tacit, complex and systematic knowledge, namely rich network ties are not always needed. The relationships in JVs are observed in light of imperfect information and double moral hazard (Sinha, 2001), therefore the network ties of R&D teams in JVs are not instable. 'Learning by doing' in cooperative networks allows the host firm in JVs to imitate without any cost at the beginning, but the technology imitated by the host firm is inferior comparing to advanced technology, so the host firm cannot really catch up with foreign technology through imitation (Sinha, 2001). Comparing with imitation performance, integrated innovation is relatively helpful to gain competitive advantages through innovations. This leads to the following hypothesis:

**H1a: Network ties of R&D teams are more positively associated with JVs' integrated innovation performance than with imitation performance.**

**2.2 Network ties of R&D teams, organizational climate, and JVs' innovation performance under different strategies**

As a characteristic of network ties, the proximity of network members supports trust. Economic actors are more likely to focus on co-operating with those partners whom they maintain a stronger interpersonal trust relationship. Furthermore, A high level of trust among teammates facilitates the exchange of highly confidential information by diminishing the risk of opportunism, which is partly beneficial to improve the innovation performance. JVs' organizational climate difference may affect the ongoing relationship between partners, minimize knowledge flows and even create obstacles to

innovation-specific performance, while team orientation and learning orientation can be modified by certain characteristics of organizational climate in JVs. When the members of a group are encouraged to learn and to develop new ideas, and are able to influence group decisions, the group is more innovative. This leads to the following hypothesis:

**H2: The JVs' organizational climate has a partial mediating effect on the relationship between network ties of R&D teams and innovation performance.**

### **2.3 R&D team learning and JVs' innovation performance under different strategies**

Organizational learning is a process related to the development of new knowledge and provides the foundation for competitive advantage (Revilla et al., 2005), and therefore affects organizational innovation performance. Thamhain (2003) highlights the importance of experiential learning in JVs' innovation, namely by learning the experience of other high-end ventures, R&D teams can make breakthroughs based on existing knowledge and experience, through repetitive trials and risk taking. Recent research has argued that innovative teams with higher learning ability can learn their partner's concepts and technologies and improve the effectiveness of existing resources, thus achieving better innovation performance. This leads to the following hypothesis:

**H3: R&D team learning is positively associated with JVs' innovation performance.**

According to the principles of JVs' establishment, the innovation resources of the different companies in the JV are complementary. R&D teams should not simply imitate each other, but they should integrate multiple resources. Innovation depends on new ideas and the integration of new resources (Mahmood and Zheng, 2009). Thus, organizational learning should not only create and share knowledge, but also reconstruct the knowledge. Innovation is therefore the result of the creative integration of existing knowledge (Kogut and Zander, 1992). JVs' innovativeness culture and innovation capacity create the ability of the organization (including R&D team) to integrate others' organizational know-how and capabilities instead of merely copying or imitating. This leads to the following hypothesis.

**H3a: R&D team learning is more positively associated with integrated innovation performance than with imitation performance.**

### **2.4 R&D team learning, organizational climate, and JVs' innovation performance under different strategies**

A good organizational climate can enhance the effects of organizational learning on innovation performance. Organizational learning changes behavior and ideology, for example by encouraging employees to actively seek new ideas, and this positively influences the innovation potential of the

R&D team in JVs (Kandemir and Hult, 2005). At the same time, R&D team learning helps to build a strong collective learning environment, and organizations with such an environment are more adept at knowledge creation, acquisition, and transfer. This improves the innovation behavior that reflects new knowledge and ideas. Moreover, when team members contribute new ideas, the internal learning model will depend on the organizational culture, such as the degree of participation in decision-making, the management style, and the commitment of the team. The internal learning model will influence the innovation results. In a good learning climate, R&D team learning positively influences innovation performance. This leads to the following hypothesis:

**H4: The JV's organizational climate has a mediating effect on the relationship between R&D team learning and innovation performance.**

Organizational learning has different effects on different types of innovation performance (Song and Thieme, 2009). On one hand, R&D team learning stresses the development and use of new knowledge during the integrated innovation process (Kandemir and Hult, 2005), and the R&D team realizes the objective of sustainable innovation by integrating the new knowledge. The cooperation between teams increases the possibility of internal cooperation and enhances the team commitment, leading to a good organizational environment, which can reduce risk and improve the integrated innovation performance of the entire JVs. When the absorptive capacity and learning effect in the organizational climate is low, it is difficult for the host firms in JVs to integrate knowledge, and therefore the integrated innovation performance is also low. It can be induced that a certain organizational climate (eg. Greater cultural distance) in JVs is associated with a lower probability that an innovation-oriented alliance of JVs will be formed, and visa versa. On the other hand, during the imitation process, R&D technological knowledge mainly comes from external clients and competitors (Kohler et al., 2012), so positive internal and external cooperation can enhance the imitation performance. R&D teams also need a stable internal support system to provide an environment that encourages the transformation of creative ideas into successful technologies or new products. This leads to the following hypothesis:

**H4a: The JV's organizational climate has a partial mediating effect on the relationship between R&D team learning and integrated innovation performance, and it has a complete mediating effect on the relationship between R&D team learning and imitation performance.**

The theoretical framework for our hypotheses is shown in Figure 1.



**Figure 1 Theoretical Framework**

### 3 Data and Method

#### 3.1 Samples

This study focuses on Characteristics of R&D team and innovation performance under different innovation strategies of JVs in emerging countries. We studied the three JVs of DFM, namely DPCA (Dongfeng Peugeot Citroen Automobile Company Ltd.), DFPV (Dongfeng Nissan Passenger Vehicle Company), and DHAC (Dongfeng Honda Automobile Co., Ltd.). These JVs, presented in Table 1, were established by DFM and Peugeot Citroen, Nissan, and Honda respectively.

**Table 1 Details of the Three JVs**

JV	DPCA (Dongfeng Peugeot Citroen Automobile Company Ltd.)	DFPV (Dongfeng Nissan Passenger Vehicle Company)	DHAC (Dongfeng Honda Automobile Co., Ltd.)
Partners	DFM & PSA Peugeot Citroen	DFM & Nissan	DFM & Honda
Date established	18 May 1992	16 Jun 2003	16 Jul 2003
Capital structure	1:1	1:1	1:1
Registered capital	¥7000 million RMB	¥16.7 billion	\$560 million
Original objective	Establishment of competitive motor enterprise on economical scale and production technology to advanced foreign level	Production of motor engines, site security, and functional parts	Progression from technological cooperation to value-chain cooperation
Sales volume for 2012 (in tens of thousands)	44	77.3	28.2
Number of researchers	1400	600	236
Average age of researchers (2012)	33	28	28
Professional titles (2012)	Senior Expert: 0.5%		Senior Engineer: 4.8%
	Expert: 5.9%	Senior Engineer: 15%	Program Engineer: 12.6%
	Third Engineer: 14.3%	Engineer: 30%	Chief Engineer: 16%
	Second Engineer: 72.2%	Junior Engineer: 55%	Engineer in Charge: 23.3%
	First Engineer: 7.1%		

### 3.2. Measures

Unless otherwise indicated, all measures use a seven-point Likert-type scale (1 = strongly disagree and 7 = strongly agree).

The number of responses from DPCA, DFPV, and DHAC were 204, 100, and 116 respectively, which represents a response rate of 93.3%. There were 192, 88, and 95 effective responses, for a total of 375, and the effective response rate is 89.3%. The sample characteristics are given in Table 2. Following Armstrong and Overton (1977), Li et al(2011), Lin(2003), Prügl and Schreier (2006), the late 25% respondents are assumed to be very similar to non-respondents, then the  $\chi^2$  tests were applied to assess non-response bias. Our results of  $\chi^2$  tests on employees' professional title and R&D employees' age are  $\chi^2_{(2)}=3.160$ ,  $p=0.206>0.05$  and  $\chi^2_{(3)}=3.057$ ,  $p=0.383>0.05$ , therefore, there is no problem of nonresponse bias in our data due to R&D employees' professional title and age.

**Table 2 Sample Characteristics**

Basic Information	Classification	Number of responses	Percentage
JVs	DPCA	88	23.5%
	DFPV	192	51.2%
	DHAC	95	25.3%
Professional Title	Assistant Engineer	163	43.5%
	Engineer	146	38.9%
	Advanced Engineer	66	17.6%
Age	<30	180	48.0%
	31–40	151	40.3%
	41–50	41	10.9%
	51–60	3	0.8%

#### 3.2.1 Dependent variables

Our dependent variables measure innovation performance under an integrated innovation strategy and imitation strategy. In our study, DPCA and DHAC demonstrate integrated innovation, and DHAC demonstrates imitation. Table 3 lists the differences in their strategies.



**Table 3 Differences in Innovation Strategies among the Three JVs**

JV	DPCA/DFPV	DHAC
Innovation strategy	Integrated Innovation	Imitation
R&D work mode	Often co-work with partner's R&D employees	Simply manufacture according to Honda's design drawing
R&D team	Many foreign R&D employees come from PSA and Nissan	Only a few auxiliary staff members come from Honda
Supplier selection and participation	Suppliers selected by both DFM and foreign partners; many, including Chinese suppliers, involved in R&D	Suppliers mainly selected by Honda; few Chinese suppliers involved in R&D
Independent design rights	Granted for some components	Almost none
Structural design	PSA and Nissan lead; DFM is involved	Complete acceptance of Honda's design
Number of authorized patents	214 and 45	11
Representative products	C5,408/ CIIMO	D50/R50
Creative manifestation	Formation of new ideas and training of locals who can then develop own-brand cars	Slight changes to reduce costs and satisfy aesthetic standards and local driving practices

### 3.2.2 Independent variables

The first independent variable is related to network ties of R&D teams. It is derived from the ties between the R&D center and other departments within each JV and the ties between the R&D center and external departments in other firms.

The second independent variable, R&D team learning, is composed of three variables that indicate whether the R&D team members can acquire new knowledge and make progress under the restriction on imitation, whether R&D team learning activities are promoted (Chen, 2008), and whether R&D employees have learning opportunities (Kandemir and Hult, 2005).

### 3.2.3 Mediating variable

The JV's organizational climate is measured by six variables (see Table 4). They measure the decentralization, openness, and trust in the organizational climate and organizational culture

(Kandemir and Hult, 2005), the effects of vision and participative safety in the organizational climate on team innovativeness (Açıkgöz and Günsel, 2011), and the aspects, including structure, rewards, warmth, support and identity, in organizational climate of the R&D.

#### 3.2.4 Control variables

To better capture the influence of characteristics of R&D teams on innovation performance, we used two control variables, the professional title and the age of the R&D team members. Professional title was controlled because more senior employees have more expertise, and to some extent their behaviors can determine the overall innovative performance (Thamhain, 2003).

### 3.3 Method

The method and application in our research are as follows:

Step 1: Exploratory factor analysis. Having conceptualized the theoretical framework of characteristics of R&D team and innovation performance under JVs' different innovation strategies from the literature, the first step of the research was of an exploratory nature (Reid and Roberts, 2011). Exploratory factor analysis (EFA) is a powerful method to analyze the dimensional structure of observables in terms of latent variables. Step 2: Confirmatory factor analysis. The results of the EFA led to a refined list of items, which were used to construct a new questionnaire. As the latent variables are relatively new constructs in our research context, automobile JVs in China, we deemed it necessary to validate its measure empirically (Mu and Di Benedetto, 2011). To do so, we performed confirmatory factor analysis (CFA). Structural equation modeling (SEM) techniques have often been used for confirmatory factor analysis (Reid and Roberts, 2011). In our research, SEM was also used for CFA.

Step 3: Multiple regression models. Multiple regression models are often used to test mediating effects. We entered the control variables, independent variables, and mediating variables into the model step by step.

## 4 Results and Discussion

### 4.1 Exploratory factor analysis and confirmatory factor analysis

Using SPSS 19.0 and choosing half of the samples at random, we performed EFA using principal component analysis with the varimax rotation approach. This revealed 4 factors (see Table 4).

**Table 4 Results of Exploratory Factor Analysis (N=188) and Confirmatory Factor Analysis (N=187)**

Item	Factor				Standardized Coefficient	T-value
	I	II	III	IV		
R&D Team Learning (AVE=0.520)						
TL1: R&D members can acquire new knowledge and make continuous progress in cooperation	0.296	0.254	<b>0.769</b>	0.055	0.68	9.99
TL2: Key personnel in the R&D team play a crucial role in learning	0.209	0.107	<b>0.785</b>	0.286	0.71	10.51
TL3: R&D members have opportunity to take challenging assignments beyond their capabilities	0.395	0.259	<b>0.646</b>	0.217	0.77	11.69
Organizational Climate (AVE=0.550)						
OC1: R&D team often carries out internal activities such as entertainment, experience communication, and training	<b>0.690</b>	0.344	0.156	0.067	0.57	8.18
OC2: All R&D members have opportunity to participate in planning and some decision making	<b>0.685</b>	0.198	0.291	0.257	0.73	11.15
OC3: R&D members can get direct and clear feedback on performance	<b>0.778</b>	0.256	0.345	0.056	0.83	13.62
OC4: R&D work is supported by supervisor department and others	<b>0.562</b>	0.227	0.465	0.043	0.65	9.58
OC5: R&D bonus distribution scheme is fair	<b>0.785</b>	0.237	0.225	0.238	0.81	12.93
OC6: R&D member has opportunity to be promoted	<b>0.690</b>	0.344	0.156	0.067	0.82	13.23
Network Ties of R&D teams (AVE=0.603)						
NT1: Center receives support from research institutes, universities and colleges, suppliers, etc.	0.285	0.315	0.164	<b>0.748</b>	0.73	11.03
NT2: R&D members are close to experimental validation and other relevant research work within the same company.	0.147	0.258	0.208	<b>0.800</b>	0.82	12.80
Innovation Performance (AVE=0.649)						
IP1: Center is strong in automotive electronic systems design	0.286	<b>0.813</b>	0.064	0.207	0.79	12.65
IP 2: Center is strong in powertrain design	0.305	<b>0.817</b>	0.227	0.116	0.81	12.99
IP 3: Center is strong in chassis-system design	0.304	<b>0.755</b>	0.275	0.250	0.85	14.11
IP 4: Center is strong in vehicle body design	0.158	<b>0.765</b>	0.218	0.271	0.77	12.19
Percentage of variance explained by each factor	25.4	21.0	16.0	11.4		

Reliability 0.902 0.903 0.787 0.771

These 4 factors explained 73.8% of the total cumulative variance. The reliability coefficients of the 4 latent variables in our study are 0.902, 0.903, 0.787, and 0.726 respectively (see Table 4), which are all greater than 0.7. The total reliability achieved was 0.935. Therefore, the scales have good inter-item consistency.

Using the other half of the samples and running LISREL 8.70, we find that the Kaiser–Meyer–Olkin measure of sampling adequacy is 0.921, which is greater than 0.9 and shows that the dataset is appropriate for factor analysis. The item-to-respondent ratios for CFA should range from 1:4 to 1:10 (Reid and Roberts, 2011). In our study, there are 17 items and 187 respondents, so our data are suitable for CFA. Table 5 shows that all the standardized coefficients are positive and greater than 0.5, and all the T-values are greater than 3.28. Table 4 also shows that Chi-Square=164.67, df=84, Chi-Square/df=1.960<3, RMSEA=0.072<0.08, CFI=0.98, and TLI=0.98, so the model gives a good fit to the data.

#### 4.2 Inter-correlations for variables studied

Table 5 reports the means, standard deviations, and correlations for the variables studied. R&D Team learning is significantly positively correlated with network ties of R&D teams ( $r=0.537, p<0.01$ ), which indicates that R&D team learning interacts with network ties of R&D teams. Organizational climate is significantly positively correlated with both network ties of R&D teams ( $r=0.516, p<0.01$ ) and R&D team learning ( $r=0.719, p<0.01$ ). Innovation performance is significantly correlated with network ties of R&D teams ( $r=0.656, p<0.01$ ), R&D team learning ( $r=0.547, p<0.01$ ), and organizational climate ( $r=0.582, p<0.01$ ).

**Table 5 Correlation Matrix for All Variables Studied**

	Mean	SD	1	2	3	4	5	6
1. Professional Title	1.74	0.738						
2. Age	1.65	0.705	0.686**					
3. NT	4.772	1.213	0.034	0.027	<b>(0.777)</b>			
4. TL	4.816	1.098	-0.072	-0.047	0.537**	<b>(0.721)</b>		
5. OC	4.123	1.125	-0.019	0.056	0.516**	0.719**	<b>(0.742)</b>	
6. IS	4.403	1.214	-0.009	-0.008	0.656**	0.547**	0.582**	<b>(0.806)</b>

Note: \*\* $p<0.01$ ; Professional Title: 1= Assistant Engineer, 2= Engineer, 3= Advanced Engineer; Age: 1:  $\leq 30$ , 2: 31–40, 3: 41–50, 4: 51–60

The EFA and CFA results have shown that our scales have good validity. In Table 5, the data in brackets are the square roots of the AVE values. The minimum value, 0.721, is greater than the maximum correlation coefficient, 0.719. Overall, the observable variables can explain the corresponding latent variables effectively, and they have better convergence and can be categorized as R&D team learning (TL), organizational climate (OC), network ties of R&D teams (NT), and innovation performance (IP).

### 4.3 Mediating effect

We use multiple regression models to test the hypotheses, table 6 presents the results of our hypothesis tests. The Max-VIF value in Table 6 is the maximum value of the variance inflation factors in each regression model. These values were all less than 3.0 and indicated that there were no multicollinearity problems among the control variables and independent variables.

**Table 6 Regression Results: Effects of R&D Characteristics on Innovation Performance under Different Innovation Strategies**

Samples	Innovation					Integrated Innovation					Imitation				
	PDCA, DFPV, and DHAC (N=375)					DPCA and DFPV (N=280)					DHAC (N=95)				
	OC		IP			OC		IP			OC		IP		
Variables	I	II	III	IV	V	I	II	III	IV	V	I	II	III	IV	V
Professional Title	0.009	-0.067	0.079	0.000	.019	0.082	0.123*	0.106	0.035	0.054	-0.086	0.057	-0.204	0.102	-0.128
Age	0.004	0.126*	0.064	-0.010	-0.044	0.000	0.119*	-0.129	-0.008	-0.027	0.383*	0.198*	0.259*	0.088	-0.004
NT		0.181**		0.509*	0.460**		0.186***		0.628**	0.598**		0.188*		0.307**	0.219*
TL		0.623**		0.273**	0.102 <sup>+</sup>		0.637***		0.224**	0.123*		0.596**		0.406***	0.127
OC					0.274**					0.159*					0.468**
F	1.779	112.676	0.016	86.590	79.139	0.933	91.148	1.117	103.540	86.363	6.016	31.375	2.291	14.797	16.969
ΔR <sup>2</sup>		0.540		0.484	0.033		0.563***		0.593	0.011		0.466		0.350	0.091

R <sup>2</sup>	0.009	0.549	0.000	0.484	0.517	0.007	0.570	0.008	0.601	0.612	0.116	0.582	0.047	0.397	0.488
Max-VIF	1.890	1.903	1.890	1.903	2.282	2.114	2.141	2.114	2.141	2.400	1.508	1.594	1.508	1.594	2.394

The network ties of R&D teams have a significantly positive effect on innovation performance ( $\beta=0.509$ ,  $p<0.001$ ), thereby supporting H1. The standardized coefficients are 0.628 ( $p<0.001$ ) for integrated innovation and 0.307 ( $p<0.01$ ) for imitation, so the network ties of R&D teams are more positively associated with integrated innovation performance than with imitation performance, thereby supporting H1a.

Although the standardized coefficients of network ties of R&D teams for overall innovation performance, integrated innovation performance and imitation performance are all significant, after the organizational-climate mediator enters the regression models, these coefficients become lower (i.e.,  $0.460$  ( $p<0.001$ )  $<$   $0.509$  ( $p<0.001$ )). Therefore, the organizational climate has a partial mediating effect on the relationship between network ties of R&D teams and innovation performance, so H2 is supported.

Similarly, R&D team learning has a significantly positive effect on innovation performance ( $\beta=0.273$ ,  $p<0.001$ ), thereby supporting H3. The standardized coefficients are 0.224 ( $p<0.001$ ) for integrated innovation performance and 0.406 ( $p<0.01$ ) for imitation performance, so R&D team learning is more positively associated with imitation performance than with integrated innovation performance, failing to support H3a.

When the organizational climate enters the regression models as a mediator, the standardized coefficients of R&D team learning become lower ( $0.102 < 0.273$ ,  $0.103 < 0.224$ ,  $0.127 < 0.406$ ), so H4 is supported, namely the JV's organizational climate has a mediating effect on relationship between R&D team learning and innovation performance. In particular, the standardized coefficient for imitation performance becomes insignificant, which implies that R&D team learning has a complete mediating effect, thus supporting H4a. Namely, the JV's organizational climate has a partial mediating effect on relationship between R&D team learning and integrated innovation performance and a complete mediating effect on relationship between R&D team learning and imitation performance. Table 7 gives the final results.

**Table 7 Overview of Hypotheses and Findings**

Hypothesis	Finding
H1: R&D network ties are positively associated with JVs' innovation performance	Supported
H1a: R&D network ties are more positively associated with JVs' integrated innovation performance than with imitation performance	Supported
H2: JVs' organizational climate has partial mediating effect on relationship between network ties and innovation performance.	Supported
H3: R&D team learning is positively associated with JVs' innovation performance	Supported
H3a: R&D team learning is more positively associated with integrated innovation performance than with imitation performance	Not Supported
H4: JVs' organizational climate has mediating effect on relationship between R&D team learning and innovation performance.	Supported
H4a: JVs' organizational climate has partial mediating effect on relationship between R&D team learning and integrated innovation performance and complete mediating effect on relationship between R&D team learning and imitation performance.	Supported

The findings of our research show that characteristics of R&D teams, including network ties and team learning, promote JVs' innovation performance. JVs' integrated innovation should focus on network ties of R&D teams, while imitation should focus on R&D team learning. Moreover, JVs' integrated innovation strategy should emphasize organizational climate as a key mediator for enhancing innovation performance. For imitation, organizational climate has a complete mediating effect.

## 5 Conclusion

Our findings demonstrate the mediating effect of organizational climate on the relationship between characteristics of R&D teams and innovation performance under different innovation strategies. The JV's organizational climate is a key mediator between characteristics of R&D teams and innovation performance. Our study further explores the mediating effects of the JV's organizational climate on the relationship between two important characteristics of R&D teams and integrated innovation or imitation performance. For host firms in JVs, network ties of R&D teams with foreign companies do not mean that they can innovate easily. Thus, network ties of R&D teams positively influence imitation performance under the mediating function of the organizational climate. However, the JV's organizational climate has a different effect on the relationship between R&D team learning and innovation performance under different strategies. The host firms in JVs cannot learn all the key technology for political, economic, or other reasons (Li and Zhou, 2008; Mahmood and Zheng, 2009).

The JV's organizational climate has a partial mediating effect on the relationship between R&D team learning and integrated innovation performance, and it has a complete mediating effect on the relationship between R&D team learning and imitation performance.

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## **Innovative Construction of Blended Teaching Patterns of College English Online Open Courses in the New Age**

Feng Yali<sup>1</sup>, Han Yue<sup>2</sup>

1 School of Foreign Languages, Hubei University of Technology, Wuhan, P. R. China, 430068

2 School of Foreign Languages, Wuhan University of Technology, Wuhan, P. R. China, 430070

(E-mail: jessicafyl@126.com, hanyuelexi@163.com)

**Abstract:** This paper mainly discusses the innovative construction of blended teaching patterns of college English online open courses in the new age from the qualitative approach. With literature research, four problems in domestic college English online open courses are analyzed, namely, less amount of course diversity, less innovation of course content, less interaction of course participants and low utilization of course resources. To further advance the development and the effect of college English online open courses in Chinese universities and solve the related problems, four innovative blended teaching patterns: student-based teaching pattern, problem-based teaching pattern, humanity-based teaching pattern, and mutual evaluation teaching pattern are put forward in this paper.

**Key words:** Innovative construction; Blended teaching patterns; College English; Online open courses

### **1 Introduction**

The unprecedented development of science and technology in this information explosion age has put the whole society under the background of big data, stimulating the revolutions in education field, especially in the constructions of teaching and learning patterns. In this new age, science and technology are being updated every moment, leaving a large quantity of information and knowledge to university students to learn about in order to keep pace with this rapid developing society. Thomas Friedman once claimed that nothing has more potential to lift more people out of poverty— by providing them an affordable education to get a job or improve in the job they have (Thomas Friedman, 2013). Open online courses provide public access to learning materials, usually organized in an academic format with components like lectures, readings, assignments, discussions and quizzes (Center for Online Education, 2014). The academic format encourages participants to share knowledge of different levels of experience and skill among them. Many of these courses allow universities to provide credits to their learners, after getting enough credits, they will be offered a degree from those universities.

In the popularity of online open courses, the United States began earliest, with MIT (Massachusetts Institute of Technology) first launching its open courses program called OCW (Open Course Ware) in 2001, and a wave of constructing open online courses was brought up. After that, many prestigious universities followed MIT's step and built their own online open courses platforms. Currently, there are three large online open courses platforms: EdX, Coursera and Udacity. In recent decades, online open courses have been developed rapidly in China, which expand the teaching time and space, increase the teaching attraction, motivate the learner's learning enthusiasm and independence as well as enlarge the high-quality education resources benefit fields (China Education Information Network, 2015). The amount of existing open online course platforms such as MOOC (Massive Open Online Courses), XuetaoX and iMOOC in China keeps growing under the encouragement of Chinese Ministry of

Education.

English is not only a compulsory<sup>1</sup> course for college students, but also a language that need to be mastered in this era of globalization. College English online open courses are widely needed and of great importance in universities. Consequently, it is necessary to construct blended teaching patterns of college English online open courses. This paper discusses four problems in domestic college English online open courses on the base of literature research, which are less amount of course diversity, less innovation of course content, less interaction of course participants and low utilization of course resources. In order to improve the quality and enlarge the expansion of college English online open courses, this study advances four innovative teaching patterns, namely, student-based teaching pattern, problem-based teaching pattern, humanity-based teaching pattern, and mutual evaluation teaching pattern.

## 2 Research Methodology

This paper mainly adopts the following methods: Firstly, comparison and contrast are adopted. In this paper, the present situation of online open courses at home and abroad is compared and contrasted, so that the similarity and difference is obtained for the development of online open courses in China. Secondly, literature inquiry is used. In organizing the paper, the related information about online open courses is inquired from different kinds of materials, in order that more information can make the argumentation persuasive. Thirdly, interdisciplinary research method is adopted. In discussing the blended teaching patterns of college English online open courses, the knowledge background of higher education, second language teaching and learning, course design and so on is fully involved, needing the mixed interdisciplinary background.

## 3 Existing Problems in College English Online Open Courses

Overviewing the history and application of college English online quality courses in China, it is not difficult to find that the curriculum construction and application have achieved fruitful results. It has basically formed a multi-disciplinary, multi-level and multi-type online curriculum system pattern, which plays a significant and positive role in expanding teaching time and space, enriching teaching content, sharing teaching resources, and innovating teaching activities (Yang Fangqi, 2018). Despite the success achieved in domestic online open courses, there are still some problems to be solved.

### 3.1 Less amount of course diversity

This paper takes Chinese University MOOC, the most popular online open course platform at present in China, as the research target. There are over three thousand online open courses from 329 Chinese universities and colleges in total distributed in 15 subject categories including engineering, science, medicine, law and so on. However, take OCW as an example, since MIT launched the OCW, according to the latest site statistic report, around 2,500 courses of MIT have been issued and its total visits have reached to approximately 2.8 billion (MIT Open Course Ware, 2019).

**Table 1 Course Distribution in Chinese University MOOC**

Course Type	Engineering	Science	Computer	Management	Psychology	History	Philosophy	College English
Quantity	701	466	288	271	38	50	43	57

As Table 1 demonstrates, courses in Chinese University MOOC are mainly distributed in engineering, science, computer and management, which are 701, 466, 288, 271 respectively, with a total of 1,726 courses, accounting for nearly 57% of the total courses. While courses of psychology, history and philosophy are obviously less, which are 38, 50, 43 respectively, only account for 4% of the total courses. College English online open courses even less, which only has 57 courses. Having a comparison of online open courses between domestic and abroad, it is apparent that there is a huge gap in the amount of college English online open courses.

### 3.2 Less innovation of course content

Course content plays an important role in online open courses, which, to a large extent, determines the quality of the course. Furthermore, the course quality is the core of improving the quality of personnel training (Fan Lixin, Jiang Shengyong, Huang Longjun, 2015). Nevertheless, according to existing college English online open courses, most of them are based on lecture videos, multimedia courseware, and text lesson plans. Most contents are subject-centered. To a certain extent, these contents may effectively help students to define the basic logical structure of the subject and understand the unique way of inquiry of the subject, but they may weaken students' interest in learning, which is not conducive to cultivating students' practical ability and comprehensive quality. There are also significant gaps in the design concept of the new curriculum content that focuses on the students and development of their abilities (Yang Fangqi, 2018). Some contents are simple, some are too difficult, and some of the content are so academic that the courses become an online version of a professional class, which limits the entry of non-professionals (Li Hai, 2019).<sup>82</sup>As for college English online open courses, the contents of some courses are obsolete because the teachers just upload the courses videos on the platform and may not up<sup>83</sup>dating them in time.

### 3.3 Less interaction of course participants

College English online open courses offer an opportunity for college students to learn knowledge not only in a traditional class but also after class— from the Internet. However, due to the traditional concept and incorrect cognition on teaching and learning, many teachers and students simply consider the online open courses as a digitalization of teaching and learning activities, which unconsciously set an obstacle when taking online open courses. In quality courses, there are only teaching contents such as syllabus, teaching plans, courseware, lecture videos and homework, but no interactions. At present, MOOC provides learners with many online course activities like comment and question function, discussion community, online note tools and quiz to offer learners better learning experience. Unfortunately, due to the lack of supervision, although many improvements have been done on the teaching and learning activities of college English online open courses, there are still separation between the course participants.

### 3.4 Low utilization of course resources

In December 2018, the number of online education users in China reached 201 million, and the online education usage rate was 24.3%. Mobile online education users reached 194 million, with a usage rate of 23.8% (The 43<sup>rd</sup> China Statistical Report on Internet Development, 2019). These figures demonstrate that though the number of registrations on online education has reached to a huge amount, the actual

<sup>82</sup> The 43rd China Statistical Report on Internet Development [EB/OL]. (2019-02-28) [2019-05-15]. [http://www.cnnic.net.cn/hlwfzyj/hlwxyzbg/hlwtjbg/201902/t20190228\\_70645.htm](http://www.cnnic.net.cn/hlwfzyj/hlwxyzbg/hlwtjbg/201902/t20190228_70645.htm)

<sup>83</sup> MIT Open Course Ware. Dashboard Report [EB/OL]. (2019-04-14) [2019-05-15]. [https://ocw.mit.edu/about/site-statistics/monthly-reports/MITOCW\\_DB\\_2019\\_03\\_v1.pdf](https://ocw.mit.edu/about/site-statistics/monthly-reports/MITOCW_DB_2019_03_v1.pdf)

usage rate is still at a low level. Over 15-year development, the number of quality online open courses reached to a considerable figure, however, after visiting dozens of university websites, many online open courses are found out missing or with few visits. The number of quality course visits on many websites has not increased, the daily maintenance of the website is not timely and the interaction with users is reduced, and the development speed of the online open courses is slow, which causes many websites to upload and update the quality course resources less frequently so that the website content become less resourceful and even some of the site's resource contents were uploaded a few months or a year ago (Cao Xiyang, He Yinghong, He Fuhui, Liu Liyang, 2019).

#### **4 Innovative Construction of Blended Teaching Patterns**

College English online open courses are increasingly called for by college students in this new age. But language teaching online is quite special because online courses may neglect the social attribute of language teaching and lack of language learning environment as students just watch the videos and have no interaction with teachers, which doesn't meet the needs of English learners in the new age. The foreign language by means of e-learning often manage to apply more slowly than it in technical subjects and sciences. That is why in the foreign language teaching gradually the seemingly most suitable method had been set—the method of blended teaching (Sarka Hubackova, 2015). Blended teaching provides more guidance by integrating face-to-face teaching with web-based teaching, as well as adding flexibility and accessibility to traditional learning through online learning (Reem Alebaikan, Salah Troudi, 2010). Therefore, in order to have a better application of online open courses in college English teaching and learning, this paper puts forward four innovative blended teaching patterns.

##### **4.1 Student-based teaching pattern**

The traditional teaching pattern is centered on the teacher's teaching. The students are only passively accepting knowledge. It is difficult to teach students in accordance with their aptitudes and targeted guidance and education. Under the student-based teaching pattern, students actively participate in the peer and self-assessment process, in conjunction with teacher assessment, for formative assessment. In other words, the students learn to analyze and evaluate their own learning process with the support of teachers, rather than wait for teachers to tell them where their learning is deficient (Renandya, Willy A., Handoyo Puji Widodo, 2016). The development of online open courses makes it possible to apply student-based teaching pattern in college English teaching and learning. In online open courses, students are the main body of the course while teachers are instructors to help students integrate and optimize teaching resources and helping students develop relevant teaching plans (Liu Xiaoyong, 2019). Student-based teaching pattern requires that teachers concern the characteristics of student, therefore, the difficulty of teaching resources and the level of details and focus of the course video should be fully considered, so that students with different levels of English and different interests can be offered with a variety of choices. This kind of teaching pattern promotes students to stimulate high-level learning motivation, fully develops students' potential, and enables students to self-educate (Xing Cong, 2019).

##### **4.2 Problem-based teaching pattern**

Problem-based teaching is an approach to structuring the curriculum which involves confronting students with problems from practice, which provide a stimulus for learning (Boud D, Feletti G, 2013). However, homework is a good approach to reflect students' problems. No matter in the traditional classes or online open courses, homework is no doubt an indispensable way to consolidate course content and test learning outcomes. Homework is an essential part of learning. Students need the opportunity to practice and apply the concepts and skills demonstrated by their instructors. Online homework systems allow students to retrieve, complete, submit and receive feedback on homework via their web browsers. Many studies demonstrate two main characteristics of an effective instructional

technology regarding online homework completion: immediate feedback and the allowing of multiple attempts to answer a question (Bibi Rabia Khan, 2018). Consequently, homework design is of great importance. In college English online open courses learning, students may have different questions and problems, most of which cannot be answered and solved. It is quite efficient to combine problems and homework. Many online open courses platforms set some new functions such as “chatting room” and “Discussion”, which can tell teachers the questions and problems students have. Then according to these questions and problems, teachers can design targeted homework. Students are required to complete the relevant online course content before class and complete the hierarchical and differentiated preview tasks, such as study notes, preview reports, project reports, forum questions, forum discussions, etc. (Liu Xijuan, Han Xiao, Xia Hengxia, 2018). After the offline course, students need to do the designed homework to internalize the learning content.

#### **4.3 Humanity-based teaching pattern**

“Humanities” is a concept that covers a wide range of things. In the modern sense, “humanities” mainly refers to the social morality, value idea, aesthetic taste and thinking mode formed in the process of social development. The essence of the humanistic quality education lies in the cultivation of humanistic spirit (Li Yifei, 2015). High-quality, rich online course resources can provide strong support for the reform of online open courses and the improvement of teaching quality (Li Hongjuan, Wang Xiang, 2018). Online courses offer a wide range of learning extended resources to enrich course resources and meet the learning needs of different students. Rich course resources can reduce the blindness of students’ learning without spending a lot of energy on online search, which can maximize student convenience and provide students with an immersive learning experience. Under the pressure of examinations and credits, students just study hard to get a better grade while neglect the development of their humanistic qualities. English language teaching is not only a simple text teaching, but also teaching a different culture. Understanding different ways of thinking and spiritual connotation, students can respect the differences of different cultures, eliminate cultural prejudice and cultivate their cultural adaptabilities and cross-cultural communication skills (Shi Qianqian, 2019). This pattern not only encourages teachers to teach students more humanistic knowledges but also increases students’ interest in college English online open courses.

#### **4.4 Mutual evaluation teaching pattern**

Teaching evaluation aims to test the effectiveness of teaching and learning, discover problems in teaching, and better promote teaching. Since online open courses are conducted through the Internet, students take these courses outside the classroom. In the virtual teaching environment, learning is inevitably boring and difficult to sustain due to less supervision and constraints. At present, the evaluation methods of many online open courses are mainly divided into classroom exercises, tests and examinations. The evaluation of college English learners should pay attention to the process evaluation, adopt the combination of online and offline evaluation, pay attention to monitoring the students’ learning status, and examine the students’ learning attitude and the ability of independent learning and collaborative learning (Zhang Jinhong, 2016). Mutual evaluation incorporates the activity of students in the forum and the participation of the curriculum into the evaluation indicators, and forms an evaluation system covering teacher’s evaluation and student’s mutual evaluation. Through mutual evaluation, both teachers and learners are under the supervision of an invisible eye, which stimulates the teachers to be responsible for the online open courses and the students have a good performance in the courses.

### **5 Conclusion**

The rapid development of modern information technology has brought unprecedented opportunities for college English teaching and learning. China’s college English online open courses have been

continuously developed, and the English teaching pattern has been innovated, enriching the content and resources of English teaching. Although there are some problems in the college English online open course for the time being, with the development of technology and the changing people's concept, the online open courses will gradually get on the right track. The college English online open course itself is a complicate project that cannot be accomplished overnight. It requires long-term experience to accumulate and improve. Blended teaching is one of the common teaching patterns with the development of college English online open courses. This paper puts forward four innovative teaching patterns, hoping they could give some inspiration to the construction of blended teaching in college English online open courses.

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## The Practice and Innovation of Task-Based Language Teaching

Lu Xiaoli , Ke Jianhua

School of Foreign Languages, Wuhan University of Technology, Wuhan, P.R. China, 430070

(E-mail: luxiaolily@hotmail.com, 2506009814@qq.com)

**Abstract:** Task-Based Language Teaching (TBLT) is an influential language teaching mode proposed by the international applied linguistics community in the 1980s. This paper introduces the principles of task design and implementation steps of Task-Based Language Teaching and details the teaching procedures through a spoken English class. Next the paper proposes the innovation practice based on the problems and advantages with Task-Based Language Teaching. Last the paper concludes that TBLT is a strong communicative approach by providing opportunities for implicit, incidental and meaningful learning.

**Keywords:** Task; Task-Based language teaching; Practice; Innovation; Problems; Advantages;

### 1 Introduction

Task-Based Language Teaching (TBLT), a language teaching mode with important impact on foreign language teaching and second language acquisition, was proposed by the international applied linguistics community in the 1980s, with reference to the theories and methods of pedagogy, psychology and other related disciplines, through a large number of studies and practices. This mode takes specific tasks as learning motivation, the process of completing tasks as learning process, and presenting task results as teaching achievements. However, there is no agreement on the definition of "task" in language teaching at home and abroad. Nunan (Nunan, 2004) defined "task" as a piece of classroom work which involves learners in comprehending, manipulating, producing or interacting in the target language while their attention is principally focused on the meaning rather on the form. The task should have a sense of completeness being also to stand alone as a communicative act in its own right. According to Breen (Breen, 1987), tasks refer to various work plans with stimulating language learning being the overall goal. Ellis (Ellis, 2003) pointed out that task is a work plan that requires students to use and process languages. Richards and others believe that task is an activity or action that learners complete on the basis of understanding and processing language. Here is a definition by Prabhu: "An activity which required learners to arrive at an outcome from given information through some process of thought and which allowed teachers to control and regulate that process was regarded as a task." (Prabhu, 1987:24) Examples of tasks include: preparing a meal; ordering food in a restaurant; making an

appointment with a doctor on the phone; solving a problem; designing a brochure; making a list of the qualities of a good husband/wife. From these different definitions, we can easily see that task involves communication with language which focuses on the meaning rather than the forms of that language. The core idea of Task-Based Language Teaching is to cultivate the ability to use language in the process of accomplishing tasks.

## **2 Activity Design and Implementation Steps of Task-Based Language Teaching**

In Task-Based language teaching, task design is mainly considered from the following five aspects: (1) degree of difficulty and individual differences. The author believes that Task-Based teaching activities should have moderate difficulty and follow the principles of from easy to difficult, from simple to complex, and layer upon layer in a progressive way. Task-Based teaching is "student-centered" and "people-oriented". Since every student is an independent individual, the teacher should try to create conditions and opportunities for each student's individual development according to the individual differences. For example, in group activities, tasks should be shared reasonably according to the level and expertise of each student. Students with poor foundation can do some simple and static tasks, such as describing things or processes. Students with good foundation should be given some abstract and dynamic tasks. (2) authenticity and interestingness. In classroom teaching, efforts should be made to create a real-life language environment which makes English classroom teaching have real communicative nature of language and enables students to have lifelike language experience so that they can apply what they have learned. (3) diversity. Language communication is a kind of creative mental activity. We should design different kinds of activities that can inspire students' thinking and stimulate their enthusiasm for learning so as to improve students' comprehensive ability of using language. Common activities are using table format, categorizing, conversation, contest, writing, debate and so on. (4) extensibility. Considering students' ages and hobbies, teachers are supposed to actively carry out various Task-Based extracurricular activities to help students increase knowledge, broaden horizons and show talents. The suggested activities are as follows: English songs, English calligraphy, English handwritten newspapers, English textbooks plays, English evening parties and other activities (Sun Kuoxing, 2006)

Task-Based learning offers an alternative for language teachers. In a Task-Based lesson the teacher doesn't pre-determine what language will be studied, the lesson is based around the completion of a central task and the language studied is determined by what happens as the students complete it. Jane Willis (Jane Willis, 1996), in his book "Task-Based Learning Mode", put forward the three-stage mode of TBLT classroom activities: pre-task, task-cycle and language focus.

The pre-task stage is also the warming-up stage or the preparation stage. Teachers first introduce subjects and tasks to students, and help them understand the instructions of tasks and make preparation.

Students understand the tasks to complete and the goals to achieve and receive relevant language input for the task. It is worth mentioning that to complete a task is to do things and students need some background and language knowledge to pave the way for the task.

The task-cycle stage includes task section, plan section and report section. First, students perform tasks. In this section, in order to complete the communicative tasks (such as discussion, debate, role-play etc.), students try their best to express themselves with the language knowledge they have learned. During this period, the focus of students' attention is not form of language but meaning. Teachers should by all means relieve various pressures to complete tasks on students so that they think they are capable enough to handle the task. Next comes the plan section. Students think about and discuss how to organize and choose the language and determine the content of the report through individual, pair and group work. In this way, learners can get more chance to communicate and meanwhile they help each other and practise cooperative learning, thus their language competence advance considerably. During this time, teachers should offer students specific guidance and language counseling in time. In the following report section students give report on the task they perform. Teachers then summarize and encourage students to reflect on what they've done. Learning is a process of discovering, solving and summarizing problems. Only by constantly internalizing and externalizing knowledge, reflecting and summarizing can we finally form our own knowledge system.

Language focus includes language analysis and practice. The purpose is to master some important language points and review language knowledge previously learned, meanwhile extract and summarize language points of this lesson.

### **3 Teaching Practice**

The following is the author's attempt to design tasks in an oral class with the topic "love" by using Task-Base language teaching mode.

**(1) Teaching objectives:** Through this lesson, students master relevant language points and focus on understanding what love is. The difficult point is the cultural differences in understanding love between Chinese and westerners.

**(2) Activities:** games, discussions, role plays, oral reports etc. in the form of pair work and group work.

**(3) Teaching procedures:**

Pre-class Tasks

A. Students are required to preview reading "What I have lived for" by Bertrand Russell to

understand the main idea of the article.

Excerpt: I have sought love, first, because it brings ecstasy---  
ecstasy so great that I would have sacrificed all the rest of life for a few hours of this joy. I have  
e sought it, next, because it relieves loneliness---  
that terrible loneliness in which one shivering consciousness looks over the rim of the world i  
nto cold unfathomable lifeless abyss. I have sought it, finally, because in the union of love I h  
ave seen, in a mystic miniature, the prefiguring vision of the heaven that saints and poets have i  
maged. This is what I sought, and though it might seem too good for human life, this is wh  
at --- at last --- I have found.

B. Students are required to watch the movie “Notting Hill” online and prepare a three-minute oral  
report on the storyline.

#### Classroom Tasks

A. After students read together parts of the article, teacher explains several key language points to  
enable students to have a deeper understanding of the article.

B. Teacher introduces the topic and the main objectives of this lesson to students.

C. The whole class is divided into two groups, A and B. The two groups compete in the vocabulary  
game "I love my love". After the teacher announces the winner she/he presents some pictures via  
multimedia to help students memorize the new vocabulary.

D. In each group of four students are encouraged to write as many love-related words or phrases as  
possible and classify them.

E. Each student in the group does the following blank-filling exercises: “Love starts  
with \_\_\_\_\_, advances with \_\_\_\_\_, breaks with \_\_\_\_\_, recalls with \_\_\_\_\_ and lasts with \_\_\_\_\_ till the end of  
happiness.” Then the students in each group communicate with each other to get to know people's  
different ideas about love.

F. Listen to the theme song "she" from the movie “Notting Hill” and then complete the lyrics.  
Teacher then summarizes how love is interpreted in the song -----Love is full of paradox---sweet  
torment.

Excerpt: The trace of pleasure or regret

May be my treasure or the price I have to pay

May be the song that summer sings  
May be the chill that autumn brings  
May be the beauty or the beast  
May be the famine or the feast  
May turn each day into a heaven or a hell  
I'll take her laughter and her tears

G. Role-play. A girl student and a boy student act out a love story between a Chinese girl studying in the United States and an American lawyer. Then students discuss the cultural differences in understanding love between Chinese and Westerners and the possible reasons behind that. This is to cultivate students' cross-cultural awareness.

H. Questions based on lifelike scenarios. Question for boys: How to let your girlfriend split the bill without ruining the date? Question for girls: You love your boyfriend but he is frugal as he comes from a poor family. You want to pay for a date but don't want to hurt his dignity. So, what do you do? Question for all: How to have a perfect night with only 50 yuan? With these questions students better understand how to deal with the relationship between love and money.

I. Group discussion: How to maintain vigorous love especially after the couple have kids? Representatives from each group give oral reports to the class and teacher makes comments on each one.

After-school Tasks.

A. Review the key words and phrases in this lesson.

B. Summarize useful expressions used to express likes, dislikes and comparisons, such as I enjoy/like.....I'm afraid I don't like....., I prefer .....to.....

#### **4 Problems and Advantages with Task-Base Language Teaching**

Some teachers criticize TBLT for focusing mainly on fluency at the expense of accuracy. Task-Base Language Teaching emphasizes meaning rather than language form, but this does not mean that teachers don't have to correct students' language errors. Teachers need to think about when to and how to do it. Since Task-Base Language Teaching mode is student-centered. Students need to actively cooperate and participate in various activities. However, some students tend to take negative and passive roles in class because of psychological and language barriers. This requires teachers to use right skills helping students overcome their fear and undertake intensive language input before the task. TBLT requires a high level of creativity and initiative on the part of the teacher. In Task-Base Language Teaching mode group activities are often carried out. What usually happens is that students have no idea where to start

and what to say after being given the task. This is mostly due to inappropriate task design. Thus it is quite necessary for teachers to study the principal involved in task design. Another common phenomenon is that when one group is making the presentation the other groups do not pay much attention to it and just wait for the teacher to make comments. In view of this, the author believes that proper interaction between students on and off the stage is quite needed. For example, the interaction can take place in the form of questions and answers.

The current English teaching in colleges is still characterized by the adoption of the traditional teaching method, which is known as the 3Ps approach (presentation, practice, production) and in which student participation and interaction are quite limited. Task-Based learning has some clear advantages: 1. Unlike a PPP approach, the students are free of language control. In all three stages they must use all their language resources rather than just practicing one pre-selected item. 2. A natural context is developed from the students' experiences with the language that is personalized and relevant to them. With PPP it is necessary to create contexts in which to present the language and sometimes they can be very unnatural. 3. The students will have a much more varied exposure to language with TBL. They will be exposed to a whole range of lexical phrases, collocations and patterns as well as language forms. 4. The language explored arises from the students' needs. This need dictates what will be covered in the lesson rather than a decision made by the teacher or the coursebook. 5. It is a strong communicative approach where students spend a lot of time communicating. PPP lessons seem very teacher-centered by comparison. Just watch how much time the students spend communicating during a Task-Based lesson. 6. It is enjoyable and motivating.

## **5 Innovation Practice**

(1) The combination of traditional teaching and Task-Based teaching. In China English learning environment is dominated by classroom teaching. The size of classes and the number of students is relatively large. Compared with other countries, classroom management is more complex and inconvenient. If we follow the concept of Task-Based teaching and completely rely on the students' cooperative learning or independent exploration of knowledge, it would be difficult to ensure the completion of tasks and achieve the proper teaching objectives. So, it is necessary to combine the traditional 3P (presentation, practice, production) teaching with Task-Based teaching.

(2) The combination of in-class collaborative tasks and extracurricular extended tasks. In class, teachers should make full use of limited time to promote cooperative learning among students and encourage exchange and discussion, rational division of labor, consultation and mutual assistance and summary. Students should be familiar with the task objectives, operation steps and thus lay a good foundation for task execution. Efforts should be made to create a humanized teaching environment and extend beyond class.

(3) Tangle language input and output appropriately. Traditional teaching pays more attention to language input, while Task-Base teaching pays more attention to language output. On one hand, Language input is a prerequisite for language learning. On the other hand, without language output and necessary training knowledge and information cannot be translated into skills, which makes language input and knowledge reserve meaningless. Input Innovation requires teachers to systematically design and present key and difficult language points in the early stage so that students have a better understanding of it. And the exploration during the task-cycle make language output more effective and the whole task would be more smoothly completed.

(4) Advocate group cooperation and encourage individual thinking. Cooperative learning is a student-centered and group-based learning. More cooperation is needed in more demanding tasks. In Task-Base teaching, teachers should guide each student for both cooperation and independent thinking. And students shall never develop the habit of relying on other group members. During the task -cycle there are occasions when some skillful students control the speak. In this case, teachers are required to have a higher sensitivity and encourage the timid and silent students to talk so that every student is involved and feels fulfilled.

## **6 Conclusions**

### **6.1 Implicit learning**

The aim of TBLT is to help learners develop implicit knowledge of the language that will enable them to participate easily and naturally in communication. The learners get the form and use of the target language without being explicitly being taught. The role of the teacher is to design tasks by replicating and creating the conditions for language learning and for communication that exists outside the confines of the classroom. The aim is that the learners' inter-language will gain implicit language knowledge while doing tasks.

### **6.2 Incidental learning**

Much of our everyday learning is incidental. TBLT provides opportunities for unplanned learning. Completing a real-world task allows the acquisition to take place without any deliberate intention on the part of the learner or the teacher.

### **(3) Meaningful learning**

TBLT allows meaningful communication to occur during the accomplishment of tasks.

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# Financial Literacy and SMEs Performances; Mediating Role of Risk Attitude

Kulathunga KMMCB<sup>1,2</sup>, Ye Jianmu<sup>1</sup>, Weerathunga PR<sup>1,3</sup>

1 School of Management, Wuhan University of Technology, China PR

2 Faculty of Management, Uva Wellasa University, Badulla, Sri Lanka

3 Faculty of Management Studies, Rajarata University, Mihintale, Sri Lanka

(E-mail: maduranga99a@gmail.com , jianmuye@126.com, weerathungaroshan@gmail.com )

**Abstract:** Role of the Small and Medium Enterprises in economic development is immense. However, in the growing literature of SMEs management, inadequate consideration has been devoted on the financial literacy of the SMEs, and the mechanisms through which it impacts on SMEs performances. Drawing upon knowledge-based view and dual process theory, we tested the impact of financial literacy and risk attitude on SMEs performances in an integrated model. The sample included 244 chief financial officers of SMEs in three provinces of Sri Lanka (Central, Western and Southern provinces). The output of structural equation model revealed a direct positive effect of financial literacy and risk attitude on SMEs performances. Further, financial literacy also has a significant positive impact on risk attitude. Moreover, risk attitude was found to be partial mediator between financial literacy and SMEs performances. Accordingly, we conferred managerial and theoretical implications for policymakers, industry practitioners and academics.

**Key words:** Financial literacy; Risk attitude; SME performances

## 1 Introduction

The emerging significance of financial literacy (FL) is well documented in recent literature. Financial literacy has been defined as the knowledge and cognitive capabilities entail to manage and to make effective decisions on finance (Adomako et al., 2016). Further, Korutaro Nkundabanyanga et al. (2014) defined FL as “the ability of an individual to make informed judgment and take effective decisions regarding the use and management of money”. Thus, FL is vital for SMEs to make financial decisions. It helps to empower and educate SMEs on finance and to use that knowledge for evaluating and making decisions on financial issues in their businesses. Further, it is expected that financial literacy would help to deal with challenges in cutting edge credit markets. Moreover, financial literacy enables SMEs to manage risks through the strategies such as maintaining financial reserves, diversifying investment portfolio and buying insurance policies. Accordingly, in this complicated, competitive and risky business setting, financial literacy helps SMEs through improving the skills to manage financial resources productively while effectively managing risks arise with financial decisions.

Presumably, business and financial risks are rapidly increasing with prevailing unstable situation of the economic systems. Specially, SMEs in emerging markets have to deal with more challenging economic conditions and most of them are struggling to survive in the market. Consequently, financial managers of SMEs have to undertake and control all these risks to safeguard their organizations from these jeopardizes (Jaroslav et al., 2014). Thus, risk attitude is important for SMEs to survive and

develop in this challenging economic environment. In psychological literature, risk attitude has been extensively used as an entrepreneurs' personality characteristic while measuring SMEs success (Rauch and Frese, 2000). Further, the importance of risk attitude for SMEs in developing countries is also well documented in the literature (Krauss et al., 2005). Economic theories also explain the relationship between risk and return. Accordingly, risk aversion entrepreneurs would accept low return in exchange of less risk exposure while entrepreneurs who are willing to take higher risk will compensate with high expected return. Further, the risk attitude of the entrepreneur is relevant in selecting business sector to invest. Some sectors generate higher return with higher variance which creates more risks for investors. Similarly, a sector which entails a large initial capital implicates additional risk through bankruptcy. Risk aversion entrepreneurs will not invest in those sectors. While theory suggests inverse relationship among risk attitude and performances, the findings of empirical studies is rather complicated about this issue. For instance, Krauss et al. (2005) and Koop et al. (2000) found a positive impact of risk attitude on SMEs performances while Rauch and Frese (2000) and Naldi et al. (2007) found a negative relationship between risk attitude and SMEs performances. Therefore we argue that SMEs performances are not solely determined by risk attitude, but the competent of the CFOs' such as sound financial literacy to manage those risks.

Despite the recognized importance of financial literacy and risk attitude in the empirical literature, there impact on SMEs performances has not been extensively studied. Further, most empirical researches has been used experimental research designs and focus only on the effect of financial literacy and risk attitude on predefined decision such as investor behavior (Norton and Moore, 2006). Moreover, most SMEs development researches has been carried out focusing on developed economies while only few researches have been focused on the SMEs sector of developing economies (Florio and Leoni, 2017). Therefore, this research is attempted to investigate the roles of financial literacy and risk attitude on SME performance in Sri Lanka. Furthermore, this study aims to investigate the mediating role of risk attitude in SMEs development of Sri Lanka.

This study contributes to financial literacy and SME development literature in four ways. First, we examine the direct impact of financial literacy on SMEs performances with the support of Knowledge Based View, confirming the findings of previous studies. Second, we add novel mechanism through which financial literacy impacts SMEs performances by testing the mediating role of risk attitude. Specifically, these novel relationships which explain how FL impact on SMEs performances, would expand the boundaries of financial literacy and SME development researches. Third, FL is identified as a predictor of risk attitude with theoretical reasoning from dual-process theory. Fourth, this study applies knowledge-based theory and Dual-Process theory to conceptualize the determinants of SMEs performances.

## **2 Theoretical Background and Hypotheses**

### **2.1 Impact of FL on SMEs performances**

The impact of financial literacy on firm performances rigorously studied in the literature and revealed the positive relationship among them (Huston, 2010). Firms that are financially literate can provide informed insights for financial perspectives on strategic issues, thereby improving firm

performance. Wise (2013) revealed the importance of financial literacy for the survival of SMEs in both developed and developing countries. Low level of financial literacy caused to poor financial management practices and to commit frequent financial mistakes. Huston (2010) pointed out the importance of financial literacy to cope with rapid economic changes. Similarly, Widdowson and Hailwood (2007) find that those who have strong financial knowledge were more likely to invest in complex assets and succeed. Davidson III et al. (2004), has also confirmed the association between financial literacy and firm performance. Further, financial literacy is known to be an important factor for the effectiveness of firm performance as well as wealth accumulation. Accordingly, financial literacy has become one of the most important driving forces in organizational decision-making and strategic long term financial planning. Financial literacy in a firm may encourage the company to employ sound financial management practices that can have beneficial effects on the development and sustainability of a vibrant firm performance. Thus, financial literacy is conceived to positively effect to the SMEs performance.

Thus, this research hypothesized that:

H1: Financial Literacy positively related to SMEs performance.

#### **2.4 Impact of financial literacy on risk attitude**

In the growing literature on financial literacy, scant consideration has been devoted to study on the role of financial literacy in relation to risk attitude (Ryack, 2011). Risk Attitude can be defined as the extent to which firms are willing to pursue risky financial resource opportunities in ventures with unknown outcomes. In other words, the term risk attitude explains the level of enthusiasm of an organization to make large and risky resource commitments. However, as claimed by Hillson and Murray-Webster (2006), risk attitude is affected by both cognitive and emotional factors. Intuitively, different firms will exhibit different responses to the same situation as a result of their differing underlying attitudes towards risk taking. Some firms can accept more risk than others and some can manage the risk better than others, depending on their attitude and orientations to uncertainty. However, human attitude on risk is often associated with the losses. Renn (1998) revealed the significance of understanding the human behavior to define the term risk. Further, he noted that the risk is highly associated with the investors' expectations and future results of an event. Accordingly, risk is subjective.

Knowledge on financial literacy and risk attitude may help to understand the business uncertainty and so perform better financially and strategically. For instance, Hallahan et al. (2004) found a correlation between both financial literacy and education level with risk attitude. Further, Gustafsson and Omark (2015) found a positive relationship between financial literacy and risk attitude. Moreover, Van Rooij et al. (2011) examined the effect of financial literacy on financial decisions and revealed that weak financial literacy caused to poor financial decisions. Increasing financial literacy within the firm may empower it to attain relevant knowledge and attitudes in dealing with financial risks and challenges. Further, financial literacy would help to improve both knowledge and managerial skills which led to effective management of financial resources and affairs of the organization.

Accordingly, second hypothesis posits as follows.

H2: Financial literacy positive effect to the risk attitude

## **2.5 Risk attitude and SMEs performances**

Firm performance is also dependent on the risk attitude of the firm. The risk attitude allows a firm to identify opportunities and risks that are associated with informed financial decisions. Gärling et al. (2009) also found risk attitude as a significant factor which affected to financial decision process of the organizations. Such attitudes have an impact on not only the decision but also the survival and failure rates of firms. The influence of risk attitude may also vary with the nature of the business owners and the management. For instance, entrepreneurs are evaluating business situations more positively than non-entrepreneurs as they are focusing on the business opportunities than the threats. Accordingly, differences in risk attitude can have a strong influence on the business performances. Thus, it is proposed that attitude towards risk taking may play a prominent role in successful SMEs performance.

Considerable research has attempted to provide empirical evidence on risk attitudes' impact on SMEs success. Empirically, Grable and Lytton (1999) showed that total income is positively related to the risk attitude. Xiao et al. (2001) report that those who are willing to take substantial risks, generally had a larger share of assets than those who were unwilling to take risks. In general, the likelihood of engaging in the risky activity reflects the tradeoff between expected activities' benefits and its riskiness. As attitude towards risk taking become more established, the firms will be able to view the potentially risky situation with greater enlightenment, and thus have a greater confidence in managing and undertaking higher risk strategies. Hence, firms who have taken their risks effectively can be expected to better produce high performance.

Accordingly, third hypothesis posits as follows.

H3: Risk Attitude is related positively to SMEs performance.

## **2.6 The link of risk attitude, financial literacy and SMEs performance**

According to the Dual-Process Theory thoughts are affected by both cognitive and intuitive processes. Intuition is the ability to acquire knowledge without conscious reasoning or evidence. Intuition provides views, judgments, understandings or beliefs that cannot be empirically verified or rationally justified. Individuals who are highly depend on intuition willing to use mental short-cuts and thus their thoughts are highly influenced by their emotions (Chan and Park, 2013). Cognition can be identified as a mental process which is acquiring knowledge and transform, evaluate, elaborate, stored and used those sensory inputs with thoughts, experiences, and the senses. Cognition is includes the comprehending, calculating, reasoning, problem solving and decision making (Chan and Park, 2013). Prevalence of both cognitive and intuitive thinking patterns influence to the human behavior (Lusardi and Mitchell, 2014). Decisions taken with the higher financial literacy would influence by cognitive and intuitive processes thereby the risk attitude. Thus, the financial literacy will not always cause for an optimal decisions. In fact, financial literacy significantly influence on business decisions hence to the business performance. Thus, we argued that the financial literacy has both direct and indirect influence to the firm performances. In other words, financial literacy may influence to firm performances through the factors such as risk attitude.

Empirically, Widdowson and Hailwood (2007) suggest that a better financial literacy would facilitate to take advantage of increased financial market competition through the knowledge and skill

on risk management. Further, financial literacy may facilitate the decision process, which provides an empowering ability to think rationally and to take critical stances. Firms identify those risky situations and within them a set of potential actions that have the least possibility of failure. That consequently minimizes the probability of making costly decisions. The notions of risk attitude relate to the belief that the greater the firm's dealing with strategic risk-taking, the less uncertainty it will have regarding the likely outcome of taking the risks and the more reasonable the decision will be. Moreover, financial literacy may reduce the degree of potential loss associated with taking a particular risk by facilitating firms to more comprehensively judge and rationalize taking actions that might otherwise be deemed too risky without such resources. The level of financial literacy may influence the extent to which particular strategic responses were understood as tolerable risks. Financially illiterate firms may lack adequate awareness to efficiently judge risks, which might limit their chances to achieve very high returns. Firms with high levels of financial literacy may be more likely to be involved in more strategic risk-takings and can be expected to better produce high performance.

Given this discussion, it is hypothesized that:

H4: Risk attitude mediates the relationship between financial literacy and SMEs performances

The hypothesized relationships and the variables are shown in Figure 1.

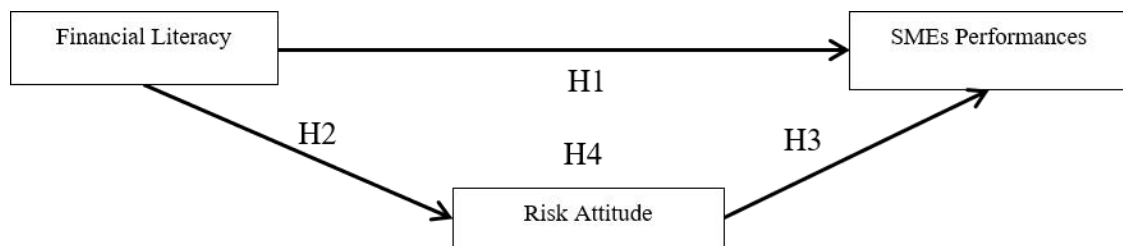


Figure 1 Research Model

### 3 Methodology

#### 3.1 Sample and population

The population of this study was comprised with SMEs in Sri Lanka. After considering number of definitions on SMEs, we considered the firms having 5 - 99 employees to select the sample, lying on the definition for Sri Lankan SMEs by World Bank. However, sample was selected from the western, central and southern provinces as more than 60 percent of Sri Lankan SMEs are located in these three provinces. Structured questionnaires were used to collect data and it was comprised with four main sections; Section 1- Demographic factors, Section 2- Financial literacy, Section3- Risk attitude and Section 4- SMEs Performances. Further, firm size and age used as controllable variables as both variables have an impact on firms' performances.

Data were collected from Chief Financial Officers (CFOs) of the SMEs considering their involvement and responsibility for the financial affairs of the organization (Anwar, 2018). We were approached to 250 CFOs of three different industries namely Manufacturing, Service and Trade to collect data. All the CFOs agreed to participate for the study and provided necessary information.

However, six questionnaires were eliminated due to the incompleteness and final sample comprised with 244 responses. Further, structural equation model (SEM) were used to achieve research objectives. Table 1 illustrates the constructs of the questionnaire.

**Table 1 Constructs of the Questionnaire**

	<b>Content</b>	<b>No. of Items</b>	<b>Source</b>
Sec. II	Financial literacy	13	Bongomin et al. (2018)
Sec. III	Risk Attitude – Risk Perception	6	Blais and Weber (2006)
	Risk Propensity	6	Blais and Weber (2006)
Sec. IV	SMEs Performances	6	Kropp, Lindsay and Shoham (2006)

## 4 Results and Discussion

### 4.1 Preliminary analysis

The sample of 244 responses was adequate for Structural Equation Model (SEM) analysis as it exceeds minimum required level of 200 (Loehlin, 1987). In the data screening stage few missing values were found and all missing values were replaced with the mean of non-missing values of the respective case (Hair et al., 2010). Normal distribution of the data confirmed with the absolute skewness values of financial literacy, risk propensity, risk perception and SMEs performances and all values were within the range of +1 to -1 (Curran et al., 1996). Then the linearity of the data were confirmed ( $p = 0.000$ ). All the Variation Inflation Factor (VIF) values were below the cut-off value of 3 and hence data were free from the multicollinearity issues (Hair et al., 2010). All the Durbin-Watson values were closed to 2 and it was confirmed data were free from autocorrelation (Field, 2013). All scale reliabilities (Financial Literacy:  $\alpha = 0.87$ ; Risk Propensity:  $\alpha = 0.92$ ; Risk perception:  $\alpha = 0.90$ ; SMEs performances:  $\alpha = 0.89$ ) are exceeds the threshold Cronbach's Alpha value of 0.7 (Hair et al., 2010). Table 2 illustrates the means, correlation coefficients and standard deviations of the variables which were employed in the study.

**Table 2 Means, Standard Deviations, and Correlations.**

<b>Variable</b>	<b>FL</b>	<b>RPR</b>	<b>RPE</b>	<b>FP</b>	<b>Mean</b>	<b>Standard Deviation</b>
FL	1.000**				3.56	0.609
RPR	0.503**	1.000**			3.28	0.781
RPE	0.614**	0.402**	1.000**		3.34	0.615
FP	0.731**	0.263**	0.307**	1.000**	3.96	0.593

\*\* Correlation is significant at the 0.01 level (1-tailed); FL, Financial Literacy; RPR, Risk Propensity; RPE, Risk Perception; FP, Firm Performance

When data is collected from same person at the same time through a questionnaire, there is an opportunity to arise common method bias (CMB). We used Harmon's One Factor test with the SPSS to detect the existence of CMB. The results confirmed that the absence of CMB in our data set as first factor explains only 32.76% variance which is less than 50%.

#### 4.2 Confirmatory factor analysis

We executed Confirmatory Factor Analysis (CFA) to evaluate the standardized factor loading, validity and reliability of the variables. The Cronbach alpha, composite reliability (CR), and average variance extracted (AVE) were used to assess the reliability and validity of the reflective constructs. Few items were dropped from the study due to low indicator outer loadings (<0.4) while, deletion of some items (0.04-0.07) increased the construct reliability and validity (Hair et al., 2014). All other indicator outer loadings were above 0.7 and thereby explain more than 50% of the indicators' variance, supporting a satisfactory degree of indicator reliability. The study found acceptable model fits (Chisq /df = 2.196, GFI = 0.87, AGFI = 0.84, NFI = 0.91, RMR = 0.019 and RMSEA = 0.061) after drawing few covariance among the error terms of the redundant items.

Moreover, we employed convergent validity test to identify the variance of the items with respect to their constructs. All the constructs have convergent validity above 0.50, thereby convergent validity of the variables are confirmed (Hair et al., 2010). The composite reliability (CR) is also has been used to evaluate the internal consistency of the constructs. Accordingly, internal consistency of constructs was confirmed as all the CR values of the constructs were above the threshold value of 0.7 (Hair et al., 2010). Discriminant validity explains the degree of the differences among the constructs of the model (Hair et al., 2010). Discriminant validity of the constructs was confirmed as AVE values are greater than the squares of inter-construct correlations. Table 3 illustrates CR values, AVE values and the discriminant validity of the constructs.

**Table 3 AVE values, Composite Reliability and Squares of Inter Construct Correlations.**

Latent Variable	FL	RA	RAPR	RAPE	CR
FL	<b>0.859</b>				0.893
RARP	0.402	<b>0.734</b>			0.923
RAPE	0.175	0.616	<b>0.816</b>		0.901
FP	0.058	0.312	0.174	<b>0.823</b>	0.961

Note: AVEs are given in diagonal in bold. FL, Financial Literacy; RPR, Risk Propensity; RPE, Risk Perception; FP, Firm Performance

#### 4.3 Structural model and hypotheses testing

This study used structural model in AMOS to test the hypotheses (Figure 2). We examined the direct relationship between FL and SMEs performance, FL and RA and RA and SMEs performance. More specifically we assessed the impact of FL on SMEs performances in the presence of RA as a mediating variable. Accordingly, the outcome of Chisq/df = 2.346, GFI = 0.90, AGFI = 0.87, NFI = 0.92, RMR = 0.029 and RMSEA = 0.071 shows a good fit in the structural model (Hair et al., 2010).

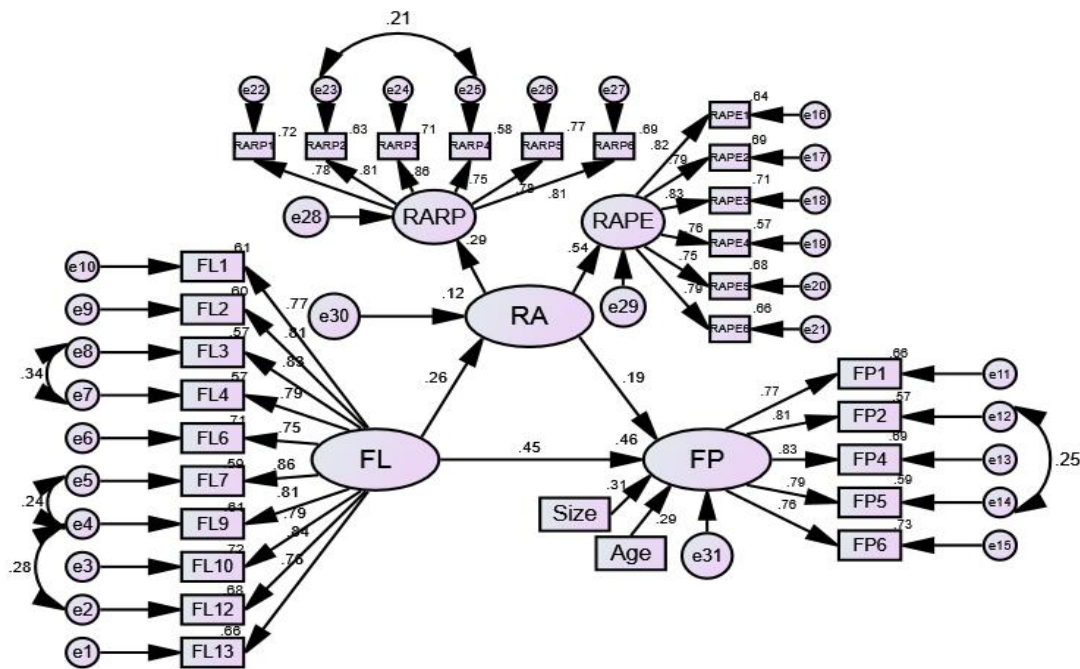


Figure 2 Structural Model

The outcome of the structural model analysis is demonstrated in the table 4. The analysis of the mediation effect initiates by showing that the direct effect of FL on SMEs performance and it was significant ( $\beta= 0.390, p < 0.05$ ). Thus, the first hypothesis was accepted. Next, mediating variable RA enters the model and results indicates that direct effects of FL on RA ( $\beta=0.211, p < 0.05$ ) and RA on SMEs performances ( $\beta=0.134, p < 0.05$ ) are significant. Accordingly, second and third hypothesis of the study was also accepted. While the direct influence on FL to SME performance remain significant, the indirect influence of FL on SME performance through RA is also found to be significant ( $\beta=0.046, p < 0.05$ ). It denotes that the construct RA does partially mediate the relationship between FL and SMEs performances, so the H4 is partially supported. The selected control variables namely firm size and firm age also shows a significant effect in the model. Further, the R-squared value demonstrates that FL, through RA, accounts for 46% variance in SMEs performances.

Table 4 Hypothesis Testing (With Mediation)

Hypothesis	Direct Effect	p	Indirect Effect	p	Total effect	p
FP < ----- FL (Through RA)	0.390	0.001	0.046	0.005	0.436	0.001
RA < ----- FL	0.211	0.007	-	-	0.211	0.007
FP < ----- RA	0.134	0.004	-	-	0.134	0.004
FP < ----- Size (Through RA)	0.153	0.001	-	-	0.153	0.001
FP < ----- Age (Through RA)	0.167	0.001	-	-	0.167	0.001

Note: FL, Financial Literacy; RA, Risk Attitude; FP, Firm Performance

## 5 Conclusion

In the emerging research area of behavioral finance, this research endeavored to answer the research



problem: How does financial literacy and risk attitude influence on SMEs performance? In particular, based on knowledge base view and dual-process theory, we developed a conceptual model that included risk attitude as mediator between financial literacy and SMEs performances. The sample of this study was consisted with 244 Sri Lankan SMEs and data were collected through a structured questionnaire. We used SPSS for the preliminary analysis and AMOS to test the hypotheses of the study. The results demonstrate that financial literacy and risk attitude directly impact SMEs performance while risk attitude partially mediate the relationship between financial literacy and SMEs performance. Therefore, financial literacy was found to be an important factor in predicting risk attitude and SMEs performance. This research expanded the SME financing literature by incorporating risk attitude as an antecedent of SMEs performance and proposed new mechanism to promote SMEs performance especially in the developing economies. Further, financially literate SMEs can enjoy outstanding status in emerging markets with increased performances.

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# Information Disclosure, Executive Compensation Incentive and Analysts' Earnings Forecast Errors

Chen Yu, Zhang Youtang

School of Management, Wuhan University of Technology, Wuhan, P.R.China, 430070

(E-mail: xll319@foxmail.com, zyt@whut.edu.cn)

**Abstract:** Taking the 2011-2018 Shanghai-Shenzhen A-share listed company as a sample, the empirical test examines the relationship between executive compensation incentive, company information disclosure and analysts' earnings forecast errors. The results show that there is a negative correlation between the company information disclosure and the analysts' earnings forecast errors. The executive compensation incentive plays a positive role in the relationship between the two, promotes the negative correlation between the company's information disclosure and the analyst's earnings forecast errors. Further research finds that the promotion effect of executive compensation incentive will change with the degree of internal compensation gap of executives. When the internal compensation gap of executives is small, the promotion of executive compensation incentive is more significant. When the gap is large, the promotion effect of executive compensation incentive is not obvious.

**Key words:** Information disclosure; Analysts' earnings forecast errors; Executive compensation; Earnings management

## 1 Introduction

With the deepening of economic system transformation, China's capital market development has steadily advanced and become an important part of the country's core competitiveness. The "China Securities Industry Development Report (2018)" issued by the China Securities Regulatory Commission also affirmed the role of securities analysts as an important part of the capital market and promoted the improvement of the capital market. As the most important information bridge between listed companies and investors, analysts provide investors with high-quality earnings forecast information and help investors to make accurate investment decisions, with their good professionalism, rich experience and informed information channels. The securities analyst research report can effectively alleviate information asymmetry and help accelerate the transmission efficiency of price-reflecting value, thereby ensuring that capital markets play a more active role in resource allocation (Ahmed A,

2005; Lee, 2013), to ensure the healthy development of the capital market, but its value must be based on the accuracy of the securities analysts' earnings forecasts. At the same time, analysts are also users of public market information. In order to ensure a more accurate forecast, it is bound to conduct comprehensive information collection. This information generally includes public information disclosed by listed companies in accordance with relevant laws and regulations or part of the private information directly obtained from the executives of listed companies. To a considerable extent, the above information will affect the accuracy of analyst forecasts.

To a certain extent, analysts are highly dependent on the public information of listed companies when making earnings forecasts. Company information disclosure will affect the accuracy of analysts' earnings forecasts (Beaver, 2002; Fang Junxiong, 2007). In order to improve the reliability of accounting information, improve the efficiency of internal corporate governance, and improve the quality of information (Wu Zhenwen, Zheng Pengxia, 2016), companies often restrict the behavior of managers through salary incentive, thereby reducing the analyst's earnings forecast errors. So, what is the relationship between the two different mechanisms of corporate information disclosure and executive compensation incentive influencing the accuracy of earnings forecasting? How does the incentive effect of executive compensation play? The existing empirical research in the theoretical circle does not give a clear answer.

Based on this, based on the panel data of CSI A-share non-financial listed companies from 2011 to 2018, this paper empirically tests the mechanism of the impact of corporate information disclosure on analyst errors and the moderating role of executive compensation incentive. This paper further considers the impact of internal pay gaps, and whether the incentive effect of executive compensation will change under different internal pay gaps of executives. The research contributions are as follows: (1) For the first time, we systematically comb the relationship between executive compensation incentive, company information disclosure and analysts' earnings forecast, and provides useful ideas for understanding the incentive effect of executive compensation; (2) This paper further studies whether there is a difference in the impact of executive compensation incentive on the accuracy of analysts' earnings forecasts under the internal salary gaps of different executives, which provides strong evidence for the company to determine the salary incentive mechanism reasonably.

The paper is divided into six sections. Research hypotheses are discussed in the second section. The third and fourth sections describe the combined states and models. In the fifth section, we provide descriptive statistics and illustrate our econometric findings. The sixth section concludes.

## **2 Research Hypothesis**

### **2.1 Company information disclosure and analysts' earnings forecast**

The accuracy of the securities analysts' earnings forecast is an important manifestation of the value of the analysts' research report. The public information is an important source of information for securities analysts (Barron et al., 2013). The more detailed information is disclosed by listed companies, the higher the quality predicted by analysts, the smaller the errors in the analyst's use of publicly disclosed information for earnings forecasts (Fang Junxiong, Hong Jianqiu, 2007). Highly transparent information will attract more analysts' attention and enrich research report of earnings forecast, and the number of analyst tracking is directly proportional to the analyst's overall earnings forecast quality (Feng Xunan and Li Xinyu, 2012). At the same time, the company's earnings management behavior will reduce the quality of accounting information, accounting information quality will have a significant impact on analysts' earnings forecasts (Bai Xiaoyu, 2009; Wang Xiaoning, 2015), the lower the quality of accounting information of listed companies, The prediction errors is also larger (Zhang Wen, 2015). In addition, if the internal governance of listed companies is more effective, they are more likely to disclose more high-quality information to reduce the follow-up of analysts and the cost of gathering and processing information, thus reducing the analysts' forecast errors (Fan and Wong, 2002).

Based on the above analysis, we hypothesize that:

**H1: The degree of company information disclosure is negatively correlated with the analyst's forecast errors.**

## **2.2 The moderating effect of executive compensation incentives**

The principal-agent theory holds that the salary incentive mechanism can effectively alleviate the conflict of interests between shareholders and executives, and the interests of managers and shareholders tend to be consistent. Salary incentive can reduce the free-riding phenomenon of company managers, reduce agency costs and the cost of monitoring the client, thus reducing the errors in analysts' earnings forecasts. The "championship theory" believes that the internal compensation of the company's executives has a competitive mechanism similar to that of the tournament. Through the salary incentive, the enthusiasm of the managers can be fully mobilized to some extent (Bergstresser and Philippon, 2006). First of all, salary incentive can play a certain role in restricting the behavior of managers, alleviating some agency problems and reducing the agency costs under the separation of powers. Secondly, salary incentive can reduce managers' adverse selection and moral hazard, reduce management's fraud motives, help analysts better predict the earnings level of listed companies, and reduce the cost of analyst tracking and processing information, thus effectively reducing the analyst's earnings forecast errors.

Based on the above analysis, we hypothesize that:

**H2: Executive compensation incentive are negatively correlated with analyst errors when other**

**conditions are constant.**

The effective compensation contract system helps to alleviate the principal-agent problem, promotes the interests of the agent and the client, and can guide the executives to make decisions that are beneficial to shareholders and beneficial to the development of the enterprise, ultimately will benefit the improvement of accounting information quality (Wang Shengnian, 2015). Management compensation incentive reduce the opportunistic behavior of managers and can effectively improve the quality of information disclosure of listed companies (Xu Xin, 2016), thereby reducing the analysts' earnings forecast error.

Based on the above analysis, we hypothesize that:

**H3: When other conditions remain unchanged, executive compensation incentive have a positive moderating effect on the relationship between corporation information disclosure and analyst forecast errors.**

### **3 Research Design**

#### **3.1 Sample selection and data source**

We take Shanghai and Shenzhen A-share listed companies as the research object. The data mainly comes from Wind Information Financial Terminal System and CSMAR Database. In addition, this paper also takes the following treatments on the data: (1) Excluding financial and insurance listed companies; 2) Excluding ST and \*ST listed companies with abnormal financial conditions and listed companies with missing financial data; (3) To avoid extreme value impact, all consecutive variables below 1% and above 99% quantile Winsorize processing. In the end, there were a total of 11,864 research samples from 2532 listed companies in 2011-2018. All statistical and regression analyses were done with stata14.0.

#### **3.2 Variable measurement**

##### **3.2.1 The dependent variable.**

Analyst earnings forecast errors (*Errors*). The errors of the analyst's forecast of the company's earnings indicator from the true value of the year. The larger the value, the greater the analyst's earnings forecast errors. The indicators of analyst's earnings forecast errors can be divided into two categories: absolute earnings error and relative surplus error rate. This paper draws on the research methods of Tucker and Zarowin (2006) and Zhang Qiaoliang (2017), using the relative surplus error rate. The absolute value of the difference between the predicted and actual value of the earnings per share of the listed company for the current year is divided by the actual earnings per share of the

company for the year.

$$Bias = \frac{|feps - eps|}{eps} \quad (1)$$

Where *feps* is the analyst's predicted earnings per share of listed companies, and *eps* is the real earnings per share of listed companies.

### 3.2.1 Independent Variables.

(1) Company Information Disclosure (*DA*). Regarding the measurement of company information disclosure, most of the existing literatures at home and abroad are measured from four aspects: constructing information disclosure indicators, information disclosure evaluation system issued by authoritative organizations, financial restatement, and earnings management. When an analyst makes a forecast, it relies heavily on the accounting information disclosed by the company. Since the company's earnings information is one of the most important information in the company's information disclosure, the company's executives often manipulate the information for opportunistic motivation. Therefore, this paper draws on the research method of Liu Qiliang et al. (2013), using earnings management as a reverse substitute indicator for corporate information disclosure. Combining the relevant research results (Jiang Fuxiu et al., 2015), the discretionary accruals is used as the measure of earnings management. The higher the discretionary accruals, the higher the degree of earnings management of enterprises. The Jones model measures the measurable accruals and takes the absolute value of the measured steerable accruals as earnings management. The specific calculation process is as follows:

$$NDA = \alpha_1 * \frac{1}{A} + \alpha_2 * \frac{\Delta Rev}{A} + \alpha_3 * \frac{PPE}{A} \quad (2)$$

$$TA = \beta_1 * \frac{1}{A} + \beta_2 * \frac{\Delta Rev - \Delta Rec}{A} + \beta_3 * \frac{PPE}{A} + \varepsilon \quad (3)$$

$$DA = TA - NDA \quad (4)$$

Where *NDA* is non-discretionary accruals, *TA* is the total accrued profit of the listed company; *A* is the total assets of the listed company,  $\Delta Rec$  is the change of accounts receivable of the listed company, *PPE* is the original value of fixed assets,  $\Delta Rev$  is the change of sales profit of listed company, *DA* is the stellar surplus, the smaller the absolute value of *DA*, the lower the company's earnings management and the higher the level of information disclosure.

(2) Executive compensation incentive (*Lnsal*). Salary incentive for listed companies include monetary compensation and non-monetary compensation incentive, monetary compensation such as



annual salary rewards, non-monetary compensation such as stock options, etc., due to current listed company executives non-monetary the disclosure of sexual remuneration is not perfect. The executive remuneration studied in this paper only involves the monetary compensation publicly disclosed in the annual report of the listed company. Referring to Chen Zhen (2006), Zhang Zhengtang (2008) for the classification of executives, this paper selects the natural logarithm of the top three executives to indicate the degree of executive compensation.

(3) Control variables. With reference to the research on the influencing factors of securities analysts' predictions (Feng Xunan and Li Xinyu, 2012; Xing Liquan and Chen Hanwen, 2014), this paper also controls the following variables, the definition of variables and related descriptions are shown in Table 1.

**Table 1 Variable Measurement**

Variable	Variable name	Variable symbol	Variable Measurement
Dependent variable	Analysts' earnings forecast error	<i>Errors</i>	Earnings per share - actual value per share   / actual value per share.
Independent variables	Company information disclosure	<i>DA</i>	The absolute value of the manipulated profit, calculated by the formula 1, 2, 3
	Executive compensation incentive	<i>Lnsal</i>	The natural logarithm of the top three salary sums of company executives
	Financial leverage	<i>Lev</i>	Total liabilities at the end of the period / total assets at the end of the period
	Profitability	<i>Roa</i>	Net profit / total assets at the end of the period
Control variables	Company Size	<i>Size</i>	The natural logarithm of the company's total assets
	cash flow	<i>Cfo</i>	Natural logarithm of net cash flow from operating activities
	Equity		
	Equity concentration	<i>Top10</i>	Proportion of the top ten shareholders of listed companies
	concentration Number of analysts	<i>Anum</i>	The number of analysts who tracked the company in the year plus 1 to take the natural logarithm
	Internal control quality	<i>DIB</i>	The number of analysts who tracked the company in the year plus 1 to take the natural logarithm

Annual dummy variable	YEAR	Belong to this year, take 1; otherwise take 0
Industry dummy variable	IND	Take 1 in the industry, otherwise take 0

#### 4 Model Construction

In order to verify the research hypothesis proposed in this paper, the following models were constructed:

$$\begin{aligned}
 Errors_{it} = & \alpha_0 + \alpha_1 DA_{it} + \alpha_2 Lev_{it} + \alpha_3 Roa_{it} + \alpha_4 Size_{it} + \alpha_5 Top10_{it} + \alpha_6 Anum_{it} + \alpha_7 Cfo_{it} \\
 & + \alpha_8 DIB_{it} \sum YEAR + \sum IND + \varepsilon
 \end{aligned}$$

( Model 1 )

$$\begin{aligned}
 Errors_{it} = & \beta_0 + \beta_1 Lnsal_{it} + \beta_2 Lev_{it} + \beta_3 Roa_{it} + \beta_4 Size_{it} + \beta_5 Top10_{it} + \beta_6 Anum_{it} + \beta_7 \\
 & + DIB_{it} + \sum YEAR + \sum IND + \varepsilon
 \end{aligned}$$

( Model 2 )

$$\begin{aligned}
 Errors_{it} = & \delta_0 + \delta_1 DA_{it} + \delta_2 Lnsal_{it} + \delta_3 DA_{it} Lnsal_{it} + \delta_4 Lev_{it} + \delta_5 Roa_{it} + \delta_6 Size_{it} + \delta_7 Top10_{it} \\
 & + \delta_8 Anum_{it} + \delta_9 Cfo_{it} + \delta_{10} DIB_{it} + \sum YEAR + \sum IND + \varepsilon
 \end{aligned}$$

( Model 3 )

Where  $\alpha_1$  is the key parameter to verify hypothesis 1. If  $\alpha_1$  is significantly greater than 0, then the company information disclosure is negatively correlated with the analyst's earnings forecast errors; if  $\beta_1$  is significantly less than 0, then the executive compensation incentive is negatively correlated with the analyst's earnings forecast errors; if  $\delta_3$  is significantly greater than 0, then the executive compensation incentive Negative correlation between corporate information disclosure and analyst earnings forecast errors has been promoted.

#### 5 Results and Discussion

##### 5.1 Descriptive statistics

Table 2 is a descriptive statistic for the variables. The results show that the average value of

analyst's earnings forecast errors is 0.954, the maximum value is 13.44, and the minimum value is 0.00216. This indicates that there is a certain errors in the analyst's earnings forecast; the average value of company information disclosure (*DA*) is 0.0606, and the maximum value is 0.299, the minimum value is 0, indicating that the degree of information disclosure of listed companies is quite different; the average value of executive compensation incentive (*Lnsal*) is 14.27, the maximum value is as high as 17.41, and the minimum value is only 10.31, indicating that there is a higher incentive for listed companies. Big gap.

**Table 2 Summary Statistics for the Variables**

Variable	N	Mean	Std. Dev.	Min	Max
<i>Errors</i>	11,864	0.954	1.903	0.00216	13.44
<i>DA</i>	11,864	0.0606	0.0612	0	0.299
<i>Lnsal</i>	11,864	14.27	0.661	10.31	17.41
<i>Lev</i>	11,864	0.429	0.203	0.0518	0.860
<i>Roa</i>	11,864	0.0581	0.0484	-0.0866	0.219
<i>Size</i>	11,864	22.23	1.221	20.05	25.97
<i>Top10</i>	11,864	57.81	14.83	22.96	89.66
<i>Anum</i>	11,864	17.73	16.13	1	71
<i>Cfo</i>	11,864	0.0430	0.0678	-0.151	0.234
<i>DIB</i>	11,864	6.495	0.109	5.999	6.743

According to the correlation analysis results, the correlation coefficient between any two variables is less than 0.5, and there is no multicollinearity problem between the variables. In addition, the correlation coefficient between the explained variable, the explanatory variable and the control variable basically passed the significance test, indicating that the variable selection is reasonable and suitable for further regression analysis. Due to space limitations, the results of the correlation analysis are not listed.

## 5.2 Regression analysis

The regression results are shown in Table 3.

From the results in the first column, the coefficient of the company's information disclosure (*DA*) is 1.379, at a confidence level of 1%, indicating that as the degree of earnings management increases, the degree of disclosure of company information will decrease, the errors of analysts' earnings forecast

will increase, and H1 will be verified.

The second column shows that the regression coefficient for executive compensation incentive (*Lnsal*) is -0.0281, at a confidence level of 1%. H2 was validated, indicating that the company's executive compensation incentive can effectively improve the company's accounting information quality and reduce analysts' forecast errors.

After introducing the interaction between company information disclosure and executive compensation incentive, the regression coefficient of the interaction term is 0.239, at a confidence level of 5%. It indicates that the executive compensation incentive plays a positive role in the relationship between the company's information disclosure and the analyst's forecast errors, which is consistent with H3.

**Table 3 Results of Regression Analysis**

Variable	(1)	(2)	(3)
<i>DA</i>	1.379*** (3.95)	-	1.361*** (3.94)
<i>Lnsal</i>	-	-0.0281*** (-3.41)	-0.0373** (-2.01)
<i>DA_Lnsal</i>	-	-	0.239** (2.86)
<i>Lev</i>	-0.0153** (-2.12)	-0.0618* (-1.73)	-0.0146*** (-2.87)
<i>Roa</i>	-9.659*** (-14.50)	-9.954*** (-14.68)	-9.690*** (-14.28)
<i>Size</i>	-0.166*** (-3.51)	-0.166** (-3.06)	-0.172** (-3.15)
<i>Top10</i>	-0.0169*** (-5.89)	-0.0176*** (-6.14)	-0.0168*** (-5.87)

<i>Anum</i>	0.00606** (3.06)	0.00556** (2.81)	0.00603** (3.03)
<i>Cfo</i>	-0.809* (-2.23)	-0.573 (-1.64)	-0.797* (-2.19)
<i>DIB</i>	-1.296*** (-5.34)	-1.352*** (-5.56)	-1.293*** (-5.34)
CONSTANT	14.62*** (7.25)	14.99*** (7.10)	14.73*** (7.00)
Year Fixed Effects	YES	YES	YES
Industry Fixed Effects	YES	YES	YES
Observations	11,864	11,864	11,864
F	52.30	51.52	42.19
R <sup>2</sup>	0.92	0.94	0.85

t statistics in parentheses, \* p<0.05, \*\* p<0.01, \*\*\* p<0.001

#### 5.4 Robust checks

Because the different measurement methods of variables may affect the results, in order to improve the credibility of the research conclusions, this paper carries out the following robustness test by replacing the analyst errors and the substitution variables of company information disclosure. The robust test results are shown in Table 4:

##### (1) Analysts' forecast errors

Referring to the practices of Fang and Yasuda (2009) and Shi Xianwang (2015), the analysts' forecast errors is measured by:

$$Errors' = \frac{|feps-eps|}{price} \quad (4)$$

Where  $|feps-eps|$  is the absolute value of the difference between the earnings per share of the

listed company and the real earnings per share of the listed company, except for the closing price of the company's stock at the end of the year, the larger the indicator, indicating that analysts' forecasts errors are greater.

(2) Executive compensation incentive

Considering the lag characteristics of executive compensation, refer to Guo Xuemeng and Liang Peng (2019) to introduce the lag one term (*LLnsal*) of executive compensation incentive, and replace the original variables to re-execute the model.

Except that the regression results of some control variables are not significant, the significance of other variables is generally consistent with the previous regression results, which indicates that the test results still support the previous assumptions, indicating that the results are robust.

**Table 4 Robustness Test Result**

Variable	<i>Errors<sup>t</sup></i>			<i>LLnsal</i>		
	(1)	(2)	(3)	(1)	(2)	(3)
<i>DA</i>	1.604*** (3.11)	-	1.500** (2.03)	1.464*** (3.92)	-	1.085** (3.99)
<i>Lnsal</i>	-	-0.112*** (-3.87)	-0.140*** (-3.99)	-	-0.197 (-1.64)	-0.190***(-3.58)
<i>DA_Lnsal</i>	-	-	1.613*** (2.99)	-	-	0.238*** (4.34)
<i>Lev</i>	-0.571 (-0.73)	-0.491 (-0.65)	-0.515 (-0.69)	-0.0456 (-0.16)	-0.230 (-0.63)	-0.181 (-0.49)
<i>Roa</i>	-12.68*** (-7.69)	-12.88*** (-7.61)	-12.59*** (-7.688)	-9.896*** (-13.78)	-10.43*** (-10.62)	-10.33*** (-10.53)
<i>Size</i>	-0.676*** (-2.67)	-	-0.630** (-2.54)	-0.173*** (-3.42)	-0.166** (-3.06)	-0.332** (-3.88)
<i>Top10</i>	-0.0246*** (-2.91)	-0.0260*** (-2.91)	-0.0248*** (-2.90)	-0.0136*** (-4.48)	-0.00747 (-1.71)	-0.00707 (-1.61)
<i>Anum</i>	0.0112** (2.96)	0.0110*** (2.92)	0.0114*** (3.01)	0.00775*** (3.70)	0.0144*** (4.50)	0.0145*** (4.53)
<i>Cfo</i>	-1.907** (-2.69)	-1.611** (-2.48)	-1.819*** (-2.73)	-0.946** (-2.36)	-1.015 (-1.83)	-1.156* (-2.03)

<i>DIB</i>	-1.911***	-2.016***	-1.932***	-1.216***	-1.256***	-1.202***
	(-3.54)	(-3.62)	(-3.56)	(-4.69)	(-3.66)	(-3.49)
CONSTANT	30.45***	31.61**	31.58**	14.07***	14.77***	14.41***
	(2.64)	(2.61)	(2.60)	(6.49)	(4.59)	(4.46)
Observations	10724	10724	10724	10195	10195	10195
R <sup>2</sup>	0.89	0.92	0.94	0.89	0.92	0.94

t statistics in parentheses, \* p<0.05, \*\* p<0.01, \*\*\* p<0.001

### 5.5 Further research

According to the Tournament theory, salary incentive can promote the convergence of interests between shareholders and executives, but at the same time, the study based on the theory of fairness and behavior also believes that as the level of salary incentive rises, the internal compensation gap of executives increases, and the pay gap will play a counter-incentive role. Although salary incentive is an important way to resolve agency conflicts, with the increase of salary incentive, the issue of fairness among different levels of executives has also attracted people's attention. At this time, the executives' compensation incentive will also change. There are hierarchical differences between executives. When executives at lower levels feel a large pay gap with high-level executives, this will result in lower-level executives uniting and using earnings controls to increase their compensation. This in turn increases profit manipulation (Kothari, 2005). The internal pay gap of executives has led to executives' earnings operations (Connelly, 2013), and executives moderate accounting earnings in order to obtain more bonuses, thereby undermining the quality of accounting information (Bergstresser and Philippon, 2006). Huang Liangjie (2010) also pointed out that most enterprises may use the method of earnings management to manipulate profits in order to maximize their own interests due to imperfect incentive and less strict supervision. Therefore, within a certain range, with the increase of executive compensation incentive level, the salary gap is gradually widened, and the salary gap will induce executives to implement earnings management behavior, thus reducing the accuracy of analyst forecasts (Li Yuxia, 2017). This paper considers that the role of executive compensation incentive will change as the internal compensation gap of executives increases. The internal salary gap of executives is introduced in model (3). According to the internal salary gap of senior executives, the samples are divided into two groups to further test the moderating effect of executive compensation incentive under the influence of different internal salary gaps. Will it change?

Drawing on the research of Chen Zhen and Zhang Ming (2004), the executives are divided into core executives and non-core executives. The top three in the salary level ranking are considered to be core executives, except for the top three, other executives are considered to be non-core executives.

The formula of the internal salary gap of executives is as follows:

$$LnGAP = Ln\left(\frac{\text{total top three executives compensation}}{3} - \frac{\text{other executive compensation totals}}{\text{directors, supervisors and senior executives}-3}\right) \quad (4)$$

**Table 5 Grouping Result**

Variable	<i>LnGAP</i> <12.8	<i>LnGAP</i> ≥12.8
<i>DA</i>	0.883**	0.184**
<i>Lnsal</i>	(1.85) -0.0794***	(0.47) -0.0420
<i>DA_Lnsal</i>	(4.12) 0.573**	(0.87) -0.128
<i>Lev</i>	(2.20) 0.203	(0.26) -0.0752
<i>Roa</i>	(1.20) -9.944***	(0.52) -9.158***
<i>Size</i>	(11.80) -0.133***	(15.04) -0.0439
<i>Top10</i>	(4.41) -0.00578***	(1.71) -0.000360
<i>Anum</i>	(2.20) 0.00179	(0.22) -0.000686
<i>Cfo</i>	(0.05) -1.070*	(0.42) -0.336
<i>DIB</i>	(2.51) -1.900***	(0.82) -1.868***
CONSTANT	(7.52) -1.070*	(8.40) 15.27***
Observations	(0.70) 5932	(0.84) 5932
R <sup>2</sup>	0.90	0.89

Note: (1) The internal compensation gap of executives is based on the median 12.8 of the internal compensation gap sample of executives; (2) t statistics in parentheses, \* p<0.05, \*\* p<0.01, \*\*\* p<0.001

From the test results, it can be seen that under the low-level internal compensation gap level, the regression coefficient of the interaction between company information disclosure and executive compensation incentive is 0.573, which is significant at the 5% confidence level, indicating that under



the low-level salary gap level, with the increase of executive compensation incentive, the speculative behavior of executives is reduced, the information quality of listed companies is improved, and the errors of analysts' earnings forecasts is smaller. The executive compensation incentive promotes the negative correlation between the analysts' forecast errors and company information disclosure.; while at the high internal pay gap level, this promotion is not significant, probably because the increase in the internal compensation gap of executives has led to speculation by some executives. Executives of low pay improve their individual performance through profit manipulation, which damages the quality of accounting information. The incentive effect of executive compensation has offset the speculative motives of executives as internal compensation gap increases.

## **6 Conclusions**

### **6.1 Conclusion**

This paper studies the impact of two different mechanisms of corporate information disclosure and executive compensation incentive on the analyst's earnings forecast errors. On this basis, it also tests the incentive effect of executive compensation under different internal pay gaps. The study found that: (1) by increasing the degree of company information disclosure can help analysts reduce their earnings forecast errors. (2) The executive compensation incentive mechanism of listed companies can effectively improve the information quality of the company and promote the negative correlation between the company's information disclosure and the analyst's earnings forecast errors. (3) This paper introduces the internal salary gap of executives for further research. As the internal salary gap of executives increases, the incentive effect of compensation will also have a negative effect, which will have a negative impact on the accuracy of analyst forecasts.

### **6.2 Suggestion**

From a business perspective, first, listed companies should continuously improve the company's information disclosure and improve the quality of accounting information to provide market investors with more effective financial information to help them make more efficient investment decisions. Second, listed companies can enhance management performance, constrain executives' speculation, improve the company's accounting information disclosure level, and help analysts make more accurate earnings forecasts through compensation incentive. Third, the salary incentive mechanism of executives only helps analysts' predictions within a certain scope. Therefore, the company should design a moderate salary incentive system to control the internal compensation gap of the executives at a reasonable level, which helps to maintain teamwork and reduce self-interested behavior of managers.

From a market perspective, from the perspective of internal corporate governance, that is, to improve the level of corporate information disclosure and executive compensation incentive to enhance the quality of analysts' forecast is necessary. In addition, the market's focus on the average executive compensation incentive level in the industry also helps to restrict the unreasonable and unfair executive compensation incentive system of listed companies, improve the accuracy of analyst forecasts, and optimize market allocation efficiency.

### **6.3 Limitations and prospects**

In the analysis of this paper, there may be some shortcomings: first, the influence factors of analysts' earnings prediction error are complex and numerous. Although this paper has tried to consider them, some factors are hard to consider. Second, this paper studied Chinese analyst earnings forecasts from overall situation, in the process of the measure of the degree of earnings management, considering the industry factors, but due to the limitation of analysts predict sample size without further refine the classification of different industries.

With the participation of institutional investors in China, the securities market will be further improved, and the analyst industry will be further improved. In the future research, we can consider the relationship between institutional investor governance and analyst earnings forecast. Whether the governance of listed companies will enhance the accuracy of analysts' earnings forecasts, and at the same time, compare the analyst's own factors and company-level factors to compare which one has a greater overall impact on earnings forecasts.

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# **Media attention to the Impact of Earnings Management on Listed Companies**

Ji Yayuan

School of Management, Wuhan University of Technology, Wuhan, P.R. China, 430070

(E-mail: 734412306@qq.com)

**Abstract:** In this paper, the empirical research method is used, and the media attention data of DATAGO database is used as the proxy variable. From the two perspectives of accrued earnings management and real earnings management, the supervision effect of media attention is studied, and the regression model is established. When the company adopts different earnings management, the media is concerned whether there is a difference in inhibition. It is concluded that a large amount of media attention has led the management of listed companies to adopt accrued earnings management to a certain extent, but at the same time, the improvement of media attention can effectively curb the real earnings management behavior of listed companies, reflecting the governance function of media attention.

**Key words:** Media attention; Accrued earnings management; Real earnings management; Corporate Governance

## **1 Introduction**

In the 21st century, with the rapid development of the Internet and the continuous improvement of information technology, Media attention, as an external governance mechanism, is increasingly being used as a control variable in accounting and economic research. At present, the research on earnings management at home and abroad is mainly based on the traditional corporate governance perspective, such as the supervision of earnings management from the perspective of institutional environment, and the perspective of other types of stakeholders about earnings management governance. A lot of research has been done in the literature and fruitful results have been achieved. As for media attention, Foreign scholars mainly focus on the role of media supervision in protecting shareholders' interests and affecting auditors' judgment. Domestic scholars focus on promoting government functions, preventing corruption, and regulating listing. In terms of corporate information disclosure, it is generally more concerned with the corporate governance role of the media. This paper intends to study the accrued earnings management and real earnings management behavior of Chinese listed companies from the perspective of corporate governance effects of media attention, in order to enrich the research content and improve the quality of corporate earnings. The following arrangements are as follows: The second section is the theoretical analysis and research hypothesis, the third section is the research design, the empirical analysis is in the fourth section, and finally the full text is summarized.

## 2 Theoretical Analysis and Hypotheses

As the medium of information transmission, the media has become one of the main channels for the public to obtain relevant information. Earnings management is the means of accounting or non-accounting to achieve the maximization of self-interest to achieve the control and adjustment of accounting income, including the management of accruals and the construction of real trading activities, and the timing of controlling related activities of enterprises. From the perspective of cost-benefit, the media exposure of listed companies' earnings management problems can bring relatively rich benefits, and the marginal effect of such supervision behavior is significantly positive, which makes the media have the motive to supervise the listed companies' earnings management behavior.

On the one hand, corporate executives implement earnings management behavior based on compensation motives, capital market motives, and regulatory motives. On the other hand, the emergence of principal-agent relationship separates the ownership and control of the enterprise, and the manager objectively has the tendency to obtain personal benefits through the means of earnings management. The media's attention to the influence of the capital market will also affect the manager's earnings management strategy. The media attention makes the enterprise's accrued project earnings management easier to find, which means that the company is more likely to be subject to regulatory penalties, and adopt a real activity earnings management based on concealment.

As early as 2000, Zingales (Zingales,2008) pointed out that we should pay attention to the role of the media in corporate governance. Chen Kejing (Chen Kejing,2017) proposed that the substitution role of media supervision and legal governance is very beneficial for managing the earnings management of listed companies during the economic transformation of China. Li Yanxi (Li Yanxi ,2018) proposed that due to the company's emphasis on reputation and long-term interests, a large number of media attention and reports will have a certain inhibitory effect on the implementation of real earnings management activities. Wang Lijuan (Wang Lijuan ,2018) proposed that media attention and internal control have supervisory effects on earnings management.

However, some studies have shown that when the company's operating performance cannot be changed in the short term, the management tends to adopt various earnings management methods to achieve market expectations under the huge market pressure to avoid a negative surplus. Ying Qianwei, (Ying Qianwei ,2017) proposed that the market pressure effect of media attention exacerbated the earnings management of enterprises more significantly than the mainstream supervision effect. Chen Shen (Chen Shen,2016) found that market pressure effects promoted the implementation of real earnings management by corporate executives. Ma Zhuang(Ma Zhuang,2018)verified the dominant effect of market pressure on media attention.The use of accrued earnings management means that the company can establish a good image in a short period of time, which can not only promote good stock price information to the public, but also do not harm to the long-term interests of the company. At this time, the management is motivated to meet the market expectations, career promotion and salary incentives to choose accrued earnings management to modify performance and improve image. The media's attention makes listed companies pay more attention to their long-term development and long-term interests. Real earnings management activities will have serious economic consequences for the company in the long run, at the expense of the company's normal business activities. Enterprises will not choose real earnings management to influence normal production and operation activities.

The competitive hypotheses H1a, H1b, H2a and H2b were proposed for the above analysis.

**H1a: the increase in media attention can effectively inhibit the accrued earnings management of listed companies.**

**H1b: the increase of media attention prompts the management of listed companies to adopt accrual earnings management.**

**H2a: media attention fails to effectively identify hidden real earnings management behaviors;**

**H2b: media attention can effectively inhibit the real earnings management behavior of listed companies.**

### **3 Study Design**

#### **3.1 Sample selection and data sources**

This paper selects the data of Shanghai and Shenzhen A-share listed companies from 2013 to 2017, and empirically tests the relationship between media attention and the accrued profits of listed companies and actual earnings management. Corporate governance data comes from the CSMAR database, and media attention data comes from the DATAGO database. Based on the research needs, this paper conducted a preliminary screening of the sample: excluding financial insurance, ST and \* ST, and deleting companies that lack relevant data. After the above screening procedure, the paper finally obtained a total of 9,848 sample observations for a period of 5 years. In addition, in order to reduce the impact of outliers on the conclusions of the paper, 1% winsorize processing is performed on all continuous variables.

#### **3.2 Measurement of variables**

##### **3.2.1 The dependent variable**

In this paper, the degree of earnings management is measured by the modified Jones model residuals calculated by year and industry. Specifically, first of all, this article use net income minus operating cash flows to calculate the total accrued, second, to calculate the total accrued as explanatory variables, using the modified Jones model is divided by year and industry return estimated coefficients obtained, and the use of the estimated coefficients obtained estimate non maneuvering accrued, then, the total accrued minus the non-maneuvering accrued is the steerability accrued DA.

In view of the lack of research on real activity earnings management by domestic scholars, this paper USES the research methods of foreign scholars Roychowdhury (Roychowdhury,2006)to measure sales control by the net cash flow of abnormal operations (EM\_CFO), measure discretionary cost control by EM\_DISEXP, and measure production control by abnormal product cost (EM\_PROD). The net cash flow of abnormal business activities, abnormal discretionary expenses and abnormal product costs are calculated from the actual value of the year minus the estimated normal value. Using the Roychowdhury method, EM\_PROXY is used to measure the level of real activity earnings management ( $EM\_PROXY=EM\_PROD+(-1) *EM\_CFO+(-1) *EM\_DISEXP$ ).

##### **3.2.2 The independent variables**

Media attention existing research basic use of such as ting-ting zhang (ting-ting zhang,2018),Chen Kejing (Chen Kejing,2017), using manual sorting important newspapers full-text database of CNKI China and the financial authority of the country's eight major newspaper reports for measurement basis, there are also some scholars such as Li Yanxi (Li Yanxi ,2016) using baidu news website news to search contains samples was reported the company's annual quantity measured Media attention, but the two ways is manual sorting so there may be noise. The quantitative public opinion database of newspapers

and periodicals is a mature data platform designed by overseas professionals. It makes the analysis result storage into an easy-to-use and convenient field, which is intended to help professionals and scholars in the financial field to carry out high-quality and convenient financial practical work quickly with the result. The data of this database is in accordance with strict academic standards and has timeliness of news itself. Therefore, this paper measures media attention based on the number of reports about listed companies in the quantitative public opinion database of newspaper news.

### 3.2.3 Control variables

In this paper, a series of control variables that will have an impact on enterprise accrual and real earnings management are added, including Size, profitability, debt paying ability, Indep, First and Big4. (Li Ming, 2018) At the same time, in order to reduce the impact of year and industry on the empirical results, year and industry dummy variables were added into the model. The specific variable definitions and calculation methods are shown in table 1.

**Table 1 Variable Definition and Description**

Variable name	variable symbol	variable definition
Accrued earnings management	DA	revised Jones measurement model measurement
Real activity earnings management	REM	real earnings management comprehensive level
Media attention	Media	Ln (1+ Number of news reports)
scale of company	Size	Ln (Total assets)
profitability	Roe	Net assets/equity balance
Debt paying ability	Lev	Total liabilities/total assets
Ratio of independent directors	Indep	Number of independent directors/total directors
The shareholding ratio of the largest shareholder	First	The shareholding ratio of the largest shareholder
Type of accounting firm	Big4	Dummy variable, audit of the four major accounting firms is 1, otherwise it is 0
enterprise property	Gov	Dummy variable, state-owned enterprise is 1, otherwise it is 0
Industry	Ind	Dummy variables to control the impact of different industries
The annual	Year	Dummy variables to control the effects of different years

### 3.3 Model building

To test the media in China's capital market play of the role of information transmission and constraints, this paper constructs the following two regression model, to test the media outside the legal system of factors on the earnings management of listed company governance. Model (1) is used to test the research hypothesis H1a and H1b, and investigate the influence of media attention on the earnings



management of accruals of listed companies; (Zhu Heping,2019)model (2) is used to test the research hypothesis H2a and H2b, and investigate the influence of media attention on the earnings management of real activities of listed companies. In addition, this paper controls for some other factors that may affect earnings management by referring to existing studies. The specific model is shown as follows:

$$DA = \beta_0 + \beta_1Media + \beta_2Size + \beta_3Roe + \beta_4Lev + \beta_5Indep + \beta_6First + \beta_7Big4 + \beta_8Gov + \beta_9\Sigma Ind + \beta_{10}\Sigma Year \quad (1)$$

$$REM = \beta_0 + \beta_1Media + \beta_2Size + \beta_3Roe + \beta_4Lev + \beta_5Indep + \beta_6First + \beta_7Big4 + \beta_8Gov + \beta_9\Sigma Ind + \beta_{10}\Sigma Year + \varepsilon \quad (2)$$

## 4 Empirical Test and Analysis

### 4.1 Descriptive statistics of variables

Table 2 reports the descriptive statistics of variables in this paper. The mean, median, maximum and minimum values of variables DA and REM are significantly different, showing a certain degree of difference and at the same time indicating that different enterprises have different degrees of accrued earnings management and real earnings management. The average value of media is 4.751, indicating that each listed company has been reported by media 4.7 times on average, and there are differences between the maximum value and the minimum value, indicating that different media of enterprises also have some differences in their reports and attention.

**Table 2 Descriptive Statistics for Variables**

	Mean	Median	Max	Min	Sd	N
DA	0.006	0.003	0.530	-0.560	0.095	988
REM	0.177	0.111	0.262	0.000	0.262	9848
Media	4.751	4.691	10.790	0	1.211	9848
Size	22.584	22.454	28.509	18.114	1.292	9848
Roe	6.731	6.730	277.380	-1290.51	31.746	9848
Lev	0.441	0.436	1.059	0.012	0.202	9848
Indep	0.376	0.364	0.800	0.028	0.055	9848
First	32.533	30.160	82.550	4.150	14.379	9848
Big4	0.063	0.000	1.000	0.000	0.244	9848
Gov	0.583	0.000	1.000	0.000	0.486	9848

### 4.2 Variable correlation test

In this paper, the multicollinearity test was carried out on the variables involved in the study. The maximum variance inflation factor (VIF) of each variable was 1.6, which was far less than 10, so the regression equation did not have multicollinearity. Meanwhile, Pearson and Spearman correlation tests were conducted on all variables in this paper. Table 3 lists the correlation coefficient matrix of variables, from which it can be seen that the coefficients of DA and REM are significantly positively correlated with 0.010, which to some extent indicates that the sample companies will alternately use real activity and accrual project earnings management. Media has a significant positive correlation with Lev, First, Big4 and Gov, which indicates that the Media are more likely to pay attention to with strong solvency,

high shareholding ratio of the largest shareholder, high audit quality and state-owned companies.

**Table 3 Variable Correlation Coefficient Matrix**

	DA	REM	media	Size	Roe	Lev	Indep	First	Big4	Gov
DA	1.000	0.010**	0.004	-0.003	-0.004	-0.006	0.014	-0.006	-0.0156	-0.024
REM	-0.002	1.000	0.019*	-0.006	0.003	0.002	0.024**	-0.011	-0.024**	0.002
media	0.015	0.017	1.000	-0.001	0.019**	0.049*	0.011	0.024*	0.030**	0.046**
Size	0.005	0.005	0.008	1.000	0.001	0.509*	0.065**	-0.023*	0.069**	0.030**
Roe	0.010	-0.040**	-0.002	-0.012	1.000	-0.016	-0.140**	0.010	0.004	0.003
Lev	0.001	0.016	0.049*	0.437*	-0.017	1.000	0.142**	-0.018	0.040**	0.044**
Indep	0.001	0.006	0.006	0.051*	-0.003	0.099*	1.000	-0.011	-0.004	-0.063**
First	0.008	-0.011	0.023*	-0.020*	0.012	-0.014	-0.013	1.000	0.003	0.242**
Big4	0.003	-0.029**	0.034*	0.074*	-0.024**	0.037*	-0.001	0.008	1.000	0.048**
Gov	-0.002	0.013	0.046*	0.030*	-0.006	0.037*	-0.044**	0.241*	0.048**	1.000

Note:(1) the upper triangle of the matrix is Spearman correlation coefficient, and the lower triangle is Pearson correlation coefficient;

(2) \*\*\*, \*\* and \* mean that the coefficients pass the significance test of 1%, 5% and 10% respectively. The same below.

### 4.3 Regression results and analysis

**Table 4 Sample Regression Results**

VARIABLES	①	Sample DA	T Value	②	Sample REM	T Value
Media		0.015***	(13.505)		-0.017***	(-13.624)
Size		-0.657***	(-16.597)		0.006**	(17.063)
Roe		0.089***	(5.024)		-0.080**	(-4.457)
Lev		0.532***	(20.129)		0.042***	(20.158)
Indep		-1.105	(-3.075)		0.0328	(3.344)

First	-0.003	(17.396)	-0.0801***	(-19.462)
Big4	-0.103**	( 21.891 )	-0.271***	(-23.270)
Gov	-0.979***	(-46.479)	0.061***	(47.710)
Year	Control		Control	
Ind	Control		Control	
Costant	0.0570***	( 5.698 )	5.363***	( 6.593 )
Obs	9848		9848	
R-squared	0.675		0.219	

Table 4 of the sample reports the regression results of the relationship between Media attention and accrual and real activity earnings management. In the regression results of table 4, the regression coefficient of DA and Media is 0.015, which is significantly positive correlation at 1% level, indicating that accrual item earnings management is positively correlated with the total number of Media reports. The above empirical results show that: the higher the media attention, the higher the degree of earnings management of accruals of listed companies, which supports H1b hypothesis in this paper. The regression coefficient between Media and REM is -0.017, which is significantly negatively correlated at the 1% level. Media attention is negatively correlated with the real earnings management behavior of listed companies, that is, the higher Media attention is, the lower the real earnings management degree of listed companies is, and the stronger the supervision and governance effect of Media is. This result supports the hypothesis H2b in this paper. Lev, the control variable, is significantly positively correlated with DA and REM, indicating that companies with high debt ratio may adopt both accrual and real earnings management methods. In addition, the coefficients of Gov and DA are both significantly negative correlated at the level of 1%, which preliminarily indicates that state-owned companies seldom adopt accrual earnings management. The positive correlation with REM at the level of 1% indicates that state-owned companies are more likely to adopt real activity manipulation earnings. The results show that there are differences between accrual and true earnings management in companies with different property rights.

#### 4.4 Robustness test

With the study of scholars in the past, this paper uses the CNKI “Chinese important newspaper full-text database” to pay attention to the media’s index measurement. The robustness test is performed by using the measured index of interest of the changed media. Repeating all of the above studies in the robustness test showed that the coefficient of DA was significantly positive at the 1% statistical level, while the REM coefficient was significantly negative at the 1% statistical level, indicating its robustness.

## 5 Conclusion

In this paper, a-share listed companies in Shanghai and Shenzhen from 2013 to 2017 were selected as the research samples to test the supervision and governance effect of media from the perspective of accrual and real earnings management, as well as the difference in the governance effect of media in

state-owned and non-state-owned companies. The conclusions of this paper are as follows : (1) a large amount of media attention makes the management face great market pressure, and limited by the cost of media reports, listed companies will adopt accrual earnings management to some extent to "beautify the image"; On the other hand, the media's attention urges the company to pay more attention to external reputation and long-term interests, motivates the company to improve its operation and management level, and can effectively inhibit the real earnings management behavior of listed companies. (2) under the supervision and governance mechanism of the media, non-state-owned companies adopt accrual earnings management more frequently than state-owned companies. (Han Dong, 2015)

This study not only provides empirical evidence for the effect of corporate governance brought by media attention, but also enriches and expands the research on the accrual and real earnings management of listed companies. After controlling the endogenous influence, the media's attention can effectively restrain the real earnings management behavior of listed companies, which is of great significance for countries in transition to give full play to the normative role of media in the capital market. The state should strengthen the protection of the freedom of the press at the policy and legal levels, improve the working environment of media and give sufficient legal protection, and ensure the role of the media as a supervisor in legislation when necessary.

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## Replacing China's Business Tax with Value-Added Tax Reform and Cost Stickiness: Evidence from the Service Industry Firms

Hui Lili<sup>1</sup>, Xie Huobao<sup>2</sup>, Liu Xiaoning<sup>3</sup>

<sup>1</sup>School of Management, Wuhan University of Technology, Wuhan, P.R.China, 430070;

<sup>2</sup>School of Economic and Management, Wuhan University, Wuhan, P.R.China, 430071

<sup>3</sup>School of Finance, Westminster College, Salt Lake City, UT, USA, 84105

(E-mail: huilili@whut.edu.cn, xie\_hb@263.net, xl0430@westminstercollege.edu)

**Abstract:** Using a sample of Chinese firms over 2010-2015 and Difference-in-Difference model, we examine the influence of replacing the business tax with the value-added tax reform on service industry firms' cost stickiness. We find that replacing the business tax with the value-added tax reform helps to decrease the degree of cost stickiness significantly. Moreover, the above effect is more significant in firms with more capital investment. A rich set of tests show that the baseline results are robust to omitted variables, sample bias, and endogeneity concerns. Further analysis shows that the degree of cost stickiness reduction changes from weak to stable as years go on after the tax reform implementation. With the unique background of China, we follow the theoretical framework of micro firm behavior affected by the macro policy and provide new empirical support.

**Key words:** Business Tax (BT); Value-Added Tax (VAT); Service Industry; Cost Stickiness

## 1 Introduction

Industrialization and urbanization continue to promote the gradual adjustment of China's industrial structure; the service industry accounts for an increasing proportion of the entire economy. Especially after Chinese government plan "joining primary, secondary and tertiary industries to boost economic growth" implementation, service industry has developed rapidly, which inputs both specialized human capital and intellectual capital into the industrial production process (Xi et al., 2015). They also effectively drive the transformation, upgrade traditional industries, improve the level of industrial service, and promote the growth of the manufacturing industry. Therefore, the service industry is hailed as the "adhesive" to promote economic growth (Riddle, 1986). As an essential way to promote the development of the service sector, the replacing business tax with value-added tax reform wholly implemented in all industries on May 1, 2016, which induces the attention of researchers. Most of the literatures on the effectiveness of the tax reform focus on changes in the tax burden of firms and its short-term performance (Jiang, 2011; Pan, 2013; Liu and Wang, 2014; Wei and Xia, 2015; Zhao, 2015; Tong et al., 2015; Guo and Liu, 2015). However, as macro tax reform, replacing

business tax with value-added tax not only targets to reduce the tax burden of the service enterprise, but also brings some economic consequences to the investment and operation activities of service firms. Cost stickiness is a vital cost behavior, which measures the degree of suboptimal cost reduction in response to a declining activity. Once the market demand declines, the activity declines. If the high-cost level is challenging to slash in the same degree with activity reduction, the shareholders' interests will suffer huge losses. Therefore, cost stickiness is a fundamental cost behavior and influenced by the macro environment.

The target of replacing the BT with the VAT reform is to reduce the tax burden actual payment by enterprises in the circulation field. It is also intended to encourage enterprises to change the business model, increase capital investment, and improve production efficiency through tax incentives. As to obtain the dominant right of market pricing, the competitive advantage in the industrial value chain reflects the effectiveness of its system. Therefore, building the theoretical framework of how replacing the BT with the VAT influences on firm cost stickiness is essential for exploring the effectiveness of the policy. We find that China's replacing the BT with the VAT reform helps to decrease the degree of cost stickiness significantly. Moreover, the above effect is more significant in firms with more capital investment. Further analysis shows that the degree of cost stickiness reduction changes from weak to strong year as the years go on.

Our research contributes to cost stickiness literature by showing the relation between replacing the BT with the VAT reform and firm cost stickiness, which is important for firm behavior and government tax reform decisions. First, we expand the researches on the effectiveness of replacing the BT with the VAT reform. The previous literature mainly focuses on the perspective of the business tax burden and short-term performance. We start our research from the perspective of firm risk and explore the consequences of replacing the BT with the VAT reform. Moreover, it provides new theoretical support and empirical evidence for the comprehensive implementation of the tax reform of China.

Second, the majority of previous studies only discuss the causes and factors of cost stickiness from the perspective of adjustment cost, executive decision, and agency problem. We take the macro tax reform as the background and research the effects of tax reform on the service industry firms' cost stickiness. Thus, we expand the literature of cost stickiness, enrich the literature of macro policy affecting micro-enterprise investment and business behavior, and shed light on the influence of macro policy on micro-enterprise risk.

The remainder of the paper proceeds as follows. Section 2 reviews the literature and develops our theoretical analysis and research hypothesis. Section 3 discusses our sample, data, and research design. Section 4 presents the analysis of empirical results. We conclude in Section 5.

## **2 Literature and Hypothesis**

Since Anderson et al. (Anderson et al., 2003) first find that cost has stickiness

characteristics, the cost stickiness problem has been widely concerned. Later literature broadens the scope of the cost gradually from the general cost to the total operating costs, general costs, and operating costs. Considering the high cost in business activities, many industries design long-term contracts to reduce the adjusting cost, such as information technology, research & design industry, and other industries. As an intermediate section in the industrial chain, service industry firms embed in the upper, middle and downstream manufacturing process, with a large amount of capital and human capital input (Sheng and Lu, 2013). Therefore, most service industry firms (e.g., construction industry, real estate industry, information technology industry) have cost stickiness phenomenon (Calleja et al., 2006; Sun and Liu, 2004; Liu, 2006; Kong et al., 2007; Liu and Wang, 2009). Since 2012, replacing the BT with VAT reform implements in the transportation and modern service industry, which divides into batches and regions in the whole of China. Replacing the BT with VAT reform is conducive to ease the tax burden generated by the imbalance economic structure and solve the problem of coexistence of the BT and the VAT, which will result in the cost stickiness reduction.

On the one hand, after the implementation of replacing the BT with the VAT reform, the firms only need to pay the value-added tax generated by the production and operation activities, which effectively solves the problem of coexistence of BT and VAT. Therefore, replacing BT with VAT reform helps to increase the firm value, bring higher profit margins. On the other hand, replacing the BT with the VAT reform has promoted the development of high-end service industries, such as design, logistics, and marketing. As a macro tax reform, the reform of replacing the BT with the VAT changes tax burden in the service industry. It breaks the original balance of benefit distribution between upstream and downstream firms. The adjustment of the tax system helps to form a new benefit distribution structure, which boosts the service industry firm development genuinely. Scientific research and other productive services firms intend to input more R&D, which will improve operational efficiency and reduce costs. At the same time, replacing the BT with the VAT reform helps to prompt manufacturing firms outsourcing the first independent, productive services business (Chen and Wang, 2016). Therefore, service firms will develop rapidly under the manufacture firms' increasing demand. Therefore, replacing BT with VAT reform is conducive to reduce the service firms' tax burden, which helps to improve operational efficiency and promote a significant reduction in cost stickiness. Therefore, the above theory develops our first hypothesis:

Hypothesis 1: The degree of cost stickiness of the service firms under the VAT policy is lower than under the BT policy.

The cost of purchasing inventory and fixed assets in service firms will be lower under the value-added tax system. Nie et al. (2009) find that the VAT tax system significantly encourages firms to invest in fixed assets, then increase the capital-labor ratio and production efficiency. Purchase more fixed assets will help them to receive more deducted cash flow (Wan et al., 2012) and also promote the production efficiency of enterprises (Yu and Jiang, 2014; Zhao, 2015). Therefore, after replacing BT with VAT reform implement, the chain of value-added tax has been profoundly improved, and firms' activities of equipment renewal will be accelerated. That means, the service industry firms have more capital expenditures, the more



deductible cash flow will receive. Along with improved operational efficiency and asset utilization capacity, firms' cost stickiness will alleviate greatly. Therefore, the above theory develops our second hypothesis:

Hypothesis 2: The reduction degree of cost stickiness is lower in the service firms with more capital expenditures under the VAT policy is lower than under the BT policy.

### 3 Model Specification

Following the launch of China's replacing the BT with the VAT reform, the promotion of the reform in transportation and modern service industry carried out in three batches. On January 1, 2012, the reform of replacing the BT with the VAT implement in Shanghai. After August 1, 2012, Beijing, Tianjin, Jiangsu Province, Anhui Province, Zhejiang province (including Ningbo), Fujian province (including Xiamen), Hubei Province, Guangdong province (including Shenzhen) joined the tax reform areas. The reform of replacing the BT with the VAT implemented nationwide in China's transportation and modern service industries since August 1, 2013. Considering the process, we build the multi-period DID model to start the empirical tests.

Following Anderson et al. (2013), we build our basic model (1). Then we extend the basic model by including the tax reform variable (*After*) and form model (2). Further, we add the capital expenditure variable (*Capex*) to model (2), then we get the model (3).

$$\begin{aligned} \Delta \ln cost_{i,t} = & \beta_0 + \beta_1 \Delta \ln sale_{i,t} + \beta_2 D * \Delta \ln sale_{i,t} + \beta_3 D * \Delta \ln sale_{i,t} * SD_{i,t} + \beta_4 D * \Delta \ln sale_{i,t} * Marketpower_{i,t} \\ & + \beta_5 D * \Delta \ln sale_{i,t} * Aintensity_{i,t} + \beta_6 D * \Delta \ln sale_{i,t} * Eintensity_{i,t} + \beta_7 D * \Delta \ln sale_{i,t} * GDP_t \\ & + \beta_8 SD_{i,t} + \beta_9 Marketpower_{i,t} + \beta_{10} Aintensity_{i,t} + \beta_{11} Eintensity_{i,t} + \beta_{12} GDP_t + \sum Year \\ & + \sum Industry + \varepsilon_{i,t} \end{aligned} \quad (1)$$

$$\begin{aligned} \Delta \ln cost_{i,t} = & \beta_0 + \beta_1 \Delta \ln sale_{i,t} + \beta_2 D * \Delta \ln sale_{i,t} + \beta_3 D * \Delta \ln sale_{i,t} * After + \beta_4 D * \Delta \ln sale_{i,t} * SD_{i,t} \\ & + \beta_5 D * \Delta \ln sale_{i,t} * Marketpower_{i,t} + \beta_6 D * \Delta \ln sale_{i,t} * Aintensity_{i,t} + \beta_7 D * \Delta \ln sale_{i,t} * Eintensity_{i,t} \\ & + \beta_8 D * \Delta \ln sale_{i,t} * GDP_t + \beta_{10} SD_{i,t} + \beta_{11} Marketpower_{i,t} + \beta_{12} Aintensity_{i,t} + \beta_{13} Eintensity_{i,t} + \beta_{14} GDP_t \\ & + \sum Year + \sum Industry + \varepsilon_{i,t} \end{aligned} \quad (2)$$

$$\begin{aligned} \Delta \ln cost_{i,t} = & \beta_0 + \beta_1 \Delta \ln sale_{i,t} + \beta_2 D * \Delta \ln sale_{i,t} + \beta_3 D * \Delta \ln sale_{i,t} * After + \beta_4 D * \Delta \ln sale_{i,t} * After * Capexp_{i,t} \\ & + \beta_5 D * \Delta \ln sale_{i,t} * SD_{i,t} + \beta_6 D * \Delta \ln sale_{i,t} * Marketpower_{i,t} + \beta_7 D * \Delta \ln sale_{i,t} * Aintensity_{i,t} \\ & + \beta_8 D * \Delta \ln sale_{i,t} * Eintensity_{i,t} + \beta_{10} D * \Delta \ln sale_{i,t} * GDP_t + \beta_{11} SD_{i,t} + \beta_{12} Marketpower_{i,t} \\ & + \beta_{13} Aintensity_{i,t} + \beta_{14} Eintensity_{i,t} + \beta_{15} GDP_t + \sum Year + \sum Industry + \varepsilon_{i,t} \end{aligned} \quad (3)$$

$$\Delta \ln cost_{i,t} = \ln(cost_{i,t} / cost_{i,t-1}) \quad (4)$$

$$\Delta \ln sale_{i,t} = \ln(sale_{i,t} / sale_{i,t-1}) \quad (5)$$

Where variable  $\Delta \ln cost_{i,t}$  is the change value of cost, which is measured by the ratio of the logarithm of operating cost in year  $t$  divided by that of in year  $t-1$ . Variable  $\Delta \ln sale_{i,t}$  the change value of the sale, which is measured by the ratio of the logarithm of the operating sale in year  $t$  divided by that of in year  $t-1$ . The base model (1) reflects the matching ability between sale and cost.  $Dis$  is a dummy variable, which is equal to 1 if the sale of firm increases and 0 otherwise. The coefficient of  $\beta_1$  suggests the degree of the cost increases when the sale increases by 1%. The sum of coefficient  $\beta_1$  and  $\beta_2$  suggests the degree of the cost decreases when the sale decreases by 1%. If  $\beta_2$  is significantly negative, it suggests that the cost reduction degree is lower than the cost increasing degree when sale changes. That means the cost is sticky.

Based on existing research (Sun and Liu, 2004; Liu and Liu, 2014; Xie and Hui, 2014; Liang et al, 2015, 2016; Jiang et al., 2015), continuous decline in sale ( $SD$ ), pricing power ( $Marketpower$ ), human capital intensity ( $Aintensity$ ) and macroeconomic growth ( $GDP$ ) are the essential variables influencing cost stickiness. Thus, we include the above control variables in the models.

**Table 1 Variable Description**

Variables Symbol	Variables Name	Explanations
$\Delta \ln sale$	Sale change	the logarithm of the ratio of sale revenue of year $t$ to that of year $t-1$ , which is calculated using the model (5).
$\Delta \ln cost$	Cost change	the logarithm of the ratio of sale revenue of year $t$ to that of year $t-1$ , which is calculated using the model (4).
$After$	reform variable	The year and after the reform takes 1, otherwise take 0.
$Capex$	Capital expenditure	Cash paid from operating leases plus cash paid for the purchase, and construction of fixed assets, intangible assets, and other long-term assets, then deduct net cash recovered from the disposal of fixed assets, intangible assets and other long-term assets
$D$	Sale declining dummy	The dummy variable, it is equal to 1 if the company's operating sale in the current year decreased compared to the previous year's operating sale, and otherwise 0.
$SD$	Successive sale decline	The dummy variable, it is equal to 1 if the company's operating sale for the second consecutive year, and otherwise 0.
$Marketpower$	Pricing power	The ratio of earnings before interest and taxes to the operating sale

<i>Aintensity</i>	Asset intensity	The ratio of total assets at the end of the year to the operating sale of the year
<i>Eintensity</i>	Human capital density	The ratio of the number of employees at the end of the year to the operating sale of the year (million)
<i>GDP</i>	Macroeconomic growth rate	The ratio of <i>GDP</i> in year t minus <i>GDP</i> in year t-1, divided by <i>GDP</i> in year t-1.

We present an explanation for key variables. Data are received or calculated from the China Stock Market & Accounting Research (CSMAR) database for the period through 2010 to 2015. We exclude ST firms and listed firms whose industry have changed during the sample period.

## 4 Empirical Results

### 4.1 Descriptive statistics and correlation analysis

Table 2 provides descriptive statistics of variables. Our sample includes 2479 observations. The mean value of  $\Delta Incost$  is 0.155, and the mean value of  $\Delta Insale$  is 0.1439. The proportion of *D* is 26.7%, and *SD* is 12.8% in the sample. Besides, other variables' descriptive statistics (e.g., *Marketpower*, *Aintensity*, *Eintensity*, and *GDP*) reported in Table 2. Table 3 is the correlation analysis, which shows that the data have no multicollinearity problem.

**Table 2 Descriptive Statistics**

Variable	N	mean	sd	p50	p25	p75
<i>ΔIncost</i>	2479	0.1550	0.4232	0.1367	-0.0060	0.3047
<i>ΔInsale</i>	2479	0.1439	0.3837	0.1276	0.0003	0.2835
<i>D</i>	2479	0.2670	0.4424	0	0	1
<i>SD</i>	2487	0.1282	0.3344	0	0	0
<i>Marketpower</i>	2479	0.1618	0.2416	0.1196	0.0508	0.2258
<i>Aintensity</i>	2479	3.5948	5.0983	2.1936	1.2374	4.0083
<i>Eintensity</i>	2479	1.5378	1.7181	0.9226	0.4093	2.0455
<i>GDP</i>	2479	1.1161	0.0381	1.1015	1.0818	1.1043

**Table 3 Correlation Analysis**

Variable	$\Delta Incost$	$\Delta Insale$	$D$	$SD$	$Market$ $-power$	$Ainten$ $-sity$	$Eintensity$	$GDP$
$\Delta Incost$	1	-	-	-	-	-	-	-
$\Delta Insale$	0.928***	1	-	-	-	-	-	-
$D$	-0.573***	-0.615***	1	-	-	-	-	-
$SD$	-0.380***	-0.411***	0.633***	1	-	-	-	-
$Market$ $-power$	0.002	0.028	-0.002	0.014	1	-	-	-
$Ainten$ $-sity$	-0.202***	-0.248***	0.203***	0.198***	0.361***	1	-	-
$Eintensity$	-0.114***	-0.149***	0.103***	0.155***	0.005	0.288***	1	-
$GDP$	0.056***	0.076***	-0.071***	0.134***	0.012	-0.020	0.016	1

#### 4.2 Main regression analysis

Table 4 reports the regression results of verifying the impact of replacing BT with VAT tax reform on the cost stickiness of Chinese service firms. Model(1) shows whether the service industry has cost stickiness. The result indicates that the regression coefficient of variable  $D * \Delta Insale_{i,t}$  is -0.304 (t=-3.60), indicating that the service industry has cost stickiness. Meanwhile, the control variable regression results show that the variable  $SD$ ,  $Market\ power$ ,  $Intensity$ , and  $GDP$  are significantly positive (0.346, t=3.40; 0.084, t=3.72; 0.067, t=3.63; 0.358, t=2.63), indicating when the sale of listed service firms continues to decline, the degree of cost stickiness reduces. While with the pricing power and human capital intensity increase, the degree of cost stickiness reduces. During the economic upswing, the cost stickiness of service companies significantly alleviate.

Model(2) indicates the impact of replacing the BT with the VAT reform on cost stickiness. The result shows that the coefficient of the variable  $D * Insale_{i,t} * After$  is 0.271 (t=1.78), indicating that the service industry cost stickiness is significantly alleviated after the implementation of the tax reform, providing support our hypothesis 1. In Model (3), the coefficient of  $D * Insale_{i,t} * After * Capex$  is 1.012 (t=2.46), which indicates the reduction degree of cost stickiness is lower in the service firms with more capital expenditures under the VAT policy is lower than under the BT policy., providing support our hypothesis 2. The control variable regression results are almost similar to the Model(2).

**Table 4 Replacing the BT with the VAT reform and Cost Stickiness**

Variable	Model (1)	Model (2)	Model (3)
$\Delta \ln \text{sale}_{i,t}$	1.448*** (49.25)	1.217*** (43.67)	1.016*** (44.50)
$D * \Delta \ln \text{sale}_{i,t}$	-0.304*** (-3.60)	-0.489*** (-3.06)	0.064 (0.64)
$D * \Delta \ln \text{sale}_{i,t} * \text{After}$	-	0.271* (1.78)	-0.072 (-0.77)
$\text{After}$	-	0.036 (1.38)	-0.005 (-0.30)
$D * \Delta \ln \text{sale}_{i,t} * \text{After} * \text{Capex}$	-	-	1.012** (2.46)
$\text{After} * \text{Capex}$	-	-	0.001 (0.04)
$D * \Delta \ln \text{sale}_{i,t} * \text{Capex}$	-	-	-1.138*** (-2.97)
$\text{Capex}$	-	-	-0.014 (-0.45)
$D * \Delta \ln \text{sale}_{i,t} * \text{SD}$	0.031 (0.32)	0.346*** (3.40)	0.276*** (2.91)
$D * \Delta \ln \text{sale}_{i,t} * \text{Marketpower}$	-0.015** (-2.19)	0.084*** (3.72)	0.105** (2.54)
$D * \Delta \ln \text{sale}_{i,t} * \text{Aintensity}$	-0.003*** (-5.30)	-0.002 (-0.98)	-0.002 (-0.91)
$D * \Delta \ln \text{sale}_{i,t} * \text{Eintensity}$	0.051*** (2.91)	0.067*** (3.63)	0.003 (0.20)
$D * \Delta \ln \text{sale}_{i,t} * \text{GDP}$	0.022 (0.26)	0.358*** (2.63)	0.146 (1.55)
$\text{SD}$	0.089***	0.137***	0.079**

	(2.90)	(4.59)	(1.97)
<i>Marketpower</i>	-0.013	0.031	0.041
	(-1.62)	(1.56)	(0.93)
<i>Aintensity</i>	-0.001**	0.002	0.002
	(-2.01)	(1.15)	(1.04)
<i>Eintensity</i>	0.010*	0.016***	0.015*
	(1.91)	(3.47)	(1.79)
<i>GDP</i>	0.001	0.059	0.013
	(0.01)	(0.84)	(0.19)
<i>_cons</i>	-0.137	-0.208*	-0.160**
	(-1.58)	(-1.72)	(-2.04)
<i>Year</i>	Control	Control	Control
<i>Industry</i>	Control	Control	Control
<i>N</i>	2479	1214	1214
<i>r2</i>	0.665	0.763	0.836
<i>F</i>	243.753	173.981	294.501

*t* statistics in parentheses \* $p < 0.1$ , \*\* $p < 0.05$ , \*\*\* $p < 0.01$ .

### 4.3 Endogeneity concern

To enhance the effectiveness of the previous empirical results, we use the placebo test method to identify the influence of the tax reform on the cost stickiness of service companies. Specially, we change the year of replacing the BT with the VAT reform. If the coefficient of variable  $D^* \text{Insale}_{i,t}^* \text{After}$  is significantly positive, it means that the implementation of the tax reform is not the essential reason inducing firms to reduce cost stickiness. Table 5 shows the test results. When the tax reform is lag and forward one year, the coefficients of variable  $D^* \text{Insale}_{i,t}^* \text{After}$  are -0.275 and -0.553 ( $t = -1.36, -2.04$ ) respectively, which support our assumption.

**Table 5 Replacing the BT with the VAT Reform and Cost Stickiness**

Variable	Model (1)		
	Lag one year	Reform year	Forward one year
<i>Insale<sub>i,t</sub></i>	1.325***	1.217***	1.207***
	(38.98)	(43.67)	(31.35)

<i>D* lnsale<sub>i,t</sub></i>	-0.209 (-1.10)	-0.489*** (-3.06)	0.807*** (2.65)
<i>D* lnsale<sub>i,t</sub> *After</i>	-0.275 (-1.36)	0.271* (1.78)	-0.553** (-2.04)
<i>After</i>	-0.019 (-0.76)	0.036 (1.38)	-0.010 (-0.29)
<i>D* lnsale<sub>i,t</sub> *SD</i>	0.390** (2.34)	0.346*** (3.40)	-0.163 (-1.01)
<i>D* lnsale<sub>i,t</sub> *Marketpower</i>	-0.144 (-0.80)	0.084*** (3.72)	0.057 (1.33)
<i>D* lnsale<sub>i,t</sub> *Aintensity</i>	0.017 (0.55)	-0.002 (-0.98)	-0.001 (-0.28)
<i>D* lnsale<sub>i,t</sub> *Eintensity</i>	-0.013 (-0.36)	0.067*** (3.63)	0.058** (2.09)
<i>D* lnsale<sub>i,t</sub> *GDP</i>	-0.157 (-0.97)	0.358*** (2.63)	-0.593** (-2.56)
<i>SD</i>	0.087** (2.51)	0.137*** (4.59)	0.022 (0.59)
<i>Marketpower</i>	-0.142*** (-2.80)	0.031 (1.56)	0.048 (1.31)
<i>Aintensity</i>	0.012*** (3.00)	0.002 (1.15)	0.001 (0.39)
<i>Eintensity</i>	0.002 (0.49)	0.016*** (3.47)	-0.003 (-0.46)
<i>GDP</i>	0.044* (1.69)	0.059 (0.84)	0.025 (0.16)
<i>_cons</i>	-0.058 (-1.11)	-0.208* (-1.72)	-0.130 (-0.87)
<i>Year</i>	Control	Control	Control

Industry	Control	Control	Control
<i>N</i>	781	1214	974
<i>r</i> <sup>2</sup>	0.762	0.763	0.700
<i>F</i>	121.417	173.981	105.596

*t* statistics in parentheses \**p*< 0.1, \*\**p*< 0.05, \*\*\**p*< 0.01

#### 4.4 Robustness tests

##### 4.4.1 Excluding the eastern regions from samples

From the perspective of firm risk, the cost stickiness reflects the mismatch between sale and cost, which may be affected by the firm development degree. The service industry in the eastern region has a higher level of development and lower risk-taking level than the central and western regions; then we exclude the sample of the eastern region in the robustness test.

Table 6 shows the test results. Model (1) shows whether the service industry has cost stickiness. The result indicates that the regression coefficient of variable  $D^* \Delta \ln \text{sale}_{i,t}$  is -0.673 (*t*=-5.64), indicating that the service industry has cost stickiness. The coefficient of  $D^* \ln \text{sale}_{i,t} * \text{After}$  of Model (2) is 0.588 (*t*=3.88), which indicates that the service industry cost stickiness significantly weakens after the implementation of replacing the BT with the VAT reform. The coefficient of variable  $D^* \ln \text{sale}_{i,t} * \text{After} * \text{Capex}$  of Model (3) in Table 6 is 0.819 (*t*=1.70), which indicates that the effect is more significant in the service firms with more massive capital investment. These results support the previous empirical results.

**Table 6 Replacing the BT with the VAT Reform and Cost Stickiness**

Variable	Model (1)	Model (2)	Model (3)
$\ln \text{sale}_{i,t}$	1.602*** (39.01)	1.204*** (42.45)	0.791*** (6.35)
$D^* \ln \text{sale}_{i,t}$	-0.673*** (-5.64)	-0.692*** (-4.36)	0.567*** (2.90)
$D^* \ln \text{sale}_{i,t} * \text{After}$	-	0.588*** (3.88)	-0.269* (-1.91)
<i>After</i>	-	0.032 (1.21)	-0.062** (-2.54)
$D^* \ln \text{sale}_{i,t} * \text{After} * \text{Capex}$	-	-	0.819* (1.70)



	-	-	0.013
<i>After*Capex</i>	-	-	(0.44)
	-	-	-1.179***
<i>D* ln<i>sale</i><sub>i,t</sub> *Capex</i>	-	-	(-2.91)
	-	-	-0.059*
<i>Capex</i>	-	-	(-1.91)
	0.241*	0.344***	-0.025
<i>D* ln<i>sale</i><sub>i,t</sub> *SD</i>	(1.78)	(3.41)	(-0.20)
	-0.047*	0.066*	-0.058
<i>D* ln<i>sale</i><sub>i,t</sub> *Marketpower</i>	(-1.78)	(1.66)	(-1.26)
	-0.005***	-0.000	-0.001
<i>D* ln<i>sale</i><sub>i,t</sub> *Aintensity</i>	(-4.44)	(-0.02)	(-0.49)
	0.050**	0.043**	-0.038
<i>D* ln<i>sale</i><sub>i,t</sub> *Eintensity</i>	(2.11)	(2.39)	(-1.54)
	0.070	0.585***	0.039
<i>D* ln<i>sale</i><sub>i,t</sub> *GDP</i>	(0.59)	(4.23)	(0.24)
	0.124***	0.098***	-0.044
<i>SD</i>	(2.80)	(3.04)	(-1.60)
	-0.049	-0.036	-0.075**
<i>Marketpower</i>	(-1.62)	(-1.06)	(-2.07)
	-0.002**	0.004	0.002
<i>Aintensity</i>	(-2.15)	(1.44)	(0.56)
	0.013*	0.003	-0.001
<i>Eintensity</i>	(1.68)	(0.64)	(-0.27)
	-0.056	0.112	-0.034
<i>GDP</i>	(-0.38)	(1.38)	(-0.21)
	-0.113	-0.277**	0.097
<i>_cons</i>	(-0.85)	(-2.08)	(0.90)
<i>Year</i>	Control	Control	Control

Industry	Control	Control	Control
N	1417	696	696
r2	0.675	0.855	0.838
F	145.174	180.524	122.542

t statistics in parentheses \* $p < 0.1$ , \*\* $p < 0.05$ , \*\*\* $p < 0.01$ .

#### 4.4.2 Excluding the first and last batches firms in the tax reform

The promotion of the reform in China's transportation and modern service industry carried out in three batches; some companies may know the tax reform in advance from the relevant government departments, then they may have expected response beforehand. Meanwhile, after the last batch firms join the tax reform, there are fewer samples in the control group. To concern these sample bias problems, we exclude the first and last batch samples in the robustness test.

Table 7 shows the test results. Model (1) shows whether the service industry has cost stickiness. The result indicates that the regression coefficient of variable  $D * \Delta \ln sale_{i,t}$  is -6.872 (t=-2.31), indicating that the service industry has cost stickiness. The coefficient of variable  $D * \ln sale_{i,t} * After$  of Model (2) is 0.370 (t=2.00), which indicates that cost stickiness significantly weakens after the implementation of the tax reform. The coefficient of  $D * \ln sale_{i,t} * After * Capex$  in Model (3) is 4.503 (t=2.46). These results support our assumption.

**Table 7 Replacing the BT with the VAT Reform and Cost Stickiness**

Variable	Model (1)	Model (2)	Model (3)
$\ln sale_{i,t}$	0.989*** (28.75)	1.025*** (29.09)	1.327*** (9.55)
$D * \ln sale_{i,t}$	-6.872** (-2.31)	-15.756*** (-3.08)	-0.356 (-1.17)
$D * \ln sale_{i,t} * After$	-	0.370** (2.00)	-0.273 (-1.39)
$After$	-	0.020 (1.00)	-0.083 (-1.40)
$D * \ln sale_{i,t} * After * Capex$	-	-	4.503** (2.46)
$After * Capex$	-	-	0.064 (1.18)

	-	-	-4.549**
<i>D* Insale<sub>i,t</sub> *Capex</i>	-	-	(-2.47)
	-	-	-0.037
<i>Capex</i>	-	-	(-0.76)
	-0.595*	-0.244	0.143
<i>D* Insale<sub>i,t</sub> *SD</i>	(-1.96)	(-0.83)	(0.82)
	0.098***	0.208**	0.284
<i>D* Insale<sub>i,t</sub> *Marketpower</i>	(2.93)	(2.02)	(1.55)
	0.002	-0.003	0.014**
<i>D* Insale<sub>i,t</sub> *Aintensity</i>	(0.68)	(-0.49)	(2.36)
	-0.028	0.091**	0.043
<i>D* Insale<sub>i,t</sub> *Eintensity</i>	(-0.88)	(2.17)	(1.20)
	6.525**	14.139***	-0.034
<i>D* Insale<sub>i,t</sub> *GDP</i>	(2.39)	(3.08)	(-0.26)
	-0.064	0.021	-0.013
<i>SD</i>	(-1.46)	(0.55)	(-0.39)
	0.079***	0.062*	0.064**
<i>Marketpower</i>	(2.93)	(1.90)	(2.16)
	0.002	0.000	-0.001
<i>Aintensity</i>	(1.15)	(0.22)	(-0.52)
	0.006	0.016**	0.011
<i>Eintensity</i>	(1.11)	(2.41)	(1.53)
	1.346	3.339***	-0.017
<i>GDP</i>	(1.62)	(2.71)	(-0.35)
	-1.731*	-0.062	11.873**
<i>_cons</i>	(-1.84)	(-0.03)	(2.13)
<i>Year</i>	Control	Control	Control
<i>Industry</i>	Control	Control	Control
<i>N</i>	1084	514	585

r2	0.865	0.821	0.790
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t statistics in parentheses \* $p < 0.1$ , \*\* $p < 0.05$ , \*\*\* $p < 0.01$ .

#### 4.5 Further analysis

As a macro tax policy, the reform of replacing the BT with the VAT has a time effect. Thus, we test the time effect in different periods. Table 8 shows the test results. The coefficients of variable  $D^* \ln sale_{i,t}$  in the different periods (e.g., one year, two years, three years) are -0.304, 0.072, and 0.204 (t=-3.60, 0.92, 4.15), indicating that the degree of cost stickiness reduction changes from weak to steady as years go on after replacing BT with VAT policy implementation.

**Table 8 Replacing the BT with the VAT Reform and Cost Stickiness**

Variable	One year	two years	three years
$\ln sale_{i,t}$	1.448*** (49.25)	1.278*** (46.87)	1.170*** (41.30)
$D^* \ln sale_{i,t}$	-0.304*** (-3.60)	0.072 (0.92)	0.204*** (4.15)
$D^* \ln sale_{i,t} * SD$	0.031 (0.32)	-0.140 (-1.54)	-0.291*** (-3.77)
$D^* \ln sale_{i,t} * Marketpower$	-0.015** (-2.19)	0.040*** (4.11)	0.042*** (5.61)
$D^* \ln sale_{i,t} * Aintensity$	-0.003*** (-5.30)	-0.001 (-1.16)	-0.000 (-0.64)
$D^* \ln sale_{i,t} * Eintensity$	0.051*** (2.91)	0.008 (0.58)	0.021 (1.47)
$D^* \ln sale_{i,t} * GDP$	0.022 (0.26)	0.150* (1.90)	0.196 (1.24)
$SD$	0.089*** (2.90)	0.046 (1.05)	0.016 (0.41)
$Marketpower$	-0.013 (-1.62)	-0.001 (-0.40)	-0.004 (-1.25)
$Aintensity$	-0.001**	0.001	0.003*

	(-2.01)	(0.78)	(1.94)
<i>Eintensity</i>	0.010*	0.005	-0.000
	(1.91)	(0.80)	(-0.05)
<i>GDP</i>	0.001	0.031	0.061
	(0.01)	(0.36)	(0.76)
<i>_cons</i>	-0.137	-0.130	-0.119
	(-1.58)	(-1.17)	(-0.98)
<i>Year</i>	Control	Control	Control
<i>Industry</i>	Control	Control	Control
<i>N</i>	2479	1796	1131
<i>r2</i>	0.665	0.626	0.686

*t* statistics in parentheses \* $p < 0.1$ , \*\* $p < 0.05$ , \*\*\* $p < 0.01$ .

## 5 Conclusion

Using a sample of Chinese firms over 2010-2015 and Difference-in-Difference model, we examine the influence of replacing the BT with the VAT reform on service industry firms' cost stickiness. We find that replacing the BT with the VAT reform helps to decrease the degree of cost stickiness significantly. Moreover, the above effect is more significant in firms with more capital investment. A rich set of tests show that the baseline results are robust to omitted variables, sample bias, and endogeneity concerns. Further, we find that the degree of cost stickiness reduction changes from weak to steady as years go on after replacing the BT with the VAT reform implementation. With the unique background of China, this paper provides empirical evidence for the economic consequences of the tax reform from the perspective of enterprise risk, expands the researches on the effectiveness of the replacing the BT with the VAT reform, and enriches the researches of micro firm behavior affected by the macro policy.

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## **Evaluation and Analysis of Enterprise Investment Activities Based on Financial Quality Perspective: Taking Haier as an example**

Xu Shiyong<sup>2</sup>, Li Xinjie<sup>1,2</sup>, Luo Xuan<sup>2</sup>

1 School of Business, Hong Kong Baptist University, Hong Kong, P.R. China, 999077

2 School of Management, Chengdu University of Information Technology, Chengdu, P.R. China, 610103

(E-mail: xsy189@vip.163.com, xinjie\_Li@hotmail.com, 1353289584@qq.com)

**Abstract:** The traditional financial quality evaluation system mainly includes indicators such as asset quality, capital structure, profit quality, and cash flow quality. However, the traditional system neglects the specific analysis of internal operation activities, investment activities and financing activities. Investment activities are important activities for enterprises to achieve their development strategies. Their quality directly affects their ability to sustain growth. The article breaks through the traditional evaluation model and constructs the framework of investment activity quality evaluation from three aspects: consistency with the development strategy of the enterprise, risk of investment activities and efficiency of investment assets. On this basis, the article combined the data of investment activities of Qingdao Haier 2013-2017, detailed analysis and evaluation of the quality of its investment activities with Gree Electric and Midea Group. It is concluded that Qingdao Haier's investment activities are basically consistent with its differentiated development strategy. Haier also faces less risk of tight demand. What's more, the overall quality of external investment of Haier is high.

**Key words:** Financial quality; Investment activities; Corporate strategy; Investment risk; Investment efficiency

### **1 Introduction**

Investment activities are important activities for companies to achieve their development strategies. The academic community has many research and analysis methods for financial quality, such as factor analysis, DuPont analysis, and EVA analysis. Especially in the classic analysis of financial analysis, many companies are still using DuPont analysis in the actual financial quality management of enterprises.

Domestic scholars have studied a lot of financial quality. The typical ones are: Zhang Xinmin believes that financial quality is the quality of the company's financial status in accordance with the carrying amount of operations or distribution. (Zhang Xinmin, 2000) Qian Aimin believes that financial quality refers to the quality of the financial consequences of the company's use of financial resources to engage in business activities. (Qian Aimin, 2008) Li



Fengtuan conducted a financial evaluation of investment activities from the perspective of corporate social responsibility. (Li Fengtuan, 2010) Yuan Chunsheng analyzed the financial quality of coal listed companies from the perspective of investors. (Yuan Chunsheng, 2015)

Foreign scholars also have relevant research on financial quality: Charles Gibusen analyzes the company's solvency, profitability and asset liquidity based on the company's balance sheets and profit and loss statements. (Charles Gibusen, 1997) J. David Cummins involved the concept of financial quality in the research of the insurance market, but did not elaborate. (J. David Cummins, 1997) The DuPont analysis method was first developed by DuPont. This method is based on the return of shareholders' equity. It is divided into several financial indicators. By analyzing the changes in indicators, we evaluate the financial quality of the company.

In summary, domestic and foreign scholars have carried out a lot of research on the overall financial quality of enterprises. But there are few analysis and evaluation of the quality of investment activities. Especially the literature for comprehensive analysis is very rare.

This paper combines qualitative and quantitative analysis. Firstly, we describe the investment activities and their quality connotations. And then we construct the framework of investment activity evaluation. Finally, according to the investment activity data and relevant information released by Qingdao Haier Company, we carry out detailed analysis to achieve the evaluation of the quality of corporate investment activities.

## **2 Data and Methods**

### **2.1 Data Sources**

This paper mainly takes the investment activities of Qingdao Haier Company as the research object. In the meanwhile, we also compare and analyze the object with the ones of Gree Electric and Midea Group. The data in the article are from annual reports released in CNINFO Network, CSMAR Database, Wind Information and official websites of Haier, Midea and Gree. CNINFO Network is a listed company information disclosure website designated by the China Securities Regulatory Commission.

### **2.2 Research methods**

This paper mainly uses two methods: literature research method and case analysis method. The literature research method is a research method that enlightens the text by combing the relevant literatures of domestic areas and overseas, summarizing the experience of related problems with the research objects, and drawing on the research results. The literature is mainly from the relevant journals of China National Knowledge Infrastructure Network. The case analysis method is based on the literature research method, in order to further elaborate and verify the viewpoint of the article, which combined with specific enterprise examples for detailed analysis. This paper takes Haier as the object of case study. On the base of that, we conduct a comprehensive and objective analysis of the strategic, safety and efficiency of its

investment activities.

### **3 The Connotation of Enterprise Investment Activities and Quality**

The most classic writing in the field of domestic financial quality research is the book "Theory of Financial Analysis of Enterprise Financial Status" by Professor Zhang Xinmin. Professor Zhang believes that the financial quality, that is, "the financial status of the enterprise which operates according to the book value or the quality of the distribution." Professor Zhang divided the financial quality analysis theory into financial status quality, asset quality, capital structure quality, profit quality, cash flow quality and financial information quality. (Zhang Xinmin, 2000) Other scholars and experts also conducted a multi-angle analysis of financial quality. However, the quality evaluation and analysis of operation activities, investment activities and financing activities from the perspective of financial activities are relatively small. In view of this, we take financial activities as the starting point to evaluate and analyze the financial quality of corporate investment activities.

The investment activity of an enterprise is the process by which the enterprise uses its own funds. Investment refers not only to the injection of funds to external companies or the purchase of financial products, but also to the use of funds by the company itself. (Li Xiaojing, 2006) According to the use of corporate funds, we can divide investment into two types: internal investment and foreign investment:

(1) Internal investment is the fact that the enterprise invests the funds into the enterprise itself, which can be the capital investment for maintaining daily operations, such as the purchase of raw materials, the consumption of water, electricity and other resources in the normal production process, etc. Of course, it can also be the investment for the company to expand the scale of production, such as the purchase of machinery and equipment, the expansion of new plants, recruitment and so on. Any use of the company's own funds for itself can be classified as internal investment.

(2) Foreign investment by enterprises is not part of internal investment. For example, enterprises use its funds to purchase financial derivatives shall be classified into foreign investment. There are two main purposes for foreign investment: the first is that the company invests its idle cash or cash equivalents into the financial market to obtain income. The most typical example is the transactional financial assets of the enterprise. The second one is the investment for generating controls and exerting significant influence on other enterprises. For this kind of investment, enterprises are not only for the purpose of obtaining income, but also for the strategic purposes of expanding market size and entering into new markets. The most typical subject is the long-term equity investment.

The evaluation of the quality of investment activities refers to the evaluation of strategy, safety and efficiency of the internal and external investment activities of enterprises.

## **4 The Framework of Investment Activity Quality Evaluation**

The quality evaluation of corporate investment activities can be carried out from many angles. This paper refers to the research results of other scholars and combines our own thinking. We construct the quality evaluation framework from three aspects: the consistency of investment activities with corporate development strategies, risk assessment and efficiency of investment assets.

### **4.1 Consistency evaluation with corporate development strategy**

From the investment activities of enterprises, we can see the main development direction of the company. When assessing the financial quality of an enterprise's investment activities, it is necessary to combine the development strategy formulated by the enterprise. It is significant to define whether the actual investment activity of the enterprise matches its development direction and strategy. (Zhang Tingting, 2017) For example, some manufacturing companies adopt a backward integration strategy. This kind of enterprise often acquires and merges many upstream enterprises to achieve control purposes. Such enterprises often hold a large amount of long-term equity investment. Some enterprises adopt differentiated strategies, so a large number of technological research and development projects will be involved to increase market entry costs and form technical barriers. (Wang Huacheng, 2013) Such enterprises need to pay attention to their annual R&D investment.

To evaluate relevancy, firstly, we need to determine the development strategy of the company. Then we conduct a practical analysis of the investment activities through the financial reports issued by the company. This process helps us to determine whether it conforms to the development strategy proposed by the enterprise. For example, we can test and verify the long-term equity investment of the company to find out if the investment is in line with the direction of the company. Also, we can analyze the annual R&D investment ratio and the growth rate of intangible assets. This process helps to determine whether it is consistent with the innovation strategy or differentiation strategy proposed by the company.

### **4.2 Risk assessment of investment activities**

Risk generally refers to fluctuations and uncertainties in the expected return on investment. The risk of investment activities is mainly the uncertainty of future earnings, including systemic and non-systematic risks (Table 1). From the risk of an investment, we can find out whether the executives of the company are risk-averse. We generally believe that the longer the investment, the greater the risk. Of course, the expected return will be greater simultaneously. (Xu Shiyang, 2016) When we measure the quality of investment activities from the perspective of security, we tend to hope the risk as small as possible since the cognition that smaller risk means a safer investment quality usually. Of course, security is always inversely proportional to the benefits.

**Table 1 Risk Types of Investment Activities**

Risk types	Contents
System risk (inevitable risk)	Mainly from the overall market factors. Such as changes in market benchmark interest rates, adjustment of import and export tariff policies, changes in commodity prices, and so on.
Non-systematic risk (Dispersible avoidable risks)	Mainly from specific industry or business factors. For example, changes in market demand, development and application of new technologies, etc.

From the perspective of financial statements of the company itself, it is often difficult to measure the investment risk of the company with quantitative indicators. By analyzing the system risks, such as market interest rates and commodity prices, still we can measure the inevitable risks faced by the company. In addition, we can evaluate the non-systematic risk by qualitatively analyzing through research on product development cycles, application of new technologies, high-level corporate mobilization, and special issues. (Wang Cuichun, 2008) Through the all above qualitative analysis, a solution to reduce the overall risk will be proposed.

#### 4.3 Efficiency evaluation of investment assets

**Table 2 Analysis of Investment Asset Efficiency Evaluation Indicators**

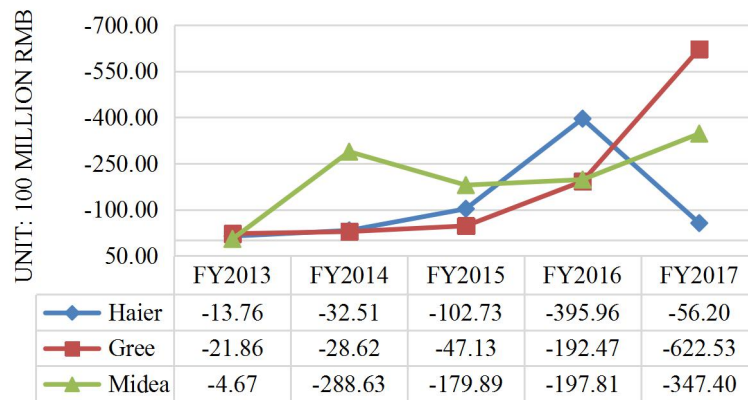
Index	Formula	Implication
Fixed asset profit margin	Total profit / average value of fixed assets	The efficiency of the return on the investment of fixed assets by the enterprise, the higher the value, the better.
Intangible asset profit margin	Total profit / average of intangible assets	The return efficiency of an enterprise investing in intangible assets (research and development patents, etc.), the higher the value, the better.
External investment efficiency	Cash received from investment income received by investment/cash investment	This value measures the ratio of the actual investment income of the enterprise to the investment expenditure from the cash basis. The higher the value, the better.

The most intuitive way to assess the effectiveness of an investment activity is to calculate how much an investment asset can bring to the business. Before making a decision, we often calculate the expected return on investment and market interest rates for comparison. (Shu Xingguo, 2010) At the end of the investment, the actual rate of return is calculated to measure

the actual quality and efficiency of the investment. When the actual rate of return is equal to or higher than the expected rate of return, we believe the investment is successful. (Miao Runsheng, 2007) If the expected goal is failed to achieve, the efficiency of the relevant investment is considered to be low. The investment asset efficiency evaluation indicators usually include indicators such as fixed asset profit rate, intangible asset profit rate and foreign investment efficiency. Please refer to Table 2 for details.

## 5 Quality Evaluation and Analysis of Haier Investment Activities

### 5.1 Evaluation and analysis of haier investment activities and enterprise development strategy



The net cash flow of Qingdao Haier's investment activities in 2017 was -56.2 billion Yuan. In 2016, this value equals to -396 billion Yuan, nearly three times lower than the -103 billion yuan in 2015. Compared with Midea and Gree, the net cash value of its investment activities is at its lowest level. This shows that Haier's investment in 2016 has greatly increased and far surpassed its peers, but can its performance be consistent with its development strategy?

"Collaborative operations with user-centered global multi-brand" is Haier's development strategy in recent years. By overviewing the annual reports of Haier in recent years, we can find out its multi-brand collaborative combat differentiation strategy ubiquitously. For example, Haier spent \$5.6 billion in 2016 to acquire GEA, a GE appliance division. In late 2015, it invested 9.8 to acquire British cold chain LabTech. In 2014, it launched a personal and commercial decoration solution. In early 2013, it invested 130 million US dollars to acquire Japanese Sanyo appliances department. At present, Haier has owned many high-end and differentiated brands such as Japan AQUA, Australia Fisher Paykel, Casarte, US General Electric Appliances and British Labtech through mergers and acquisitions, which have enabled Haier to increase its market share in different consumer groups. Secondly, Haier invested in the financial company established by the group company in 2016, making Haier's capital

operation more efficient and convenient.

From these, we have evidences to believe that Haier's investment activities are basically consistent with its differentiated development strategy. The investment principle of Haier is “collaborative operations with user-centered global multi-brand”. Haier's annual expansion of investment activities will help the company's rapid development in overseas markets which will increase its profitability and efficiency.

## 5.2 Risk evaluation and analysis of Haier investment activities

The risk of investment activities mainly refers to the uncertainty of the future earnings of the investment. Since Haier is currently guided by the M&A strategy and differentiated strategy, it is currently in a period of rapid expansion. At present, Haier has invested in a large number of home appliance start-ups in China and acquired large overseas high-quality assets. Haier's current investment activity risks are mainly divided into two categories: the first category is systemic risk and the second category is non-systematic risk.

(1) Exchange rate risk. Since most of Haier's investment projects are overseas home appliance companies, 50% of the production plants are set up in China. Haier's overseas branches are denominated in US dollars. In the same time, domestic manufacturing companies use RMB to calculate costs. Exchange rate fluctuations will inevitably affect manufacturing



Figure 2 Spot Exchange Rate

costs. (Shanghai National Accounting Institute, 2012) Financial expenses-exchange loss-makes Haier has to pay attention to exchange rate risks. It has a significant impact on home appliance exports.

According to Wind Information, from late May to early September 2017, the exchange rate of RMB against the US dollar showed a rapid appreciation trend. In early September, it rose to a peak of 6.46. This exchange rate appreciated by 7.74% compared to the beginning of 2017. The appreciation of the RMB will not only curb the total export value of home appliance exporters like Haier, but also increase the exchange losses caused by exchange rate fluctuations.

In 2016-2017, Qingdao Haier's exchange loss reached RMB 179 million, accounting for nearly 25% of the financial expenses. In particular, after Haier's acquisition of General Electric Appliances, GEA's individual assets accounted for 50% of its total assets. The risk of

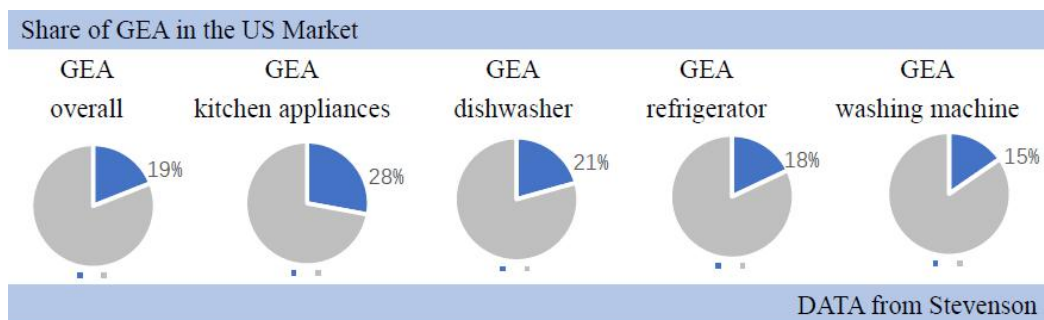


Figure 5 Haier's GEA Market Share in the U.S.

fluctuations may cause more exchange losses.

(2) Tariffs and policy risks. The Sino-US trade war recently will definitely impact the free trade beneficiaries, including the home appliance industry. In 2017, the United States imposed anti-dumping duties on washing machines (mainly LG and Samsung products) produced in Japan and South Korea. Then these companies relocated their manufacturing plants to China, making domestic appliance exporters facing the same policy risks.

US home appliance imports are heavily dependent on China. China's exports of home appliances account for nearly 50% of the total imports of the US home appliance industry. GEA held by Haier currently accounts for 19% of the US market share. Excessive import tariffs will increase the retail price of home appliances which curbs domestic consumption, thus affecting Haier's exports. In 2018-2019, Haier will face greater tariff and policy risks and directly affect the investment income of its overseas assets.

(3) Industry risk. Since 2015, consumption upgrades and product upgrades have driven demand for home appliances in Mainland China. At the same time, the boom in the real estate market from 2016 to 2017 has also stimulated the growth in demand for home appliances. In the long run, there is still room for improvement in the home appliance market. In the domestic market, with the acceleration of the consumer consumption upgrade process, consumers have provided a huge market for Haier's brand recognition. The prospect of the home appliance industry in Haier is relatively optimistic. The total demand for the industry continues to rise. In the meanwhile, the risk of tightening is small.

### 5.3 Evaluation and analysis of the efficiency of haier investment activities

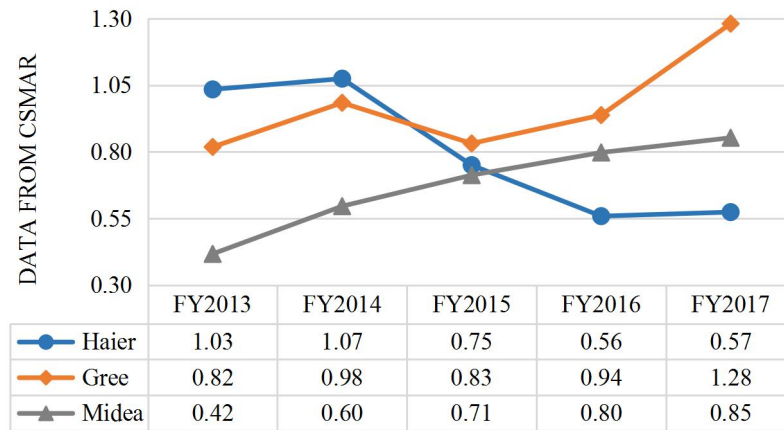


Figure 7 Comparison of Fixed Assets of Three Assets

#### (1) Fixed asset profit margin

From 2013 to 2017, Haier's fixed asset profit margin showed a downward trend year by year. In 2017 it rebounded slightly. On the other hand, the fixed assets profit rates of Midea and Gree, are at a high level. Also the fluctuations of competitors are smaller compared with Haier. This aspect shows that Haier's long-term asset investment activities in recent years have been frequently decreasing. In the meanwhile, the scale has been growing rapidly. On the other hand, Haier also shows that its profitability of long-term asset investment is much lower than the industry leaders.

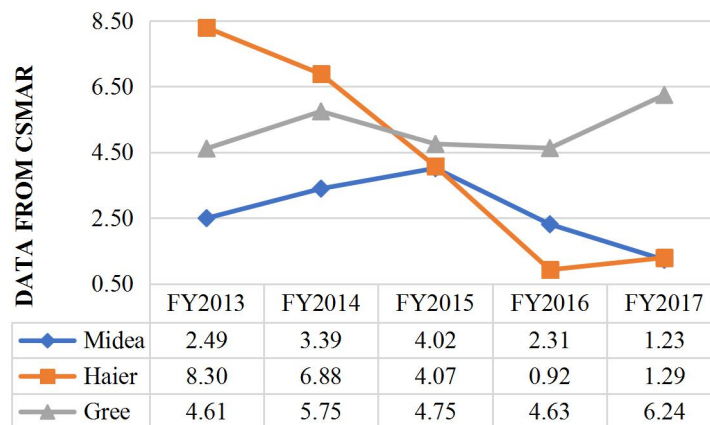


Figure 5 Comparison of Profit Rate of Intangible Assets

#### (2) Profit rate of intangible assets



The profit rate of Haier's intangible assets has also been declining in recent years, especially in 2016, it fell to 1.3 level, and rebounded slightly in 2017. Compared with Gree and Midea, Haier's downward trend was too fast. In 2016, the lowest profit margin of Haier's intangible assets was mainly due to the rapid accumulation of intangible assets. It is caused by the patent technology formed by R&D expenditure in the year 2016-2017. However, the market has not yet responded effectively.

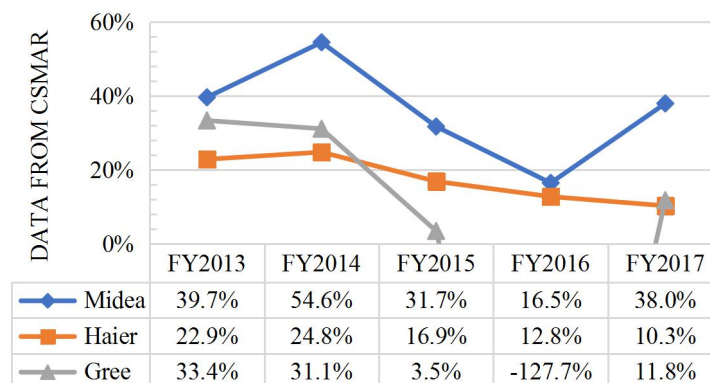


Figure 6 Comparison of foreign investment efficiency

### (3) Foreign investment efficiency

From the perspective of foreign investment efficiency, Haier's foreign investment efficiency has been in a slight downward trend since 2014. In 2017 it ended at its lowest point. Compared with competitors, Gree led Haier in 2013 and 2014. However, Haier's foreign investment efficiency was higher than Gree Electric after 2015. It is reflected that Haier's foreign investment is at a relatively high level in the industry.

### (4) Other project analysis

During the reporting period in 2016-2017, Haier held Bailian (600827.SH), Bank of Communications (601328.SH), Neusoft Carrier (300183.SZ), foreign exchange forward contracts and other financial assets totaling 23.03 million Yuan. During the reporting period of 2016-2017, the investment loss was approximately 8.85 million Yuan. The fair value of the cumulative appreciation is 80.27 million Yuan which was mainly contributed by foreign exchange forward contract.

Haier's investment income in 2016-2017 reached at 1.62 billion yuan. Since Haier has no long-term debt investment, it can be considered that most of the investment income is derived from the long-term equity investment. The amount of dividends receivable on the balance sheet was 106 million Yuan. The cash items received from the investment income in the cash flow statement amounted to 130 million Yuan. The excess part was the investment income receivable in the previous year. This shows that Haier's foreign investment income quality is relatively high.

## 6 Conclusion

Based on the above analysis, we can see that Haier's investment activities are of high quality. Its investment activities are matched with development strategies. However, Haier needs to pay attention to the improvement of systemic risks such as exchange rate and tariff policies in the future. Haier needs to take corresponding measures to diversify investment risks. In addition, Haier's return on investment is at a relatively high level in the industry, but large gap with its competitors such as Midea and Gree is indispensable. There is still room for improvement when we refer to Haier.

According to the evaluation of Haier's investment quality, we put forward the following two countermeasures. We hope that our study will be beneficial to the enterprise construction. Firstly, Haier needs to strengthen brand building. Haier's R&D investment has increased continuously in recent years. As a result, a large number of foreign brands have been acquired. However, the brands bought outside are not proportional to the profit in the statement. Haier already has a good brands package and technology foundation. Haier should further strengthen the construction of high-level brands, enhance consumer brand recognition, and strengthen the domestic market. The second is to strengthen the risk dispersion of investment activities. After Haier acquired GEA, its individual assets accounted for 50% of the total assets, which further improved Haier's investment risk. Haier should strengthen its management of investment activities. We believe all these tips will benefit the company.

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# Comprehensive Financial Evaluation of Listed Biomedical Companies Based on Factor Analysis and Cluster Analysis

Huang Ziyu

School of Management, Wuhan University of Technology, Wuhan, P.R. China, 430070

(E-mail: 1911711661@qq.com)

**Abstract:** This paper will study the financial status of 88 listed companies in the biomedical industry in 2019. Factor analysis will be used to extract three public factors reflecting the capability of three aspects from 10 indicators, and the companies will be ranked by calculating the score of each factor and the total score. According to the extracted three factors, cluster analysis is carried out on the companies, and 88 companies are divided into strength companies, ordinary companies and problem companies by means of multiple comparison of means, which provided certain basis for the business decisions of the company operators and the investment decisions of the investors. Finally, the paper puts forward countermeasures and suggestions to improve the business performance of listed companies in the biomedical industry, pointing out the direction for the improvement of performance and better development of biomedical enterprises.

**Key words:** Factor analysis; Cluster analysis; Financial status; Biological medicine companies

## 1 Introduction

In China, the biomedical industry is regarded as a sunrise industry with a rapid development momentum. With the rapid and stable growth of new product R&D expenditure, the production and marketing scale of new products of large and medium-sized enterprises in the bio-pharmaceutical industry in China showed a rapid growth trend from 2000 to 2015, but there is still a certain gap between China and developed countries. A few developed countries hold an absolute proportion in the global biomedical market and are in the leading position in the industry. Therefore, it is of long-term significance for the construction of biomedical enterprises to evaluate the financial performance of listed companies in China's biomedical industry, carefully analyze the financial status of enterprises in the industry, and then put forward suggestions for the biomedical industry. In this paper, factor analysis and cluster analysis in SPSS are carried out on the financial capacity of listed companies in the biomedical industry in 2018, and 88 companies are divided into three categories by means of multiple mean comparison, so as to provide certain basis for the company operators to make business decisions and investors to make investment decisions.

Dupont analysis is a financial ratio index analysis model created by DuPont company in the United States. It takes the return on equity as the comprehensive index and the return on total assets as the evaluation core. It is a method to comprehensively analyze and evaluate a company's financial status and profitability according to the relation and hierarchical relationship between financial ratios. Dupont analysis can analyze the profitability, operating capacity and solvency of enterprises. (Chen Yingying, 2015) Erik Hofmann and Kerstin Lampe used the detailed balance sheet analysis of

contingency theory, supplemented by correlation analysis, to provide information about the internal and internal financial structure, similarity and difference of LSP clusters. (Erik Hofmann, Kerstin Lampe,2013)

At present, there is not much research literature on the performance evaluation of biomedical industry in the theoretical circle, and there is even less literature on the evaluation by factor analysis. Chen Hongming and Xu Si conducted a comprehensive evaluation and research on the financial competitiveness of 50 listed biomedical companies by using the method of factor analysis, and proposed to increase the input-output and growth potential to improve the financial competitiveness, pointing out the development direction for bio-pharmaceutical companies. (HongMing and Xu Si ,2012)Yuan Kanglai and Liu Siwei evaluated the financial quality of listed companies in Hunan biomedical products from four perspectives, namely, operating quality, financing quality, investment quality and profit distribution quality, using methods such as index analysis and change comparative analysis, and concluded that the overall financial quality of listed companies in Hunan biomedical products was good. (Yuan Kanglai and Liu Siwei 2013)Liang Mengxue took listed biomedical companies in Hebei and its surrounding provinces as an example, constructed the financial comprehensive evaluation system of the industry through the dimensionality reduction thought of factor analysis, made evaluation and drew conclusions and Suggestions.(Liang Mengxue,2017) Zhang Min selected 40 listed biomedical companies as research samples and drew the conclusion of empirical study on the financial competitiveness of thesample companies after analysis. Finally, she found the existing problems in the financial competitiveness of biomedical companies at the current stage and put forward corresponding solutions and suggestions. (Zhang Min,2016)

## 2 Data and Methodology

According to the definition of the biomedical industry, this paper selects 88 a-share listed biomedical companies in Shanghai and Shenzhen and the data are all from CSMAR database. In order to comprehensively analyze the financial situation of the industry, \*ST companies are retained and the companies with missing financial data are excluded. A variety of financial indicators of the biomedical industry in 2018 are comprehensively selected,using factor analysis and cluster analysis to conduct research on its financial performance.

Considering the characteristics of the development of the biomedical industry and combining with the relevant theories of financial ability, this paper selects the ten variables including current asset ratio, cash ratio, accounts receivable ratio, rate of return on assets, return on equity, net operating rate, cost return rate, accounts receivable turnover, inventory turnover and fixed asset turnover.(Shimin, Wang Zeping,2010)

## 3 Results

### 3.1 Factor analysis

**Table 1 KMO and Bartlett's Test**

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		0.634
Approx. Chi-Square		661.941
Bartlett's Test of Sphericity	df	45
	Sig.	0.000

The closer the KMO value is to 1, the stronger the correlation between variables and the more suitable the original variables are for factor analysis. Bartlett is used to test whether the correlation matrix is the unit matrix, that is, to test whether each variable is independent. In factor analysis, if the null hypothesis is rejected, it means that factor analysis can be conducted. If the null hypothesis is not rejected, it means that these variables may independently provide some information, which is not suitable for factor analysis.

Through KMO and Bartlett spherical tests on the data, the results are shown in Table 1, and KMO value =0.634 and p value =0.000<0.05. It can be seen that the original data is suitable for factor analysis.

**Table 2 Total Variance Explained**

Component	Initial Eigenvalues			Extraction Sums of Squared Loadings	
	Total	% of Variance	Cumulative %	Total	% of Variance
1	3.635	36.347	36.347	3.635	36.347
2	2.374	23.745	60.092	2.374	23.745
3	1.439	14.393	74.485	1.439	14.393
4	0.965	9.652	84.137		
5	0.653	6.527	90.664		
6	0.335	3.348	94.011		
7	0.273	2.727	96.739		
8	0.221	2.207	98.945		
9	0.078	0.779	99.725		
10	0.028	0.275	100.000		

In order to eliminate the impact of dimensionality, the original data are first standardized, and factor analysis is conducted on the standardized data using SPSS, and the total explained variance is shown in Table 2. Three common factors are extracted according to ten factors, and the cumulative variance contribution rate is up to 74.485%, that is, the information reflected by these three factors accounts for 74.485% of the total information, which can describe the financial situation of listed biomedical companies more accurately

**Table 3 Rotated Component Matrix**

	Component		
	1	2	3
Current asset ratio	0.095	0.804	0.252
Cash ratio	0.017	0.687	0.241
Accounts receivable ratio	0.149	0.779	-0.458

Rate of return on assets	0.949	0.144	0.010
Return on equity	0.928	0.197	0.020
Net operating interest rate	0.869	-0.120	0.060
Rate of return on cost	0.962	0.002	0.053
Accounts receivable turnover	0.097	-0.151	0.824
Inventory turnover	0.006	-0.070	0.659
Turnover of fixed assets	-0.007	0.152	0.815

In this paper, the maximum variance method is adopted to rotate the load matrix, and the rotating component matrix is obtained as shown in Table 3. It can be seen that factor 1 is highly correlated with the rate of return on assets, the rate of return on net assets, the rate of return on component expenses and the rate of return on net assets, reflecting the profitability of enterprises. Factor 2 is highly correlated with current assets ratio, accounts receivable ratio and cash ratio, reflecting the solvency of enterprises. Factor 3 is highly correlated with accounts receivable turnover, inventory turnover and fixed assets turnover, reflecting the operating capacity of enterprises, which exactly confirms the three representative indicators reflecting the financial capacity of enterprises.

**Table 4 Component Score Coefficient Matrix**

	Component		
	1	2	3
Current asset ratio	0.019	0.327	0.183
Cash ratio	0.032	0.477	0.108
Accounts receivable ratio	0.024	0.302	-0.309
Rate of return on assets	0.272	0.014	-0.026
Return on equity	0.263	0.037	-0.017
Net operating interest rate	0.259	-0.089	0.007
Rate of return on cost	0.281	-0.044	0.001
Accounts receivable turnover	0.005	-0.053	0.563
Inventory turnover	-0.027	-0.038	0.266
Turnover of fixed assets	-0.046	0.118	0.334

According to the factor score coefficient matrix in Table 4, the factor score function can be obtained as follows:

$$F_1 = 0.019X_1 + 0.032X_2 + 0.024X_3 + 0.272X_4 + 0.263X_5 + 0.259X_6 + 0.281X_7 + 0.005X_8 - 0.027X_9 - 0.046X_{10}$$

$$F_2=0.327X_1+0.477X_2+0.302X_3+0.014X_4+0.037X_5-0.089X_6-0.044X_7-0.053X_8-0.038X_9+0.118X_{10}$$

$$F_3=0.183X_1+0.108X_2-0.309X_3-0.026X_4-0.017X_5+0.007X_6+0.001X_7+0.563X_8+0.266X_9+0.334X_{10}$$

Based on the results of factor analysis in Table 4, profit-seeking ability factor, debt paying ability factor and operation ability factor score values as the independent variable, with explanation as dependent variable, build multivariate linear regression model, the formula is:

$$Y= (0.36347F_1+0.23745F_2+0.14393F_3) /0.74485$$

**Table 5 Score and Ranking of Biomedical Enterprises**

Enterprise Name	F1	F2	F3	Y	Ranking	Euclidean distance
Nanjing Medicine	-0.30017	4.28171	-0.64099	1.095	1	3.544
Baiyun Mountain	0.21973	1.72522	1.01892	0.854	2	0.663
Renhe Medicine	0.54091	0.39571	2.2394	0.823	3	1.613
Yunnan Baiyao	0.50706	0.83305	1.5563	0.814	4	0.848
Ma Yinglong	-0.03107	0.76556	2.97086	0.803	5	2.157
Qian Jin Medicine	0.26688	0.67696	2.29124	0.789	6	1.512
Ji Chuan Medicine	1.53695	0.3054	-0.45	0.76	7	1.581
De Zhan Health	1.07784	0.98151	-0.42887	0.756	8	1.594
Heng Rui Medicine	1.06259	0.62054	0.1306	0.742	9	1.269
East China Medicine	0.65848	1.50665	-0.3659	0.731	10	1.386
Jilin Aodong	0.34135	-1.50663	-0.60968	-0.432	78	1.185
North China Medicine	-0.11259	-1.00572	-0.29238	-0.432	79	0.664
Sheng Ji tang	0.04407	-0.83175	-1.25451	-0.486	80	1.061
Qian jiang Biochemical	-0.65475	-0.75393	0.15696	-0.53	81	0.972
Ren Fu Medicine	-0.78158	-0.15118	-0.88513	-0.601	82	1.105
Hai Zheng Medicine	-0.33771	-1.20901	-0.3497	-0.618	83	0.946
Jiangsu Wuzhong	-0.85368	-0.56267	-0.28077	-0.65	84	0.993
Bai Yi Medicine	-1.2114	-0.48496	0.42538	-0.664	85	1.52
*ST Biological	-1.6795	-0.65447	0.31285	-0.968	86	1.921
Jiaoda Angli	-4.55518	-0.79393	-0.02916	-2.482	87	0.923
*ST Baihua	-6.07603	-0.0882	-0.80238	-3.148	88	0.923



Factor analysis scores were summarized, and 88 enterprises are ranked according to their scores, as shown in Table 5. Due to space constraints, this article lists the top 10 and bottom 10 companies.

(1) Comprehensive analysis: From the comprehensive score, there are 43 companies with a positive score and 45 companies with a negative score. Nanjing Medicine is the only company with a score greater than 1 and 18 companies with a score greater than 0.5, indicating that the overall financial level of China's biomedical industry is relatively good. From the perspective of individual enterprises, Nanjing Medicine, Baiyun Mountain, Renhe Medicine and other listed companies have a high total score and significant financial level, while \*ST biology, Jiaoda Angli only and \*ST Baihua and other enterprises have a total score significantly lower than the average level. Sort by composite scores, the top five with Nanjing Medicine, Baiyun Mountain, Renhe Medicine Yunnan Baiyao and Ma Yinglong has good performance, because they are the most common factor depends on top. It shows the company's financial performance is the result of comprehensive factors, and not just rely on one thing.

(2) Single factor analysis: In general, among the three factors, the first factor, namely the solvency factor, has obvious differences. Under the premise of standardization, there is still the level of minimum value -6.07602 and maximum value 1.780339. The profit level also has the big difference, in comparison, the operating ability difference is small; Secondly, among the 88 companies, most of them have significant differences in solvency, profitability and operating capacity. For example, Nanjing Medicine scores as high as 4.28171 in F2 solvency factor, while Jilin Aodong scores as low as -1.50663. In addition to the three consecutive years of lossmaking enterprises with the \*ST logo, there are also some enterprises showing varying degrees of losses, such as the operating net interest rate of Qidi Guhan is -20.548% and Ren Fu Medicine is 12.7024%. It can be seen that some enterprises like them fail to make profits in 2019, which also indicates that these enterprises need to update their financial strategies.

**Table 6 Descriptive Statistics**

	Minimum	Maximum	Mean	Std. Deviation	Variance
F1	-6.07602	1.780339	0.000000	1.00000	1.000
F2	-2.71060	4.281701	0.000000	1.00000	1.000
F3	-1.95239	2.970864	0.000000	1.00000	1.000
Y	-3.14812	1.094626	0.000000	0.614074	0.377

Through the description statistics analysis Table 6, biological medicine between solvency and profitability of listed companies is larger. Operating capacity difference is small and the total score difference is also bigger. The overall differentiation phenomenon is serious as well.

### 3.2 Cluster analysis

#### 3.2.1 Cluster analysis and results

**Table 7 Cluster Analysis**

Category	Number	The Name of the Company
		Yunnan Baiyao , Ren He Medicine, Bei Da Medicine, Tai He Health, De Zhan Health, Shanda Huate, Jinlin Medicine, East China Medicine, China Medicine, Tong Ren Tang,

one	23	Tong Ji Tang, He Rui Medicine, Zhong Xin Medicine, Baiyun Mountain, Health Yuan, Qian Jin Medicine , Nanjing Medicine , First Medicine Ma Yinglong, Jiu Zhou Tong, Guo Nong Technology, Lizhu Group, Qidi Guhan  Feng Yuan Medicine, Zhen Xing Biochemical, Dong'e donkey hide gelatin, *ST Biochemical, Zhongyuan Xiehe, Sihuan Biochemical, Wanze Group, Haihan Medicine, Dongbei Medicine , Haixin Group, Jilin Aodong, Changchun Gaoxin, Zhejiang Zhenyuan, Berry Gene, Guang Yuyuan, Pulo Medicine ,Xinhua Medicine, Tonghua Jinma, Jingfeng Medicine, Lukang Medicine, Zhongguancun, Guangji Medicine ,Jiu Zhi Tang, Huarun Sanjiu, Qianjiang Biochemical, Wandong Medicine, Huarun Shuanghe, Renfu Medicine ,Jinhua Group, Jianmin Group, Taiji Rroup, Fuxing Group, Jiangsu Wuzhong ,Tibetan Medicine , North China Medicine, Zhejiang Medicine, Tailong Medicine,  Haizheng Medicine, Hayao Group, Kaikai Company, Lingrui Medicine, Yabao Medicine, Modern Medicine, Furen Medicine, Kunyao Group, Tianyao Rroup, Lianhuan Medicine, Guofa Group, Tonghua Dongbao, Kangmei Medicine, Huahai Medicine , Shandong Yaopi, Tian Shili, Lanhai Investment , Kangyuan Medicine, Jichuan Medicine, Kang Enbei, Tianmu Medicine, Yibai Medicine, Shenqi Medicine, Fudan Medicine, Xinhua Medical
two	63	
three	2	Jiaoda Angli, *ST Baihua

Clustering is a process of classifying data into different classes or clusters, so objects in the same cluster have great similarity, while objects in different clusters have great heterogeneity. In this paper, k-means Cluster clustering method is adopted to classify the business performance level of listed companies in the biomedical industry through cluster analysis on the basis of factor analysis, so as to observe their performance distribution more intuitively. The results of cluster analysis are shown in Table 7.

Category 1 companies have the best business performance, with 23 companies accounting for 26.14% of the total sample, indicating that there are many high-quality companies in the biomedical industry in China. The second-class companies have medium and lower business performance levels, accounting for nearly three-quarters of the total samples. The characteristics of such companies are that their overall performance is generally lower, with their own advantages, but also some problems. There are only two companies in the three categories, with poor business performance, unsatisfactory factor scores and comprehensive score. For these companies, they are under great pressure to make a breakthrough in financial performance.

### 3.2.2 Multiple mean comparison

Table 8 shows the types of the importance of each factor can be seen that the first kind of solvency factor and profitability factor value, namely the three types of first class in the debt paying ability factor and profitability factor represents a significant advantage.

Power Companies: The first kind of companies, including Yunnan Baiyao and Ren He Medicine, etc., their solvency factor and profitability factor are seriously, namely the company solvency and profitability are strong, their composite scores were in the top several, the company has powerful strength, therefore, the first kind of companies can be said for the power companies, investors to invest in the company can get better returns.

Ordinary Companies: The second category of companies, including Feng Yuan Medicine, Zhen Xing Biochemical, and the revitalization of their solvency factor, profit ability factor and operation ability factor, the importance of general, namely, the company's solvency, profitability, operation ability is very general, they also ranked in the lowest scores, therefore, the second type of company can be said for the ordinary companies. This should attract the attention of corporate managers, and investors need to be cautious.

Problem Companies The third category of companies only have Jiaoda Angli and \*ST Baihua, they do not pay much attention to the three types of factors, their comprehensive score ranking in the last few, it can be said that the third type of companies as problem companies. Such companies shall create attaches great importance to the company managers. (You Yi, Liu Wanlu,2014)

**Table 8 The Importance of Each Factor for Each Category**

	The first kind	The second kind	The third kind
Profitability factor	2.12566	0.12287	-5.31561
Solvency factor	1.09245	-0.38483	-0.44106
Operating capacity factor	0.84472	-0.29519	-0.41577

## 4 Conclusion

Through factor analysis and cluster analysis, it is found that the overall financial performance of listed bio-pharmaceutical companies in China is average, but the gap between enterprises is large, and some enterprises have insufficient financial capacity.

In order to maintain the good momentum of development, biological medicine industry should take measures from the following several aspects: (1) Different companies in terms of profitability, operation ability, debt paying ability each are not identical. Decision-makers can make decisions according to their different focuses on the company, and can find out the company's relative competitive advantages according to the analysis results, learn from each other, give play to the advantages of the company, and improve the competitiveness of the company.(Xu Guoxiang, Tan Xiangqiu,2000)(2) Enterprise managers should always pay attention to summarize and analyze the financial situation and operating results of enterprises, so as to timely find and solve problems. Nowadays, only by constantly transforming and upgrading, actively seeking innovation, and developing suitable products according to its own actual situation, can an enterprise be invincible in the competition. (Zhang Fengshun, Cui Gang,2010)

In this paper, factor analysis and cluster analysis are used to comprehensively evaluate the business performance of listed biomedical companies, and the evaluation results are obtained. The evaluation indexes have good objectivity, and many indexes are integrated into a few basically unrelated comprehensive factors, so as to achieve the purpose of reducing dimension and reducing the superposition of information among evaluation indexes. If the financial statement data of multiple time periods are selected for comprehensive research and analysis by factor analysis method, the operation situation of listed biomedical companies can be judged more clearly, which is more conducive to the scientific decision-making of decision makers. (Ma Shuzhong, Chen li, Zhang Hongsheng,2008)

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## **Empirical Research on Corporate Social Responsibility and Tax Radical: Independent Directors as Adjustment Variables**

Li Zhouliang, Yu Shuang, Zhou Guoqiang

School of Management, Wuhan University of Technology, Wuhan, P.R.China, 430070

(E-mail: 269519708@qq.com, 2414819414@qq.com, gzhouq@whut.edu.cn)

**Abstract:** This paper takes China's 2012-2018 A-share listed companies in Shanghai and Shenzhen Stock exchange as a research sample, using regression analysis to find out: (1) The higher the degree of fulfilling social responsibility, the more enterprises tend to reduce tax radical; (2) Independent directors have a regulatory effect on the relationship between corporate social responsibility and tax radical. The conclusions of the study reminded Chinese enterprises to strengthen the implementation of social responsibility and the construction of independent directors to control corporate tax risks.

**Key words:** Corporate social responsibility; Independent director; Tax radical; Regulation

### **1 Introduction**

In order to obtain more retained resources, enterprises will adopt tax radical, and corporate tax radical will risk tax violations if they are not controlled. How to adjust its tax radical and avoid breaking the boundaries of illegality has become a risk issue, enterprises cannot ignore. Researchers at home and abroad have conducted in-depth analysis. On the one hand, some scholars believe that corporate social responsibility can significantly affect tax radical (Hancock,2005). If a company adopts tax radical and does not pay due taxes, which has a negative impact on society, then tax radicals against its social responsibility (Zhai,2012). The government's corporate income tax is mainly used for the construction of public facilities. If the enterprise does not pay the due tax if it adopts tax radical, it will hinder the government's public construction funding sources and cause bad social influence, so tax radical of the company is against its social responsibility(William, 2007).Corporate social responsibility requires companies to consider the impact on social interests when making business decisions, including the impact of tax radical decision-making on social interests (Avi-Yonah, 2008).Foreign scholar uses the KDJ index to measure corporate social responsibility performance, and uses unrecognized tax radical as a proxy for tax radical, and finds that companies with good social responsibilities have lower tax radical(Watson, 2011).Tax radical are intangible assets that reduce the company's reputation, so companies will reduce their tax radical to maintain the ultimate corporate value(Manon, 2015).On the other hand, some scholars believe that independent directors can significantly influence tax radical (Richardson, 2013), Minnick et al first proposed that the company's tax radical may be affected by independent directors. They found that company supervision (including independent directors) has no significant impact on the company's book tax, but company supervision will determine the company's tax policy(Minnick et al, 2010).If the proportion of independent directors on the board increases, the tax radical for companies will decrease(Lanis, 2011),and independent directors also have an impact on the implementation of corporate social responsibility (Jamali,2008). Domestic scholar believes that in corporate governance, companies have an incentive to improve the sense of ethics, openness and responsibility of their business operations, and company decisions should take into account the interests of various stakeholders inside and outside the company, including employees, customers, suppliers,

Community, society and environment(Huang, 2010). Their findings suggest that corporate governance (including independent directors and property rights) has a significant positive impact on corporate social responsibility performance. Then will independent directors have a regulatory effect on the relationship between corporate social responsibility and corporate tax radical? There are still few scholars concerned about this point. Based on this, this paper takes China's 2012-2018 A-share listed companies in Shanghai and Shenzhen as a research sample, and empirically analyzes the role of independent directors in regulating the relationship between corporate social responsibility and corporate tax radical.

## **2 Theoretical Analysis and Research Hypothesis**

### **2.1 The impact of corporate social responsibility on tax radical**

When management makes aggressive tax decisions, it often considers the impact of social concerns, such as corporate social responsibility performance and corporate social reputation. Foreign scholars have conducted data surveys through questionnaires, they found that most managers consider the risk of corporate reputational loss when planning taxation (Graham, 2012). In order to reduce the overall risk of the company and increase the trust of stakeholders to maintain a good corporate reputation, the company will reduce the losses caused by negative events (such as tax radical) (Yang, 2015). At the same time, one of the ways to maintain corporate reputation is the fulfillment of corporate social responsibility, so corporate social responsibility will also affect tax radical (Hancock, 2005). From the perspective of social contract, domestic scholars have found that corporate social responsibility performance is significantly negatively correlated with tax radical. The more companies with higher social responsibility, the more concerned about the impact of corporate activities on society and the environment, the more likely their management is to consciously reduce tax radical (Zhai,2012). As a corporate culture always measures standards, if the corporate social responsibility performance is lax, it will damage the reputation of the company, and it's likely to increase the tax radical of the company (Fan, 2014). Some scholars have found that companies with higher social responsibility have lower tax radical, moreover, they report the willingness to disclose the negative impact of social responsibility on tax a radical (An, 2017). Therefore, this paper presents the first hypothesis.

Hypothesis 1: The better the performance of corporate social responsibility, the lower the corporate tax radical.

### **2.2 The role of independent directors in regulating corporate social responsibility and tax radical relationship**

Independent directors often have a wealth of knowledge, they can provide professional advice for management decisions, improve the quality of strategic decisions (Anderson, 2004; Dahya, 2005). Independent board of directors helps managers to weigh the importance of stakeholder rights or corporate performance and shareholder rights. Therefore, the role of independent directors in regulating corporate social responsibility and tax radical is likely to exist. This paper argues that the direction of this regulation is influenced by the independence of independent directors. Companies with more independent directors pay more attention to social performance in addition to financial performance (Ibrahim, 2003; Duhigg, 2012), Will support managers to reduce tax radical and enhance the negative impact of corporate social responsibility on tax radical. On the contrary, it will put the interests of shareholders in the first place, and oppose the excessive reduction of tax radical by managers, and weaken the negative impact of corporate social responsibility on tax radical. Therefore, this paper proposes a second hypothesis.

Hypothesis 2: The greater the proportion of independent directors to the total number of board members, the greater the degree of corporate social responsibility to curb tax radical.

### 3 Research Design

#### 3.1 Sample selection and data source

This paper selects A-share listed companies in Shanghai and Shenzhen stock markets from 2012-2018 as research samples. The corporate social responsibility index data comes from RKS, and the rest of the financial indicators are from the CSMAR database. And the following screening: (1) Excluding ST and \*ST companies; (2) Excluding gross profit and income tax expenses less than 0; (3) Excluding samples with missing financial data; (4) Excluding multiple nominal income tax rates sample. Through screening, this paper obtained 2835 samples. In order to prevent the influence of outliers on the results, we performed a tailing treatment of less than 1% and more than 99% of the continuous variables in the model.

#### 3.2 Variable design

Tax radical and progress. This article uses the term “tax radical” to represent the degree of tax radical (Jin, 2015; An, 2017). Calculate tax radical based on the fixed effect residuals method (*TAGG*) based on accounting tax differences. Accounting tax differences  $BT D_{i,t} = \alpha TA_{i,t} + \mu_i + \varepsilon_{i,t}$ , tax radical  $TAGG_{i,t} = \mu_i + \varepsilon_{i,t}$ . Among them, *BT D* is the accounting tax difference = total profit before tax - income tax expense / actual applicable tax rate, *TA* is the accrued item equals net profit - net cash flow generated by operating activities.  $\mu_i$  is the part of the accounting tax difference that does not change with time.  $\varepsilon_{i,t}$  is the characteristic part of the accounting tax difference.

Performance of social responsibility. This article uses the RKS Corporate Social Responsibility Score to measure corporate social responsibility performance.

Regulatory variables - the proportion of independent directors.

Control variables. This paper controls the company's size, asset-liability ratio, inventory intensity, capital intensity, growth capacity, shareholding ratio of the largest shareholder, annual, industry and other variables.

**Table 1 Variable Design**

Variable type	Variable meaning	Variable meaning	Variable description
Explanatory variables	Tax radical	<i>TAGG</i>	Accounting-tax differences that deduct the impact of accrued profits
Explained variable	Social responsibility performance	<i>CSR</i>	China's listed company social responsibility score issued by RKS
Moderator	Percentage of independent directors	<i>OUTDIRP</i>	Number of independent directors / total number of board members
Control variable	Business scale	<i>SIZE</i>	Natural logarithm of total assets
	Assets and	<i>LEV</i>	Total liabilities / total assets

	liabilities		
	Inventory weight	<i>INVENT</i>	Ending balance of inventory / total assets at the beginning of the period
	Fixed assets	<i>PPE</i>	Ending balance of fixed assets / total assets at the beginning of the period
	Intangible assets	<i>INTA</i>	Ending balance of intangible assets / total assets at the beginning of the period
	Growth ability	<i>MB</i>	Market value / total assets
	Equity concentration	<i>TOP1</i>	The shareholding ratio of the largest shareholder
	Annual dummy variable	<i>TEAR</i>	Take 1 when the variable data belongs to the year k, otherwise 0
	Industry dummy variable	<i>IND</i>	Take 1 when the company belongs to industry j, otherwise 0

### 3.3 Model design

In order to verify the impact of corporate social responsibility on tax radical in hypothesis 1, this paper constructs a regression model (1):

$$TAGG_{i,t} = \alpha_0 + \alpha_1 CSR_{i,t} + \alpha_2 SIZE_{i,t} + \alpha_3 LEV_{i,t} + \alpha_4 INVENT_{i,t} + \alpha_5 PPE_{i,t} + \alpha_6 INTA_{i,t} + \alpha_7 MB_{i,t} + \alpha_8 TOP1_{i,t} + \alpha_9 YEAR_{i,t} + \alpha_{10} IND_{i,t} + \varepsilon_{i,t} \quad (1)$$

In order to verify the role of independent directors in the hypothesis 2 on the adjustment of corporate social responsibility and tax radical relationship, this paper builds a model (2):

$$TAGG_{i,t} = \beta_0 + \beta_1 CSR_{i,t} + \beta_2 OUTDIR_{i,t} + \beta_3 CSR_{i,t} * OUTDIR_{i,t} + \beta_4 SIZE_{i,t} + \beta_5 LEV_{i,t} + \beta_6 INVENT_{i,t} + \beta_7 PPE_{i,t} + \beta_8 INTA_{i,t} + \beta_9 MB_{i,t} + \beta_{10} TOP1_{i,t} + \beta_{11} YEAR_{i,t} + \beta_{12} IND_{i,t} + \theta_{i,t} \quad (2)$$

Where i and t respectively represent the enterprise and year to which the variable data belongs,  $\alpha_0$  and  $\beta_0$  represent constant terms,  $\alpha_1 \sim \alpha_{10}$  are regression coefficients of variables in model (1), and  $\beta_1 \sim \beta_{12}$  are the regression coefficient of each variable in model (2),  $\varepsilon$  and  $\theta$  are random disturbance terms.

## 4 Empirical Analysis

### 4.1 Descriptive statistics

As can be seen from Table 2, the average of the tax radical is close to zero, and the median is negative, indicating that the accounting-tax differences caused by tax radical in some companies are negative, that is, the tax radical of more than half of the enterprises are lower. Moreover, the standard deviation of the tax radical is 0.0197, indicating that the tax radical vary widely between companies.



**Table 2 Sample Descriptive Statistics**

Variable	Maximum	Minimum	Mean	Standard deviation	median
<i>BTD</i>	0.0789	-0.0610	0.0016	0.0180	0.0007
<i>TAGG</i>	0.0751	-0.0605	0.0001	0.0197	-0.0009
<i>CSR</i>	80.4769	19.5890	40.4900	13.4250	37.1800
<i>OUTDIR</i>	0.5695	0.3070	0.3690	0.0539	0.3590
<i>SIZE</i>	29.4187	20.3180	23.3100	1.8480	23.0280
<i>LEV</i>	0.9425	0.0545	0.5210	0.2200	0.5260
<i>INVENT</i>	0.9693	0.0000	0.1900	0.2170	0.1280
<i>PPE</i>	0.8300	0.0019	0.2390	0.2090	0.1890
<i>INTAN</i>	0.5490	0.0000	0.0520	0.0794	0.0284
<i>MB</i>	0.0088	0.0001	0.0015	0.0014	0.0009
<i>TOPI</i>	0.7890	0.0790	0.3765	0.1610	0.3580

#### 4.2 Regression analysis

First, a regression analysis of the relationship between corporate social responsibility and tax radical is carried out to verify hypothesis 1. Then the regression analysis of the independent director's adjustment role is carried out to verify hypothesis 2.

The regression results of model (1) show that social responsibility performance and tax radical are negatively correlated and significant at 1%, that is, corporate social responsibility will curb tax radical. Enterprise size, asset-liability ratio, inventory proportion, fixed assets ratio, and intangible assets were significantly negatively correlated with tax radical. Growth capacity and tax radical were significantly positive. Relatedly, equity concentration is also negatively correlated with tax radical but the results are not significant. Therefore, this article accepts hypothesis 1.

The regression results of model (2) show that the product of social responsibility performance and independent directors ( $CSR*OUTDIR$ ) is significantly positively correlated with the tax radical at 5%, with a correlation coefficient of 0.001. When the proportion of independent directors is greater, the suppression of corporate social responsibility on tax radical is weakened. In this paper, the larger the proportion of independent directors predicted in hypothesis 2, the greater the suppression of corporate social responsibility on tax radical. Therefore, the empirical result rejects hypothesis 2.

**Table 3 Regression Results**

Variable	TAGG			
	Model (1)		Model (2)	
	Regression coefficients	Z test value	Regression coefficients	Z test value
<i>OUTDIRP</i>			-0.000219***	-5.08
<i>CSR*OUTDIR</i>			0.00100**	-2.65
<i>CSR</i>	-0.000220***	-5.03	-0.000220***	2.11
<i>SIZE</i>	0.00219***	4.45	0.00228***	4.58
<i>LEV</i>	-0.0116***	-3.67	-0.0120***	-3.75
<i>INVENT</i>	-0.00589**	-2.07	-0.00563**	-2.01
<i>PPE</i>	-0.00540**	-2.11	-0.00538**	-1.88
<i>INTA</i>	-0.0140**	-2.09	-0.0140**	-2.20
<i>MB</i>	1.634***	5.50	1.671***	5.57
<i>TOP1</i>	0.00313	0.90	0.00335	0.95
Constant term	-0.0389***	-3.91	-0.0338***	-3.30
<i>YEAR/IND</i>			Control	
Sample size			2835	
Adj-R <sup>2</sup>	0.3165		0.3174	
F value	36.6430		34.1490	
		Wald chi2 = 95.87 Prob > chi2 = 0.0000		

Note: \*\*\*, \*\*, and \* indicate significant levels at 1%, 5%, and 10%, respectively.

### 4.3 Robustness test

In order to enhance the reliability of the research conclusions, this paper uses *BTD* as the substitute variable of *TAGG* to measure the corporate tax radical, and conducts regression analysis again to enhance the robustness of the empirical results. The regression results of *BTD* are consistent with the regression results of *TAGG*, and support again hypothesis 1 and reject hypothesis 2.

## 5 Conclusion

The research results show that the performance of corporate social responsibility is negatively

correlated with the tax radical. The greater the proportion of independent directors, the less the degree of suppression of corporate social responsibility on tax radical, and the industry with good corporate social responsibility can effectively curb tax radical. Based on this, this paper proposes from the enterprise level and the government level respectively: enterprises should include corporate tax radical behaviors as social responsibility evaluation indicators and strengthen the construction of independent directors; the government should strengthen tax radical review and improve the performance of enterprises with low social responsibility. Independent director system to improve the independence of independent directors.

Through the analysis of relevant theories, this paper tentatively studies the relationship between corporate social responsibility, independent directors and tax radical. This paper still has some shortcomings. Independent directors are only a part of corporate governance. This article only focuses on independent directors. Whether the other corporate governance variables have a similar role in regulating the social responsibility and tax radical, future research can be cut into other parts of corporate governance to study the role of corporate governance in regulating the social responsibility and tax radical of independent directors.

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## Research on Information Disclosure Behavior of Listed Companies: Taking \*ST Olefin Carbon as An Example

Zhu Hanlin, Wan Youqing

School of Management, Wuhan University of Technology, Wuhan, P.R. China, 430070

(E-mail: 295094403@qq.com, w13308641188@126.com)

**Abstract:** This paper uses the methods of statistical analysis and case analysis to conduct statistical analysis of the administrative penalty decision issued by the China Securities Regulatory Commission from 2013 to 2017. It is considered that the disclosure of information violations by listed companies in China is divided into three types: information disclosure is incomplete, unreal, and not timely, of which incomplete disclosure is the most commonly used method of disclosure of information by listed companies. Taking silver-based carbon new material group Co., Ltd. as an example, this paper deeply studies the disclosure of accounting information violations of listed companies, and then carefully analyzes the root causes of the company's violations. The main reasons for the disclosure of information violations of listed companies are as follows: Avoid ST and illegal profit, illegal cost is too low, the company's board of directors and the board of supervisors dereliction of duty, the company's internal governance structure is not perfect and internal control is not perfect, the external agency supervision is insufficient, the intermediary agency's responsibilities are lacking, and then proposed to curb the violation of the securities market Disclosure of behaviors that frequently occur in this behavior.

**Key words:** Information Disclosure; Violations; Listed Companies; \*ST Olefin Carbon

### 1 Introduction

The accounting information disclosure of listed companies affects the decision-making power and judgment of investors, and is an important basis for the supervision and management of the state regulatory authorities. Only the correct disclosure of accounting information can reflect the company's real operating conditions, and get effective market feedback to form a good trading environment for the securities market. If a listed company has a violation of information disclosure, it will lead to confusion in the market order, and will also infringe on the rights of the company's stakeholders, which will adversely affect the sound development of the entire securities market.

In China's securities market, incidents of disclosure of accounting information violations have occurred from time to time. Listed companies such as Zhangzidao, Wuliangye, Beidahuang and Zixin Pharmaceuticals have serious disclosures of accounting information violations. These violations not only infringe on the interests of investors, but also cause investors to lose confidence in the securities market, which is not conducive to establishing a good image of listed companies in China, and seriously hindering the healthy and sustainable development of China's securities market. How to ensure the standardization of accounting information disclosure behavior of listed companies and solve the quality and quantity problems of accounting information disclosure will have important significance for the majority of stakeholders and have a positive effect on promoting the sound development of China's securities market.

This paper analyzes the administrative penalty decision issued by China Securities Regulatory

Commission from 2013 to 2017, and selects Silver-Based Carbon New Materials Group Co., Ltd. (hereinafter referred to as \*ST Olefin Carbon) as a case to study the accounting of the listed company. Information disclosure violations, analysis of the causes of the company's violations, proposed governance measures relative to the company, and more effective ways to prevent accounting fraud and financial fraud relative to the entire financial market. This can be used as a reference for peers, enabling relevant departments to play a more effective regulatory role, protect the rights of stakeholders, and contribute to the healthy development of China's securities market.

## 2 Literature Review

By combing the research status and research characteristics of information disclosure violations of listed companies in China, through analysis, it is found that the status, types, causes and opinions of information disclosure violations are the main direction of scholars' research.

Many scholars have explored the status and types of violations of listed companies.

Lu Yating (2014) and Sun Hongmei, Jiang Na and Yan Lei (2011) all selected certain samples to statistically analyze the multiple levels of individuals and groups of corporate listed companies in China, and reached a consensus conclusion and proposed relevant measures: violations of listed companies in China The information disclosure violations in the behavior accounted for the highest proportion, the main problem is the incomplete disclosure of major issues. Listed companies should strengthen legal system construction, increase penalties, broaden financing channels, strengthen internal control and internal audit, and strengthen research on auditing methods and auditing methods.(Lu Yating, 2014; Sun Hongmei, Jiang Na, Yan Lei, 2011)

Wang Ruixue and Qiao Ruihong (2015) selected 352 listed companies from 2006 to 2012 as samples to statistically analyze the causes, types and means of management fraud of listed companies, and concluded that listed companies obviously prefer information disclosure violations, among which the most frequent violations occur. It is postponed disclosure and major omissions. (Wang Ruixue, Qiao Ruihong, 2015)

Many scholars have explored the reasons for the disclosure of information violations by listed companies.

Song Chuan and Lai Yiran (2012), Feng Wenli (2015), Yi Yi (2018), Zhang Yue and Wu Qifu (2018) all believe that the main reason for the disclosure of information violations by listed companies is the lack of strict supervision by external regulators. Too small. Among them, Song Chuan and Lai Yiran (2012) and Zhang Yue and Wu Qifu (2018) selected listed companies for a certain period of time as the research object for empirical research, and found that the supervision of the CSRC increased the level of R&D information disclosure.(Song Chuan, Lai Yiran, 2012;Feng Wenli, 2015;Yi Yi,2018; Zhang Yue, Wu Qifu, 2018)

Yan Huahong and Bao Nan (2015) and Xu Xiang (2015) conducted case studies to analyze the disclosure of information violations by listed companies. Yan Huahong and Bao Nan (2015) analyzed the case of Wuliangye financial fraud. The game analysis results and data backwashing results confirmed that the fundamental reason for the low quality of information is that the corporate governance is imperfect and fails to suppress the speculative motives of the operators. Xu Xiang (2015) analyzed the case of \*ST Boyuan and proposed corresponding measures and suggestions for violations. He believes that improvements should be made in three aspects: regulatory agencies, internal operations and intermediaries. (Yan Huahong and Bao Nan, 2015; Xu Xiang, 2015)

Wu Guoping and Ma Shi (2010) selected companies that were punished by the Securities and Futures Commission as research objects, and selected some companies that regulate disclosure to compare the two. They found that financial pressures are highly correlated with accounting information violations. The greater the financial pressure on listed companies, the greater the probability of information breaches. (Wu Guoping, Ma Shi, 2010)

Fang Hongxing et al. (2009) believe that larger listed companies will generate higher agency costs and are more willing to disclose true and complete accounting information. (Fang Hongxing, Sun Wei, Jin Yunyun, 2009)

Based on the research of the literature, this paper summarizes the status quo, influencing factors and improvement measures of the accounting information violation behavior of listed companies. Domestic and foreign scholars mainly analyze the violations from the aspects of financial status, internal structure and external supervision. This paper makes use of the research results of predecessors to conduct statistical analysis on the administrative penalty decision issued by China Securities Regulatory Commission from 2013 to 2017, and analyzes the status quo of listed companies' illegal disclosure of accounting information behavior, and discusses its causes and harms. Propose corresponding governance measures.

### 3 The Statistical Analysis of Information Disclosure Violations of Listed Companies

#### 3.1 The overall distribution of information disclosure violations of listed companies

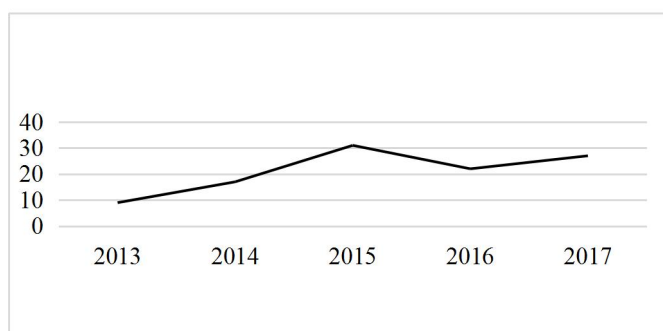
This paper analyzes and studies 522 administrative penalties published publicly on the official website of China Securities Regulatory Commission from 2013 to 2017, excluding penalties that are not related to information disclosure violations, as well as accounting firms, law firms, securities companies, and asset valuation companies. Penalties for a series of intermediaries and senior executives of listed companies, media organizations, and 106 listed companies were selected as data samples for research.

**Table 1 Classification Statistics of Punishment Objects**

Punishment Object	Sample listed company	Accounting firm	Law office	Securities company	Asset valuation company	Media	Executive	Other
Statistics	106	21	2	12	6	5	300	60

Source: According to the official penalty website of the China Securities Regulatory Commission

After counting the number of listed companies that violated the disclosure of accounting information in 2013-2017, it was found that the number of companies from 2013 to 2015 showed an upward trend year by year, and declined in 2016, and rebounded again in 2017. To a certain extent, this shows that the work of China's regulatory agencies has certain effectiveness, but the regulatory effect is not enough, and it is impossible to completely suppress the listed company's illegal disclosure of



information. The specific situation is shown in Figure 1.

**Figure 1 Annual Distribution of Information Violation Disclosure Behavior**

Source: According to the official penalty website of the China Securities Regulatory Commission

After statistical analysis of the sample companies selected, 106 listed companies reported a total of 160 violations, and the frequency of violations was 150.94%. The specific results are shown in Table 2. It shows that each sample listed company has at least 1.5 information disclosure violations, which reflects the universality of violations of information disclosure in listed companies.

**Table 2 Statistics on the Number of Disclosures of Sample Company Information Violations**

Number of sample companies	Number of occurrences	Frequency occurring in the sample (%)
106	160	150.94

Source: According to the official penalty website of the China Securities Regulatory Commission

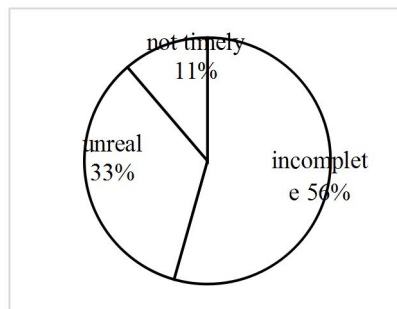
**3.2 Classification and statistics of information disclosure violations of listed companies**

This article divides information disclosure violations into three types: information disclosure is incomplete, information disclosure is not true, and information disclosure is not timely. This paper further analyzes the types of specific information violation disclosure behaviors of 106 sample listed companies. See Table 3 for details.

**Table 3 Classification of Information Violation Disclosure**

Type of violation disclosure	Number of occurrences	% of violations
incomplete	87	54.38
unreal	55	34.37
not timely	18	11.25
total	160	100

Source: According to the official penalty website of the China Securities Regulatory Commission



**Figure 2 Classification of Information Violation Disclosure**



Source: According to the official penalty website of the China Securities Regulatory Commission

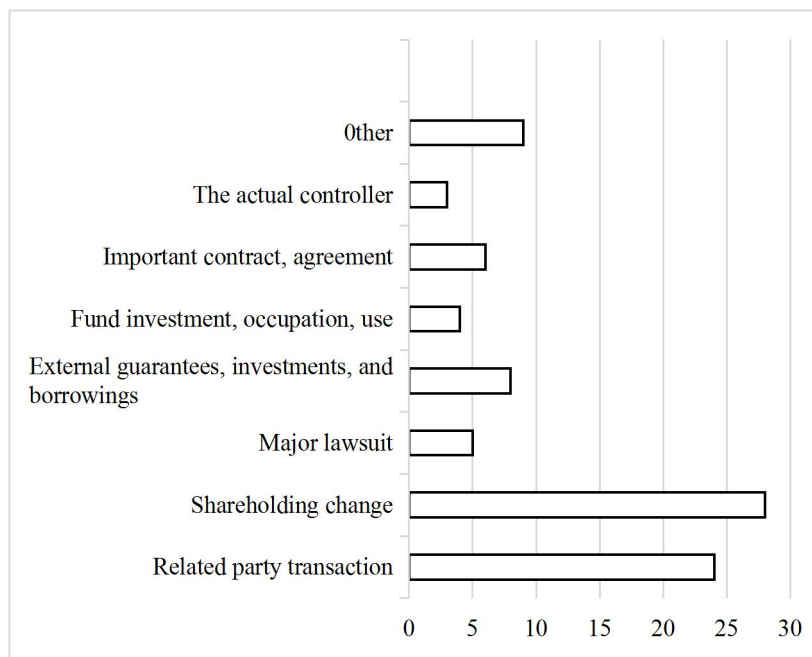
According to the statistical analysis in Table 3 and Figure 2, 106 sample companies have disclosed 160 information violations and 87 incomplete information disclosures. The frequency of violations in the disclosure is 54.38%, more than half. The infrequent disclosure behavior of listed companies has the highest frequency, indicating that this method is the most commonly used method for information disclosure in violation of regulations. The reason may be that if a listed company has a major violation, it is easy to be discovered by the CSRC and severely punished. The integrity of the disclosure information is difficult to identify. The company is not easy to find in this way, and can mislead investors to make wrong decisions and obtain illegitimate interests.

According to the announcement of the administrative punishment of the CSRC, the information disclosure behavior of listed companies was further analyzed. The analysis results are shown in Table 4.

**Table 4 Statistics of Incomplete Disclosure Types**

Incomplete disclosure type	Number of occurrences	% of incomplete disclosure	% of violations
Related party transaction	24	27.59	15.00
Shareholding change	28	32.18	17.50
Major lawsuit	5	5.75	3.13
External guarantees, investments, and borrowings	8	9.20	5.00
Fund investment, occupation, use	4	4.60	2.50
Important contract, agreement	6	6.90	3.75
The actual controller	3	3.45	1.88
Other	9	10.34	5.63
Total	87	100	54.38

Source: According to the official penalty website of the China Securities Regulatory Commission



**Figure 3 Non-integrity Disclosure Type Statistics**

Source: According to the official penalty website of the China Securities Regulatory Commission

From the analysis of the statistics in Table 4 and Figure 3, there are 82 incomplete behaviors in 97 companies, and the incomplete disclosure of shareholdings occurs most frequently. It shows that the listed company failed to accurately and completely disclose the shareholdings, share transfers and holdings. There are also many occurrences of incomplete relationships between related relationships and related party transactions. Explain that the company lacks comprehensiveness and completeness in the disclosure of related transactions that can affect financial results and operating conditions.

## **4Case Analysis of \*ST Olefin Carbon Information Violation Disclosure Behavior**

### **4.1 Basic situation of \*ST olefin carbon**

Silver-Based Carbon New Materials Group Co., Ltd. (hereinafter referred to as \*ST-olefin) was established in 1989 and listed on the Shenzhen Stock Exchange in 1993 (000511). It is the first listed company in the Northeast of Shenzhen Exchange. Its main business includes the development, processing and sales of olefinic carbon new materials such as graphene carbon, rare earth activated carbon and refractory carbon.

The company's development process is as follows:

In 2000, the company entered the real estate market and became one of the largest real estate developers in the Northeast. In 2013, the company entered the graphene and advanced carbon industry and was committed to creating a service platform for graphene industrialization. In 2016, the company entered the new energy automobile industry, promoted the replacement of traditional fuel vehicles by new energy vehicles, and implemented the policy of fully developing the new energy automobile

industry chain with power batteries as the mainstay, supplemented by motor electronic control.

When the violation occurred	Event
May 4, 2016	The audit institution issued an audit report that could not express opinions on the 2015 annual report, and the Shenzhen Stock Exchange ordered it to implement the “delisting risk warning” from now on.
July 19, 2016	The CSRC issued a warning letter stating that *ST olefin carbon concealed the behavior of major information disclosure matters and ordered it to implement rectification.
October 13, 2016	The CSRC filed a case to investigate its information disclosure violations.
February 15, 2017	The Shenzhen Stock Exchange issued the "Decision on Public Reprimands for the Company and Related Parties", because its annual report disclosed errors and corrections for two consecutive years of losses and concealed external guarantees to publicly condemn the company and related responsible personnel.
June 16, 2017	The CSRC issued the "Administrative Punishment and Advance Notice for Market Prohibition". As a result of failing to disclose major events in 2015, the financial data of the annual report was falsely given a warning, a fine of 600,000 yuan, and warning and fines of other responsible personnel.
July 6, 2017	As the company lost 271 million yuan, 17.41 million yuan, 474 million yuan in the three years from 2014 to 2016, it will be suspended from now.
September 9, 2017	Received the “Notice of Administrative Punishment Prior Notice” from the Securities Regulatory Bureau, because it did not disclose the 2016 annual report and the first quarterly report in 2017 within the statutory time limit, it was ordered to correct the company, give a warning and impose a fine of 400,000, and give it to the responsible person. Warning and fine.
October 11, 2017	The Shenzhen Stock Exchange issued the "Decision on Disciplinary Action against Companies and Related Parties", pointing out the eight violations of the company.  The CSRC issued the "Administrative Punishment Decision", because the company failed to disclose major events in 2015 and the financial data of the annual report was falsely

\*ST Olefin Carbon group owns Jiangsu Yinjiene Carbon Energy Technology Co., Ltd., Shenzhen Yinjiene Carbon Energy Technology Co., Ltd., Panjin Yinjiene Carbon New Energy Technology Co., Ltd., Shenyang Yinji Real Estate Co., Ltd., Haicheng Magnesium Trading Co., Ltd. Beijing Yinxin Investment Co., Ltd. and Beijing Ethylene Graphene Technology Research Institute Co., Ltd. It will form a three-dimensional business development pattern with two strategic emerging industries – new materials and new energy vehicles as the core and real estate as the supplement.

\* ST olefin carbon corporate governance structure is as follows: the board of directors consists of a chairman, three directors, three independent directors of the decision-making body. The board of supervisors is responsible for supervising the board of directors and senior management of the company, consisting of one supervisor and two supervisors. The senior management is responsible for the day-to-day operations of the company and consists of a president, two vice presidents and directors of various departments.

#### 4.2 \* ST Olefin Carbon Information Violation Disclosure Case Review

Table 5 \* ST Olefin Carbon Information Violation Disclosure Case Review

December 19, 2017	given a warning, a fine of 600,000-yuan, warning and fine related person in charge, taken against the two principal responsible persons Market ban measures.
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Source: According to the official penalty website of the China Securities Regulatory Commission

### 4.3 \*ST Olefin Carbon Information Disclosure Problem Analysis

This paper analyzes in detail the specific violations of \*ST olefinic carbon from three aspects: incomplete, untrue, and untimely information disclosure.

#### 4.3.1 Information disclosure is incomplete.

In terms of incomplete disclosure of information, the company has a series of information disclosure violations, such as incomplete disclosure of related party transactions, undisclosed foreign investment and major external borrowings, and undisclosed asset impairment.

The disclosure of related party transactions is incomplete. In 2016, Ningbo Hangzhou Bay New District Carbon-based New Materials Co., Ltd., a wholly-owned subsidiary of ST-Alken Carbon, purchased about 300 million yuan of electrolytic copper from related party Xiangyi Tonglian Supply Chain Co., Ltd. The "Stock Listing Rules of Shenzhen Stock Exchange" stipulates that listed companies shall promptly disclose transactions with related parties (transaction amount is more than 3 million yuan, and account for more than 0.5% of the latest audited net assets of listed companies). The transaction amount is far more than 3 million yuan, and accounted for 22.85% of the company's audited net assets at the end of 2015. It can be seen that the above matters have constituted connected transactions. However, \*ST olefin carbon did not disclose any information about this related transaction, which is an incomplete disclosure of information.

Major foreign investment and external borrowings were not disclosed. \*ST Olefin Carbon and Tianjin Yinrui Wantong Asset Management Co., Ltd. and Hengrong Co., Ltd. signed the "Xihua Carbon Exchange Financing Leasing Co., Ltd." contract on November 10, 2015, and the contract stipulated the establishment of Xihua Carbon Exchange Financing Leasing Co., Ltd. the company. The contract stipulates that \*ST olefin carbon will be paid a total of 180 million yuan.

Beijing Yinxin Investment Co., Ltd. (\*ST olefin carbon holding subsidiary) signed the "Loan Agreement" with Panjin Zhongyue Optoelectronics Technology Co., Ltd. on April 26, 2016, which agreed that Beijing Yinxin will lend to China on the date of signing the agreement. Photoelectricity of 385 million-yuan, loan interest of 4 million yuan, the term is not more than 30 days. On the same day, the three companies also signed a "guarantee contract", and the contract stipulated that Zhongyue Investment shall be jointly and severally liable for the above-mentioned loans.

The Shenzhen Stock Exchange Listing Rules stipulate that listed companies should disclose that the transaction amount (including debts and expenses) accounts for more than 10% of the latest audited net assets of the listed company, and the absolute amount exceeds 10 million yuan. Among them, "transactions" include foreign investment and creditor's rights. The Measures for the Administration of Information Disclosure of Listed Companies stipulates that when a listed company has a major investment behavior and enters into an important contract, which may have an important impact on the company's assets, liabilities, equity and operating results, it shall promptly perform the information disclosure obligations of major events. The transaction amount of the above two events far exceeded the prescribed amount, and the first item accounted for 12.9% of the net assets audited by \*ST olefin 2014, and the second item accounted for 27.5% of the net audited assets of \*ST olefin 2014. \*ST olefin carbon

concealing these two major issues is an incomplete disclosure.

Undisclosed asset impairment provision. \*ST-Alcohol's 2016 asset impairment losses amounted to approximately RMB 400 million, accounting for 2252% of the net profit attributable to owners of the parent company in 2015. The Measures for the Administration of Information Disclosure of Listed Companies stipulates that when a listed company has significant losses and major losses, it shall promptly perform its information disclosure obligations. \*ST Olefin Carbon did not disclose the matter and was incompletely disclosed.

#### 4.3.2 Information disclosure is not true.

In terms of the untrue disclosure of information, the company has a series of information disclosure violations such as false predictions of performance and false financial report data (such as false assets, liabilities, expenses, profits).

There are significant differences in performance forecasts. \*ST Olefin Carbon released the 2016 annual results forecast on January 26, 2017. The announcement pointed out that the net profit attributable to shareholders of listed companies in 2016 was 450 million yuan to 520 million yuan. However, the amount disclosed in the 2016 annual report disclosed by the company was negative 474 million yuan. There is a significant difference between the company's disclosed performance forecast and the performance in the periodic report, and the relevant amendment announcement has not been disclosed.

Financial data is false. \*ST Olefin Carbon did not account for financing service fees, capital borrowing fees, loan interest and employee salary performance in the 2015 annual report. The above-mentioned several expenses were reported as "other receivables" and were not included in the current profit and loss. As a result, the 2015 consolidated financial statements accounted for a total of 17.95 million yuan of assets, a liability of 1.72 million yuan; a consolidated income statement of less than 19.76 million yuan, a net profit of 19.76 million yuan, accounting for 868% of 2015 net profit, affecting The company's net profit for the year of 2015 was -24 million yuan, and the undistributed profit was -68.84 million yuan. The error rates were 138% and -165% respectively.

Article 63 of the Securities Law stipulates that the information that the issuer and the listed company must disclose in a true, accurate and complete manner shall not contain false records, misleading statements or major omissions. \*ST Olefin carbon is not accounted for in accordance with accounting standards, and the disclosure of false financial information is untrue.

#### 4.3.3 Information disclosure is not timely.

In terms of the timely disclosure of information, the company has not disclosed the annual report and foreign investment matters in a timely manner.

The annual report was not disclosed in time. \*ST Olefin Carbon disclosed the 2016 annual report and other related announcements on June 24, 2017, but in fact the company held the board of directors and the board of supervisors on June 15, 2017 to review the 2016 annual report and other related proposals. Article 67 of the Securities Law stipulates that when an investor has not been informed of a major event that may have a significant impact on the stock trading price of a listed company, the listed company shall immediately submit and announce an interim report stating the cause and current status of the incident. Possible legal consequences. \*ST Olefin Carbon did not disclose the 2016 annual report in time, and the information disclosure was not timely.

Foreign investment matters were not disclosed in a timely manner. \*ST Olefin Carbon was

entrusted to Beijing Gold Trading Center Co., Ltd. on December 27, 2016 by entrusting its wholly-owned subsidiary Beijing Yinxin Investment Co., Ltd. to dispose of the assets and to purchase 450 million yuan of funds for the purchase of gold wealth management products. The wealth management principal accounted for 12% of the company's audited total assets in 2015. However, the board of directors did not consider the matter until December 29, 2016, and the payment date preceded the resolution of the board of directors. According to the relevant provisions of the Securities Law, \*ST olefin carbon is not timely in information disclosure.

#### **4.4 Analysis of the reasons for the violation of information disclosure of \*ST olefin carbon company**

According to the analysis results of the information disclosure violations of listed companies mentioned above, this paper uses the root cause analysis method and 5W2H analysis method to analyze the specific violations of \*ST olefin carbon in detail from three aspects: incomplete, untrue and untimely information disclosure.

##### **4.4.1 Avoid being ST and illegally profitable**

The 2015 annual report of Silver-Based Carbon New Materials Group Co., Ltd. provided false financial data, which led to the company's net profit increased by RMB 19,967,400 in 2015. If the company adds a deductible fee, the company's 2015 net profit will be negative. Moreover, the company not only operated losses in 2015, but also had a negative net profit on the 2014 annual report. Relevant regulations show that if a listed company has a poor operating condition or even an operating loss for two consecutive years, it will face the implementation of "ST", which indicates that the company has the risk of being delisted from the market. Therefore, this article considers this to be one of the reasons for the company to disclose information on violations. In this case, there are two main reasons for the company to disclose accounting information in violation of regulations: one is that the company will issue stocks to avoid the loss of shareholders, and avoid being suspended from the market; the other is that the company is going through the forgery because of the worsening business conditions and insufficient funds. Income to raise funds. According to relevant regulations, before the bank issues a loan, the bank needs to evaluate the solvency of the company through the company's financial statements and assess the financial status of the loan company. The company is in urgent need of capital turnover, but the real financial situation cannot meet the required standards, the company will conduct financial fraud in order to obtain bank loans. In another case, some listed companies disclose false information in order to attract more investors and earn more benefits.

##### **4.4.2 The illegal cost is too low**

On December 19, 2017, the CSRC issued an administrative penalty decision letter, analyzing the illegal behavior of the company and the person involved in the incident and its nature and the resulting harmful consequences. The following punishment decision was made: the company was given a warning and ordered to He was ordered to make corrections and fined 600,000 yuan. He also warned the direct responsible persons Fan Zhiming and Xiong Shuaihui, fined 300,000 yuan, warned the indirect responsible person Wang Daming, and fined 200,000 yuan. He warned the department manager and other members of the board of directors and the board of supervisors. And a fine of 50,000 yuan or 30,000 yuan will be imposed depending on the illegal circumstances. The company's financial fraud exceeded 100 million yuan, but it was guaranteed to be listed. After the final violation disclosure was exposed, it was only given a warning and fined several hundred thousand yuan. Compared with illegal interests, the illegal cost is too low, which is one of the reasons for the continuous disclosure of information violations in the securities market.

#### 4.4.3 Dereliction of duty of the company's board of directors and the board of supervisors

The professional level of the senior management staff of listed companies has a great influence on the quality of information disclosed. Regular and irregular training of company employees to improve their work ability and professional level is conducive to the development of healthy savings of the company's operations. Company executives may, under the temptation of huge profits, conduct unfair profit manipulation and damage the interests of investors.

The board of directors of a listed company shall be diligent and responsible for the illegal disclosure of company information. In this case, although Wang Daming (who was chairman of \*ST Ethylene) pointed out at the hearing that he did not participate in the actual operation of the company and did not receive remuneration, he was only a named director, but this could not be a reason for exemption. Other members of the company's board of directors, members of the board of supervisors, and senior management should also be diligent. At the hearing, the independent directors and supervisors of the company stated that they were not financial professionals, were not responsible for the company's financial work, and were unable to judge financial data. Authenticity, but this is not a reason for exemption. The independent directors and the board of supervisors of listed companies shall do a good job in supervision and management. The company's financial director Xiong Shuaihui said that he has no energy and time. This reason is even more absurd. The role of the chief financial officer is to ensure that the company conducts business activities, financial budget final accounts, profit distribution, fund use scheduling, financing plans, etc., and the chief financial officer should be the person directly responsible for the time of violation of the disclosure.

#### 4.4.4 The internal governance structure of the company is not perfect and the internal control system is not perfect.

The shareholders of a listed company have substantial ownership of the company, the company's operators and senior management personnel have the company's management rights, and the board of supervisors has the power to supervise and manage the operators. In the case, \*ST Olefin Carbon company has the problem of imperfect corporate governance structure. The senior management company controls the company and holds the real power. The chairman is just a name, the board lacks independence, and the independent director system is not perfect. Supervise and manage the role of senior management. Moreover, the company's internal control system is not perfect, which makes it unable to play its role, and cannot ensure that the company regulates operations and regulates the disclosure of accounting information.

#### 4.4.5 Insufficient supervision of external institutions

In this case, the company's violation disclosure information caused by the lack of external supervision has two main aspects: on the one hand, the relevant laws and regulations give the company a less serious punishment for violations. In the relevant laws and regulations promulgated by China, illegal companies and illegal personnel are not severely punished, failing to achieve the expected disciplinary effect, and cannot attract the attention of the company, so that the company's senior management and accounting personnel are bold in financial fraud. On the other hand, the company's senior management's own professional quality is insufficient, and the laws and regulations on accounting information disclosure are not well understood, and there is a chance of being lucky or even knowingly committing crimes. But in the final analysis, the company's pursuit of high-value interests exceeds the fear of legal punishment. The huge profits brought by illegal disclosure of information far exceeds the penalty for its punishment, which leads to violations of listed companies.

#### 4.4.6 Lack of responsibilities of intermediaries

In this case, the lack of responsibility of the CPA should not be ignored. As a professional auditing institution, the CPA should be able to take into account the possibility of the company's financial statements. The CPA firm should strictly control the auditing procedures and check the risk of non-compliance. In this case, the company inflated a profit of 100 million yuan a year. In order to continue to maintain its status as a listed company, in order to continue to earn profits, it has caused such serious consequences and infringed the interests of countless investors. In response to such a terrible violation of information disclosure incidents, the auditor issued an audit report that could not express opinions, and did not publish a report of reservations or negative opinions, which could not attract investors' attention. It can be considered that the accounting firm failed to perform its due diligence when conducting audit work on the company, so its opinions were invalid.

## **5 Related Recommendations and Measures**

### **5.1 Improve the company's internal control system**

One of the reasons for the disclosure of information violations by listed companies is the imperfect internal control system. The lack and inefficiency of the internal control system cannot play a corresponding role, and cannot guarantee the authenticity and integrity of the enterprise's standardized operation and disclosure of accounting information. For the company's internal control system to really play its role, it is necessary to establish a wind control system within the company, real-time monitoring of major issues, to prevent the occurrence of high-level violations.

A listed company shall establish a major risk early warning mechanism and a major event handling mechanism to conduct risk identification, analysis, and evaluation in production, sales, and finance joints, establish standardized procedures, clarify responsible personnel, and formulate contingency plans for possible risks. Ensure that the company's risks are effectively controlled when significant events occur. In addition, listed companies should do daily supervision to ensure that the management's daily behavior is within the controllable range, improve the management level of the management and the company's ability to prevent risks. Listed companies can introduce a good information communication system, enabling the company to timely and accurately understand the business status and executive behavior, and improve the efficiency of the company's internal control.

### **5.2 Strengthen the supervision of external institutions**

Strengthen government supervision. First of all, the CSRC should improve the information disclosure system and accounting standards of listed companies, and continually revise and improve existing laws and regulations in accordance with the changing new economic environment. Secondly, the CSRC should improve the working ability of law enforcement personnel in the process of law enforcement, and give specific punishment measures according to the characteristics of illegal behaviors. Moreover, the CSRC should openly and transparently punish the punishment process, the punishment basis, and the punishment results, and accept the inspections of the mass media and the masses.

Strengthen the supervision of certified public accountants. The role of the CPA is to test whether there is any violation of the listed company. If the CPA lacks independence, the false accounting disclosure will become more and more serious and will not be contained. First of all, it is necessary to strengthen the assessment of the professional competence of CPAs, and assess whether their firm is legal and compliant, and whether it has a sound internal control system. For emerging industries, staged intensive training should be conducted for CPAs. Secondly, the professional ethics of certified public accountants should be improved, and penalties should be increased for non-compliant CPAs. In this way,



it can have a deterrent effect on CPAs, ensure the independence of their practice, and ensure the standardization of information disclosure of listed companies.

### **5.3 Increase illegal costs**

The disclosure of information violations by listed companies has been repeatedly prohibited. One of the important reasons is that the illegal cost is too low. When the illegal cost is greater than the illegal interests, the information violation disclosure behavior can be effectively curbed. The CSRC should comprehensively strengthen penalties for illegal listed companies from the aspects of law, administration, and public opinion, and increase illegal costs.

From the legal point of view, most of the penalties for the disclosure of information violations by listed companies are administrative penalties, which rarely involve criminal penalties and civil penalties, and the amount of penalties is small and does not have deterrence. Relevant departments should increase the amount of punishment, extend the market entry period, and strengthen penalties. In addition, we should constantly improve and supplement the penalties. For example, special securities courts and securities arbitration institutions can be set up; the limits of criminal penalties in China can be increased, the statutory sentence of free penalties should be increased; the civil liability should be improved, and the relevant provisions on civil liability should be formulated in the securities law.

From the perspective of public opinion, the illegal disclosure of information on listed companies is not enough for the listed companies to contain the violations, which has led some listed companies to repeatedly violate the law. Relevant departments can use the power of public opinion to curb violations. For example, establish an integrity file that records the credit history of all listed companies and their directors, senior managers and intermediaries. For listed companies that have violated the rules, they can restrict their market rights and relax their market rights to reputable companies. And the integrity record is made public, so that the company's individual behavior is expanded into market behavior, so that the influence of violations is extended to financing, sales and other links.

### **5.4 Improve the internal governance structure of the company**

For \*ST olefinic carbon, the company's behavior of information violation disclosure, one of the important reasons is that the separation of the three powers has not been achieved. The company should improve the corporate governance structure, clarify the division of responsibilities between the board of directors, senior management and the board of supervisors, and establish corresponding restraint and incentive mechanisms. The specific measures are as follows:

Establish a system of checks and balances on the rights of the three powers. First of all, the chairman and the manager should be separated. The board should assume the supervisory responsibility and supervise the manager's behavior while making business investment financing decisions. Secondly, the proportion of independent directors in the board of directors should be increased, their supervisory responsibilities and rights should be clarified, and the decision of management should be judged to be appropriate to prevent them from harming the interests of shareholders. Finally, it is necessary to play the supervisory role of the board of supervisors, improve the professional level of the board of supervisors, and supervise the management behavior of the company's management. In addition, the incentive and restraint mechanism for directors, operators and supervisors should be established, and their wages can be linked to the interests of shareholders, which can improve their supervisory motivation and improve the quality of accounting information disclosure.

Establish an internal audit system. A listed company should establish an internal audit system and establish a subordinate audit institution in the board of supervisors, which can effectively curb the role

of senior management in internal audit intervention to a certain extent. Internal audit institutions can understand the trends of senior management in a timely manner, and can prevent managers from covering up facts and illegally disclose accounting information. Moreover, internal audit institutions can regularly evaluate the management performance of senior management, which is beneficial to the board of directors to effectively evaluate their own governance and senior management.

## 6 Conclusion

This paper analyzes the administrative penalty decision issued by the China Securities Regulatory Commission from 2013 to 2017, selects certain valid samples, conducts overall analysis and classified statistics on the information disclosure violations of listed companies, and combines case analysis to draw the following conclusions. (1) Listed companies mainly have three types of information disclosure: incomplete, untrue, and untimely. Among them, the incomplete disclosure of listed companies is the most commonly used method for information disclosure. (2) The main reasons for the disclosure of information violations by listed companies are: avoiding ST and illegal profits, illegal cost is too low, the company's board of directors and the board of supervisors are derelict, the internal governance structure of the company is not perfect and the internal control system is imperfect, and the supervision of external institutions is insufficient. The responsibilities of the intermediary are missing. This conclusion has the following implications and significance: (1) Listed companies should pay attention to the consequences of information violation disclosure, improve the company's internal control system, and improve the company's internal governance structure. (2) The regulatory authorities should further strengthen the supervision of information disclosure of listed companies, increase the penalties for illegal listed companies and intermediaries, and improve and supplement the penalties. (3) Intermediaries should do their jobs to improve the professional ethics of CPAs and maintain a good order in the securities market.

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# **A Study on Foreign Direct investment and Economic Growth in China: The Role of Human Capital Development**

Zhang Yuling, Wu Zihao, Brima Sesay

School of International Education, Wuhan University of Technology, Wuhan, P.R. China, 430070

(E-mail: zhangyuling@whut.edu.cn, ryanng@whut.edu.cn, brimasesay30@gmail.com)

**Abstract:** Foreign Direct Investment is generally considered a vital source of economic growth for China, generating employment opportunities, capital investment, and business knowledge needed for economic growth. This paper investigates the relationship between FDI and economic growth of China for the period of 1990–2017 using time series data and by extension verify for the role of human capital development. The study used multiple regression (OLS) model and the results revealed that FDI alone bring less significant positive impact on growth performance in China. However, the simultaneous interaction of FDI with human capital development brings about a greater positive and significant impact on growth. This confirmed that high positive impact of FDI on growth is conditional on the level of human capital development. Consequently, the study recommends that government policy makers should design policies towards improving human capital.

**Key words:** Foreign direct investment; Economic growth; Human capital development; China

## **1 Introduction**

The notion of economic growth is fundamental to economists and policy makers because of its central role in economic development. Therefore, the key factors that propel economic growth have been an area of interest for a very long time to economists and policy makers because of their significant role towards development. Foreign direct investment (FDI) is the key element of the globalization and of the world economy. FDI is important as a driver of employment, technological progress, productivity improvements, and eventually economic growth. It plays the important roles of filling the development, foreign exchange, investment, and tax revenue gaps in developing countries. FDI plays a key role in the development of developing countries. One reason is that FDI helps in transferring advance technologies know-how and increases employment levels to the host countries. Economists believe that FDI through new technologies and high standard managements puts pressures on domestic firms while making the markets competitive. Furthermore, FDI brings significant and positive externalities to the developing economies such as labor managements, training opportunities and thus increases the standard of the production function. By technology transfer, it boosts the economies of the developing countries to stand there on feet by technology spill over. A hand full of researches has been conducted on FDI and economic growth. However, their findings differ from diverse methods used on their research, some of the researchers found that FDI has a positive outcome on economic growth while others found the reverse. These contradictory results were as a result of the differences in methodology employed, time frame, and case selection. This present research gears towards filling this gap by unearthing the effect FDI have on economic growth for China between 1990-2017 and by extension verify for the role of human capital development on FDI-growth relationship.

From the literatures, regarding the relationship between FDI and GDP, different scholars hold different opinions (Pollin, R., & Zhu, A., 2006). Erik Biørn (Erik Biørn, 2015) developed a panel model which indicates that there is a positive but insignificant relationship between the aggregate FDI and GDP. It especially improves the GDP growth of Asian countries. And the manufacturing FDI affects both manufacturing and service GDP growth positively where no negative spillover effects between them was found. According to the research by Parviz Asheghian (Parviz Asheghian, 2016), there is no causal relationship between FDI and GDP growth and it also does not affect other variables through the model that based on the postulation of de Mello. Shujie Yao (Shujie Yao, 2006) suggested that the FDI contributed to the GDP growth of China which might be useful for other developing and transitional economies to make policies.

Also, in the case of China, the impact of FDI may vary during different time periods. Fleisher and Zhao (Fleisher and Zhao, 2010) pointed out that from 1985 to 1994, China's FDI had a significant impact on economic growth and from 1995 to 2003, and promotion of FDI was no longer significant. This phenomenon is estimated to associate with encouragement and policy support for non-public enterprises (Fleisher & Zhao, 2010).

Turning to the relationship between FDI and human capital, empirical evidence provided by Noorbakhsh, Paloni and Youssef (2001) reveals the significant correlation between human capital and FDI, which means human capital, might be one of the important factors influencing capital inflows to developing countries. Miller & Upadhyay (2000) hold the view that the impact of human capital on TFP varies in countries with different incomes. The human capital of middle-income countries shows a positive correlation with total factor productivity whereas those of the high-income countries have negative influence. In addition, a recent study conducted by Li and Wang (2016) demonstrates that the influence of human capital on economic growth is carried out through multiple channels. And the basic human capital is mainly through the “factor-accumulation channel”, thus improving the TFP to affect economic growth.

The relationship between inflation rate and GDP growth has also been widely discussed by scholars. Robert Pollin (2006) pointed out that the inflation and economic growth is strongly correlated under the goal where macroeconomic policy tries to stimulate growth. Similarly, the study by Fountas, S., et. al. (2002) based on Japan indicates that high inflation is more likely to associate with lower output. In other words, low and stable inflation rate will probably improve the economic growth. Generally, Mohsin S. Khan (2001) indicates that threshold for developing and developed countries are respectively 1%-3% and 11%-12. There is a significant negative relationship between the inflation and economic growth when inflation is beyond the threshold.

## **2 Methodology**

The study uses primarily secondary data; that were retrieved from the online publication of World Development Indicators–China Database published by World Bank and the National Bureau of Statistics of China database. The study collected and analysis time series data over the period of 1990 to 2017 for the variables included in the model specification. The multiple regression analysis of the ordinary least square (OLS) is the estimation technique that is being employed in this study to determine the relationship.

## **3 Empirical Model Specification**

Following an endogenous growth framework, the study specifies a model that best captures the effect of foreign direct investment (FDI) on economic growth. Given the growing empirical evidences supporting the positive effect of FDI on economic growth (Erik Biørn (2015; Shujie Yao 2006) we

control for other factors considered as control variables that influence long run growth and generalize the specification of a growth equation that accounts for the effects of FDI on economic growth. Thus, in deriving our empirical model for estimating this relationship for China, we put forward that:

$$GDP = F (FDI, HK, INF) \tag{1}$$

Where GDP = real GDP growth

FDI = foreign direct investment inflow

HK = human capital development

INF = inflation

The econometric form of equation (1) can be specified as:

$$\ln GDP_t = \beta_0 + \beta_1 FDI_t + \beta_2 HK_t + \beta_3 INF_t + \varepsilon_t \tag{2}$$

In order to enrich the analysis, we test for the intervening role of human capital development with foreign direct investment. This was done to verify whether the effect of FDI on growth is dependent on the level of human capital development. If human capital development complements foreign direct investment, then we would expect a significant impact of their combined effect on growth. In view of this, the coefficient would capture the interactive effect between foreign direct investment and human capital development. The significance of interaction terms would imply that the marginal effect of foreign direct investment on economic growth depends on the level of human capital development. This was done by the aid of the following equation:

$$\ln GDP_t = \beta_0 + \beta_1 FDI_t + \beta_2 HK_t + \beta_3 (FDI_t * HK_t) + \beta_4 INF_t + \varepsilon_t \tag{3}$$

The a priori expected signs are that  $\beta_1, \beta_2,$  and  $\beta_3 > 0$  and  $\beta_4 < 0$ .  $\beta_0$  is the slope coefficient and  $\varepsilon_t$  is the error term. E-views version 10 was used to run the analysis.

#### 4 Results and Discussion

This sub-section discusses the results and findings from the study, it commences with an analysis of the summary statistics of the variables used in the study. The summary statistics reported in table 1, below indicates that on average real GDP growth stood at 9.53 percent. The ratio of foreign direct investment to GDP averaged around 3.47 percent; inflation averaged around 4.44% and human capital development stood at an average of 67.37. The inflation rate observed from the summary statistics demonstrates an indication of macroeconomic stability.

**Table 1 Summary Statistics and correlation results**

Variables	GDP	FDI	HK	INF
Mean	9.5373	3.4774	67.392	4.4451
Maximum	14.231	6.1868	95.100	24.256

Minimum	3.9071	0.9663	40.600	0.3478
Std. Dev	2.4830	1.3180	19.674	5.5144
<b>Correlation Matrix</b>				
GDP	1.0000	--	--	--
FDI	0.7091	1.0000	--	--
HK	0.1322	0.1163	1.0000	--
INF	-0.4307	-0.2771	-0.2243	1.0000

Unlike for inflation, the pair wise correlation matrix as reported in the lower segment of table 1 indicate positive relationship of all the independent variables with GDP growth, with human capital (HK) measured as secondary school enrollment in the summary statistics stood at (67.37), fairly strong. There is no presence of multicollnearity as the correlation among the explanatory variable are fairly low.

#### 4.1 Unit root test

Here we analyses the time-series properties of the variables of interest for the function (see table 2). The augmented Dickey-Fuller (ADF) test is used to determine the order of integration of data compiled for each variable. This is followed by an analysis of the co-integration results and short run dynamics. The diagnostics test results are then analyzed.

**Table 2 Unit Roots tests**

**Results of Unit Roots tests of the variables at their levels**

Variables	ADF Statistic	ADF Critical (5%)	P-Value
lnGDP	0.109708	-1.953858	0.7091
lnFDI	-0.559120	-1.953858	0.4655
lnHK	3.135998	-1.953858	0.9991
lnINF	-1.672829	-1.953858	0.0886

**Results of Unit Roots tests of the variables at their first differences**

lnGDP	-6.000748	-1.954414	0.0000
lnFDI	-3.390340	-1.954414	0.0015
lnHK	-4.263678	-1.954414	0.0001
lnINF	-5.791541	-1.954414	0.0000

The ADF unit root tests are performed under the null hypothesis that unit root exists against the alternative hypothesis that unit root does not exist. The ADF unit root test in tables 2 shows that all the variables are not stationary in level but stationary at first difference, implying that all the variables are

integrated of order one, denoted as I (1).

#### 4.2 Co-integration test results

Having found the series to confirm the existence of unit root and are stationary at first difference I (1), the next logical thing to do is to test for long-run equilibrium relationship between the dependent variable and the explanatory variables using the Johansen Co-integration test. These tests results are reported in table 3 below.

**Table 3 Co-integration Test Results**

Unrestricted Co-integration Rank Test (Trace)				
Vectors	Eigenvalue	Trace Statistics	0.05 Critical Value	Prob.**
$r = 0$	0.749410	93.20776	69.81889	0.0002
$r \leq 1$	0.652845	57.22540	47.85613	0.0052
$r \leq 2$	0.558768	29.71784	29.79707	0.0511
$r \leq 3$	0.197060	8.445067	15.49471	0.4191
Unrestricted Co-integration Rank Test (Maximum Eigenvalue)				
$r = 0$	0.749410	35.98236	33.87687	0.0276
$r \leq 1$	0.652845	27.50756	27.58434	0.0511
$r \leq 2$	0.558768	21.27277	22.13162	0.0578
$r \leq 3$	0.197060	5.706371	14.26460	0.6511

\* denotes rejection of the hypothesis at the 0.05 level

Table 3 shows that for the trace test, there are two co-integrating equation at the 5% level. It can be observed that the null hypothesis of none ( $r = 0$ ) and at most one ( $r \leq 1$ ) vectors, the trace statistics are less than their corresponding critical values and secondly their probabilities are above the threshold of 5%, which leads to the acceptance of the null hypothesis. For the second and third hypotheses of no co-integration respectively, the null hypotheses are rejected as the probability values are less than 5% and the critical values less than the trace statistic. The maximum eigenvalue test also confirms the existence of one co-integration equation as seen in table 3 above. The presence of co-integration implies that long run equilibrium relationship exists between the dependent variable and the explanatory variables. Hence the hypothesis that long-run equilibrium relationship between foreign direct investment and economic growth exists in China is supported.

#### 4.3 Result of the error correction model

The Johansen co-integration trace and maximum eigenvalue rank tests conducted confirms that there is unique co-integration equation in the model implying that there is long run equilibrium relationship between foreign direct investment and economic growth. Since this long run relationship has been confirmed, it thus allows for the estimation of an error correction model. The results of the ECM are presented in table 4.



**Table 4 Regression Output**

Variables	Model 1	Model 2
C	1.718309** (0.560975)	-0.331176** (0.118151)
DlnFDI	0.271610** (0.079576)	0.270073** (0.091190)
DlnHK	0.100556** (0.040840)	0.266156** (0.101348)
DlnINF	-0.068958* (0.039032)	-0.286494** (0.095240)
DlnFDI*HK		0.379944** (0.083750)
ECM(-1)	-0.643415** (0.143604)	-0.679900** (0.135746)
R-squared	0.622491	0.636642
Adjusted R-squared	0.530974	0.534448
F-statistic	10.00099	6.229724
Durbin-Watson stat	2.015094	2.096032

Note \*\*, and \* represents significant at the 5% and 10% levels respectively. The variables are expressed in log form and standard error-values are reported in parenthesis.

The result in table 4, shows that in model 1, FDI and human capital development have positive effect on real GDP growth and are statistically significant at the 5%, while inflation was found to have a negative effect on real GDP and significant at and 10% level. This indicates that high inflation raises the cost of production and reduces returns from investment and thus impact negatively on growth. Other things being equal, after adjustment for the degrees of freedom, the result suggest that about 62.2% of the variation in real GDP is explained by variation in the independent variables. The coefficient of the error correction term E (-1) is - 0.643415as measure of the speed of adjustment which is negative and statistically significant, this implies that for any drift away from the long run equilibrium in previous years, convergence to the equilibrium is corrected by 64.3%. That is approximately 64% of the error is corrected every year in the event of shocks in the system. Similar interpretation holds for model 2.

Interestingly, the combination of foreign direct investment with human capital development generates robust and positive effects on growth (0.379944). This simply implies that human capital development is

connected to the effectiveness of foreign direct investment on growth in China. Practically, the result confirms that in the absence of human capital development, foreign direct investment alone would have less (0.271610) significant positive impact on growth. In effect, improving the human capital development is important for growth. By these results, human capital development and foreign direct investment are complementary in the growth process of China.

## 5 Conclusion

The study analyzes the effect of foreign direct investment (FDI) on the economic growth of China over the period 1990-2017. The study applied correlation and multiple regression analysis to determine the impact of FDI on the economic growth of China. The results of the study expose that FDI has a positive impact on the economic growth of China. Correlation analysis also suggests that FDI and GDP are positively related to each other and inflation rate is negatively related to GDP growth. The results revealed that FDI alone bring less significant positive impact on growth performance in China. However, the simultaneous interaction of FDI with human capital development brings about a greater positive and significant impact on growth. This confirmed that high positive impact of FDI on growth is conditional on the level of human capital development. Consequently, the study recommends that government policy makers should design policies towards improving human capital.

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# **Empirical Research on Financial Capability of Listed Companies in Northwest Five Provinces in China Under the Background of “One Belt and One Road” Strategy**

Song Tianqi, Liang Shanshan

School of Management, Wuhan University of Technology, Wuhan, P.R. China, 430070

(E-mail: 3043916958@qq.com, 1548814274@qq.com)

**Abstract:** Owing to unique physiographic condition of northwest five provinces in China, the “one belt and one road” strategy offers more important policy support and brings unprecedented development opportunity for northwest five provinces in China. This paper adopts principal component analysis (PCA) and takes SPSS as analysis tool to conduct empirical research on the financial capability of listed companies in northwest five provinces under the background of “one belt and one road” strategy, propose 8 indicators in total representing four perspectives of debt paying ability, profitability, operation capacity and development ability, know the current situation of unbalanced economic development in northwest five provinces in China and put forward reasonable suggestions to shorten economic development gap, including giving play to regional advantages and accelerating economic integration; making positive response to the “one belt and one road” strategy and realizing internal-external balanced development; enlarging investment in northwest five provinces in China.

**Key words:** One belt and one road; Northwest five provinces; Financial capability; Empirical research

## **1 Introduction**

In September and October of 2013, the state president Xi Jinping respectively put forward the cooperation initiatives of “building a Silk Road Economic Belt” and “a 21st century Maritime Silk Road”, which aimed at strengthening relationship with economic partners along the ancient silk road. The “one belt and one road” strategic development lines include the northern line, the middle line, the southern line and the central line, wherein, the middle line and the central line all involve the northwest five provinces in China. The “one belt and one road” strategy provides great opportunity for economic development of Shanxi, Gansu, Qinghai, Ningxia and Xinjiang (Liu Gang, 2016). For a long time, the northwest district, as the gate of northwest China, has abundant resources and large territory, while the slow economic development of surrounding countries causes the economies of northwest five provinces to be depressed, Therefore, the northwest district has always been the key resource transportation and poverty alleviation region (Wang Yimiao, 2018). The northwest five provinces in China are prime areas of the “Silk Road Economic Belt”, however, the economic levels of which are uneven. The imbalance of regional economic development in developing countries has always been the core problem of regional economic research, and the location theory has important value to consider spatial factors for the first time in economic analysis. Since the 1980s, the study of regional economic space has entered a new stage of economic spatial structure in the new economic geography represented by scholars such as Krugman, Venables and Fujita. Overviews of domestic research, domestic scholars have also conducted in-depth research on regional economy. In the aspect of theoretical research, the “point-axis” theory of Lu Dadao has laid the theoretical foundation for the development of modern regional space in China.

China's main theories include Lu Yulin's "dual-core" development model, Chen Xiuying's five basic elements of optimization combination, Cheng Biding's the space structure of the three-time transformation theory (Hao Wufeng, 2017). In empirical research, Chinese scholars mainly focus on urban clusters, economic zones and provincial areas, such as the Yangtze River Delta, the Pearl River Delta, Jiangsu, Xinjiang and other regions. In summary, it can be divided into the following kinds of research: economic space evolution and pattern research, economic space linkage research, economic space reconstruction and optimization research.

From the existing literature, there are still some shortcomings in the study of regional economy: (1) the lack of economic research in the five northwest provinces. With the continuous development of globalization and economic integration, the economic structure of the five northwest provinces has changed greatly compared with the past, but there are few literatures in China to study it. (2) Lack of reliability indicators for evaluating regional economies. According to this situation, under the background of "Belt and Road", taking the financial capacity of listed companies in the five northwest provinces as the research object, and as a measure of the economy of the five northwest provinces, reveal the current situation of regional economic development imbalance in the five northwest provinces, and put forward innovative ideas to narrow the regional development imbalance gap (Ma Wei, Cao Xiaoshu, Li Tao, Gao Xingchuan, 2019). The main contributions of this paper are: (1) to make up for the five northwest provinces of the current economic situation research gap under the "Belt and Road" background, and provide a more reliable study for the evaluation of the economic situation of the five northwest provinces. (2) Through sub-regions, sub-sectors and sub-categories, accurately selecting data, provide a more systematic examination of the "Belt and Road" policy on the economy of the five northwest provinces in China.

## **2 Empirical Research Design**

### **2.1 Sample selection and data source**

This paper selects financial data of 50 listed companies in northwest five provinces in China from 2016 to 2018 as samples. Wherein, 10 listed companies with top 10 average market value in each province are respectively selected. In addition, the related data all source from CSMAR database, while all data processing and statistical analysis are all be completed through Excel 2016 and SPSS 25. Meanwhile, the listed companies existing with major debt restructuring items, incomplete information disclosure or abnormal financial information from 2016 to 2018 are eliminated (Xu Xiaoli, Chen Peipei, 2018). Otherwise, select the companies with weak comprehensive strengthen, and so on in a similar fashion.

### **2.2 Indicator selection**

The selected indicators must be representative, correct and comparable. Based on comprehensive consideration of the economic development characteristics of various regions and combined with the related theories of financial capability (Huang Yangshuo, Wang Yufeng, 2016), this paper firstly selects four first-level indicators: debt paying ability, profitability, operation capacity and development ability. Each first-level indicator includes two second-level indicators, 8 indicators in total. The debt paying ability indicators include liquidity ratio and cash ratio; the operation capacity indicators include turnover of account receivable and current asset turnover; the profitability indicators include return on total assets and return on business; the development ability indicators include total assets growth rate and net profit growth rate. These indicators can comprehensively present the current economic development level of northwest five provinces in China.

**Table 1 Economic Development Research Index System of Five Provinces in Northwest China**

Primary index (Financial Ability )	Secondary index
Repayment capacity	Current ratio (%)
	Cash ratio (%)
Operating capacity	Accounts receivable turnover (%)
	Current assets turnover (%)
Profitability	Return on total assets (%)
	Net operating interest rate (%)
Development capacity	Growth rate of total assets (%)
	Net profit growth rate (%)

### 2.3 Model establishment

By studying the internal structure of the original multiple variables, principal component analysis (PCA) reduces the original data information to several comprehensive variables on the basis of covering the original data information as much as possible. It plays the role of reducing and simplifying problems and can obtain more scientific and effective data information. PCA can overcome incompleteness of a single variable, that is, it cannot reflect the real situation of enterprise's financial ability truthfully, and this can make complex problems simple and scientific.

### 3 Empirical Result and Analytical Investigation

Standardize the 8 representative variables of listed companies in northwest five provinces in China, conduct PCA analysis, establish the principal component regression equation and calculate the final principal component scores of various enterprises. Wherein, the principal component results are as follows:

**Table 2 KMO and Bartlett's Test**

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		.535
	Approx. Chi-Square	85.829
Bartlett's Test of Sphericity	df	28
	Sig.	.000

KMO and Bartlett are used to preliminarily test whether the selected data are suitable to PCA, wherein, KMO test coefficient >0.5 while Bartlett significance testing P value <0.05, therefore, they can be used for PCA.

Component	Initial Eigenvalues			Extraction Sums of Squared Loadings			Rotation Sums of Squared Loadings		
	Total	The Proportion of Variance%	Cumulative %	Total	The Proportion of Variance%	Cumulative %	Total	The Proportion of Variance%	Cumulative %
1	2.127	26.588	26.588	2.127	26.588	26.588	1.991	24.888	24.888
2	1.540	19.255	45.844	1.540	19.255	45.844	1.539	19.235	44.123
3	1.272	15.903	61.747	1.272	15.903	61.747	1.261	15.761	59.884
4	1.076	13.446	75.193						
5	.790	9.881	85.074						
6	.682	8.528	93.602						
7	.309	3.860	97.462						
8	.203	2.538	100.000						

**Table 3 Total Variance Explained**

Extraction Method: Principal Component Analysis.

It can be seen from explained total variance that three principal components meet with the situation that the characteristic roots > 1, and the accumulative explained total variance reaches to 59.884%, which shows that the three principal components can better reflect most information covered by original indicators. Therefore, make the three principal components to be *F1*, *F2* and *F3* respectively, which can effectively replace the financial levels of 50 listed companies in the northwest five provinces in China. Meanwhile, the linear regression function for average comprehensive financial capacity of northwest five provinces from 2016 to 2018 can be obtained. In addition, the results of the three principal components can be clearly and intuitively presented in the three-dimensional diagram.

**Table 4 Rotated Component Matrix<sup>a</sup>**

	Component		
	1	2	3
Net operating interest rate	-.125	.085	.073
Growth rate of total assets	.150	-.917	-.061
Current ratio	.926	.053	-.026
Return on total assets	.406	.818	-.052
Current assets turnover	-.243	.120	.227

Net profit growth rate	.058	-.037	-.758
Accounts receivable turnover	.029	-.018	.789
Cash ratio	.931	.050	-.007

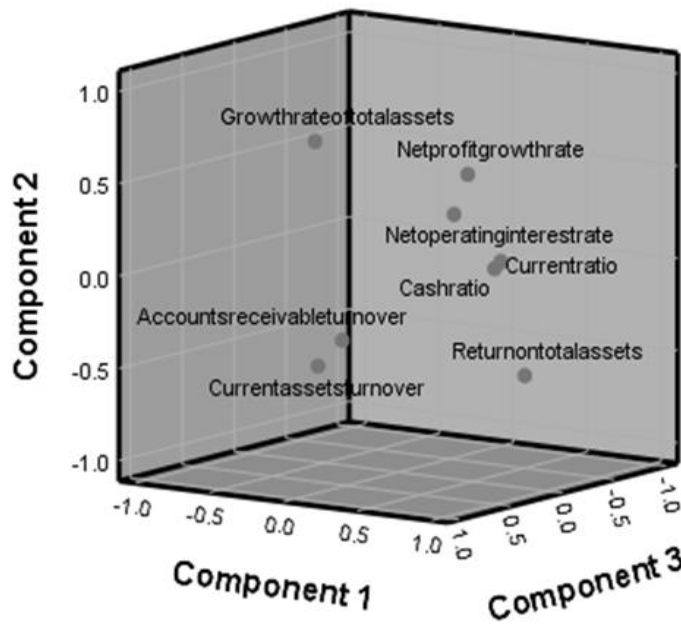


Figure 1 Component Plot in Rotated Space

Rely on the above three principal components to establish initial component loading matrix and realize maximum rotation of variance to get the rotation component matrix (see form 4), and then the explanatory powers and represented variables of the three principal components can be obtained based on variable proportion. wherein, the first principal component is mainly composed of liquidity ratio (92.6%), cash ratio (93.1%), total assets growth rate (15.0%) and net profit growth rate (5.8%), which can effectively represent the debt paying ability and development ability of listed companies; the second principal component mainly consists of return on total assets (81.8%) and return on business (8.5%), which can effectively represent the profitability of listed companies; the third principal component mainly consists of turnover of account receivable (78.9%) and current asset turnover (22.7%), which can effectively represent the operation capacity of listed companies.

The three-dimensional rotation diagram can effectively verify the result of the above rotation component matrix. The first principal component represents the following variables: liquidity ratio, cash ratio, total assets growth rate and net profit growth rate; the second principal component represents the following variables: return on total assets and return on business; the third principal component represents the following variables: turnover of account receivable and current asset turnover. Meanwhile, the conclusion can be obtained that partial variables have close relationship and fit highly with each other in the three-dimensional rotation diagram, such as cash ratio, liquidity ratio, net profit growth rate, turnover of account receivable and current asset turnover.

**Table 5 Component Score Coefficient Matrix**

	Component		
	1	2	3
Net operating interest rate	.102	.083	.136
Growth rate of total assets	.156	-.622	-.010
Current ratio	.472	-.043	.039
Return on total assets	.140	.510	-.058
Current assets turnover	-.096	.078	.094
Net profit growth rate	-.017	.003	-.599
Accounts receivable turnover	.062	-.044	.649
Cash ratio	.479	-.047	.048

Based on component score coefficient matrix, set the variables in the form 4 to be  $X_1, X_2, \dots, X_8$  respectively, and the three principal components are  $F_1, F_2$  and  $F_3$  respectively. And the score expressions of the principal components can be obtained:

$$F_1 = 0.472 X_1 + 0.062 X_2 - 0.102 X_3 - 0.096 X_4 + 0.156 X_5 + 0.140 X_6 - 0.017 X_7 + 0.479 X_8$$

$$F_2 = -0.043 X_1 - 0.044 X_2 + 0.083 X_3 + 0.078 X_4 - 0.622 X_5 + 0.510 X_6 + 0.003 X_7 - 0.047 X_8$$

$$F_3 = 0.039 X_1 + 0.649 X_2 + 0.136 X_3 + 0.094 X_4 - 0.010 X_5 - 0.058 X_6 - 0.599 X_7 + 0.048 X_8$$

Based on the regression equation, the comprehensive score of financial capability of listed companies in northwest five provinces can be seen in the following form 6. Take the characteristic value proportion of each principal component accounting for total characteristic value as weights and adopt regression analysis to establish the principal component score regression equation:

$$Y = 26.588\%F_1 + 19.255\%F_2 + 15.903\%F_3$$

**Table 6 Comprehensive Score of Five provinces in northwest China Financial Ability**

Listed Company Of Shanxi	The score of $F_1$	The score of $F_2$	The score of $F_3$	Y-Comprehensive Score
YABK (002411)	0.844593931	-0.66496	0.705738	0.208756
XBZJ (002673)	-0.085587266	-1.9698	-1.58108	-0.65348
ZHFJ (000768)	2.256917217	7.414129	-2.97253	1.554938
SXMY (601225)	0.617196624	-0.49416	-6.13079	-0.90603
LJGF (601012)	0.853750404	0.813121	-1.54155	0.138409



ZGX ( 601179 )	0.704864546	1.572708	-0.86511	0.352656
GJY ( 000516 )	0.499107338	-2.90912	-30.9079	-5.34273
JMG ( 601958 )	0.682188832	0.428201	-13.9247	-1.95062
SGT ( 000563 )	0.979636311	0.642099	0.449715	0.45562
HTD ( 600343 )	0.385263098	0.519042	-1.1851	0.013909
Average	0.773793	0.535126	-5.79533	-0.61286
Listed Company Of Xinjiang	The score of <i>F1</i>	The score of <i>F2</i>	The score of <i>F3</i>	Y-Comprehensive Score
SW (000166)	0.406839031	-0.40467	-4.48988	-0.68377
ZYZ (000617)	35.18734056	-2.97617	-5.14214	7.964794
ZYGC (600339)	0.260805483	-0.04881	-1.31707	-0.14951
TBDG (600089)	0.03657013	-1.0357	-1.65171	-0.45237
DZJK (000813)	4.579120061	1.200728	5.840475	2.377507
ZTHX (002092)	0.056321013	-1.11772	-15.3648	-2.6437
XYGF (300159)	0.216434475	-0.64588	-0.19356	-0.0976
TJT (600090)	0.47161252	-0.26899	-1.3496	-0.14103
GHNY (600256)	-0.118942366	-1.16694	-16.9683	-2.95479
XBHJ (601069)	-5.066456817	-0.27568	-1.89729	-1.70188
Average	3.602964409	-0.67398	-4.25339	0.151765
Listed Company Of Gansu	The score of <i>F1</i>	The score of <i>F2</i>	The score of <i>F3</i>	Y-Comprehensive Score
GSDT (000791)	-0.238599727	-2.48732	-2.019	-0.86345
YYGF (000981)	-0.997944862	-3.00408	-9.49605	-2.35393
ZHTB (002415)	0.211599108	-0.75702	-4.68421	-0.83443
HTKJ (002185)	0.225265462	-1.36721	-3.74487	-0.79891
HKYL (002219)	0.236435667	-0.14354	-0.66475	-0.07049
YSJT (600108)	0.318219514	0.087106	-1.21207	-0.09138

JGHX (600307)	-3.258454757	-4.76737	-107.05	-18.8085
FDTS (600516)	0.181523151	-1.03944	-4.43554	-0.85726
GTKG (600687)	0.321687845	0.736049	-2.78165	-0.21511
LSCZ (603169)	-0.987778642	-2.835	-0.04592	-0.81581
Average	-0.3988	-1.55778	-13.6134	-2.57093
Listed Company Of Qinghai	The score of <i>F1</i>	The score of <i>F2</i>	The score of <i>F3</i>	Y-Comprehensive Score
YHGF (000792)	-0.642487852	-0.44307	-20.2338	-3.47392
QQKJ (002646)	-10.01653259	-32.632	-44.8922	-16.0857
QHHD (600243)	14.46092056	-1.46134	0.284096	3.608669
QHCT (600381)	-1.167164864	4.897106	2.8439	1.084877
GYY (600771)	1.371094749	2.83044	0.214674	0.943688
ZHNY (600869)	-0.745839271	-3.964	-1.20094	-1.15256
XBKY (601168)	-13.95542406	-11.4058	-3.94033	-6.53169
ZPGF (603843)	0.792444451	2.078646	-1.09089	0.437454
ZGKG (000408)	0.887511861	0.76281	-2.6857	-0.04426
SLB (000606)	3.161597073	2.128617	-2.70479	0.820328
Average	-0.585387994	-3.72085	-7.3396	-2.03931
Listed Company Of Ningxia	The score of <i>F1</i>	The score of <i>F2</i>	The score of <i>F3</i>	Y-Comprehensive Score
YLT (000635)	-4.954081516	7.729457	-1.73778	-0.10526
MLY (000815)	0.097858445	1.175958	-7.30862	-0.90984
SYHQ (600146)	1.123817396	-0.41017	9.8202	1.781529
XRHL (600165)	0.021679193	0.459602	-9.9801	-1.49287
NXJC (600449)	-0.063904479	-2.14972	-3.72844	-1.02385
XHBH (600785)	-1.397249498	-5.6177	-37.3875	-7.39893
BTSY (000595)	-0.444708836	-0.39498	0.204669	-0.16174
QLGY (002457)	0.100624942	0.557351	-0.33186	0.081296
JZXN (601619)	0.10393933	-0.5892	-0.35906	-0.14292

XBCY (000557)	0.801081606	1.928675	-3.88899	-0.03411
Average	-0.46109	0.268927	-5.46975	-0.94067

The names of listed companies are replaced by initial letters.

#### 4 Comprehensive Score Evaluation of Financial Ability of Five Provinces in Northwest China

From a single principal component analysis (see Table 7, Figure 2), *F1*, *F2*, *F3* are relatively balanced in the degree of generation of regional financial capacity, the gap is not significant. As shown in Table 11, the correlation between *F1* and Ningxia's comprehensive score is close to 1, the highest among the five provinces, while the correlation between *F1* and Xinjiang's comprehensive score is only 0.514, the lowest among the five provinces. Compared with other industries, Ningxia's short-term solvency and development ability in garment manufacturing and transportation industry are stronger, while Xinjiang's short-term solvency in medicine industry is more prominent. From the perspective of profitability *F2*, its specific indicators mainly include net interest rate of total assets and net operating interest rate. The ranking of profitability of the five provinces from high to low is Shanxi, Ningxia, Gansu, Xinjiang and Qinghai. Operating capability *F3* has the highest correlation with regional financial capability in the three principal components, but it has the lowest representation of regional financial capability, which is only 15.903%.

**Table 7 Correlations**

	<i>F1</i>	<i>F2</i>	<i>F3</i>	
Y-Shanxi	Person Correlation	0.460	0.675	0.942**
	Sig.(2-tailed)	0.181	0.032	0
Y-Gansu	Person Correlation	.923**	.727*	.998**
	Sig.(2-tailed)	.000	.017	.000
Y-Xinjiang	Person Correlation	.514	-.238	.965**
	Sig.(2-tailed)	.129	.508	.000
Y-Qinghai	Person Correlation	.756*	.461	.990**
	Sig.(2-tailed)	.011	.18	.000
Y-Ningxia	Person Correlation	1.000**	-.996**	1.000**
	Sig.(2-tailed)	.000	.000	.000

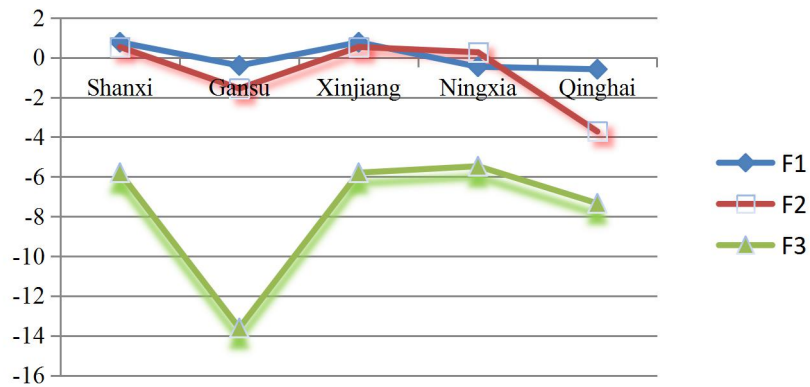


Figure 2 Average Score of Each Principal Component

According to the comprehensive situation analysis (see figure 3), the average comprehensive scores of the five northwest provinces are lower, followed by Shanxi, Gansu, Xinjiang, Qinghai and Ningxia. Compared with the single related component mentioned above, it can be seen that the correlation between the principal components of Ningxia and financial ability is significant, but the overall economic level of Ningxia is relatively backward, reflecting to a certain extent that the regional superior industries of Ningxia are not outstanding, the overall economic industry integration is poor, and there is a big gap in the economic level within the region itself. If the economic level wants to catch up with the eastern provinces, it still needs long-term unremitting efforts. Gansu, Qinghai and Xinjiang are in the middle level of financial capacity of the five northwest provinces. Their economic development is relatively stable, but the imbalance of industrial development within the region can't be ignored. The comprehensive score of Shanxi Province is higher than that of the other four provinces, which shows that the overall economic strength of Shanxi Province is prosperous and prosperous, the development of the industry is in step, and if the internal financial capacity is improved, its economic development level will reach a new height.

### Financial Capacity

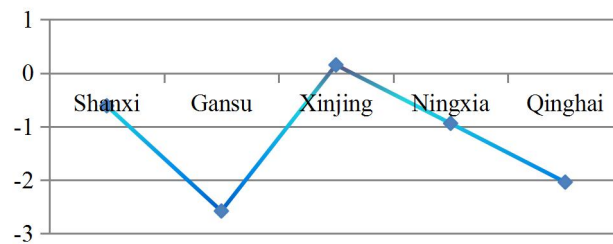


Figure 3 Financial Capacity

## **5 Policy Suggestions**

### **5.1 Give play to regional advantage and accelerate economic integration**

The unique geographic positions of northwest five provinces in China form different economic development characteristics, therefore, if the five provinces want to continue to give full play to regional advantages, they need to realize self-development, pay more attention to economic integration with surrounding provinces and seek for common economic profits and supplementation thus to accelerate their economic development(Lv Jingye, Ding Zhouxiang, Li Penglin, 2018). Wherein, Shanxi province should give play to its hub role to connect the economies of the northwest district and the middle areas and guide common economic development; The Xinjiang Uygur Autonomous Region should give play to its resource advantage, introduce some energy-based manufacturing industries, develop and utilize clean energies and new energies positively; Gansu, Qinghai and Ningxia should introduce labor force and technology positively, strengthen integration of technology, talent and industry, and consolidate their economic foundations(Jiang Anyin, Liu Xiaowei, 2017).

### **5.2 Carry out the national strategy of “Silk Road Economic Belt” and realize internal and external balanced development**

The northwest five provinces in China should grasp the opportunity of silk road to carry out national strategy positively, strengthen cooperation with the countries along the “Silk Road Economic Belt” in emerging industries thus to attract them to make investment and give financial resource support, moderate the problem of financing difficulty(Shen Minghui, 2019). Meanwhile, Shanxi, Sinkiang, Gansu, Qinghai and Ningxia should combine with their development characteristics to further optimize product export structure, enhance additional value of product export, persist in low-carbon economy, green economy and northeast five provinces, reduce resource consumption for economic development, realize benign circulation of economy and environment, and realize internal and external balanced development.

### **5.3 Enlarge investment and perfect technical innovation**

Compared with the eastern region, the northwest five provinces are weak in the economy, they should enhance their economic development levels through technical innovation. The government departments should strengthen financial support for technical innovation and give play to guidance role positively. On the one hand, the government departments can establish special policy-based financial institutions to provide targeted service for technical innovation, offer financial support to attract other financial institutions and give play to lever effect of financial policy. On the other hand, they should perfect the talent selection and information sharing mechanism for the northwest five provinces in China and establish idea bank(Lu Shanbing, 2018) in order to realize information sharing between governments and enterprises, realize mutual learning and reference in technical innovation, provide powerful support for the innovation work, and finally realize win-win.

## **6 Conclusion**

This paper adopts PCA to conduct empirical research on the economic development of the northwest five provinces in China under the background of “one belt and one road”, and verify the current situation of imbalanced economic development in the northwest region more scientifically, manifests the stability and total financial capacity of principal components is largely different in different areas. Wherein, Shanxi and Sinkiang have stronger financial capability while Qinghai, Ningxia and Gansu are weaker, which shows that the economic development of the northwest five provinces is commonly driven by Shanxi and Sinkiang, meanwhile, the economic development levels of other three

regions have large development space. Generally, with the international attention to the strategy of “one belt and one road” china will intensify efforts to play regional advantages fully, speed up the economic integration, implement the national development strategy, investment, science and technology innovation, these measures can effectively shorten economic gap of northwest five provinces in China effectively narrow and the level of regional economic development is moving towards new peaks in the future. Then it may drive the development of Chinese economy.

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## **A Study on the Influencing Factors of Financial Leverage: Taking Real Estate Industry as a Sample**

Shen Jialu

School of Management, Wuhan University of Technology, Wuhan, P.R. China, 430070

(E-mail: shenjialu1120@126.com)

**Abstract:** Real estate, as is acknowledged, is an important industry in the deleveraging task. On the basis of domestic scholars' research, this paper chooses more significant financial indicators for regression analysis. It finds out that profitability (ROA) is negatively correlated with financial leverage. Return on net assets (ROE) explains that financial leverage is significantly positively correlated, while inventory turnover is not significantly negatively correlated. This paper tries to explain the variable of financial leverage in order to provide effective suggestions for the real estate industry to de-leverage.

**Key words:** Real estate; Financial leverage; Regression analysis; Deleverage

### **1 Introduction**

In the supply-side reform, General Secretary Xi Jinping has repeatedly emphasized 'capacity reduction, de-stocking, deleveraging, improving underdeveloped areas', in which deleveraging refers to reducing long-term financial risks and systematization. The appropriate use of leverage effect can expand the scale of enterprise capital operation, and is conducive to the development of enterprises. However, the high financial leverage of real estate will make the debt growth rate too fast, increase the financial risk of enterprises, and even eventually lead to the rupture of the capital chain of enterprises. Real estate industry is a pillar industry related to the people's livelihood of the country, and most of them belong to high asset-liability ratio enterprises. In recent years, the continuous rise of real estate prices makes the task of de-leveraging imminent.

Looking back on the past, the earliest research on financial leverage was the famous MM theory put forward by foreign scholars Modiglian and Miller, that is, the EBIT level remains invisible now and in the future. The liabilities of companies and individuals are risk-free, so the interest rate on liabilities is risk-free. In the 1990s, many scholars made various explorations on the influencing factors of financial leverage, such as Brailsford T J, Oliver B R and other scholars think that the stronger the profitability of enterprises, the higher the asset-liability ratio. (Brailsford T J, Oliver B R, Pua S L H, 2002) Kurshev A and Strebulaev I A believe that the size of the company is negatively related to the level of financial leverage. Through empirical analysis, Raghuram Rajan and Luigi Zingale conclude that there is a significant negative correlation between profitability and financial leverage, and it is the same as the growth trend of corporate size. Graham Hall and Patrick Hutchinson classify the types of debt. They think that short-term liabilities are negatively correlated with profitability, while long-term liabilities are not significantly correlated.

At the current stage, some domestic scholars have different opinions on deleveraging. Yin

Jianfeng proposed the way of debt-to-equity swap to improve the financing structure of enterprises and improve the efficiency of asset utilization. (Yin Jianfeng, 2016) Li Wenqin pointed out that financial leverage can enhance the investment efficiency of the real estate industry to a certain extent, and has a positive effect. (Li Wenqin, 2015) Gou Wenjun and other scholars proposed to vigorously develop equity financing based on the CA model, in order to improve the sustained and stable effect of China's financial system. (Gou Wenjun, 2016) Zhao Shuaiyin made an empirical study on the overall level of financial leverage, positive and negative effects and influencing factors of real estate listed companies. He believed that financial leverage decreased with the increase of profitability of enterprises, and increased with the growth and scale of enterprises. (Zhao Shuaiyin, 2012)

On the whole, there are more studies on the influencing factors of financial leverage of listed companies, less studies on a specific industry, more qualitative analysis and less quantitative analysis. In this paper, SPSS software is used for regression analysis. It summarizes and analyses the changes of financial leverage effect level in the past three years, and calculates the significant variable coefficients that affect the financial leverage of the real estate industry.

## 2 Research Design

### 2.1 Sample selection principle

*In order to ensure the validity of the study, this paper takes the financial data of real estate listed companies in China from 2016 to 2018 as the initial research sample, and eliminates the abnormal samples of ST, PT listed companies and the lack of financial data during the study period. The financial indicators data of past years are all from the CSMAR database. After sample removal and data processing, the sample of real estate listed companies is 101. This paper will use these financial indicators of real estate listed companies as independent variables and use regression analysis method to explore the influencing factors of high leverage in the real estate industry.*

### 2.2 Measurement of variables

#### 2.2.1 Selection of dependent variables

In fact, both asset-liability ratio and financial leverage coefficient are used to measure financial risks. In this paper, the asset-liability ratio is used to replace the financial leverage coefficient. Its measurement formula is total liabilities/total assets, which is expressed by FL. The level of financial leverage and the performance of debt-paying indicators of real estate enterprises reflect the degree of security of the real estate enterprises' capital chain. Under the background of tightening financing policy in the future, the analysis of financial leverage level and debt-paying ability indicators seems particularly important.

#### 2.2.2 Selection of independent variables

(1) Retained earnings: The internal accumulation of earnings extracted or formed by an enterprise from the profits realized over the years, including surplus reserve and undistributed profits = surplus reserve plus undistributed profits) / total assets, expressed in RST.

(2) Corporate profitability: Net profit margin of total assets = net profit/average total assets, expressed in ROA, is an important indicator to measure the profitability of enterprises by utilizing the total equity of creditors and owners.



(3) Enterprise operating capacity: Inventory turnover ratio = cost of goods sold/average inventory balance, is a comprehensive index to measure the enterprise's sales capacity and inventory management level. Because the expenditure and capitalized interest of real estate enterprises in the process of land acquisition and development are all recorded in the "inventory" of current assets, real estate enterprises mainly measure the overall operating level of enterprises by current assets (inventory), which is expressed by ITR.

(4) Net Asset Return Rate: This index reflects the income level of shareholders' equity, which is used to measure the efficiency of the company's use of its own capital. The higher the index value, the higher the return of investment.

(5) Earnings per share: It is the net profit or the net loss of an enterprise that a common shareholder can enjoy for each share he holds, expressed in EPS.

### 2.2.3 Selection of control variables

In order to ensure the data discretization caused by enterprise scale factors, this paper tries to construct a multiple regression equation and add the growth rate of total assets (growth ability), turnover rate of current assets, turnover rate of accounts receivable, operating profit rate and other indicators to ensure the validity of the model.

Through consulting a large number of literatures on the influencing factors of financial leverage of real estate listed companies, it is found that most scholars in China use panel data and multiple linear regression equation to prove that financial leverage of real estate listed companies is affected by specific financial indicators. Li Yang (2015) used empirical analysis method to draw a conclusion that profitability is negatively correlated and operating capacity is positively correlated. Combining with the variables selected in the previous paper, the following model is constructed:

$$FL = a_0 + a_1 * ROA + a_2 * ROE + a_3 * EPS + a_4 * RST + a_5 * ITR$$

In the formula,  $a_0$  is constant term;  $a_1, a_2, a_3, a_4, a_5$  are coefficient of explanatory variables

## 3 Sample Data Analysis

### 3.1 Dependent variable description statistics

This paper extracts 101 listed companies' financial leverage data from 2016 to 2018 to describe the statistics. The results are as follows:

*Table 1 Descriptive Statistics of the Means of Indicators of Sample Companies from 2016 to 2018*

Data	Min(M)	Max(X)	average value (E)	standard deviation	skewness	kurtosis
Statistics	Statistics	Statistics	Statistics	Statistics	Statistics	Statistics
					Standard error	Standard error

2016financial leverage	101	.927166	2.498071	1.28380	.375987066	1.941	.319	3.320	.628
2017financial leverage	101	.945649	4.350005	1.32224	.598239028	3.658	.319	14.884	.628
2018financial leverage	101	.863927	2.723099	1.21306	.309624353	2.800	.319	10.420	.628
Asset-liability ratio	101	.118612	.940897	.66196652	.180441894	-.830	.240	.340	.476
Net interest rate on total assets	101	-.087765	.121395	.03004370	.031408629	.510	.240	2.902	.476
Inventory turnover	101	.008958	540.59752	6.9051078	54.0454950	9.829	.240	97.883	.476
Return on net assets	101	-.469744	.314412	.09198130	.097163654	-1.973	.240	11.571	.476
Earnings per share	101	-.917092	4.463413	.72393766	.841237932	1.959	.240	5.446	.476
Retained earnings per share	101	-.699398	8.491688	2.31612547	1.68063885	1.037	.240	1.052	.476
Effective N (in columns)	101								

According to Table 1, we can see that the average financial leverage index of A-share real estate listed companies in Shanghai and Shenzhen in 2017 is 3.1% higher than that in 2016. Although there is a slight upward trend, the financial leverage index in 2018 is 8.3% lower than that in 2017, and the financial leverage has dropped by 5.4% in three years. This shows that most real estate companies are now more inclined to "reduce financial leverage appropriately" to reduce financial risk under the domestic policy environment of de-leveraging and de-productivity. In fact, financial leverage is essentially a measure of risk allocation between creditors and debtors. The total amount of financial risk does not change with the change of financial leverage coefficient.

Moreover, it can be seen that the average value of ROA and ROE is less than 0.1, which indicates that the real estate industry is not optimistic. The difference between the maximum value and minimum value of asset-liability ratio and inventory turnover ratio is large, which indicates that the real estate industry has good and uneven debt-paying ability. It also proves that the level of financial

leverage in the industry is due to company size, financing strategy and other reasons. This leads to polarization.

### 3.2 Empirical analysis

SPSS software was used for regression analysis. In order to eliminate the difference of business and profit scale among different real estate listed companies, this paper adds control variables such as total asset growth rate, turnover rate of current assets and operating profit rate, in order to make the independent's explanatory effect on dependent variable more remarkable. The model summary results are as follows:

**Table 2 Model Summary**

Model	R	R square	Adjusted R Square	Errors in Standard Estimation	Change statistics					
					R side change	F change	df1	df2	Significant F change	Durbin-Watson(U)
1	.745 <sup>a</sup>	.555	.531	.123555945	.555	23.656	5	95	.000	
2	.752 <sup>b</sup>	.565	.522	.124758246	.010	.544	4	91	.703	1.970

a. Predictive variables: (Constant), Inventory Turnover Rate, Return on Net Assets (ROE), Retained Earnings per Share, Total Asset Net Profit Rate, Earnings per Share

b. Forecast variables: (constant), inventory turnover, return on net assets (ROE), retained earnings per share, net profit margin of total assets, earnings per share, turnover rate of accounts receivable, growth ability (growth rate of total assets), turnover rate of current assets, operating profit margin

The adjusted  $R > 0.6$  in the model summary shows that there is a clear linear relationship between dependent variables and independent variables, and the multivariate linear regression equation fits well. After adding control variables, the significance of regression equation  $F = 0.000 < 0.005$ . It can be considered that the regression equation has statistical significance.

**Table 3 Analysis of Variance**

ANOVA <sup>a</sup>						
Model		Sum of squares	variance	mean square	F	Saliency
1	regression	1.806	5	.361	23.656	.000 <sup>b</sup>
	residual	1.450	95	.015		
	Total	3.256	100			
2	regression	1.840	9	.204	13.132	.000 <sup>c</sup>
	residual	1.416	91	.016		
	Total	3.256	100			

a. Dependent variable: asset-liability ratio

b. Forecasting variables: (constant), inventory turnover, return on net assets (ROE), retained earnings per share, profitability (ROA-net profit margin of total assets), earnings per share

c. Forecast variables: (constant), inventory turnover, return on net assets (ROE), retained earnings per share, net profit margin of total assets, earnings per share, turnover rate of accounts receivable, growth ability (growth rate of total assets), turnover rate of current assets, operating profit margin

Table 3 is the variance analysis table of the regression model. The adjusted F value is 23.656, the regression square sum  $U = 1.806$ , the residual square sum  $Q = 1.450$ , the deviation square and  $S_{yy} = 3.256$ , and their corresponding degrees of freedom are 5, 95 and 100, respectively.

**Table 4 Regression Coefficient and Significance Test**

Model	Coefficient <sup>a</sup>			t	Saliency	
	Non-standardization coefficient		Standard coefficient			
	B	Standard error	Beta			
(constant)	.716	.025		29.000	.000	
1	Net profit margin of total assets	-6.152	.651	-1.071	-9.451	.000
	Retained earnings per share	-.019	.011	-.173	-1.648	.103
	Return on net assets	1.399	.258	.753	5.432	.000
	Earnings per share	.064	.028	.297	2.285	.025
	Inventory turnover	-7.502E-5	.000	-.022	-.326	.745

a. Dependent variable: asset-liability ratio

Table 4 shows the regression coefficients of the multivariate linear equation of financial leverage. The coefficient of constant term is  $\alpha_0=0.716$ ,  $\alpha_1=-6.152$ ,  $\alpha_3=1.399$ ,  $\alpha_4=0.064$ . After testing, the Retained Earnings per Share (RST) and Inventory Turnover Ratio (ITR) are greater than the standard value of elimination factor 0.1. Therefore, the above two dependent variables should be removed from the regression model. Therefore, the regression equation is:

$$FL=0.716-6.152ROA+1.399ROE+0.064EPS$$

Based on the results, it can be seen that total net asset profit margin (ROA) is negatively correlated with financial liability ratio, but net asset return (ROE) is positively correlated. EPS has little effect on financial leverage of real estate enterprises, while ITR and EPS are not negatively correlated.

*Table 5 Colinearity Diagnosis of Interpretation Variables*

Model	dimension	characteristic value	Condition index (constant)	Variance ratio				
				Inventory turnover	Net profit margin of total assets	Earnings per share	Return on net assets	
1	1	3.181	1.000	.03	.00	.02	.02	.01
	2	.992	1.790	.00	.36	.00	.01	.00
	3	.385	2.873	.04	.01	.20	.42	.01
	4	.361	2.967	.48	.02	.00	.12	.04
	5	.079	6.335	.06	.00	.38	.43	.93

a. Dependent variable: asset-liability ratio

In view of the large number of explanatory variables selected in this paper, collinearity diagnosis of each explanatory variable should be continued after regression analysis, and the results are shown in table 5. In the table, the condition index <10 and the variance ratio are all <0.5, indicating that there is no serious linear relationship between the variables, proving that the linear regression results are statistically significant.

### 3.3 Results and suggestions

#### 3.3.1 High Debt Ratio is the Restricting Conditions Affecting the Profit Level of Real Estate Enterprises

According to the results of regression analysis, the total asset net profit margin (ROA) of real estate listed companies is negatively correlated with the financial leverage level, indicating that the decline of the asset-liability ratio will improve the enterprise's total asset profit margin, thus increasing the wealth of shareholders. The regression coefficient of the profit rate of total assets as high as -6 indicates that the high leverage of the real estate industry has caused the negative effect of financial leverage, resulting in a significant decline in the profitability of the real estate industry. This is consistent with the research results of scholars. The loan interest rate of commercial Banks in China is affected by macro policies. Real estate enterprises should adjust the debt structure reasonably, broaden the financing channels, and increase the proportion of owners' equity in the total assets in the form of debt-for-equity swap, so as to reduce the financial leverage.

#### 3.3.2 Sound operational capability is an important basis for real estate enterprises to exert the positive effect of financial leverage.

It is well known that the inventory turnover rate (ITR) reflects the enterprise's operational capacity as a whole, and the turnover rate represents the measured value of the enterprise's interests. The higher the inventory turnover rate, the higher the interest rate under the same amount of funds. Regression analysis shows that there is no significant negative correlation between inventory turnover and financial leverage, indicating that the increase of inventory turnover can lead to the reduction of financial leverage in real estate enterprises. Influenced by the state's macro-control policy, the

property market has been unsalable in recent years, the inventory turnover rate of the real estate industry has declined, and the developers have difficulties in capital turnover. In view of this situation, real estate enterprises can obtain a large number of land resources through acquisitions, mergers and acquisitions, cooperation and other low-cost ways; they can also show their operational advantages through agent construction to help enterprises obtain funds.

### 3.3.3 The Increase of Net Asset Return Rate is an Effective Measure to Deleverage Real Estate Enterprises

In fact, the return on net assets is used to measure the efficiency of enterprises' use of their own capital, and also the efficiency of companies' use of shareholders' investment capital. The higher the return on net assets, the higher the return on investment. Through DuPont analysis, we can get three ways to improve the profit margin, leverage and turnover speed of funds. Today, the real estate industry requires financial stability, which requires real estate enterprises to improve the speed of capital turnover. Enterprise decision makers can delay the development of the way to make the cost of capital in a controllable range of conditions, thus guiding the return on net assets to a positive direction.

## 4 Conclusion

In this paper, the following conclusions are drawn through regression analysis of the relevant data of real estate listed companies from 2016 to 2018: real estate financial leverage is negatively correlated with total net asset profit margin, positively correlated with earnings per share and net asset profit margin, and not negatively correlated with inventory turnover rate. At present, the financial leverage of real estate listed companies is still at a high level, so it is necessary for enterprises to consider their own operating conditions, multi-channel financing, and optimize the capital structure. As the net profit margin of total assets is negatively correlated with financial leverage, the improvement of total asset profit margin is the most important thing for real estate enterprises to de-leverage in practice.

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# **A Study on The Impact of Accounting Conservatism on Corporate Debt Financing Cost from the Perspective of Environmental Uncertainty**

Li Jiaying, Hong Hong

School of Management, Wuhan University of Technology, Wuhan P.R. China,430070

(E-mail: 807399929@qq.com, 420379607@qq.com)

**Abstract:** Taking the 1860 A-share listed companies in 2013-2017 as the research sample, this paper discusses the impact of accounting conservatism on the corporate debt financing cost under environmental uncertainty, and draws three research conclusions: 1. There is a significant negative correlation between accounting conservatism and corporate debt financing costs; 2. There is a significant positive relationship between environmental uncertainty and corporate debt financing costs; 3. Under the uncertainty environment, the effect of accounting conservatism on reducing corporate debt financing costs is more significant.

**Key words:** Uncertainty environment; Accounting conservatism; Debt financing costs; Accounting information quality

## **1 Introduction**

### **1.1 Accounting conservatism and debt financing costs**

As the “oldest and most influential principle in accounting measurement”, accounting conservatism has a long-term impact on accounting practice. Accounting conservatism is usually defined as the asymmetry of the recognition of gains and losses, as evidenced by the recognition of accelerated losses and the recognition of delayed returns. Therefore, accounting stability plays an important role in the development of enterprises and the prevention of risks.

Under what conditions does accounting conservatism improve corporate performance? One explanation proposed in the literature is that conservatism serves as a disciplining device that constrains managerial opportunism (Hsu, C.,2017). Especially, conservatism can lead to a lower cost of debt



(García,2016). The main reason for enterprises demand for accounting conservatism comes from the contract of debt and compensation, and that the debt contract is the most important reason for enterprises to choose a robust policy(The Watts,2003).From the perspective of M&A investment, It is proved that accounting conservatism helps managers make more favorable M&A investment decisions and improve corporate investment efficiency (Francis,2010).The principle of accounting conservatism is firstly used to alleviate the conflicts between corporate creditors and business owners on dividend policy and reduce the cost of debt financing (BalakrishnanK.,2016).Domestic research in related fields appeared after the US subprime mortgage crisis. Empirical research found that accounting information reduces the asymmetry of credit decision information and increases the chance ratio of making correct credit decisions (Zhang Guangyuan,2017). Accounting conservatism encourages companies to more easily obtain external debt financing and equity financing opportunities, reduce financing costs, and thus ease financing constraints (Zhang Yuemei,2017).

### **1.2 Environmental uncertainty and debt financing costs**

Environmental uncertainty is created by the perceived variability and complexity of external factors. Variability refers to the rate of change in factors such as customers, suppliers, and competitors. This affects the accuracy and quality of information available to decision-makers(Yu, C.L,2016).Perceived uncertainty in the external environment impacts managerial attitudes towards identifying competitors since in these situations external events and trends cannot be predicted(Milliken,1987).In terms of information asymmetry, corporate environmental uncertainty will exacerbate corporate information unequal issues. Uncertain business environment is stimulating corporate response processes, such as innovation activities, business strategy shifts and even management's earnings management behaviors, which have become important driving forces for information asymmetry, and thus the changes in trait risks have a role (Hua Fengtao,2016). It is concluded that due to the increase of environmental uncertainties, the capital cost of enterprises will increase. The more turbulent the environment, the higher the debt cost of the enterprise, and the relationship between the two is more obvious in private enterprises (Li Jianfeng,2016).It is also found that the lower the degree of environmental uncertainty, the more significant the negative relationship between the customer concentration and the cost of equity capital(Wang Yan,2016).Some research pays attention to how the debt costs faced by Chinese companies in a more complicated and volatile environment after 2008. The results show that the more turbulent the environment the higher the corporate debt cost, and the relationship between the two is more obvious in private enterprises (Zeng Yanxue,2014).

### **1.3 Summary of literature review**

Previous studies on environmental uncertainty have mostly focused on business operations (involving corporate performance and corporate strategy choices, market orientation, etc.), accounting

perspectives (earnings management, investment efficiency, financial flexibility, audit fees, audit opinions, etc.). However, there are few empirical studies on environmental uncertainty and debt cost, and few scholars have conducted in-depth research on the relationship between accounting conservatism and debt cost under environmental uncertainty. Therefore, this paper studies this aspect focus.

## **2 Theoretical Analysis and Research Hypothesis**

### **2.1 Accounting conservatism and debt financing costs**

The higher the degree of accounting conservatism of the enterprise, the more controllable the financial profit in the financial statements can be controlled. When the creditor knows that the enterprise has adopted a sufficiently sound accounting policy, it can make a reasonable judgment based on various financial information disclosed by the listed company. In the case of satisfying the interests of creditors, the credit risk of creditors can be reduced, and creditors are more willing to provide debt companies with lower loan interest rates, which in turn reduces the debt financing costs of the above companies. Therefore, the following assumptions are made:

Hypothesis 1: The higher the accounting stability of listed companies, the lower the cost of debt financing.

### **2.2 Environmental uncertainty and debt financing costs**

Accounting conservatism can reduce the information asymmetry between enterprises and creditors, and reduce the risk premium faced by creditors from the perspective of internal enterprises. The external environmental factors are largely beyond the control of enterprise managers, which leads to environmental uncertainty. There are mainly market, policy, culture and other factors, the increase of environmental uncertainty, the greater the volatility of corporate performance, the increased operational risks faced by enterprises, and the greater incentives for managers to undermine the interests of creditors in this situation. From the creditor's point of view, the debtor's bad debt risk increases, so it is necessary to compensate for the risk premium faced by raising the borrowing rate.

Hypothesis 2: Environmental uncertainty is significantly positively correlated with corporate debt financing costs.

Hypothesis 3: In the case of environmental uncertainty, the level of accounting conservatism has increased the role of reducing debt costs.

## **3 Data and Methodology**

### **3.1 Sample selection**

This paper takes 1860 companies in the A-share market of listed companies in China from 2007 to 2013 as the initial research object. When selecting samples, we need to consider the following factors: (1) Excluding 25 listed companies in the financial industry, because the financial industry listed companies have special business and the financial data; (2) Excluding "ST" or "\*ST" sample 65 listed companies. (3) Excluding the sample with the missing variable value during the study period and the sales income of 5 years due to the uncertainty of the computing environment, in addition, in order to eliminate the interference of extreme values, all variables in the text were subjected to winsorize tailing processing at the 1% level. The specific data of this study is from the Guotaian (CS-MAR) database, and the data is collated and analyzed using SPSS20.0

### 3.2 Selection and measurement of main research variables

#### 3.2.1 Measurement of environmental uncertainty

This section refers to the practice of Shen Huihui and Wu Liansheng (2012), excluding the stable growth of sales revenue, and measuring the environmental uncertainty by the coefficient of variation of sales income over the past five years after the industry median adjustment. This article uses the ordinary least squares (OLS) method to run the following model:

$$\text{Sale} = \beta_0 + \beta_1 \text{Year} + \varepsilon$$

Among them, Sale represents sales income, Year is an annual variable, and the number is from the current year. If it is the 5th year, then Year=1; if it is the 4th year, then Year=2; and so on, if it is the current year, In the first year, Year=5. The residual of the model is the abnormal income of the enterprise. The standard deviation of the abnormal income in the past 5 years is calculated, divided by the average of the sales income in the past 5 years, and the environmental uncertainty that has not been adjusted by the industry in the current year is obtained. For the current year, the environmental uncertainty of all companies in the same industry takes the median, and the industry environment is uncertain. Finally, the unadjusted environmental uncertainty index of each company is divided by the industry environmental uncertainty of the year.

#### 3.2.2 Measurement of accounting conservatism

This paper uses Basu's (1997) surplus-stock compensation measurement method to test the impact of product market competition on accounting robustness.

$$EPS_{i,t}/P_{i,t-1} = \beta_0 + \beta_1 DR_{i,t} + \beta_2 RET_{i,t} + \beta_3 RET_{i,t} \times DR_{i,t}$$

In the model,  $EPS_{i,t}$  is the accounting earnings per share of fiscal year  $i$  company  $t$ ;  $P_{i,t-1}$  is the stock price of  $i$  company at the beginning of the year;  $RET_{i,t}$  is the stock return of  $i$  company  $t$  year;  $DR_{i,t}$  As a dummy variable, take 1 when  $RET_{i,t} < 0$ , otherwise 0. In this model,  $\beta_2$  measures the

sensitivity of accounting earnings to good news. The larger the coefficient, the faster the earnings reflect good news.  $(\beta_2 + \beta_3)$  measures the sensitivity of accounting earnings to bad news. The larger, the surplus reflects the bad news faster than the good news, and the  $\beta_3$  measures the sensitivity of the accounting information to the bad news, which is the so-called robustness coefficient. If  $\beta_3 > 0$ , then there is robustness.

### 3.2.3 Measurement of debt financing costs

In this paper, combined with the financial data that the listed companies in China are used to disclose, the measurement method for debt financing cost is: debt financing cost = interest expense / (short-term borrowing + non-current liabilities due within one year + long-term borrowing ten Bond + long-term payables + other non-current liabilities)

## 3.3 Model design

### 3.3.1 Design of the impact of accounting conservatism on corporate debt financing costs

In order to test the relationship between accounting conservatism and corporate debt financing costs, this paper first examines the accounting conservatism and corporate debt financing costs as explanatory variables and explanatory variables, respectively.

$$DOC = \beta_0 + \beta_1 EPS/P + \beta_2 RET_{i,t} + \beta_3 SOE_{i,t} + \beta_4 SIZE_{i,t} + \beta_5 LEV_{i,t} + \beta_6 ROE + \beta_7 GROWTH + \beta_8 \sum year + \beta_9 \sum industry + \varepsilon \quad (1)$$

### 3.3.2 Model design of the impact of accounting conservatism on debt cost under environmental uncertainty

In order to test the impact of accounting conservatism on debt financing costs under environmental uncertainty, we designed the following model, adding the cross terms of  $EPS_{i,t}/P_{i,t-1}$  and EU:

$$DOC = \alpha_0 + \alpha_1 EPS_{i,t}/P_{i,t-1} + \alpha_2 EPS_{i,t}/P_{i,t-1} \times EU + \alpha_3 LEV + \alpha_4 SIZE + \alpha_5 ROE + \alpha_6 SOE + \alpha_7 GROWTH + \alpha_8 \sum year + \alpha_9 \sum industry + \varepsilon \quad (2)$$

According to Hypothesis 3, it can be expected that accounting conservatism is negatively correlated with debt financing costs,  $\alpha_1$  is negative; environmental uncertainty makes accounting conservatism more obvious, and the sign of  $\alpha_2$  can be expected to be negative.

## 4 Results

### 4.1 Descriptive statistics

From the sample observations, during the sample period, the surplus index (EPS/P) has a skewness of -1.262, which is left-biased, and the stock return rate (RET) has a skewness of 2.744, which is right-

biased. Therefore, on the whole, China's 2013-2017 Shenzhen Main Board listed company A-share market companies may have accounting conservatism. Table 1 shows the descriptive statistics of the main variables. It can be seen from Table 1 that the standard deviation of stock return rate (RET) is 0.28096, which is much larger than the standard deviation of the explanatory variable EPS/P 0.07321, which indicates that the stock market volatility is greater than the volatility of accounting earnings. The mean value of the dummy variable DR is 0.1463, which indicates that approximately 14.63% of the company's annual stock returns are negative. The average and median cost of corporate debt financing are 0.0622 and 0.0531, respectively, indicating that the debt financing costs of different enterprises are 6% on average, and the minimum debt cost is 0.0013, indicating that the debt cost of the sample is greater than 0 and the maximum is 0.4529. Different enterprise debt financing costs vary widely. The mean and median of the variable EU representing the environmental uncertainty are 0.4981 and 0.0000, respectively, and the standard deviation is close to the mean, which indicates that the difference in environmental uncertainty between different companies is obvious.

**Table 1 Descriptive Statistics of Variables**

Variables	Mean	Median	Standard deviation	Minimum	Maximum
EPS/P	0.01937	0.01841	0.07321	-0.99911	0.19718
RET	0.05824	0.04393	0.28096	-2.80509	3.61809
DR	0.1463	0	0.35407	0	1
EU	0.4981	0.0000	0.5001	0.00000	1.0000
SIZE	9.5811	9.5221	0.4773	8.6532	10.9666
LEV	0.48396	0.48649	0.31661	0.00675	3.98452
SOE	0.4075	0	0.4914	0	1
DOC	0.0622	0.0531	0.0578	0.0013	0.4529
GROWTH	0.5053	0.1243	2.69990	-0.6321	12.2131
ROE	0.0561	0.0609	0.1313	-0.7688	0.3534

## 4.2 Correlation analysis

We find that both the Pearson coefficient and the Spearman coefficient, there is a significant negative correlation between accounting robustness and debt cost at 1%, and environmental uncertainty is significantly positively correlated with debt cost at 1%. This is initially consistent with Hypothesis 1, Hypothesis 2. In terms of control variables, there is a significant negative correlation

between equity nature, return on equity, company size, growth rate of main business income, and debt size.

**Table 2 Correlation Test**

	DOC	EPS	EU	SOE	SIZE	LEV	GROWTH	ROE
DOC	1	-0.31***	0.51***	-0.16***	-0.13***	-0.06**	-0.02**	-0.02***
EPS	-0.12***	1	-0.26***	0.09***	0.03***	-0.18**	0.08**	0.44**
EU	0.04***	-0.20**	1	-0.23***	-0.18***	-0.05**	0.02**	-0.28***
SOE	0.002***	0.08***	-0.19**	1	0.26***	0.02**	-0.04**	0.02**
SIZE	-0.17**	0.22**	-0.54**	0.25*	1	-0.14**	-0.01*	0.08**
LEV	0.02**	-0.12***	-0.22**	0.24**	0.43**	1	0.02*	-0.01*
GROWTH	-0.08**	0.02**	0.05**	-0.05**	0.02**	0.05**	1	0.08**
ROE	-0.14**	0.31**	-0.20**	-0.01*	0.21**	-0.14**	0.08**	1

### 4.3 Multiple regression analysis

#### 4.3.1 Accounting conservatism and corporate debt financing costs

The regression coefficient of accounting conservatism is one 0.008, and it is significant at the level of 1%. It is a strong argument that the debt cost is significantly negatively correlated with accounting conservatism.

**Table 3 Regression Results of Accounting Conservatism on Corporate Debt Financing Costs**

Variables	Model 1 coefficient	T-Value
Constant	0.141***	6.53
EPS/P	-0.008***	-5.08
SOE	-0.004**	-2.01
SIZE	0.049***	8.58
LEV	0.093***	9.06
GROWTH	-0.001**	-1.44
ROE	-0.011	-1.34

Year/Industry	Control
R <sup>2</sup>	0.237
F	21.78***

#### 4.3.2 The impact of accounting conservatism on corporate debt financing costs under environmental uncertainty

After adding the balance item EU\*EPS/P, the model regression yields a coefficient of EU of 0.029, and is significantly positively correlated with the debt cost at 1%, assuming that 2 is proved. The coefficient of the balance item EU\*EPS/P is 0.010, which is significantly negatively correlated with the debt cost at the level of 1%, indicating that the governance effect of accounting information is more obvious after adding environmental uncertainties.

**Table 4 Regression Results of the Impact of Accounting Conservatism on Corporate Debt Financing Costs after Adding Environmental Uncertainty**

Variables	Model 2 coefficient	T-Value
Constant	0.130***	5.81
EPS/P	-0.003**	-1.82
EU	0.029***	3.24
EU*EPS/P	-0.010***	-3.37
SOE	-0.004***	-2.1
SIZE	0.048***	8.44
LEV	0.092***	9.03
GROWTH	-0.001**	-1.41
ROE	-0.011	-1.32
Year/Industry	Control	
R <sup>2</sup>	0.239	
F	21.78***	

#### 4.4 Robustness test

In order to enhance the reliability of the research conclusions, this paper will test the robustness of

the model by changing the way the enterprise debt cost is measured. In the robustness test section, the three detailed accounts of interest expense, handling fee and other financial expenses are used as the approximate value of the net financial expenses, divided by the average value of the total corporate debt as a measure of the cost of debt.

**Table 5 Results of the Robustness Test**

Variables	Replace corporate debt financing			
	Model 1 coefficient	T-Value	Model 2 coefficient	T-Value
Constant	0.133	6.23	0.127	5.73
EPS/P	-0.0008***	-5.08	-0.003**	-1.82
EU			0.019***	3.13
EU*EPS/P			-0.010***	-3.37
SOE	-0.004**	-2.01	-0.004**	-2.1
SIZE	0.049***	8.58	0.048***	8.44
LEV	0.093***	9.06	0.092***	9.03
GROWTH	-0.001**	-1.44	-0.001**	-1.41
ROE	-0.011	-1.34	-0.011	-1.32
Year/Industry		Control		
R <sup>2</sup>	0.24		0.239	
F	21.78***		18.24***	

## 5 Conclusion

The increase in uncertainty outside the firm is caused by many uncontrollable factors. In the case of increased environmental uncertainty, the negative correlation between corporate accounting robustness and debt financing costs is more significant. In other words, creditors have a good governance effect in the process of risk assessment and interest rate determination, which can mitigate the impact of environmental uncertainty on corporate debt financing costs to some extent.

Based on the conclusions of this paper, we put forward the following suggestions: (1) Enterprises should pay attention to the principle of accounting conservatism and improve the quality of their financial information; (2) Enhance the ability of enterprises to adapt to the environment and enhance the flexibility of business strategy; (3) Investment People should always pay attention to external



information and strengthen the emphasis and recognition of corporate accounting robustness. At the same time, in the future measurement of environmental uncertainty, future scholars may consider integrating political, legal, economic, and cultural factors into environmental uncertainty indicators.

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# A Study on Carbon Accounting Information Disclosure of Listed Companies in China's Steel Industry

Ma Huizhi, Tang Miao

School of Management, Chengdu University of Information Technology, Chengdu, P.R.China, 610103

(E-mail: 24507404@qq.com, 1363712983@qq.com)

**Abstract:** This paper conducts research on five steel listed companies, based on their annual financial reports, annual audit reports, social responsibility reports, and board reports. And this paper analyzes the current situation of carbon accounting information disclosure from four aspects of the carrier, form, content and quality. It was found that there were problems in the disclosure of carbon accounting information in the steel industry, such as imperfect laws and regulations, imperfect supervision mechanism, inadequate form and insufficient content, and lack of carbon accounting talents. To this end, it is necessary to improve laws and regulations related to carbon accounting information disclosure, improve the corresponding supervision mechanism, establish standards for carbon accounting information disclosure, and formulate carbon accounting professional talents training programs. Only by improving the standardization of carbon accounting information disclosure of listed companies in an all-round way can we promote the development of low-carbon environmental protection.

**Key words:** Carbon accounting; Carbon accounting information disclosure; Steel industry; Listed companies

## 1 Introduction

In 1987, the United Nations World Commission on Environment and Development, chaired by Norwegian Prime Minister Gro Harlem Brundtland, formally proposed the concept of sustainable development in "Our Common Future", which has attracted worldwide attention. With continuous development, it has gradually established that the core of sustainable development is to meet the needs of the present, without compromising the ability of future generations to meet their needs. At the same time, "corporate social responsibility" has become a topic we are paying more and more attention to. Even when Forbes ranks global enterprises, corporate social responsibility is also a very important criterion.

Foreign scholars' research on carbon accounting is earlier than China. Carbon Accounting was first proposed by Janek & Stewart, who argued that carbon accounting is a collective term for accounting issues such as carbon emissions, carbon trading and forensics (Janek Ratnatunga & Stewart Jones, 2008). Kolk and others pointed out that companies should not only disclose greenhouse gas emissions data, but also disclose information on climate change (AnsKolk, David Levy & Jonatan Pinkse, 2008). Jan Bebbington and Carlos believe that a company's carbon account needs a third-party independent assurance before trading in the carbon market (Jan Bebbington & Carlos Larringga-gonzalez, 2008). Michel Callon pointed out that carbon accounting mainly involves accounting treatment of

carbon emission allowances, risk accounting and reporting related to carbon emissions, uncertain accounting and reporting related to carbon emissions, and disclosure and management of carbon emissions information (Michel Callon, 2009). Carbon disclosures is said to assist corporations position themselves strategically in terms of the carbon risks and opportunities they may face (Jane Andrew & Corinne L.Cortese, 2010).

In terms of domestic research, Zhang Caiping and Xiao Xu proposed that the carbon accounting information disclosure framework should include carbon emission accounting, management measures and carbon auditing (Zhang Caiping & Xiao Xu, 2010). Chen Hua and others found that carbon information disclosure has characteristics such as scattered structure, large industry differences, and asymmetrical quantity and quality in China. They also suggested that the carbon disclosure content of Chinese enterprises should mainly include “carbon emissions”, “carbon emissions related risks, opportunities and coping strategies”, “low carbon measures and performance”, “enterprise carbon trading”, “carbon information auditing” and other information (Chen Hua, Wang Hai & Yan Jingxin, 2013). Zhang Lu believes that the content of carbon accounting information disclosure mainly includes low carbon performance information and carbon accounting information. She pointed out that the way of carbon accounting information disclosure is mainly: 1. Use financial statements, post-report notes, etc.; 2. Prepare a special low-carbon report in the form of a report (Zhang Lu, 2016). Zhao Zeming and Wu Mengyue analyzed the motivations of corporate carbon accounting information disclosure from the aspects of compulsory and voluntary (Zhao Zeming & Wu Mengyue, 2018).

The steel industry is one of the main sources of carbon emissions in China. In order to more accurately understand the development status of China's steel industry, this paper selects the steel industry as the research object, conducts research on the carbon accounting information disclosure status of selected samples, proposes improvement suggestions and measures for existing problems. Improving carbon accounting information disclosure can provide a theoretical basis for promoting environmental protection and ecological construction, and raise social awareness of carbon emissions and environmental protection.

## 2 Current Status of Carbon Accounting Information Disclosure in China's Steel Industry

### 2.1 Sample selection and data source

This paper selects the top five in market value in listed steel companies in China as analysis samples. Carry out carrier analysis, formal analysis, content analysis and quality analysis on the accounting information disclosed in the annual financial report, annual audit report, social responsibility report and board report of the three years from 2016 to 2018. The basic information of the sample company is shown in Table 1:

**Table 1 Basic Information of Sample Companies DD: Dec. 31, 2018**

Company name	Stock code	Listing	Market capitalization (¥ 100m)
Baoshan Iron & Steel Co.,Ltd. (Baosteel)	600019	2000	1,617.80
Inner Mongolia Baotou Steel Union Co.,Ltd. (BSU)	600010	2001	592.36
Hbis Company Limited (HBIS)	000709	1997	366.28

Angang Steel Company Limited (ANSTEEL)	000898	1997	361.56
Shanxi Taigang Stainless Steel Co., Ltd. (STSS)	000825	1998	293.92

Source: Shanghai Stock Exchange official website, Shenzhen Stock Exchange official website (the same below).

## 2.2 Carrier Analysis of Carbon Accounting Information Disclosure in Steel Industry

From Table 2 and Table 3, we can see that the sample companies use a variety of disclosure carriers when disclosing carbon accounting information, mainly including board report, social responsibility report and important matters in the annual report. It can be seen from Table 2 that the number of carbon accounting information disclosure carriers of the sample companies in each year is increasing, which reflects the increasing awareness of the importance of carbon accounting information disclosure and the importance attached to corporate image.

**Table 2 Number of Disclosed Carriers in Each Year**

Year	Note	Board report	Social responsibility report	Important matters	Total
2016	0	3	5	3	11
2017	0	3	5	5	13
2018	0	3	5	5	13

**Table 3 Proportion of Various Disclosed Carriers in Each Year**

Year	Note	Board report	Social responsibility report	Important matters
2016	0.00%	27.27%	45.45%	27.28%
2017	0.00%	23.08%	38.46%	38.46%
2018	0.00%	23.08%	38.46%	38.46%

Through Table 3, we can find that the proportion of social responsibility reports is the largest when the sample company chooses the carbon accounting information disclosure carrier. Therefore, the social responsibility report is the main disclosure carrier (Note: Baosteel issued a sustainability report, which was classified into a social responsibility report due to its attribution to the social responsibility sector.) Through Table 4, we can find that the sample companies listed on the Shanghai Stock Exchange (Baosteel & BSU) and the sample companies listed on the Shenzhen Stock Exchange (HBIS&ANSTEEL&STSS) have large inconsistencies in the disclosure carrier, especially in the board report. Steel companies listed on the Shenzhen Stock Exchange generally clarify green development in the board report, but listed on the Shanghai Stock Exchange do not.

**Table 4 Disclosed Carrier of Sample Companies**

Company	Note	Board report	Social responsibility report	Important matters
Baosteel	0.00%	0.00%	20.00%	15.38%
BSU	0.00%	0.00%	20.00%	23.08%
HBIS	0.00%	33.33%	20.00%	23.08%
ANSTEEL	0.00%	33.33%	20.00%	15.38%
STSS	0.00%	33.34%	20.00%	23.08%

**2.3 Formal analysis of carbon accounting information disclosure in steel industry**

From Table 5, we can see that the sample companies mainly use the combination of text and data to disclose carbon accounting information, and the quantitative data can understand carbon accounting information more intuitively. Among them, in the board report, because there are few parts involved in carbon accounting information, mainly based on text.

**Table 5 Form Of Disclosure (Vertical Comparison)**

Year	Note		Board report		Social responsibility report		Important matters	
	Text	Text & Data	Text	Text & Data	Text	Text & Data	Text	Text & Data
2016	0.00%	0.00%	33.33%	66.67%	0.00%	100.00%	0.00%	100.00%
2017	0.00%	0.00%	100.00%	0.00%	0.00%	100.00%	0.00%	100.00%
2018	0.00%	0.00%	66.67%	33.33%	0.00%	100.00%	0.00%	100.00%

We can find from Table 6 that the sample companies have higher consistency in the form of carbon accounting information disclosure. Although most companies do not disclose much data, they have relatively comprehensive data disclosure on green production performance. However, there are few specific data on carbon emissions, and each company's disclosure of carbon emissions data is inconsistent.

**Table 6 Form Of Disclosure (Horizontal Comparison)**

Company	Note		Board report		Social responsibility report		Important matters	
	Text	Text & Data	Text	Text & Data	Text	Text & Data	Text	Text & Data
Baosteel	0.00%	0.00%	0.00%	0.00%	0.00%	100.00%	0.00%	100.00%
BSU	0.00%	0.00%	0.00%	0.00%	0.00%	100.00%	0.00%	100.00%

HBIS	0.00%	0.00%	66.67%	33.33%	0.00%	100.00%	0.00%	100.00%
ANSTEEL	0.00%	0.00%	33.33%	66.67%	0.00%	100.00%	0.00%	100.00%
STSS	0.00%	0.00%	100.00%	0.00%	0.00%	100.00%	0.00%	100.00%

#### 2.4 Content analysis of carbon accounting information disclosure in the steel industry

From Table 7, it can be found that the sample companies mainly explain the emission reduction performance and emission reduction measures in the content of carbon accounting information disclosure, and secondly respond to the call of national policies and respond to energy conservation and emission reduction and green environmental protection development.

**Table 7 Disclosure Of Content (Vertical Comparison)**

Year	Response to national policies	Risks and opportunities	Corporate carbon accounting strategy	Emission reduction performance	Emission reduction measures	Government grant for environmental protection
2016	100.00%	40.00%	20.00%	100.00%	100.00%	100.00%
2017	80.00%	100.00%	20.00%	100.00%	100.00%	100.00%
2018	100.00%	100.00%	20.00%	100.00%	100.00%	100.00%

It can be found from Table 8 that only Baosteel has made a clear plan on the corporate carbon accounting strategy. In September 2014, it issued the “Measures for the Management of Carbon Assets of Baosteel Co., Ltd.”. Other companies in the carbon accounting strategy mostly only talk about environmental protection and sustainable development strategies, and the more specific strategic deployment of carbon accounting is vague. At the same time, Baosteel is also the only company that has disclosed data on CO<sub>2</sub> emissions, including detailed disclosures on CO<sub>2</sub> emissions and CO<sub>2</sub> emission reduction rates per ton of steel. In addition, ANSTEEL made a textual explanation on carbon emissions, mentioning that the total carbon emissions of ANSTEEL's headquarters increased with the increase of steel output, and the carbon emissions per ton of steel showed a trend of decreasing year by year. The remaining sample companies did not disclose the specific carbon dioxide emissions, which is a common current situation of steel listed companies.

The possibility of a reduction in profits caused by environmental problems is mentioned in the new risks of steel listed companies. However, it is worth mentioning that the five sample companies have given specific measures to deal with risks while disclosing environmental risks. For example, STSS mentioned in the annual report: combing the company's existing atmospheric, water, solid waste and noise, radiation control requirements, on the basis of existing online monitoring, improving the environmental remote monitoring and forecasting information system platform, while speeding up the construction progress of the environmental protection project that has been determined and meeting the national environmental protection requirements.

**Table 8 Disclosure of Content (Horizontal Comparison)**

Company	Response to national policies	Risks and opportunities	Corporate carbon accounting strategy	Emission reduction performance	Emission reduction measures	Government grant for environmental protection
Baosteel	100.00%	33.33%	100.00%	100.00%	100.00%	100.00%
BSU	100.00%	33.33%	0.00%	100.00%	100.00%	100.00%
HBIS	33.33%	100.00%	0.00%	100.00%	100.00%	100.00%
ANSTEEL	100.00%	100.00%	0.00%	100.00%	100.00%	100.00%
STSS	100.00%	33.33%	0.00%	100.00%	100.00%	100.00%

### 2.5 Quality analysis of carbon accounting information disclosure in the steel industry

In order to better understand the quality of carbon accounting information disclosure of sample companies, this paper will use the data to conduct quality analysis.

Assumptions: (1) The carrier and content of carbon accounting information disclosure have the same degree of influence on the quality of disclosure, and the weight is set to 1. Because the form of disclosure in the most important social responsibility report is the Data & Text mode, the difference is small. So it is ignored and not included in the quality score. (2) The carbon accounting strategy has long-term guiding significance and is more important, with a weight of 2; the social responsibility report is an independent reporting form with a weight of 2.

The calculation formula for the carbon accounting information quality score is:  $EID = \sum_{j=1}^{10} EID_{ij}$ .  $EID_{ij}$  means the term of j of i company, and if j is not having, it adds 0. The total score is 12 points, and Table 10 is calculated according to Table 9.

**Table 9 Quality Score Table**

Term	Score
Note	1
Board report	1
Social responsibility report	2
Important matters	1
Response to national policies	1
Risks and opportunities	1
Corporate carbon accounting strategy	2



Energy saving performance	1
Energy saving measures	1
Government grant for environmental protection	1

**Table 10 Quality Scores Of Sample Companies**

Company	2016	2017	2018
Baosteel	8	10	10
BSU	7	8	8
HBIS	9	8	9
ANSTEEL	8	9	9
STSS	8	9	9

From Table 10, we can see that the quality score of the carbon accounting information disclosure of the sample company is on the rise as a whole, which indicates that the company pays more and more attention to the disclosure of carbon accounting information. At the same time, the fluctuations of the companies are not large and relatively stable. But for the quality of the entire disclosure, the sample company still needs to improve further.

### **3 Problems of Carbon Accounting Information Disclosure in China's Steel Industry**

#### **3.1 The legal system of carbon accounting information disclosure is not sound**

Undoubtedly, China is paying more and more attention to the disclosure of carbon accounting information. However, from the steel listed companies in the selected samples, it is not difficult to find that their disclosure of carbon accounting information is not perfect and mature. This is inseparable from China's lack of a sound and complete carbon accounting information disclosure system. China has promulgated the "Guidelines for the Preparation of Enterprise Environmental Protection Books", "Guidelines for Social Responsibility of Listed Companies", "Guidelines for Environmental Information Disclosure of Listed Companies", "New Environmental Protection Law" and New Pollution Emission Standards, etc. And the government has continuously strengthened its supervision and enforcement of environmental protection, and has also made certain progress in carbon emissions trading. However, there are no rules and regulations for the disclosure of carbon accounting information. This is also one of the main reasons leading to problems in the disclosure content and quality of carbon accounting information for listed steel companies.

#### **3.2 The supervision mechanism of carbon accounting information disclosure is imperfect**

China's corporate carbon accounting information disclosure lacks a sound supervision mechanism. In terms of government supervision, China does not currently have a special supervisory body or a

clear division of supervisory powers. In terms of social supervision, although the public is concerned about corporate carbon emissions, and even dissatisfied with high-pollution industries with large carbon emissions, they are often only verbal abuses that unable to rise to the level of public opinion and fewer inspections are held. But some local governments have tried to supervise carbon emissions. As of the end of May 2018, the Jiangsu Provincial Audit Office basically completed the project to ease the congestion and reduce carbon emissions in Suzhou by the Global Environment Facility grant. This project has achieved four years of follow-up audit, which has better achieved the goal of “relieving urban congestion and reducing carbon emissions”. We can see that the audit of carbon emissions can better promote low carbon development. However, in general, China's supervisory mechanism needs to be further improved to meet the social requirements for the validity and authenticity of carbon accounting information, thereby promoting the implementation of the carbon trading mechanism.

### **3.3 The form of carbon accounting information disclosure is arbitrary and the disclosure content is insufficient**

In the form of carbon accounting information disclosure, we can find from the selected samples that only the steel companies listed on the two major stock exchanges in China have inconsistencies in the disclosure of carriers. Some only use social responsibility reports and annual reports to disclose and some use social responsibility report, board report and annual report to disclose at the same time. And, various steel listed companies also have inconsistencies in the form of carbon accounting information disclosure. For example, in the data disclosure of carbon accounting information, Baosteel adopts a more intuitive and clear form of combination of charts and data, while HBIS only uses Aggregate data for disclosure. This inconsistency has made carbon accounting information for steel companies extremely incomparable.

China Steel listed companies have insufficient disclosure of carbon accounting information. From the more important information of emission reduction performance, ANSTEEL disclosed the chemical oxygen demand per ton of steel, while Baotou Steel did not disclose it. In terms of the disclosure of the same information, ANSTEEL explained the quantity and distribution of the discharge ports and the pollutant discharge standards implemented. BSU only disclosed the total amount of emissions but compared the emissions in different years. Most steel companies disclose in their own way, and the content of carbon accounting information disclosure in the same industry cannot be compared in a deeper horizontal comparison. And there is less disclosure of carbon accounting information in the annual report, especially in the more detailed subjects, such as carbon assets, carbon liabilities, carbon rights, etc. It makes the lack of effective in-form information disclosure.

### **3.4 Lack of professional talents for carbon accounting**

Carbon accounting is a branch of accounting. Compared with traditional accounting, carbon accounting has added many aspects of environment, ecology and resources on the basis of traditional accounting theory. Therefore, carbon accounting needs to understand the latest theories related to environmental resources protection based on the knowledge reserves and skills of traditional accountants. This kind of interdisciplinary composite accountant is the professional talent required for carbon accounting. The current situation in China is that there are talents who are studying accounting, but there are few people who know and can use carbon accounting.

## **4 Improvement Suggestions and Measures**

### **4.1 Improve the relevant laws and regulations of carbon accounting information disclosure**

There are not laws to define carbon accounting elements in China's accounting field, and there is no clear regulation on the disclosure of carbon accounting information. This makes China's carbon accounting lack effective legal guidance in the actual business, and enterprises also lack strong brakes to disclose relevant carbon accounting information. Internationally, since 2009, the UK has issued the "Guidelines for the Disclosure of Greenhouse Gas Emissions", "Commitment on Carbon Emission Reduction" and "Guidelines for Reporting Compulsory Carbon Information Disclosure". In 2007, Australia issued the "National Greenhouse Gas and Energy Reporting Law". The USA introduced the "Greenhouse Gas Mandatory Reporting System" in 2009. All of them made legally mandatory requirements for the disclosure of carbon accounting information. China should complete the legislative work of carbon accounting as soon as possible, and clarify the responsibilities and obligations of listed companies in the disclosure of carbon accounting information. In the in-balance sheet and off-balance sheet, it also needs to make clear requirements for the disclosure of carbon accounting information carrier, form, content, etc. But in the process of formulating and promulgating relevant laws and regulations, it is necessary to adhere to the principle of seeking truth from facts, and complete the work of sound regulations step by step.

### **4.2 Improve the supervision mechanism of carbon accounting information disclosure**

Establishing a monitoring mechanism for carbon accounting information disclosure needs to start from three aspects: the government needs to set up or appoint relevant departments to supervise the disclosure of carbon accounting information of enterprises, and the relevant agencies of the auditing bureau can review the information disclosed by enterprises to ensure that the authenticity and legitimacy of information; enterprises need to establish an independent audit team for carbon accounting information disclosure in internal control, strengthen supervision over their carbon accounting information disclosure, and increase the supervisory authority of independent directors on carbon accounting information disclosure; Strengthen the propaganda of the environmentally friendly low-carbon economy and raise the society's emphasis on carbon accounting, so that everyone in the society can play the role of mass supervision. Only when the supervision mechanism of carbon accounting information disclosure is improved and effectively implemented can the quality of corporate carbon accounting information disclosure be truly guaranteed.

### **4.3 Establishing standard specifications of carbon accounting information disclosure**

Chinese listed companies have inconsistencies in carbon accounting information disclosure, such as content, form, carrier, etc. This requires us to establish a norm for carbon accounting information disclosure, making information disclosure more comparable. In 2016, the Ministry of Finance issued the "Interim Provisions on Accounting Treatment for Carbon Emissions Trading Pilots (Draft for Comment)". It has made a unified regulation on the handling of pilot accounting for carbon emission trading, which is conducive to regulating the disclosure of carbon accounting information in China. But further strengthening of standards construction is needed in off-balance sheet disclosure. We can build a comprehensive standard for carbon accounting information disclosure based on China's national conditions by drawing on international experience.

### **4.4 Formulate a carbon accounting professional talents training program**

Carbon accounting professionals not only need accounting knowledge, but also need a variety of subject knowledge reserves such as environmental economy and sustainable development. This makes us need to develop a more comprehensive training program for carbon accounting professionals. We should add relevant knowledge in carbon accounting, such as environmental accounting and low-carbon economy, to accounting education in China. First, students who are studying accounting courses at colleges and universities need to increase their knowledge of carbon accounting. Secondly, enterprises need to carry out relevant on-the-job training for accounting personnel to improve the functional accomplishment of accounting personnel. Only when the importance of carbon accounting is deepened in the whole society and the professionals of carbon accounting play a role in enterprises and society, can China implement the guidelines and norms for carbon accounting information disclosure.

## 5 Conclusion

Through the research of this topic, we can find that Chinese steel listed companies have achieved certain achievements in carbon accounting information disclosure. But there are also many problems, such as irregular disclosure content, lack of regulations, and shortage of professional talents. Through the joint efforts of the government, enterprises and society, we continuously improve carbon accounting laws and regulations, improve the carbon accounting supervision mechanism, establish unified standards, and carry out personnel training programs. Then, we can better and faster improve the framework of China's carbon accounting information disclosure. Only by effectively implementing various targeted measures can the carbon accounting information disclosure be qualitatively improved.

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# A Study on the Influence of Interest Rate Liberalization on Enterprise Investment Efficiency: Based on the Nature of Property

Dong Xueqin, Zhang Youtang

School of Management, Wuhan University of Technology, Wuhan, P.R. China, 430070

(E-mail: 15927598290@163.com, zyt@whut.edu.cn)

**Abstract:** Taking Chinese A-share non-financial listed companies as samples in 2004-2017, based on the perspective of nature of property, the research empirically tests the influence of interest rate liberalization reform on enterprise investment efficiency. The study found that: (1) Interest rate liberalization can alleviate inefficient investment of enterprises, and it has a stronger alleviation effect on state-owned enterprises than non-state-owned enterprises; (2) Interest rate liberalization can inhibit enterprise overinvestment, and it has a stronger inhibitory effect on state-owned enterprises than non-state-owned enterprises; (3) Interest rate liberalization will intensify enterprise underinvestment, and it has a stronger intensive effect on non-state-owned enterprises than state-owned enterprises.

**Key words:** Interest rate liberalization; Enterprise investment efficiency; Nature of property; Overinvestment; Underinvestment

## 1 Introduction

Under the background of the new era of supply-side structural reform, investment has become a key force to optimize the supply structure and solve the supply-side structural problems. However, there are still some obstacles to the circulation of elements in Chinese capital market. The real economy is generally suffering from "ischemia". Enterprise investment efficiency is severely constrained and the country's overall investment level still has growth potential.

The Financial Deepening Theory believes that in order to smooth capital flows and achieve a virtuous circle of mutual promotion between financial development and economic growth, it is necessary to eliminate financial regulation and guide funds to flow to high-efficiency departments. Based on the theory, China has proposed interest rate liberalization reform. Till 2019, Chinese interest rate liberalization process has reached more than 90%, but the reform deepening is still a major issue of government concern. The "Government Work Report of 2019" also pointed out that "intensify interest rate liberalization reform, lower the actual interest rate level".

Since the concept of interest rate liberalization was proposed, the academic community has studied the reform mainly based on the perspective of macro investment and commercial banks. As for its impact on enterprise micro investment, foreign scholars began research earlier. Interest rate liberalization has a crises reducing effect and the improvement of financial liberalization can alleviate enterprise finance constraints (Barrell R et al., 2016). In China, Zhao (Zhao X et al., 2019) and Yang (Yang Zheng et al., 2017) pointed out that interest rate liberalization can improve the efficiency of capital utilization and ease the inefficient investment of enterprises. However, the inefficient investment of enterprises is characterized by overinvestment and underinvestment. How does the interest rate liberalization effect on the overinvestment and underinvestment of enterprises? Under samples with different property rights, is the effect significantly different? There are no scholars to systematically

study these issues.

The possible research contributions of this paper are as follows: Firstly, based on the Financial Deepening Theory, this paper explores the impact of interest rate liberalization on enterprise investment efficiency with 24,049 research samples, distinguishing between inefficient investment, overinvestment, and underinvestment; Secondly, based on the phenomenon of “property discrimination” in Chinese financing market, the paper explores the different impacts of interest rate liberalization on investment efficiency under samples with different property nature, in order to provide relevant policies for the government, and provide a theoretical basis for enterprises to comply with policy guidance.

## **2 Theoretical Analysis and Research Hypothesis**

According to the Financial Repression Theory, in the capital market with interest rate control, the interest rate is artificially lowered to the equilibrium level, and the behavior of enterprises and financial institutions will be distorted. Under interest rate control, insufficient capital supply may lead to non-price discrimination. Banks tend to finance companies with government implicit guarantees or companies with larger scales. These companies are prone to “overinvestment” due to easily obtaining “cheap” funds, while it is difficult for other companies to obtain external financing, resulting in “underinvestment”.

### **2.1 Interest rate liberalization and enterprise inefficient investment**

With the interest rate liberalization policy, the supply and demand of funds in the credit market tend to balance, and financial resources tend to flow efficiently to enterprises with real capital needs. Secondly, under the continuous advancement of interest rate liberalization, the capital market can adjust the cost of funds according to the risk of capital utilization, thereby achieving the matching of capital risks and costs. Furthermore, according to the Capital Structure Theory, loosening interest rate control can help eliminate the friction of credit market, thus alleviating the inefficient investment of enterprises.

Under the interest rate control, state-owned enterprises can easily obtain credit funds relying on the government's implicit guarantees. As a result, when making investment decisions, state-owned enterprises take less cost-benefit factors into consideration, prone to inefficient investment (Morgenroth E, 2016). In addition, state-owned enterprises bear more “policy burdens”, and many investment decisions have strong “political motives” rather than pure market behavior. In contrast, less politically restrained, non-state-owned enterprises investment decisions can reflect management's consideration of the revenue and cost.

Based on the above analysis, this paper proposes the following assumptions:

**H1: Interest rate liberalization can alleviate inefficient investment of enterprises, and it has a stronger alleviation effect on state-owned enterprises than non-state-owned enterprises.**

### **2.2 Interest rate liberalization and enterprise overinvestment**

Under the promotion of interest rate liberalization, the real interest rate of the capital market will rise as a whole, and the rise will curb enterprise credit demand, thereby curbing enterprise overinvestment (Ji Yang et al., 2015). Furthermore, banks can collect risk premiums based on the risk characteristics of individual loans, then overinvestment can be inhibited through capital cost channels. What's more, with the competition intensifying, banks will pay more attention to the management of loan risks. As for the low-yield and high-risk projects, the difficulty of refinancing will increase, and the motivation for overinvestment will be weakened.

Compared with non-state-owned enterprises, state-owned enterprises are more likely to overinvest in the case of surplus internal cash flow (Xiao et al., 2014). Due to the “credit discrimination”, state-owned enterprises usually have lower financing thresholds, and the financing costs are lower under interest rate control, which will more easily lead to overinvestment. Moreover, state-owned enterprises generally have the problem of “soft budget constraints”, which exposes them to more serious moral hazard and agency problems. At the same time, the rigid control of executive compensation in state-owned enterprises made its managers more motivated to overinvest for self-interest. Under the liberalization of interest rates, the competition in the capital market more fair, state-owned enterprises must consider investment income more when making investment decisions.

Based on the above analysis, this paper proposes the following assumptions:

**H2: Interest rate liberalization can inhibit enterprise overinvestment, and it has a stronger inhibitory effect on state-owned enterprises than non-state-owned enterprises;**

### **2.3 Interest rate liberalization and enterprise underinvestment**

Under the interest rate liberalization, with the overall interest rate increasing, the financing burden of enterprises will increase. The tightening of deposits and loans caused by interest rate liberalization can lead to a reduction in the scale of enterprise financing (Zhang Benzhao et al., 2016), which will reduce the investment motive of the company. The study by Zhan (Zhan Minghua et al., 2015) also shows that the high discount rate brought by interest rate liberalization will reduce the present value of collateral and increase the moral hazard of borrowing enterprise, thus inhibiting the investment. In addition, with the advancement of interest rate liberalization, the banks have shown the original hidden charges as capital prices (Lv Jinsong, 2015), which will reduce the enterprise investment motive.

The research by Xiao (Xiao Wei et al., 2014) shows that it is more likely to generate underinvestment for non-state-owned enterprises when internal cash flow is insufficient. Under the interest rate liberalization, loan-deposit spreads will be tightened, which will seriously reduce the operating profit of commercial banks, leading to “reluctant loan” phenomenon. In addition, banks will conduct more rigorous review of loan targets in order to achieve the lowest bad debt rate (Zhang Benzhao et al., 2016). Non-state-owned enterprises are more difficult to become banks' lending targets for their size and qualifications. Furthermore, the interest rate increase will make enterprises more cautious in facing investment opportunities. State-owned enterprises usually undertake some government policy objectives, so when they decide to abandon investment opportunities, they must also consider multiple factors such as social responsibility and government performance. Comparing state-owned enterprises, non-state-owned enterprises will be more sensitive in giving up investment opportunities.

Based on the above analysis, this paper proposes the following assumptions:

**H3: Interest rate liberalization can intensify enterprise underinvestment, and it has a stronger intensive effect on non-state-owned enterprises than state-owned enterprises.**

## **3 Research Design**

### **3.1 Sample selection and data source**

In 2004, the central bank no longer restricted the bank loan interest rate upper limit, so the paper uses the 2004-2017 A-share listed company as the initial samples all from the CSMAR database. To ensure the integrity and comparability of the data, the financial companies, ST and ST\* companies, and



the missing samples were excluded. In addition, the sample data was subjected to 1% level winsorize processing, finally 24,049 samples obtained. All data processing was based on STATA14.0 and EXCEL software.

### 3.2 Measurement of variables

#### 3.2.1 Investment efficiency

Investment efficiency is the explanatory variable of the study, measured by the Richardson (2006) model.

$$Invest_{it} = \beta_0 + \beta_1 \times Invest_{it-1} + \beta_2 \times Size_{it-1} + \beta_3 \times Lev_{it-1} + \beta_4 \times Growth_{it-1} + \beta_5 \times Lnage_{it-1} + \beta_6 \times Ret_{it-1} + \beta_7 \times CFO_{it-1} + \sum \beta_i Industry + \sum \beta_j Year + \varepsilon_{it} \quad (1)$$

According to the model (1), the optimal investment scale of the enterprise is estimated. The actual investment scale minus the best investment scale is the residual, which means the inefficient investment level. If the residual is greater than 0, it means overinvestment, expressed by Over-Inv; if the residual is less than 0, it means underinvestment, expressed by Under-Inv. For convenience, we use the absolute value of the residual to indicate the level of underinvestment.

#### 3.2.2 Interest rate liberalization

The paper uses Peng's method (Peng Jiangang, 2014) to construct interest rate liberalization index, by combing the process of Chinese interest rate liberalization. On the basis of Professor Peng, we extend the index to 2017, and finally obtains the results of 2004-2017, as shown in Figure 1.

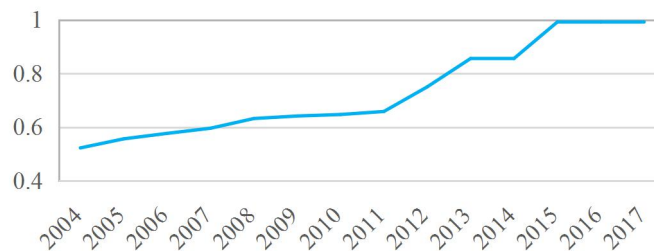


Figure 1 Interest Rate Liberalization Index Measurement Results

#### 3.2.3 Control variable

Based on the conventional practices of existing researches, the paper selects variables such as company size as control variables. The specific variable settings are shown in Table 1.

Table 1 Variable Definition

Variable Type	Variable Name	Variable Symbol	Variable Definition
Explained Variable	Inefficient investment	Inv	The absolute value of the residual between the actual investment scale and the optimal investment scale.
	Overinvestment	Over-Inv	The actual investment scale is larger than the optimal investment scale.

	Underinvestment	Under-Inv	The actual investment scale is smaller than the optimal investment scale.
Explanatory Variable	Interest Rate Liberalization	IRL	Interest rate liberalization index
	Nature of property	State	Dummy variables, 1 for state-owned enterprises and 0 for non-state-owned enterprises
	Company Size	Size	Natural logarithm of total assets at the end of the year
	Asset-liability ratio	Lev	Total liabilities at the end of the year / total assets
	Operating income growth rate	Growth	(Operating income of the current period - operating income of the previous period) / operating income of the previous period
Control Variable	Net cash flow from operating	NCFO	From the cash flow statement
	Return on assets	ROA	(Total profit + interest expense) / total assets
	GDP growth rate	GDP	Annual growth rate of Chinese GDP
	Industry	Inds	Industry dummy variable, according to the CSRC 2012 version of industry classification
	Year	Year	Year dummy variable

### 3.3 Model setting

According to the above research ideas, this paper constructs the following regression model. Model (2), Model (3), and Model (4) are respectively used to verify H1, H2, and H3. “IRL×State” is the intersection of interest rate liberalization index (IRL) and property dummy variable (State). In the model, *i* represents a company, *t* represents a year,  $a_0$  is a constant term,  $a_i$  ( $i = 1, 2, 3 \dots$ ) is the parameter to be estimated, and  $\varepsilon_{it}$  is a random error term.

$$Inv_{it} = a_0 + a_1 \times IRL_{it} + a_2 \times State_{it} + a_3 \times IRL_{it} \times State_{it} + a_4 \times Controls_{it} + \varepsilon_{it} \quad (2)$$

$$Over - Inv_{it} = a_0 + a_1 \times IRL_{it} + a_2 \times State_{it} + a_3 \times IRL_{it} \times State_{it} + a_4 \times Controls_{it} + \varepsilon_{it} \quad (3)$$

$$Under - Inv_{it} = a_0 + a_1 \times IRL_{it} + a_2 \times State_{it} + a_3 \times IRL_{it} \times State_{it} + a_4 \times Controls_{it} + \varepsilon_{it} \quad (4)$$

## 4 Empirical Analysis

### 4.1 Descriptive statistics and correlation analysis

From the descriptive statistics table, we can find some statistical results. (1) The samples of state-owned enterprises and non-state-owned enterprises respectively account for about one-quarter and three-

quarters, which is in line with the actual situation in China. (2) In the sample of full sample, state-owned enterprises, and non-state-owned enterprises, the number of overinvestment samples is far less than the underinvestment samples, indicating that the underinvestment of Chinese enterprises is more common. Under the three samples, the average values of Over-Inv indicators are 0.0745, 0.0709 and 0.0766 respectively, both higher than the average of Inv and Under-Inv, indicating that although the companies with underinvestment status in China are the majority, the situation of overinvestment is even worse. (3) Under the sample of non-state-owned enterprises, the average values of Inv, Over-Inv and Under-Inv are larger than the figure under the full sample and the state-owned enterprises sample, indicating that non-state-owned enterprises are facing more serious inefficient investment. (4) IRL indicator shows that Chinese interest rate liberalization process has been greatly improved and it has basically been completed. (5) There are also significant differences in control variables.

**Table 2 Descriptive Statistics**

Variable	N	Min	Max	Mean	Std.Dev.
Full sample					
Inv	24049	0.0008	0.4194	0.0525	0.0627
Over-Inv	8980	0.0006	0.6448	0.0745	0.1013
Under-Inv	15069	0.0010	0.1825	0.0401	0.0301
IRL	24049	0.5228	0.9942	0.7909	0.1730
State	24049	0	1	0.2631	0.4403
Size	24049	19.0286	25.8090	21.9450	1.2939
Lev	24049	0.0594	1.2624	0.4808	0.2232
Growth	24049	-0.6585	4.4642	0.2258	0.6109
ROA	24049	-0.1975	0.2739	-0.0325	0.06320
NCFO	24049	-2.03×10 <sup>9</sup>	1.10×10 <sup>10</sup>	4.49×10 <sup>8</sup>	1.49×10 <sup>9</sup>
State-owned enterprises sample					
Inv	6328	0.0006	0.3397	0.0500	0.0551
Over-Inv	2557	0.0004	0.4914	0.0709	0.0836
Under-Inv	3771	0.0008	0.1394	0.0364	0.0253
Non-state-owned enterprises sample					
Inv	17721	0.0009	0.4510	0.0535	0.0659
Over-Inv	6423	0.0006	0.7473	0.0766	0.1120
Under-Inv	11298	0.0010	0.1930	0.0414	0.0316

According to the correlation analysis results, the Pearson correlation coefficient between all variables is less than 0.5, which can preliminarily indicate that there is no multicollinearity problem between the variables. At the same time, the correlation coefficient between variables basically passed the significance test, indicating that the variable selection is reasonable and suitable for further regression analysis. Due to space limitations, the results of the correlation analysis are not listed.

#### 4.2 Regression analysis

In this paper, using STATA14.0 software, based on panel data from 2004 to 2017, each hypothesis is empirically tested. Table 3 shows the results of regression analysis for each model.

**Table 3 Results of Regression Analysis**

Variable	Model(2) Inv		Model(3) Over-Inv		Model(4) Under-Inv	
	coefficient	t	coefficient	t	coefficient	t
IRL	-0.0082*	-1.83	-0.0353**	-2.49	0.0091***	3.03
State	0.0199***	4.40	0.0510***	4.31	0.0080***	2.92
IRL×State	-0.0243***	-3.93	-0.0603***	-3.82	-0.0100***	-2.61
Size	0.0024***	3.02	0.0112***	5.13	-0.0042***	-8.88
Lev	0.0003	0.09	0.0420***	7.52	-0.0304***	-14.94
Growth	0.0129***	19.75	0.0211***	15.38	0.0021***	4.51
ROA	-0.0681***	-8.68	-0.1612***	-8.42	0.0011	0.23
NCFO	$-4.57 \times 10^{-13}$	-1.02	$-3.86 \times 10^{-13}$	-0.67	$-1.52 \times 10^{-12}$ ***	-3.04
GDP	0.0009**	2.49	0.0014	1.40	0.0007***	3.52
CONS	-0.0065	-0.39	0.1996***	-4.12	0.1317***	13.03
Inds& Year	control	/	control	/	control	/
N	24049	/	8980	/	15069	/
F	70.19	/	49.98	/	58.82	/

The regression results of model (2) show that the coefficient of IRL is -0.0082, which is significant at the 10% confidence level, indicating that interest rate liberalization can alleviate the enterprise inefficient investment; The regression coefficient of “IRL×State” is -0.0243, and it is significant at the 1% confidence level, indicating that interest rate liberalization is more effective in mitigating inefficient investment of state-owned enterprises than non-state-owned enterprises. Hypothesis 1 is verified.

The regression results of model (3) show that the coefficient of IRL is -0.0353, which is significant at the 5% confidence level, indicating that interest rate liberalization can inhibit enterprise overinvestment; The regression coefficient of the transfer term (IRL×State) is -0.0603, and it is significant at the 1% confidence level, indicating that interest rate liberalization has a stronger inhibitory effect on state-owned enterprises than over-state-owned enterprises. Hypothesis 2 is verified.

The regression results of model (4) show that the coefficient of IRL is 0.0091, significant at the 1% confidence level, indicating that interest rate liberalization intensifies the underinvestment; The regression coefficient of the intersection term (IRL×State) is -0.01, and it is significant at the 1% confidence level, indicating that the interest rate liberalization has a stronger effect on the underinvestment of non-state-owned enterprises than the state-owned enterprises. Hypothesis 3 is verified.

## 5 Further Research and Robustness Test

### 5.1 Further research

The above regression results illustrate the regulation role of property nature through the coefficient of the intersection term (IRL×State). In order to further explore whether the impact of interest rate liberalization on enterprise investment efficiency is significantly different under samples with different property nature, the research sample is subdivided into sample of state-owned enterprises and sample of non-state-owned enterprises. The regression results are as follows. Due to space limitations, only the regression results of key variables are listed.

**Table 4 Regression Results After Grouping by Property Rights**

Variable	Model (2) —Inv			Model (3) —Over-Inv			Model (4) —Under-Inv		
	Full	State-	Private	Full	State-	Private	Full	State-	Private
IRL	-0.0082*	-0.0424***	0.0008	-0.0353**	-0.1049***	-0.0241	0.0091***	-0.0052	0.0117***
State	0.0199***	/	/	0.0510***	/	/	0.0080***	/	/
IRL×State	-0.0243***	/	/	-0.0603***	/	/	-0.0100***	/	/
N	24049	6328	17721	8980	2557	6423	15069	3771	11298
F	76.98	15.67	67.27	54.30	11.90	51.53	65.29	20.86	34.69

The model (2) further regression results show that: (1) Under the sample of state-owned enterprises, the coefficient of IRL is -0.0424, significant at the 1% confidence level, indicating that interest rate liberalization significantly eases the inefficient investment of state-owned enterprises. (2) Under the sample of non-state-owned enterprises, the coefficient of IRL is positive but not significant, indicating that interest rate liberalization may intensify inefficient investment of non-state-owned enterprises, but the impact is not significant. (3) The state-owned enterprise IRL coefficient is less than the coefficient of the full sample. The above shows that compared with non-state-owned enterprises, interest rate liberalization has a stronger mitigation effect on state-owned enterprises' inefficient investment. Hypothesis 1 is further verified.

The model (3) further regression results show that: (1) Under the sample of state-owned enterprises, the coefficient of IRL is -0.1049, significant at the 1% confidence level, indicating that interest rate liberalization significantly inhibits state-owned overinvestment. (2) Under the sample of non-state-owned enterprises, the IRL has a negative coefficient on Over-inv, but is not significant, indicating that interest rate liberalization does not inhibit the overinvestment of non-state-owned enterprises significantly. (3) The state-owned enterprise IRL coefficient is less than the coefficient of the full sample. The above shows that compared with non-state-owned enterprises, interest rate liberalization has a stronger inhibitory effect on state-owned enterprises' overinvestment. Hypothesis 2 is further verified.

The model (4) further regression results show that: (1) Under the sample of state-owned enterprises, the coefficient of IRL is negative but not significant, indicating that the interest rate liberalization has a mitigating effect on the underinvestment of state-owned enterprises but is not significant. (2) Under the sample of non-state-owned enterprises, the coefficient of IRL is 0.0117, and it is significant at the 1% confidence level, indicating that interest rate liberalization significantly intensifies the underinvestment

of non-state-owned enterprises. (3) The non-state-owned enterprise IRL coefficient is greater than the full-sample IRL coefficient. The above shows that compared with state-owned enterprises, interest rate liberalization has a stronger effect on the underinvestment of non-state-owned enterprises. Hypothesis 3 has been further verified.

### 5.2 Robustness test

In order to test the robustness of the research conclusions, replace the interest rate liberalization measurement method to adopt Tao Xionghua's construction method. The regression results of the robustness test are shown in the following table. It can be seen from Table 5 that the key coefficient regression results of each model under the robustness test are basically consistent with the above empirical analysis, indicating that the research conclusions in this paper are robust. Due to space limitations, only the regression results of key variables are listed.

**Table 5 Robustness Test**

Variable	Model (2) Inv coefficient	t	Model (3) Over-Inv coefficient	t	Model (4) Under-Inv coefficient	t
IRL	-0.0012*	-1.87	-0.0014*	-1.82	0.0017***	4.08
State	0.0385***	4.68	0.0874***	4.19	0.0174***	3.42
IRL×State	-0.0005***	-4.35	-0.0011***	-3.84	-0.0002***	-3.26
Inds& Year	Controll	/	Controll	/	Controll	/
N	24049	/	8980	/	15069	/
F	70.01	/	48.87	/	60.01	/

## 6 Conclusion

The study found that:(1) Interest rate liberalization can alleviate inefficient investment of enterprises, and it has a stronger mitigation effect on state-owned enterprises than non-state-owned enterprises;(2)Interest rate liberalization can inhibit enterprise overinvestment and has a stronger inhibitory effect on state-owned enterprises than non-state-owned enterprises;(3) Interest rate liberalization can intensify enterprise underinvestment, and it has a stronger effect on non-state-owned enterprises than state-owned enterprises.

Based on the above research conclusions, this paper proposes the following policy recommendations. (1) Interest rate liberalization reform can effectively cope with overinvestment. In the current stage of overcapacity, China should firmly carry out a new round of supply-side structural reforms with market-oriented tools, and drastically carry out market-oriented reforms of other factors. (2) Correctly treat the different impacts of interest rate liberalization reform on different types of enterprises, introduce supporting policies for different types of enterprises to reasonably reduce the possible adverse effects of interest rate liberalization on non-state-owned enterprises. (3) Deepen the structural reform of the financial supply side, pay full attention to the issue of "credit discrimination" in the financing market, eliminate various hidden barriers to the non-state-owned economy and small-sized enterprises, create a more equitable financing environment, and ensure that all types of enterprises are legally participate in market competition fairly, to continuously improve the ability of financial services to the real economy.

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# A Research on the Contributing Factors of Cash Dividend Policy in Chinese Listed Companies

Huang Ziying

School of Management, Wuhan University of Technology, Wuhan, P.R. China, 430070

(E-mail: 1174284310@qq.com)

**Abstract:** This paper uses multiple linear regression method to empirically test the impact of financial indicators of Chinese listed companies on their cash dividend policy. The study finds that: (1) Since the introduction of semi-mandatory dividend policy by the regulatory authorities in China, the number of cash dividend distributing companies has shown an overall upward trend, some of which, however, focus on stock dividends while neglecting cash dividends. The policy of cash dividend distribution is divided into two extremes--either excess cash dividend distribution or insufficient cash dividend distribution; (2) Generally speaking, earnings per share, operating cash flow per share, ratio of assets to liabilities, logarithm of total assets and total assets turnover ration all have a significant impact on the cash dividend policy of listed companies, but profitability and solvency are the most important financial factors affecting the cash dividend distribution level of listed companies in China.

**Key words:** Cash dividends; Stock dividends; Profitability; Solvency

## 1 Introduction

The study on dividend policy was firstly advocated by Lintner in 1956. (Lintner, 1956) Over the years, many theories have been developed to explain the company's dividend policy. However, the "dividend puzzle" (Black, 1976) is still pending. Currently, China's securities market is still an emerging market, which has problems such as institutional defects and imperfect supervision system. The dividend policy of listed companies in China shows a "dividend puzzle" different from that of mature capital markets in the West, which has aroused widespread interest in both practical and theoretical research.

In 1961, Miller and Modigliani put forward the famous theory of "irrelevant dividend view", which marked a new era for the study of dividend distribution theory. They believed that in a completely frictionless capital market environment, corporate dividend decision-making will not affect corporate value. However, the rigorous assumptions of irrelevant dividend view are hard to be fulfilled in the real capital market. Therefore, many scholars have relaxed these assumptions from different perspectives. For example, Jensen and Meckling advocated reducing managers' opportunistic behavior by dividend payment (Jensen and Meckling, 1976), while Myers believed that dividend payment would make companies bear higher external financing risks (Myers, 1984). The life cycle model of dividend payment embodies the idea that companies should decide on dividend-payment policies according to different life stages (Grullon et al.2002; DeAngelo et al. 2006). In order to reconcile the above disputes about whether companies should pay cash dividends, Ross et al. proposed that cash dividend can only be paid when companies create sufficient internal free cash flow and can provide sufficient financial support for current and foreseeable future investment projects (Ross et al.2013).



Domestic research mainly uses the data of China's capital market to verify the classical theories abroad, so as to prove the applicability of these theories in China. In terms of the contributing factors of dividend policy, Chinese scholars find that the factors affecting dividend policy of listed companies in China include financial factors and non-financial factors. Among them, financial factors include profitability, growth ability, operating ability, cash flow status, asset liquidity, debt paying ability and asset size, etc. For example, Yang Shu'e and Bai Yong found that cash dividend policy was mainly influenced by two factors: the balance of cash and the profits available for dividend, and the policy was positively correlated with them (Yang Shu'e and Bai Yong, 2000). Xie Jun found that profitability, earnings level, cash holdings, company size and financial leverage have a certain impact on cash dividend policy (Xie Jun, 2006). In recent years, scholars have further found that cash dividend policy is related to other financial decisions, which can adjust the capital structure and reduce the cost of bond financing (Wu Yuhui et al. 2018; Hu Jianxiong et al. 2019). Non-financial factors include regulatory policies (Wei Zhihua et al. 2017), corporate governance (Yuan Hongqi, 2001; Wang Huachen et al. 2007; Jin Qinglue et al. 2016), enterprise life cycle (Xing Tiancai et al. 2018), regional factors (Zhang Weiting et al. 2015) and so on.

From the existing research on dividend payment, it can be seen that there is no consistent conclusion on whether or not dividends are paid and how much dividends are paid. Among the many factors affecting the cash dividend policy of companies, financial factors play a dominant role. The contribution of this paper lies in the fact that it comprehensively considers the financial indicators affecting the cash dividend policy and examines thoroughly the impact of the financial characteristics of listed companies on their cash dividend policies. In addition, using the latest sample and data, this paper has found out the main financial factors affecting the cash dividend policy of listed companies in China under the background of institutional changes. Therefore, it can help the regulatory authorities and listed companies make sound decisions on dividend policy.

## 2 The Institutional Background and Current Situation of Cash Dividend Policy of Listed Companies in China

Since 2000, the government and regulatory authorities have paid unprecedented attention to investor protection, and a large number of relevant laws and regulations have been promulgated intensively. Among them, the dividend distribution policies are shown in Table 1.

**Table 1 Historical Evolution of Dividend Allocation Policies**

Time	Names of Laws and Regulations	Main Contents
2001.3.28	Management Measures for New Share Issuance of Listed Companies	Securities companies acting as principal underwriters must focus on those companies that have not paid dividends in the latest three years and whose reasons for non-distribution have not been reasonably explained by the board of directors, and explain them in due diligence reports.
2004.12	Some Provisions on Strengthening the Protection of Shareholders' Rights and Interests in Public Shares	A listed company which fails to distribute cash profits in the last three years shall not issue new shares to the public, issue convertible bonds or distribute shares to the original shareholders.

2006.4.26	Administrative Measures for the Issuance of Securities by Listed Companies	The cumulative distribution of profits in cash or stock in the last three years is not less than 20% of the average annual distributive profits achieved in the last three years.
2008.10.9	Decision on Revising Several Provisions on Cash Dividend of Listed Companies	Relevant regulations have been revised in detail, such as "the company should specify the cash dividend policy in its Articles of Association, and the profit distribution policy should maintain continuity and stability", "the listed company can carry out mid-term cash dividend distribution", "the accumulated profits distributed in cash in the last three years are not less than 30% of the average annual distributable profits realized in the last three years", and so on.
2012.5.4	Notice on Further Implementing the Relevant Issues Concerning Cash Dividends of Listed Companies	From the perspective of strict refinement of information disclosure, the transparency of cash dividends of listed companies will be enhanced, and listed companies will be urged to strengthen the awareness of returning shareholders. For example, "emphasize that IPO companies should disclose specific profit distribution plans for the next three years" and so on.

According to Table 1, it can be seen that for a long time, China's A-share listed companies have been "focusing on financing while neglecting returns". China Securities Regulatory Commission (CSRC) urges listed companies to distribute cash dividends to shareholders by linking the level of cash dividend distribution with refinancing qualifications. The direct effect of the implementation of these semi-mandatory dividend policies has led to the emergence of new features in the dividend policy of listed companies. Table 2 shows the statistics of dividend distribution of listed companies on main-board market from 1998 to 2017.

**Table 2 Number/Percentage of Listed Companies that Distributed Cash Dividends**

Year				(Number/Percentage)
	Cash dividends	Stook dividends	Undistributed	Number of listed companies on main-board market
1998	264	224	430	849
	(31.10)	(26.38)	(50.65)	
1999	309	183	513	943
	(32.77)	(19.41)	(54.40)	
2000	698	198	322	1055
	(66.16)	(18.77)	(30.52)	

2001	706 (61.77)	166 (14.52)	409 (35.78)	1143
2002	632 (52.67)	154 (12.83)	533 (44.12)	1200
2003	616 (48.50)	219 (17.24)	607 (47.80)	1270
2004	697 (52.92)	178 (13.52)	594 (45.10)	1317
2005	590 (45.32)	379 (29.11)	495 (38.02)	1302
2006	621 (47.19)	178 (13.53)	631 (47.95)	1316
2007	633 (47.67)	292 (21.99)	599 (45.11)	1328
2008	638 (47.97)	149 (11.20)	659 (49.55)	1330
2009	656 (49.10)	189 (14.15)	631 (47.23)	1336
2010	710 (52.02)	199 (14.58)	617 (45.20)	1365
2011	776 (55.63)	170 (12.19)	587 (42.08)	1395
2012	904 (63.84)	111 (7.84)	494 (34.89)	1416
2013	940 (66.29)	115 (8.11)	459 (32.37)	1418
2014	967 (65.74)	151 (10.27)	478 (32.49)	1471

2015	989 (64.05)	247 (16.00)	515 (33.35)	1544
2016	1190 (70.71)	159 (9.45)	478 (28.40)	1683
2017	1427 (76.35)	258 (13.80)	425 (22.74)	1869

Data source: CSMAR

As can be seen from Table 2, the proportion of listed companies with cash dividends has increased significantly since 2000. From 1998 to 2017, the proportion of listed companies with cash dividends has increased from 31.10% to 76.35%. At the same time, it can be seen that companies that do not allocate or allocate stock dividends still account for a considerable proportion, indicating that there is still the situation of "focusing on stock dividends, but neglecting cash dividends" in listed companies in China.

The introduction of semi-mandatory dividend policy has played a positive role in guiding and regulating the dividend policy of listed companies and protecting the interests of investors. But this regulation may also have a negative impact on those companies with inadequate cash, which in order to achieve the purpose of refinancing have to pay cash dividends so that the shortage of cash is to worsen. To get over the difficulty, they have to increase external financing, especially debt financing, thus increasing the financing risk. By studying the relationship between the company's basic financial characteristics and cash dividends, this paper explores how listed companies should formulate dividend policy rationally, and provides decision-making reference for regulatory authorities and listed companies.

### 3 Research Design

#### 3.1 Hypothesis development

On the basis of drawing lessons from domestic and foreign research results and according to the present situation of dividend distribution of listed companies in China, this paper puts forward several hypotheses from the perspective of internal factors affecting dividend policy of listed companies in China.

The formulation of dividend distribution policy is closely related to the interests of shareholders and creditors, which will affect the company's financial situation and investment opportunities. In order to protect the interests of all parties, various countries regulate the formulation of dividend policy through laws and regulations, such as: company dividends can only be paid from current profits and retained earnings accumulated in the past; when a company is unable to pay its debts due, it will not be able to pay cash dividends, etc. Profitability is the basis of dividend payment and debt repayment. Cash dividend is essentially a distribution of the company's after-tax earnings. To a large extent, the dividend policy of the company will be affected by its profitability and stability. Generally speaking, the more profitable a company is, the higher its cash dividend payment rate will be. Therefore, the hypothesis 1 is made:

**Hypothesis 1: The stronger the profitability is, the higher the cash dividend per share will be.**

Flexible turnover of company funds is a necessary condition for the normal operation of the company. If the liquidity of the company is stronger, the company is willing to distribute cash dividends without worrying about financial risks. If the actual cash disbursed by the company is less than the net cash inflow from operating activities, it means that the company has surplus cash after paying dividends. In this case, the distribution of cash dividends will not endanger the liquidity of the company's operation. If the dividend is greater than the net cash flow of operating activities, it indicates that the overdraft of existing funds may damage the daily operation of the company. Therefore, the more cash flows from business activities, the more cash dividends the company can distribute. Therefore, the hypothesis 2 is made:

**Hypothesis 2: The more net cash flow per share is, the higher cash dividend per share will be.**

The heavy debt burden of the company will lower the liquidity of the company and increase its financial risk. In this case, the company tends to use retained earnings to improve the company's financial situation and avoid further deterioration of the financial structure. In addition, the restraint from creditors will also force the company to distribute less cash dividends, so as to protect creditors' rights. Therefore, the higher the company's debt ratio is, the greater the restriction on the company's ability to distribute cash dividends will be. Therefore, the hypothesis 3 is made:

**Hypothesis 3: The higher the debt ratio is, the lower the cash dividend per share will be.**

The size of listed companies has a great impact on their dividend policy. The smaller the company is, the larger the growth space and the stronger the demand for expansion will be. As a result, cash dividends are paid less and profits are retained or stock dividends are paid more. At the same time, the larger the company is, the greater its social influence will be. With the strength and reputation of large companies, it is easier to obtain funds from other sources at low cost, and it also has sufficient strength and willingness to pay cash dividends. Therefore, the hypothesis 4 is made:

**Hypothesis 4: The larger the company is, the higher the cash dividend per share will be.**

The turnover rate of total assets reflects the operation ability of the company's overall assets. Generally speaking, the more turnover times or less turnover days of assets indicates the faster turnover speed and the stronger operational capacity. The acceleration of asset turnover will increase the absolute amount of income, and the more funds will be recovered, thus guaranteeing the distribution of cash dividends. Therefore, the hypothesis 5 is made:

**Hypothesis 5: The higher the total asset turnover rate is, the higher the cash dividend per share will be.**

### 3.2 Sample selection and data sources

The sample data of this paper select A-share listed companies which have paid cash dividends on Shanghai and Shenzhen main-board market from 2014 to 2017. In order to ensure the validity of the data, this paper excludes some samples. The selection principles of samples are as follows:

- ① Companies that issue B shares and H shares at the same time are excluded;
- ② Financial and insurance listed companies are eliminated;
- ③ Companies with incomplete information are eliminated;

After screening, 3,189 samples were finally selected. The research data comes from the window

information database. This paper uses EXCLE and SPSS 20.0 statistical software to process the data.

### 3.3 Variables and model

Based on the above hypotheses, the following dependent and independent variables are defined, as shown in Table 3.

**Table 3 Definitions of Variables**

	Names of Variables	Variable Symbols	Formula
Dependent variable	Cash Dividends Per Share	DIV	Total Cash Dividends / Weighted Average Common Shares Outstanding
	Earnings Per Share	EPS	Net Income / Weighted Average Common Shares Outstanding
Independent Variables	Cash Flow from Operating-Activities Per Share	OCF	Cash Flow from Operating Activities / Weighted Average Common Shares Outstanding
	Debt Ratio	LEV	Total Liabilities / Total Assets
	Total Assets	LNSIZE	Natural Logarithm of Total Assets
	Total Asset Turnover Ratio	TAT	Net Sales / Average Total Assets

In order to analyze the impact of financial indicators on cash dividend policy of listed companies, a model is established as follows:

$$DIV = \alpha_0 + \alpha_1 EPS + \alpha_2 OCF + \alpha_3 LEV + \alpha_4 LNSIZE + \alpha_5 TAT + \varepsilon$$

Of them, DIV represents the company's cash dividend policy, which is the dependent variable of the whole model. The influence of other independent variables on it was investigated; EPS, OCF, LEV, LNSIZE and TAT are independent variables, representing profitability, cash adequacy, solvency, company size and operating capacity respectively; and  $\varepsilon$  is a residual term.

## 4 Empirical Results and Analysis

### 4.1 Descriptive statistics

Table 4 shows the descriptive statistical results of the relevant variables.

**Table 4 Descriptive Statistics**

Variables	Sample Size	Mean	Median	Standard Deviation	Minimum	Maximum
-----------	-------------	------	--------	--------------------	---------	---------

DIV	3189	0.167	0.100	0.178	0.004	2.300
EPS	3189	0.551	0.420	0.515	-0.493	6.280
OCF	3189	0.610	0.440	1.518	-8.030	25.400
LEV	3189	0.446	0.457	0.208	0.011	0.978
LNSIZE	3189	12.813	12.535	1.505	9.994	21.020
TAT	3189	0.834	0.685	0.643	0.031	8.915

As can be seen from Table 4, the absolute value of cash dividend payment of listed companies in China is generally at a low level. The average value of cash dividend per share is only 0.167 yuan per share, while the maximum value of cash dividend is 2.300 yuan per share and the minimum value is 0.004 yuan per share. The standard deviation is relatively large, which indicates that there are great differences in dividend distribution among companies, and the dividend distribution policy of listed companies in China is seriously divided into two levels. In addition, the minimum value of earnings per share is - 0.493 yuan per share, and the minimum value of operating cash flow per share is - 8.030 yuan per share. This shows that companies with negative earnings per share and operating cash flow still make cash dividends payment, and excess cash dividend distribution and insufficient cash dividend distribution coexist in China's listed companies.

#### 4.2 Correlation analysis

Pearson and Pearson correlation analysis aims to preliminarily test the relationship between independent variables and dependent variable, so as to preliminarily examine the impact of each independent variable on dependent variables. The specific results are shown in Table 5.

**Table 5 Pearson and Spearman Correlation Statistics**

	DIV	EPS	OCF	LEV	LNSIZE	TAT
DIV	1.000	0.664***	0.290***	-0.247***	0.033**	0.108***
Sig.		0.000	0.000	0.000	0.040	0.000
EPS	0.647 ***	1.000	0.327 ***	-0.140 ***	0.137***	0.166 ***
Sig.	0.000		0.000	0.000	0.000	0.000
OCF	0.243 ***	0.391 ***	1.000	0.103 ***	0.239***	0.144 ***
Sig.	0.000	0.000		0.000	0.000	0.000
LEV	-0.229***	-0.082***	0.162 ***	1.000	0.574***	0.136 ***
Sig.	0.000	0.000	0.000		0.000	0.000

LNSIZE	0.052 ***	0.189 ***	0.277 ***	0.574 ***	1.000	-0.011
Sig.	0.001	0.000	0.000	0.000		0.493
TAT	0.068***	0.104 ***	0.096 ***	0.142 ***	0.027	1.000
Sig.	0.000	0.000	0.000	0.000	0.106	

① Pearson correlation statistics are shown in the lower left part of the table, and Spearman correlation statistics are shown in the upper right part of the table.

② \*\*\* Indicates significance at 1 percent level; \*\* indicates significance at 5 percent level; \* indicates significance at 10 percent level in a two-tailed test.

From the statistical results shown in Table 5, taking Pearson correlation coefficient analysis as an example, the cash dividend per share of listed companies has significant positive correlation with earnings per share, operating cash flow per share, total assets and total asset turnover rate, and has significant negative correlation with debt ratio. It preliminarily verifies hypothesis 1, hypothesis 2, hypothesis 3, hypothesis 4 and hypothesis 5. The small correlation coefficient between the independent variables indicates that the model does not have the problem of collinearity.

### 4.3 Multivariate linear regression analysis

In order to further study the contributing factors of cash dividend of listed companies, this paper uses the multiple linear regression method to analyze the contributing factors of cash dividend payment of listed companies. The regression results are shown in Table 6.

**Table 6 Results of Multivariate Regression Analysis**

	2014	2015	2016	2017	2014-2017
intercept	0.066*** (2.83)	0.071 (1.510)	0.093** (2.275)	0.097** (2.08)	0.067*** (2.809)
EPS	0.209*** (43.135)	0.194*** (20.883)	0.189*** (20.577)	0.247*** (26.276)	0.208*** (42.655)
OCF	0.008*** (3.729)	-0.001 (-0.211)	0.017*** (3.906)	0.005 (1.135)	0.008*** (3.868)
LEV	-0.187*** (-14.044)	-0.143*** (-5.293)	-0.172*** (-7.157)	-0.209*** (-8.27)	-0.185*** (-13.759)
LNSIZE	0.004** (2.14)	0.004 (0.923)	0.001 (0.403)	0.002 (0.502)	0.004** (2.057)
TAT	0.008**	0.003	0.015**	-0.007	0.008**



	(2.401)	(0.511)	(2.355)	(-0.908)	(2.387)
YEAR					control
Adj.R <sup>2</sup>	0.456	0.432	0.483	0.504	0.456
F	616.882	124.249	168.702	247.923	385.594

\*\*\* Indicates significance at 1 percent level; \*\* indicates significance at 5 percent level; \* indicates significance at 10 percent level in a two-tailed test.

According to Table 6, the factors affecting the cash dividend distribution level of listed companies are varied in different years. Of them, whether mixed sample or annual samples, earnings per share and cash dividend per share are significantly positively correlated, which verifies hypothesis 1 (the stronger the profitability of the company is, the larger the cash dividend payment will be). The profitability has a very significant impact on cash dividend. The debt ratio has also passed the significant test. Either the mixed sample or the annual samples, the debt ratio is negatively correlated with cash dividend per share, which verifies hypothesis 3(the higher the debt ratio is, the lower the cash dividend per share will be) The solvency has a significant impact on cash dividend.

As for the three variables of operating cash flow per share, logarithm of total assets and total assets turnover, there is a significant positive correlation between them and cash dividend per share at the levels of 1%, 5% and 5% respectively in the mixed sample, which verifies hypothesis 2, hypothesis 4 and hypothesis 5 to some extent. But there are some divergence n various years. For example, operating cash flow per share is positively correlated with cash dividend per share in 2015 and 2017, but not significantly; the logarithm of total assets is only positively correlated with cash dividend per share at the level of 5% in 2014; total asset turnover rate is positively correlated with cash dividend per share in 2015, but the significance test has failed, and it is even negatively correlated with cash dividend per share in 2017. Such results indicate that the positive correlation between these three variables and cash dividend is not particularly stable.

R<sup>2</sup> is always more than 40% based on both annual samples and mixed sample, which shows that the independent variables selected in this paper have a greater impact on dependent variables.

#### 4.4 Robust Test

In order to make the results of this paper more reliable, the robust tests were carried out. First of all, this paper changes the measurement method of the dependent variable DIV, and uses paying or not paying cash dividend to reflect the willingness of the listed company paying cash dividend. That is, when the company issues cash dividends, the value of DUMDIV is 1. Otherwise it is 0. Thus, this paper can further examine the impact of financial indicators on the willingness of listed companies paying cash dividend. The result of the mixed data test shows that earnings per share, operating cash flow per share, total assets logarithm and total assets turnover rate are positively correlated to the willingness of the listed company paying cash dividend, and debt ratio is negatively correlated with the willingness paying cash dividend. So, the result further supports hypotheses 1-5. In addition, return on assets (ROA) is used to measure the profitability of listed companies. The empirical result is not significantly different from the previous analysis. Finally, this paper uses panel data to solve endogenous problem and the problem of missing variables. There are many factors affecting the cash dividend policy, but the financial factors play a major role. This paper focuses on the impact of financial factors on the cash dividend policy of listed companies, so panel data is used to solve the problem of missing variables to

ensure the validity of the model. The empirical result of panel data supports the above-mentioned research results.

## 5 Conclusion

This paper empirically examines the impact of the basic financial characteristics of Chinese listed companies on their cash dividend policies. The study finds that, on the whole, earnings per share, operating cash flow per share, debt ratio, total assets logarithm and total assets turnover rate have a significant impact on cash dividend policy of listed companies. Of them, the impact of earnings per share and debt ratio is relatively stable; mixed data and annual data support its significant impact on cash dividend. Operating cash flow per share, logarithm of total assets and total asset turnover rate have passed the test significantly based on mixed sample, but the results are not stable in various years. The results show that profitability and solvency (capital structure) are the most important financial characteristics that affect the cash dividend distribution level of listed companies in China.

Based on the above conclusions, this paper suggests that the dividend distribution of listed companies should be based on their profitability level. Excess cash dividend distribution and insufficient cash dividend distribution are not advisable. Excess cash dividend distribution will lead to insufficient investment due to lack of cash. If external financing is used to make up for the cash gap, it will increase the financing risk. The insufficient cash dividend distribution will release unfavorable signals to investors, which is not conducive to the promotion of corporate value. In addition, as a financial decision, the cash dividend policy should be considered together with other financial decisions. If the company has a high debt ratio and faces greater financial risks, it should reduce the cash dividend, ensure the solvency of the company, and make the cash dividend policy compatible with the capital structure decision. On the other hand, the regulatory authorities should further improve the relevant laws and regulations on dividend payment, guide listed companies to formulate dividend payment policies on the basis of profits while controlling financial risks, so as to complete the task of "deleveraging" in the "supply-side" reform and create a good market environment.

This paper mainly focuses on the financial factors affecting the cash dividend payment policy of listed companies in China, but the factors affecting the cash dividend payment policy include non-financial factors such as corporate governance, which need to be studied in the future research.

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## Media Coverage, Political Connections and Corporate Risk

Zhou Yi, Zhang Youtang

School of Management, Wuhan University of Technology, Wuhan, P.R. China, 430070

(E-mail: zhouyi9723@163.com, zyt@whut.edu.cn)

**Abstract:** Media coverage, as an important part of the external corporate governance mechanism, plays an important guiding role in corporate behavior patterns and public opinion. Taking A-share listed companies of Shanghai Stock Exchange and Shenzhen Stock Exchange from 2012 to 2017 as research examples, this paper analyzed how media coverage and political connections exert influence on corporate risk in an empirical study approach. This paper makes the following conclusions. First, the media, as information medium and external participant of the company, significantly lower the listed company's corporate risk through closed media coverage. Second, the closer connection a company has with government, the higher corporate risk it encounters and, in the meantime, less effect of media coverage's aversion effect towards corporate risk. Third, based on a further research on the nature of company's property rights, this paper revealed that in state-owned companies, close political connections weaken much more media coverage's aversion effect towards corporate risk than that in private companies.

**Key words:** Media coverage; Political connections; Corporate risk; Nature of property rights

### 1 Introduction

The media exert profound influence on the market during the market economy era. As society and economy progress and reform constantly, vibrant rising of the media not only makes the listed companies' financial activities more transparent, but significantly lower the time cost in acquiring information. That the media closely follow listed companies ensure that information would be transmitted accurately and in a timely manner, and in the meantime, lead the public to respond to information released by listed companies, thus guiding the public opinion. In the past few years, the media has reported "Melamine scandal" of the dairy industry, " clenbuterol scandal" of Shuanghui Group and financial fraud case of Nine Top in 2017. All these cases reveal that the media play an important role in supervising listed companies, protecting investors' interests and benefiting and stabilizing market.

Corporate risk refers to the uncertainty and volatility of corporate income flow. Forty years has passed since the implementation of reform and opening policy, and China's national economy has achieved profound progress. However, many companies blindly pursue the fast growth of corporate profits, while ignoring the ever-worsening corporate risk condition. The outbreak of 2008 financial crisis in the United States indicated that the outbreak of corporate risk not only lead to corporate bankruptcy, but result in severe struck to macro economy. Therefore, when focusing on the corporate performance, the public should also pay attention to corporate risks, based on which policy-makers and the academia begin to put much emphasis on factors concerning corporate risk. Current studies on corporate risk are mostly searching the relations between corporate risk and judicial supervision mechanism, internal control and managers, yet few studies probe into the influence of the media on corporate risk. At present, the media play an ever increasingly important role in listed companies'

management, and a study researching corporate risk from the perspective of the media is highly relevant and theoretical.

Political connections are common among Chinese and foreign companies. No specific conclusions on such corporate-government ties have been made and its influence remain unknown. On the one hand, if maintaining positive communications with government, companies could be benefited from competitive advantages through preferential tax, facilitation in financing, breaking of industry barriers offered by government, and could be relieved from corporate risk to some extent. On the other hand, existence of political connections may result in problems such as excessive corporate investment and low-quality of accountant information, which will worsen corporate risks to some extent. In addition, Chinese capital market started later and is characterized by its unique institutional condition and market environment. The complexity of “Renqing”, a special nepotistic practice, result in that political connections also exist within the media. Therefore, under such a complex circumstance, it is urgent and worthwhile studying the influence that establishment of political connections have exerted on corporate risk and moderating effect that political connections have on listed companies focused by the media.

This study makes innovations in the following aspects. First, from the perspective of corporate risk management, this study examines what effects may happen to corporate risk if there were media attention and political connections, and reveals that media coverage, as an external supervision mechanism, have aversion effect towards corporate risk, which has filled in the blank of the studies in corporate management and risk management; second, through empirical method, this study verifies that political connections will cause moderating effect on media coverage’s aversion effect towards corporate risk, and based on listed companies’ different nature of property rights, carries out variation analysis of moderating effect between listed companies and their connections with government, which renders reference and advice for preventing and lowering corporate risk.

## **2 Literature Review**

### **2.1 Media coverage and corporate risk**

Over the past years, Chinese and foreign scholars studying media coverage have mainly focused on its supervision functionality and its role as information medium.

First, the media function as an information medium. Through information announcement, collection and distribution, the media benefit investors with less information collection cost and less asymmetrical information disadvantage. (Xiong Yan,2014) started from the perspective of asymmetrical information and through an empirical study, verified that media coverage on corporate behaviors significantly lower the imbalance between company and investors in acquiring information, and reduce the corporate risk as a result. (Sun Yanmei and others,2018) utilize the language analysis tools to construct index indicating media coverage and language, to analyze what influence media is going to have on risk of stock price collapse and how that happens. The empirical result of her research revealed that media spread and distribute information, which effectively alleviate information asymmetry and increase the cost, legislative punishment and reputation cost that law-breakers of company must take in hiding negative news. Therefore, it is beneficial to constraining stock prices from collapsing. (Fang and Feress,2009) also through empirical studies, found out that stocks with less media coverage are more likely to yield profit. This is because less accounting transparency lead to higher risk of information asymmetry, so more risk premiums are needed for compensation, which indirectly verified the role media has played as information medium. (Bushee and others,2016) also carried out studies on the media as information medium. Their results reported that the media could reduce the errors existing in

the corporate financial report through transmitting package information.

Second, the media also function as a supervisory body. As an important part of the external corporate governance mechanism, media coverage could investigate and reveal illegal activities infringing upon public goods, such as accounting fraud and earnings management, and thus, restrain management board from conducting opportunist behaviors. (Luo Jinhui,2012) used simultaneous equations models to conduct an empirical test on the benefits media converge produce on corporate governance. The result revealed that media coverage could reduce cost of dual agency to lower its risk. When corporate media coverage increase, corporate production efficiency, performance and social responsibility also increases, and company reported less violations in earning management. (Kong Dongmin,2013). (Li Peigong and Shen Yifeng,2010) discovered that media coverage may lead concerned supervisory bodies to intervene and drive up the violation cost, forcing companies to upgrade corporate governance and lower risk. (Dyck and others,2008) also put forward that companies encroaching outside investors are getting more attention form media, so media coverage effectively forces these companies to correct relative policies and conducts.

## **2.2 Political connections and corporate risk**

After organizing current studies in this regard, this paper discovered that at present, the academia hasn't reached consensus about the influence of political connections on corporate risk. That said, political connections may exert dual effect on corporate risk.

First, political connections could lower corporate risk. Some scholars believe that compared with companies having no political connections, those that have political connections are more likely to acquire competitive advantages such as preferential tax policy, financing facilitation and convenient business entry, and finally lower the corporate risk. (Wang Zhongwei,2015) took private listed companies from 2008-2013 as examples, and found out that China's private companies tend to establish political connections to acquire preferential tax policies. The more connections they have with the government, the more profits they benefit from tax policies. (Yu Wei's,2012) researches discovered that political connections could function as information transmitter, and thus alleviate the information asymmetry between capital suppliers and demanders. Political connections could also help strengthen private companies' ability in acquiring resources to loosen the bond in financing, thus reducing corporate risk. (Luo Danglun and Liu Xiaolong,2009) found out that private listed companies can break industry barriers, develop corporate performance and reduce corporate risk through establishing political connections.

Second, political connections add to corporate risk. Some scholars believe that political connections lead to extra burden on companies, interfere in corporate operation and decision-making, and intervene their daily operation. (Hu Guoliu,2012) research on basic information on corporate manager and investment data, and found out that because of the over-confidence of corporate managers, company may overly invest, causing higher corporate risk. In addition, (Li Tian and others,2018) also discovered on their revealing studies researching relations between corporate political connections and corporate information environment that the closer company board are with government, the lower of the accounting information quality that company release, which is an obvious negative correlation. (Shen Hongbo,2014) put forward that for private listed companies, political connections, as an unofficial mechanism, restrain companies from releasing high-quality accounting information, resulting in higher corporate risk.

### 3 Theory Analysis and Research Hypothesis

#### 3.1 Media coverage and corporate risk

Media coverage exert influence on corporate risk mainly from the following aspects:

Media coverage effectively alleviate information asymmetry between companies and investors, serving as an information medium. According to information asymmetry theory, in a market with uneven information distribution, different market players are equipped with different abilities in acquiring information, and market status is decided by how much information a market player possesses. Under such circumstance, companies with absolute advantage in information acquiring ability whitewash their earning abilities through measures jeopardizing stake-holders such as manipulating profits and producing false report. Such measures not only seriously disorder investors' decision-making process and market operation, but prevent companies from sensing risk and controlling it in a swift manner. In general, as information distributor and transmitter, the media constantly reporting on listed companies is beneficial to alleviating market information asymmetry and creating a capital market that is comparatively transparent, and hence, reduce corporate risk caused by misconducts of management board.

To function as an external supervisory body, media coverage produces an effect called "overseeing effect", which refers to that listed companies reported by the media would be under the spotlight of investors, analysts and auditing agencies, and conducts jeopardizing investors' interests decrease. For companies, any negative reports concerning them may be reported by the media, therefore, out of egoistic impulse, companies tend to manage information. The public opinion is closely following them, so their information management behaviors are more likely to be disposed than companies that are not under the spotlight. Under such circumstance, companies face not only pressure from public opinions, but possible investigation from concerning administrative supervisory bodies, which to some extent lowers corporate risk caused by unstable ethical factors of corporate management board.

Based on the preceding analyses, this study put forward with the following hypotheses:

**H1: Media coverage boasts profound risk aversion effect on corporate risk.**

#### 3.2 Political connections and corporate risk

Political connections exert dual effect on corporate risk. Positive influence on corporate risk from connections with government are mainly reflected on the following aspects:

First, in operation, companies often meet with difficulties when financing. Political connections render companies some convenience in financing. In domestic financing market, information is highly, unevenly distributed among capital supplying side and demanding side, and adverse selection problems originated from such phenomenon are important factors hindering companies' financing process. Companies with strong political connections could lift restrictions on financing through delivering positive signals of corporate performance to the market, and reduce corporate risk in the end.

Second, tax laws in China are still incomplete. Government still enjoy much decision-making power in object of taxation, applicable tax categories, applicable tax rate, taxation basis, tax reduction and exemption and other preferential policies. According to Political Power Hypothesis, the closer connections corporate management board has with government officials, the more communications they will have. Therefore, companies with closer political connections enjoy more tax preferential policies through the political advantages they possess.

Negative influence on corporate risk from political connections are mainly reflected on the following aspects:

First, compared with companies without political connections, companies that have such connection could take advantage of it and acquire bank loans easily. Under such circumstance, companies are benefited with promising financing outlook, rich capital supply and more investment opportunities, which, to some extent, will lead to excessive investment in these companies and increase corporate risk.

Second, compared with companies without political connections, companies that have such connection tend to release information of lower quality. The quality of information that companies release are simultaneously decided by incentives of management board, rent-seeking behaviors and level of financing facilitation. To be specific, when there is higher level of rent-seeking behaviors as well as other incentives in the management board, and more convenient financing channels, companies are less interested in releasing quality information. Political connections provide corporate management board with natural privileges in power and rent-seeking behaviors, and strengthen their ability in capturing interests from investors and their incentives in rent-seeking. Meanwhile, such connections also provide companies with financing facilitation and alleviate their financing pressure. Therefore, when having political connections, companies tend to lower their information released, and have less demand in seeking quality information authentication service.

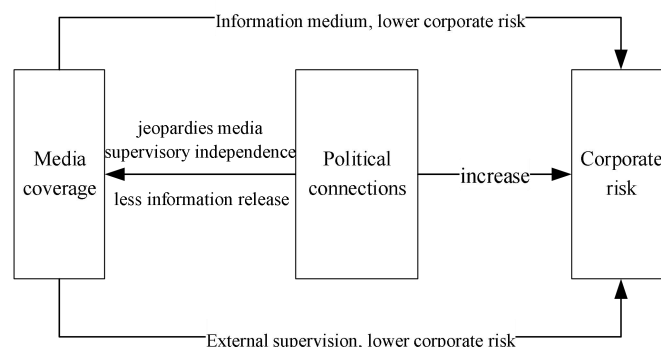
Considering that there are two completely different influence mechanism of political connections and corporate risk, this paper put forward following hypotheses:

**H2a: Political connections efficiently check corporate risk.**

**H2b: Political connections efficiently promote the corporate risk.**

**3.3 Political connections will cause moderating effect on media coverage 's aversion effect towards corporate risk**

As an important part of the external corporate governance mechanism, media coverage functions as information medium and supervisory body, yet such functions could be affected by many factors. Objectivity remains the core factor affecting quality of media information, while companies with political connections have a major influence on that objectivity. Currently, domestic laws protecting the liberty and independence of news report are not complete, and as many news agencies are under governance of local CPC committee and government, contents of news report are often censored by these authorities. Therefore, the media's role of information medium and supervisory body could be restrained by pressure from administration. Considering that a media agency released a negative report on a company that has political connections and such report had led to negative impact on corporate interests. Since this company have common interests with government, and corporate loss may carry a negative impact on government, it is reasonable to conclude that this company is very likely to protect its own interests and reputation by adopting special measures to interfere with this media agency so as to limit the scope of the negative impact. Thus, political connections can be an invisible guarantee for corporate risk. In addition, compared with companies without political connections, those





that have connection intend to cover their rent-seeking behaviors, and will release less accounting information. This will cause a sharp increase of cost for the media intending to supervise and investigate these companies, and hinder performing of the media's supervisory function.

**Figure 1 Influence Mechanism of Political Connections' Moderating Effect on  
Media Coverage's Aversion Effect Towards Corporate Risk**

Based on the analysis above, this paper made following hypothesis:

**H3: Ceteris paribus, political connections weaken media coverage's aversion effect towards corporate risk**

## **4 Research Design**

### **4.1 Sample selection and data sources**

This paper took non-financial A-share listed companies of Shanghai Stock Exchange and Shenzhen Stock Exchange from 2012 to 2017 as research samples. Information about the media reports was manually collected from China Core Newspapers Full-text Database. Background information about senior executives of listed companies was manually collected from CSMAR Database. Other accounting information was also collected from CSMAR Database. Adopting methodologies widely used by the academia, this paper has sifted and processed original information with following steps so as to eliminate abnormal samples:

(1) Financial listed companies were excluded. (2) ST and \*ST stocks were excluded when samples were collected. Because companies trapped in financial debt are always under the spotlight of the media, furthermore, these companies are always with higher corporate risk, so research results obtained from these samples are jeopardized in terms of credibility and universality. (3) Companies with inaccessible data were excluded. (4) In order to avoid outliers, this paper winsorized 1% of the data acquired. The results included 12,916 samples.

### **4.2 Variable definition**

(1) Corporate risk. Current domestic studies mainly evaluate corporate risk level through fluctuation of corporate profit capability. Based on that, this paper set three year as a time range and by using continuous calculation, calculated standard deviation of net return on equity. This standard deviation was used as proxy variable for risk level. The higher continuous standard deviation of net return on equity is, the higher corporate risk level is.

(2) Media coverage. This paper focuses on the influence that the media, as external supervisory function and information medium function, has on corporate risk, and doesn't lay emphasis on the differences caused by the preferences of different media reports. Under this circumstance, this paper chose the number of media reports as proxy variables. To be specific, drawing experience from (Li Peigong and Shen Yifeng, 2010), and (Yi yi, 2011), this paper selected eight most influential national financial daily newspapers from China Core Newspapers Full-text Database. These newspapers include *China Security Journal*, *Security Daily*, *Securities Times*, *ShangHai Securities News*, *The Economic Observer*, *China Business Journal*, *China Business News*, and *21st Century Business Herald*. This paper adopted methods of theme search and title theme to acquire all news reports about these samples by searching the full name and abbreviation of company samples. After manual collection of research

results, this paper listed news report information about non-financial A-share listed companies of Shanghai Stock Exchange and Shenzhen Stock Exchange from 2012 to 2017.

(3) Political connections. Political connections refer to an unofficial communication mechanism that companies established with government as well as its staffs, with senior executives as the medium. Most of the previous papers adopted dummy variables to evaluate whether a company established political connections, yet such method failed to measure the level of connection, thus lacking comprehensiveness. Drawing experience from research methodology of (Jia Ming,2010), this paper searched information form CSMAR Database by using key words of names of senior executives as well as their companies. After manual collection and organization of searching results, this paper set political background of senior executives (Pc) as proxy variables, and, through algorithm of value assignment, acquired the score of corporate political connections to measure the level of such connection. The value assignment standard are as follows:

**Table 1 Score Assignment Standard for Measuring Political Connections**

Categories	Score Assignment
Government Officials	Working in the State Council=7
	Working in the provincial government=5
	Working in the municipal government=3
	Working in the government below the municipal level=1
Non-government Officials	Deputy of the NPC or Member of the CPPCC=6
	Deputy of the provincial NPC or Member of the provincial CPPCC=4
	Deputy of the municipal NPC or Member of the municipal CPPCC=2
	Deputy of the NPC below the municipal level or Member of the CPPCC below the municipal level=0

(4) Control variables. Control variables refer to other factors affecting corporate risk. This paper followed the common practices of current studies, and chose six variables as control variables, including Size (size), Age (age), Operating margin (Om), Financial leverage (Lev), Operating income growth rate (Oigr), Proportion of independent directors (Indept). Specific definitions of variables are described as Table 2.

**Table 2 Definition of Variables**

Types of variables	Titles and Abbreviation of Variables	Definition of Variables
Explained variables	Corporate risk (Risk)	Continuous standard deviation of ROE from year of t-2 to year of t

Explanatory variables	Media coverage (Media)	LN (1+the number of news reports in last year)
	Political connections (Pc)	The score of corporate political connection acquired through algorithm of value assignment
	Asset size (Size)	Natural logarithm of total assets at the end of the period
	Company age (Age)	Calculated from the founding date of the company
	Operating margin (Om)	Total profits during the period/operating income during the period
	Control variables	Financial leverage (Lev)
Operating income growth rate (Oigr)		Growth amount of operating income during the period/ operating income at the beginning of the period
Proportion of independent directors (Indept)		The ratio of independent directors to total director members

### 4.3 Model design

Based on theory analysis and study hypothesis mentioned above, this paper designed Formula 1 and Formula 2 to verify hypothesis H1 and hypothesis H2 respectively to analyze the influence of media coverage on corporate risk and the influence of political connections on corporate risk.

$$Risk_{i,t} = \alpha_0 + \alpha_1 Media_{i,t-1} + \alpha_2 Size_{i,t} + \alpha_3 Age_{i,t} + \alpha_4 Om_{i,t} + \alpha_5 Lev_{i,t} + \alpha_6 Oigr_{i,t} + \alpha_7 Indept_{i,t} + \varepsilon_{i,t} \quad (1)$$

$$Risk_{i,t} = \alpha_0 + \alpha_1 Pc_{i,t} + \alpha_2 Size_{i,t} + \alpha_3 Age_{i,t} + \alpha_4 Om_{i,t} + \alpha_5 Lev_{i,t} + \alpha_6 Oigr_{i,t} + \alpha_7 Indept_{i,t} + \varepsilon_{i,t} \quad (2)$$

In these formulas,  $i$  refers to sample object,  $t$  refers to the year;  $\alpha_0$  refers to the constant term,  $\alpha_i$  ( $i=1,2,\dots,7$ ) refers to the parameter to be estimated, and  $\varepsilon_{i,t}$  refers to stochastic interference term. The explanatory variable of Formula 1 is media coverage (Media). The natural logarithm of the number of news reports that plus one is set as the proxy variable for measuring. Considering that this paper focuses on the influence caused by the number of news reports each year on the corporate risk and that corporate risk are measured by the volatility of the net return on equity at the end of the year, this paper added one time period to the media coverage (Media), which is the explanatory variable, and after that, calculated it with regression method. By this method, the internal problem that explained variable and explanatory variable are reciprocal causations were resolved in the meantime. Based on hypothesis H1, if the

variables' regression coefficient is far less than 0, then it indicates that media coverage is beneficial to lowering corporate risk. the explanatory variable of Formula 2 is corporate political connections (Pc). Algorithm of value assignment was adopted to calculate the score of corporate political connections to measure its level. According to hypothesis H2a, if the variables' regression coefficient is far less than 0, then it shows that political connections are beneficial to lowering corporate risk; according to hypothesis H2b, if the variables' regression coefficient is far more than 0, then it indicates that political connections lead to rising of corporate risk.

In addition, to testify if political connections exert influences on relation between media coverage

$$Risk_{i,t} = \alpha_0 + \alpha_1 Media_{i,t-1} + \alpha_2 Pc_{i,t} + \alpha_3 Media_{i,t-1} * Pc_{i,t} + \alpha_4 Size_{i,t} + \alpha_5 Age_{i,t} + \alpha_6 Om_{i,t} + \alpha_7 Lev_{i,t} + \alpha_8 Oigr_{i,t} + \alpha_9 Indept_{i,t} + \varepsilon_{i,t}$$

and corporate risk, this paper, based on Formula 1, added variable of political connections and multiplicity of media coverage and political connections, and designed the testing Formula 3 as this:

(3)

Corporate risk (Risk) is the explained variable for both Formula 1, Formula 2 and Formula 3, and corporate risk is measured by three-year continuous standard deviation of corporate net return on equity and thus is a continuous variable. Also, since this paper took non-financial A-share listed companies of Shanghai Stock Exchange and Shenzhen Stock Exchange from 2012 to 2017 as research samples, which is a typical panel structure of statistics, this paper, based on the result of Hausman Test, adopted fixed effect model to verify formulas mentioned above.

According to hypothesis H3, regression coefficient of the interaction term of media coverage and political connections is the core parameter to be tested in Formula 3. If the regression coefficient of interaction term  $\alpha_3$  is far more than 0, then it indicates that corporate political connections cause negative moderating effect on media coverage's aversion effect towards corporate risk. In other words, compared with companies without political connections, companies that have such connection are affected deeper by media coverage's aversion effect towards corporate risk, and as the level of political connections become higher, the media coverage's aversion effect towards corporate risk would be further limited.

## 5 Empirical Test and Result Analysis

### 5.1 Descriptive statistics

Descriptive statistical results of major variables, including corporate risk (Risk), media coverage (Media), political connections (Pc) and others described in this paper, are shown in the Table 3. The results in this table indicate that: First, mean value and standard deviation of corporate risk (Risk) is 0.0618 and 0.185, which shows that there is obvious fluctuating volatility of the net return on equity between different samples, and, in other words, that there is relatively big difference of corporate risk between different companies. Second, the mean value and standard deviation of media coverage is 1.094 and 1.128 respectively, which shows that listed companies received much different media coverage. Third, the mean value and standard deviation of political connections (Pc) is 3.715 and 2.146 respectively, which shows that the number of companies building political connections is high, and in among these companies, there is relatively large gap in terms of the level of political connections. Fourth, the differences between maximum value and minimum value of size (Size), financial leverage (Lev) and other control variables are huge, which shows that there are also huge differences between

different sample companies in terms of asset scales, liability level and other aspects.

In addition, this paper adopted Pearson analysis to test mutual relations between explanatory variables and control variables. The test results show that different variables are not revealing serious collinearities. In the meantime, since variance inflation factors (VIF) are all less than 5, the possibility of multicollinearity between different variables are excluded as well.

**Table 3 Descriptive Statistics**

Variable	N	Mean	Std.Dev.	Min	Max
Risk	12,916	0.0618	0.185	0	1.505
Media	12,916	1.094	1.128	0	6.125
Pc	12,916	3.715	2.146	0	7
Media*Pc	12,916	7.883	5.500	0	31.50
Size	12,916	22.13	1.448	19.52	27.27
Age	12,916	9.965	7.043	-0.0444	23.91
Om	12,916	0.0885	0.188	-0.790	0.715
Lev	12,916	0.437	0.224	0.0492	0.943
Oigr	12,916	0.458	1.302	-0.726	9.639
Indept	12,916	0.374	0.0528	0.333	0.571

## 5.2 Empirical results and analysis

With software Stata (14.0), this paper utilized fixed effect model to conduct fixed effect multiple regression analysis on Formula 1, Formula 2 and Formula 3 respectively. The results of multiple regression analysis are shown as in the Table 4.

As the results of Formula 1 show in Table 4, the regression coefficient of media coverage is far less than 0, which shows that the more report the media conducted on a list company, the higher of its media coverage level. Its corporate risk drops as well, which verify the hypothesis H1 made before. Therefore, based on preceding theory analyses, this paper made the reasonable research conclusion that the media, as an important information medium and a crucial part of external corporate governance mechanism, alleviate information asymmetry in the capital market and exert “overseeing effect” on companies, and enforce the companies to restrain from conduct immoral behaviors jeopardizing public interests, so as to improve corporate performance and reduce corporate risk.

As the results of Formula 2 show in Table 4, the regression coefficient of political connections is far more than 0, which shows that there is a positive correlation between political connections and corporate risk, verifying the hypothesis H2 made before. Based on preceding analysis of the positive effect and negative effect of corporate political connections, along with the regression analysis results, this paper made the reasonable conclusion that companies can break industry barriers, develop corporate performance and reduce corporate risk through establishing political connections, but such connections may lead to problems such as excessive investment and inauthentic accounting information, and such

political connections bring out much more negative effects to companies than positive effects. Therefore, overall, political connections exert negative influence on corporate governance, and lead to higher corporate risk.

As the results of Formula 3 show in Table 4, the regression coefficient of multiplication of media coverage and political connections (Media\*Pc) is evidently positive under 1% confidence level. This proves that political connections cause negative moderating effect on media coverage's aversion effect towards corporate risk, which verifies preceding hypothesis H3. Based on preceding analysis of moderating effect theory of political connections, this paper made this reasonable conclusion that as an invisible guarantee, corporate political connections may exert negative impact on the independence of the media, weaken the media's function of information medium and external supervisory body. And, out of safeguarding corporate interests and reputation, senior executive with political connections may resort to special measures to influence or even control the content of the media. In the end, the existence of corporate political connections weakens the media's aversion effect toward corporate risk. In addition, media coverage is evidently negative under 1% confidence level, and the regression coefficient of political connections is evidently positive. Both of them didn't undergo much changes, which further verify the hypothesis H1 and hypothesis H2b.

**Table 4 Multiple Regression Analysis**

Variable	Dep.=Risk		
	Formula 1	Formula 2	Formula 3
Media	-0.0302*** (-5.39)		-0.0274*** (-6.08)
Pc		0.0385** (4.48)	0.0988*** (4.52)
Media*Pc			0.0526*** (5.23)
Size	-0.0618*** (-17.50)	-0.0592*** (-16.89)	-0.0440*** (-30.96)
Age	0.0108*** (11.40)	0.00942*** (10.28)	0.00347*** (15.14)
Om	-0.0627*** (-6.45)	-0.0627*** (-6.45)	-0.156*** (-17.97)
Lev	0.274*** (20.11)	0.271*** (19.91)	0.294*** (33.83)
Oigr	0.00378*** (3.42)	0.00383*** (3.47)	0.00209 (1.85)
Indept	0.0272 (0.69)	0.0267 (0.68)	0.0412 (1.49)

_Cons	1.184*** (16.17)	1.155*** (15.78)	0.868*** (28.40)
Industry	control	control	control
Year	control	control	control
N	12916	12916	12916
Ajusted-R <sup>2</sup>	0.2191	0.2251	0.2187
F 值	113.89***	109.44***	88.61***

Notes: \*\*\*, \*\*, \* represents evident level of 1%, 5% and 10% respectively, the value of *t* is inside (), and the same as follows.

### 5.3 Further analysis

This paper holds the view that for listed companies with different nature of property rights, political connections cause negative moderating effect on media coverage's aversion effect towards corporate risk, yet these negative moderating effects may vary tremendously. This is because, compared with private companies, state-owned companies have "natural connections" with the State Council or local governments, and generally have much higher level of political connections than private companies. Meanwhile, management board of state-owned companies mainly consist of government officials with relative political background. Compared with other management board in private companies, they are more likely to protect their reputations, because corporate performance of their companies are directly related with their political careers. Hence, to maintain political images and prospects, management board of state-owned companies are more motivated to take advantage of their political connections to suppress the release of negative news about their companies. Therefore, in state-owned companies, political connections cause more negative moderating effect on media coverage's aversion effect towards corporate risk.

Based on these theory analyses, this paper made following hypotheses:

H4: Ceteris paribus, compared with private companies, political connections in state-owned companies cause more negative moderating effect on media coverage's aversion effect towards corporate risk.

To further verify this hypothesis, this paper divided all samples into two groups, one group consists of private companies, the other one includes state-owned companies, in terms of nature of property rights, and analyze Formula 3 through regression analysis. This paper tested listed companies in different groups to check whether in companies with different nature of property rights, moderating effect caused by political connections on media coverage's aversion effect towards corporate risk vary, and the test results are shown in Table 5. As Table 5 shows, whether in state-owned companies groups or private companies group, the regression coefficient of multiplication of media coverage and political connections (Media\*Pc) is evidently positive, which shows that political connections cause negative moderating effect on media coverage's aversion effect towards corporate risk in both private companies and state-owned companies. In addition, the regression coefficient of multiplication of state-owned companies' group is 0.0569, which is evidently positive under 1% confidence level. And, this regression coefficient is more than that in private companies, which shows that, political connections in state-owned companies cause more negative moderating effect on media coverage's aversion effect towards corporate risk. Based on these theory analyses, this paper concludes that state-owned companies generally have much higher level of political connections than private companies, and management board of state-owned companies are more motivated to take advantage of their political connections to

suppress the release of negative news about their companies so as to avoid the negative impact on their social reputations and political careers. Therefore, hypothesis H4 is verified.

**Table 5 Further Analysis**

Variable	Dep.=Risk	
	State-owned companies	Private companies
Media	-0.0223*** (-5.74)	-0.0336*** (-6.71)
Pc	0.0907*** (3.92)	0.0702* (2.22)
Media*Pc	0.0569*** (4.37)	0.0448* (2.56)
Size	-0.0389*** (-15.94)	-0.0504*** (-27.20)
Age	0.00224*** (4.89)	0.00487*** (16.41)
Om	-0.175*** (-11.01)	-0.134*** (-12.92)
Lev	0.313*** (19.94)	0.285*** (27.35)
Oigr	-0.000334 (-0.18)	0.00394** (2.73)
Indept	0.107* (2.07)	-0.0269 (-0.83)
_Cons	0.738*** (13.95)	1.024*** (25.43)
Industry	control	control
Year	control	control
N	4794	8122
Ajusted-R <sup>2</sup>	0.1085	0.1638
F Value	73.90***	193.22***



### 5.4 Robustness test

To strengthen the robustness of the research conclusions, this paper replaced explanatory variables to further carry out empirical test on the regression model. To be specific, since the current studies take various methods to measure level of political connections of companies with different nature of property rights, this paper adopted algorithm of value assignment to calculate the score of corporate political connections to measure its level, and, in reference to research of (Faccio,2007), set dummy variable of political connections (Newpc). If the chairman of the board or general manager was or is government official, representative of the party congress, deputy of the NPC or member of the CPPCC, then the dummy variable is 1, or 0 otherwise. This paper replaced the preceding general score of political connections with the dummy variable to measure the level of political connections and substituted it into Formula 2 and Formula 3 to conduct fixed effect regression analysis. The results are shown in Table 6. As Table 6 shows, the regression coefficient of major explanatory variables didn't undergo fundamental shift, proving that the research results are robust.

**Table 6 Robustness Test**

Variable	Dep.=Risk		
	Formula 1	Formula 2	Formula 3
Media	-0.0402*** (-5.39)		-0.0183*** (-4.85)
Newpc		0.0619*** (4.64)	0.0512*** (5.00)
Media*Newpc			0.0789** (2.28)
Size	-0.0618*** (-17.50)	-0.0585*** (-16.76)	-0.0611*** (-17.36)
Age	0.0108*** (11.40)	0.00925*** (10.17)	0.0107*** (11.29)
Om	-0.0627*** (-6.45)	-0.0606*** (-6.25)	-0.0604*** (-6.25)
Lev	0.274*** (20.11)	0.264*** (19.47)	0.267*** (19.67)
Oigr	0.00378*** (3.42)	0.00393*** (3.57)	0.00387*** (3.52)
Indept	0.0272 (0.69)	0.0284 (0.72)	0.0292 (0.75)

_Cons	1.184*** (16.17)	1.140*** (15.65)	1.171*** (16.04)
Industry	control	control	control
Year	control	control	control
N	12916	12916	12916
Ajusted-R <sup>2</sup>	0.2191	0.2233	0.2172
Numerical value of F	113.89***	105.86***	85.76***

## 6 Conclusions

### 6.1 Research conclusion

Taking A-share listed companies of Shanghai Stock Exchange and Shenzhen Stock Exchange from 2012 to 2017 as research examples, this paper analyzes how media coverage and political connections exert influence on corporate risk respectively, and the moderating effect of corporate political connections on media's aversion effect toward corporate risk. This paper makes the following conclusions. First, as a crucial part of external supervisory body, media coverage makes up deficiency of legislative supervision, and effectively alleviate information asymmetry within and outside companies. Therefore, media coverage exerts evident aversion effect on corporate risk. Second, political connections refer to a communication mechanism that companies established with government by hiring senior executives with political backgrounds. The closer connection a company has with government, the higher corporate risk it encounters. Third, corporate political connections weaken the media's aversion effect toward corporate risk. Fourth, based on further research on companies with different nature of property rights, this paper found out that in state-owned companies, political connections weaken media coverage's aversion effect towards corporate risk to a larger extent.

### 6.2 Research enlightenment

Based on preceding research conclusions, this paper offers countermeasures and advice from the perspective of the media, government and listed companies.

The media. First, the media should strengthen its independence and objectivity, and constantly enhance the spirit of obligation and self-discipline. The media should release news reports about listed companies and capital market in an objective, precise, timely and genuine manner, to build an open and transparent atmosphere for capital market and to play its role of information medium and supervisory body. Second, in order to deliver precise and credential information to the public and government in a timely manner, the media should make continuous efforts to improve capabilities of employers and develop a keen sense to various problems existing in listed companies and capital market.

The government. Political connections in listed companies may exert negative impact on function of information medium and supervisory role for the media. Therefore, the government should establish a protection mechanism to safeguard the media's rights of reporting and supervising, and should do its best to minimize the possibility that companies with political connections influence the media with unofficial measures so that the media, an important part of external corporate governance, smoothly supervise corporate performance and control corporate risk.

The listed companies. First, as an unofficial communication mechanism between government and companies, political connections are able to reduce the uncertainties of market to some extent for companies, and bring more resources and opportunities. However, companies should pay attention to the negativities of political connection, such as high cost of rent-seeking behaviors, government plundering, excessive investment of companies, etc. Second, as the media swiftly rise to prominence, more attention have been paid to accounting information of listed companies and transparency of decision-making process. Companies should closely follow media coverage, and consider it as an effective external supervisory mechanism to improve corporate efficiency.

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## **A Study on Public Demand and Optimization Strategies for University Libraries Based on Big Data from Search Index**

Liu Nan

Library, Wuhan University of Technology, Wuhan, P.R. China, 430070

(E-mail: Liu\_tushuguan@whut.edu.cn)

**Abstract:** In this paper, public demand and optimization strategies for university libraries are explored through the big data platform (Baidu Index, 360 Index) with Wuhan University of Technology and Central China universities as examples. Firstly, we analyzed the search trends, population distribution, public opinion insight and demand map of Wuhan University of Technology Library through two kinds of index platform. Then, we draw the public demand map of university libraries according to the demand graph of the other 5 universities in central China based on the same method. The public demand focuses on the following questions: how to land the university library website outside of the campus; the way of non-university workers entering the campus physical library; database website use guide; how to retrieve, download and use data resources; examination papers of the university; website links of related university libraries and other departments in the university (such as Academic Affairs). According to the demands, we suggest that the library should use texts, pictures, videos and website links as the carriers to solve the readers' questions through the school and the library homepages, the blog, WeChat platform and meet the most extensive public needs. Finally, we should dig the big data of library user' behaviors and improve the quality of library services with integration of public big data.

**Key words:** Big data; University library; Baidu index; 360 index; Public demand

### **1 Introduction**

The massive behavior data of netizens is an important manifestation reflecting the concerns and needs of netizens in the big data environment. For example, Taobao judges our consumption behavior according to our browsing footprint, and recommends us suitable products; Alipay judges our financial management tendency according to our financial management process, recommending suitable financial products to us to achieve mutual benefit (Hao, 2017). As a service organization, it is important for the library to grasp the needs of users. However, libraries have not fully utilized the value of big data, even though they are already on the road to big data (Read and Smith, 2000). At present, the library's access to user needs is mainly obtained through research, questionnaires, etc., but these research methods usually have the subjective intention of the investigator and the scope of the survey is narrow, which cannot fully reflect the user's wishes. The emergence of big data can just overcome the above deficiencies, making the national and even world-wide user surveys a reality, and the investigation process objective and fair, without personal subjective intentions (Fox et al., 2016; Fox et al., 2017). Therefore, we consider to use big data to explore the needs of national netizens for university libraries and to design targeted coping strategies based on the research results (Zhang and Guo, 2016; Tu and Liu, 2016). Firstly, the Baidu Index and 360 Index (Ilic et al., 2014; Scott et al.,

2009), which analyze the behavior of massive netizens, are used as carriers to analyze the demand of Internet users for the Wuhan University of Technology Library. Then, by comparing the other 985 and 211 universities in Wuhan, the public willingness to the university library is summarized according to the quantitative behavior data of netizens. Then, based on the summarized demand results, we develop targeted responsible strategies, optimize service forms and service contents to meet the broadest needs of the public through the library home page, Weibo and WeChat platform. Finally, we dig the existing user behavior data of the library and provide a reference plan for the library to use big data to improve service quality.

## **2 Data and Methodology**

In 2008, the journal of Nature put forward the data flood and opened a special column to introduce the present situation and the future of Big data, taking Google, Harvard and biology as examples. Since then, the concepts of Big data are raised up and developed rapidly accompanying with the development of information technologies such as cloud computing, the Internet of Things and the mobile Internet. Big data not only refers to a great amount of data, but also has four basic characteristics: large volume, strong variety, high velocity, low value density, short for 4V.

Baidu and 360 are the most two popular search engines in China and possess the biggest data of citizen behaviors. Therefore, they have established data sharing platforms based on the behavior data of massive netizens, separately. The platforms are important statistical analysis platform for the current Internet and even the entire data age and are important references for the marketing decision of many enterprises. The platforms not only provide open source of big data, but also provide an integrated tool for data mining, analysis, and visualization. So, we choose these two sites as our research platform. The websites of Baidu index and 360 index are <http://index.baidu.com> and <https://trends.so.com/>. The index platforms can tell the users the current search times and trends of certain keywords, the news and public opinion changes related to the keywords and the people who pay attention to these key words. The aim of designing these platforms is to reflect the needs of netizens who search particular keywords (Sojka et al., 2011).

Firstly, we search "the Library of Wuhan University of Technology" as the search keywords on Baidu Index and 360 Index platform, and analyzed the overall search trends of the "Wuhan University of Technology Library", the number of media reports, news headlines and media attention, the characteristics of user groups, Baidu know, search terms search index etc. to sum up the public demand. Apparently, results from only one technical university could not represent the whole demands. So, we choose some other universities from the fields of science, normal, agriculture and technology, including Wuhan University, Huazhong University of Science and Technology, Huazhong Normal University, Huazhong Agricultural University, Wuhan University Of Science and Technology as examples to summarize public demand for college libraries in Central China in the same method. Then, targeted response strategies are proposed based on the summarized public needs and the service form and contents are optimized to meet the broadest needs of the public through the library home page, Weibo and WeChat platform.

## **3 Public Demands for the Library of Wuhan Universities of Technology**

### **3.1 Exploring the demands by Baidu index and 360 index**

The demand map is the relevant search term demand expressed by the user in the search

behavior change before and after searching for the word. We count the related words displayed on the demand map of the Baidu index and 360 index platform in one year. Quantitative data shows that 80% of related words are concentrated on “Wuhan University of Technology Library vpn”, “Wuhan University of Technology Academic Affairs Office”, “Wuhan University of Technology Graduate School”, “Wuhan University of Technology mailbox”, “Wuhan University of Technology Transportation College”, web of science, Wuhan weather, Wuhan University Library and so on. Among them, at least 3-4 related words per week are related to “vpn”, such as “Wuhan University of Technology vpn”, “Wuhan University of Technology Library vpn”, “Wuhan University of Technology vpn client”, “Wuhan University of Technology vpn System”, indicating that the public most want to know is how to use the school resources outside the campus, including access, login account, password. For the remaining 20% of the related words, they change differently over time: sometimes there will be a college or department within the school, such as the material archives, the Science and Technology Party network, the welcome network etc.; sometimes other school libraries appear, such as the Hubei Provincial Library, Huazhong Agricultural University Library, etc.

The source and destination search terms reflect which search requirements the user has before and after the search center word. We also counted the weekly source and destination search terms for the “Wuhan University of Technology Library” in the Platforms. The statistical results are completely consistent with the results of the related words of the demand map.

### 3.2 Exploring the demands by Baidu Know

We count the top ten questions related to the “Wuhan University of Technology Library” proposed in the “Baidu Know” since 2013 and analyze them. The results show that the number one question is the same every year, that is how to enter the “Wuhan University of Technology Library” website outside the campus net, and at least four of the remaining nine questions are the same or similar to the first one. The Vpn problems and the remaining main questions are listed in Table 1. According to the analysis results since 2013, the questions related to the library of Wuhan University of Technology that the public focus on are external and internal network login problems, examination papers, literature search and download, CD download.

**Table 1 The Main Questions Related to Wuhan University of Technology Library on Baidu Know**

Number	Question
	how to enter the “Wuhan University of Technology Library” website outside the campus net
	how to enter the Wuhan University of Technology vpn
1	why cannot access the Wuhan University of Technology Library website
	the user name and authorization of Wuhan University of Technology Library Yirui landing system
	the campus card number and password to log in Wuhan University of Technology Library
2	whether Wuhan University of Technology Library have the examination papers
3	how to download the English literature from the Wuhan University of Technology Library

- 
- 4 how to download the CD with the book
  - 5 why cannot open the database of the Wuhan University of Technology Library homepage
  - 6 where is the new campus of Wuhan University of Technology
- 

#### 4 Public Demands for the Libraries in Other 5 Universities in Central China

According to the needs of the “Wuhan University of Technology Library”, the public will pay attention to other libraries in the same area when they pay attention to our library. Based on the above results, we select “Wuhan University Library”, “Huazhong University of Science and Technology Library”, “Huazhong Normal University Library”, “Huazhong Agricultural University Library” and “Wuhan University of Science and Technology Library” as the research objects. The same approach was used for exploring the public need for the above libraries.

##### 4.1 Exploring the demands by Baidu index and 360 index

Similarly, in the above five colleges and universities, relevant words that people search for before and after the university library on the Baidu index and 360 index are university library off-campus landing, academic affairs office, curriculum management, graduate school, employment information network, campus mailbox, journal, Web of science, Wuhan weather, Admissions Network, University Accommodation, etc.

##### 4.2 Exploring the demands by Baidu Know

Taking five university libraries as examples, the main questions on Baidu Know are listed below. We can easily find public demands are similar from table 2.

**Table 2 The Main Questions Related to 5 Other Represent Universities on Baidu Know**

Number	Question
1	How to enter the library internal website in the external network
2	How non-school persons enter university libraries
3	How to apply for library cards, borrow books and renew loans
4	Accounts and passwords for online login of university libraries
5	Access to university library databases, literature search and download
6	the use of the internal wireless network of the university library
7	download the CD with the book
8	whether the library can get the examination papers
9	the similarity check of papers



## **5 the Optimizations to Meet Public Demands for Central Libraries**

### **5.1 Library website optimization**

The analysis results of every university show that the most common question for the public is how to log in the campus library website outside the school. For example, the public ask about the VPN system of Wuhan University of Technology and the hub system of Huazhong University of Science and Technology. In response to this demand, the library should publish obvious notices including website portals, login methods, account passwords, etc. on the campus network, the library network, the official Weibo and WeChat of the school, and the official Weibo and WeChat of the library, and show the use methods through pictures and videos, enabling teachers and students throughout the world to enjoy campus resources at any time. For non-school teachers and students, it is recommended to develop appropriate compensation methods so that non-school personnel can also enjoy the school resources. Another issue of public concern is how non-school personnel enter the campus physical library. It is a good idea to take the form of paid card entry.

The use of electronic resources is another concern. The library should use the multifaceted propaganda method, such as documents, teaching ppt, teaching videos, and live broadcast, to promote the use of the database, especially Web of Science which is the public's most concerned. Meanwhile, the library should open a column to introduce database retrieval, document download, CD download and other issues on the library home page, the library Weibo and WeChat.

The analysis results of relevant search terms show that the public will retrieve the words such as the Academic Affairs Office, the Graduate School, the Employment Information Network, the campus mailbox and so on before and after the university library is searched. Therefore, the library can embed the weather, the Academic Affairs Office, the Graduate School, the Employment Information Network, the campus mailbox, and the journal links on the homepage. For enrollment and orientation, we can open a column on the homepage and Weibo and WeChat platform.

### **5.2 Organization optimization in the library**

Except the demands we dig from the two platforms, there are many other demands about library we can't dig from the Internet. These demands are called invisible demands. For example, teachers haven't realized that their teaching materials, papers and other first-hand materials should be kept in the library as a part of the internal big data of the university. The librarians in the University of Cornell, Purdue University, University of Minnesota have set a program to consummate their internal big data. They form a team including a data librarian, a subject librarian and a teacher to teach students special data literacy. No Chinese libraries have tried to reorganize the librarians. We should learn from these American universities and started to think in the big data way.

## **6 Conclusions**

In this paper, public demand and optimization strategies for university libraries are explored through the big data platform (Baidu Index, 360 Index) with Wuhan University of Technology and other Central China universities as examples. The public demand focuses on the following questions: how to land the university library outside of the campus; the way of non-university workers entering the campus physical library; database website use guide; how to retrieve, download and use data

resources; examination papers of the university; website links of related university libraries and other departments in the university (such as Academic Affairs). According to the demands, we suggest that the library should use texts, pictures, videos and website links as the carriers to solve the readers' questions through the school and the library homepages, the blog, WeChat platform and meet the most extensive public needs.

### **6.1 The utilization of the big data in the interior of the university**

However, the big data about library are not only obtained from the search engine, but also from the internal of the University. Firstly, we should dig the big data of library user' behaviors and improve the quality of library services with integration of public big data. For example, we use big data to help us purchase the books and database (Podnar et al., 2006). Teachers and students need to log in when they search for the books or electronic resource. We can analyze the search behaviors and recommend them the similar resource. Secondly, the library should collect teachers' teaching materials, including teaching PP, teaching video, and exam questions and so on. The library has already begun to establish institutional knowledge base to store their own big data of the university, serving teachers and students.

### **6.2 Big data improve the scientific research evaluation**

Another kind of big data is the papers, patents, dissertations from teachers and students. We have been analyzing all the papers and patents to investigate the research strength, heading direction, heading strategy, award scheme, funding plan and so on, providing the basis for university managers to make developing plans and policies. We can help the school managers to promote research evaluation and help to recommend similar resources such as the book category, database, and research field to readers by analyzing their activity behaviors. Meanwhile, the analysis can also give the researchers message about submitting a manuscript, looking for cooperators, communicating internationally, getting the research fronts. It's said that Obama won the president by the help of big data analysis. We library can also use the big data to value ourselves.

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## Moderating Effect of Ratio of Independent Director on the Relation between Managerial Overconfidence and Enterprise Value

Dai Fei, Li Yan

Pan-Asia Business School, Yunnan Normal University, Kunming, P.R. China, 650092

(E-mail: yidoucai@126.com, 1060676974@qq.com)

**Abstract:** Based on the moderating effect of the ratio of independent director, this paper chooses the sample of Chinese Shanghai and Shenzhen A-stock listed companies from 2012 to 2015, using hierarchical regression to test the influence of managerial overconfidence on enterprise value. The study shows: (1) There exists a positive relation between managerial overconfidence and enterprise value. (2) The ratio of independent director exerts a positive moderating regulating effect on the relation between managerial overconfidence and enterprise value. This paper enriches the theoretical research on the relationship between managerial overconfidence and enterprise value, meanwhile has some enlightenment to the improvement of the enterprise value of Chinese listed companies.

**Key words:** Managerial overconfidence; Ratio of an independent director; Enterprise value; Moderating effect

### 1 Introduction

The relation between enterprise value and managerial overconfidence has always been a hotspot in corporate governance. Some studies (Roll, 1986; Heaton, 2002; Hackbarth, 2003) have concluded that there is a significant negative correlation between managerial overconfidence and corporate value while another studies (Ye Bei & Yuan Jianguo, 2008) argue that moderate manager overconfidence can enhance corporate value, and excessive manager overconfidence will reduce corporate value. Although there exists a controversial conclusion on this aspect, most studies show that managerial overconfidence can significantly improve enterprise value (Gervais, Heaton & Odean, 2011; Geol & Thakor, 2008; Rao Yulei & Wang Jianxin, 2010; Lin Huiting & Wang Maolin, 2014).

From related articles, we find that previous studies mainly focus on the general effect of managerial overconfidence on enterprise value. They don't investigate the relation under different circumstances. The ratio of independent director is one of important factors that influence the relation between managerial overconfidence and enterprise value. With his independence and expertise, independent director, using their professional knowledge, capability, and experience to make independent judgment and give valuable suggestion on board of directors, management and problem related, cast a significant influence on enterprise decision-making. The number of board seat of independent directors directly decides their speaking right in a company. Thus, it's necessary to investigate the moderating effect of the ratio of the independent director on the relation between managerial overconfidence and enterprise value.

Based on above, this paper chooses the sample of Chinese Shanghai and Shenzhen A-stock listed

companies from 2012 to 2015, and systematically investigates the influence of managerial overconfidence on enterprise value, from the perspective of the moderating effect of the ratio of independent director, with the aim of providing meaningful reference for listed company to optimize the board structure according to the degree of managerial overconfidence, by offering research result with theoretical and practical value.

## **2 Theoretical Analysis and Research Hypothesis**

### **2.1 Managerial overconfidence and enterprise value**

The overconfident performance exists among people's daily life. People tend to owe their success to personal ability and their effort, while their failure to all kinds of misfortune or external factors (Miller & Ross, 1975). In enterprise management, the manager's overconfidence is more obvious than in normal people. During the decision-making process, manager tends to overestimate the possibility of success, yet underestimate the risk of failure (Malmendier & Tate, 2005). In enterprise management, the manager holds an important position on supervision and enterprise control, their decisions determine the future performance of enterprise as well as its value. Hence managerial overconfidence and enterprise value is closely related.

Most studies show that managerial overconfidence contributes to improving enterprise value because an overconfident manager has limited possibility to make an insufficient investment. Compared with risk averse manager, overconfident manager is more inclined to underestimate project risk and exercise during the best exercise period of the project. Hence, they are more likely to invest project with positive net present value, which improves the possibility of getting extraneous income that finally improves the enterprise value (Gervais, Heaton & Odean, 2003).

Our hypotheses are as follows:

H1: Managerial overconfidence is positively related to enterprise value.

### **2.2 Moderating effect of ratio of independent director on the relation between managerial overconfidence and enterprise value**

Since independent directors have no business connection with company or management and can make independent judgment by their solid professional knowledge, capability and experience, the listed company establishes the independent director position, to supervise and constraint decision-making of manager. Therefore, an independent director is a rational outsider during enterprise daily operation. The higher the degree of managerial overconfidence is, the higher possibility that manager overestimates his ability and the chance to succeed and underestimates the cost company takes and the risk of failure. At this time, independent director corrects the inappropriate decision of manager, decreasing agent cost, improving management efficiency, and finally improving enterprise value (Hermalin & Weisbach, 1991). The more board seats of independent directors there are, the more speaking right they have. Thus, they can correct decision that undermines the interest of company (Richardson, 2006), to improve enterprise value by correcting manager's self-attribution bias.

Our hypotheses are as follows:

H2: The ratio of independent director has positive moderating effect on the relationship between managerial overconfidence and enterprise value.

### 3 Research Design

#### 3.1 Sample selection and data sources

The study chooses the sample of Chinese Shanghai and Shenzhen A-stock listed companies from 2012 to 2015. And our selection rules are as follow: (1) Excluding the sample of financial insurance industry (considering the huge difference of asset-liability ratio between financial insurance industry and other industries; (2) Excluding the sample of ST stock, \*ST stock and delisted company; (3) Excluding the sample with asset-liability ration over 100%. Finally, we get 3148 observation from 784 companies in 14 different industries during 4 years from CSMAR database and establish balanced panel data.

#### 3.2 Measurement of variables

1 Explained Variable: Enterprise value is an ability that can give stakeholder satisfactory return, which can be defined with economic meaning and measured. In previous studies, there is a lot of index and proxy to describe enterprise value, such as ROE, EVA, DCF, Tobin'Q. Considering feasibility, we take Tobin'Q (LiuXing & Li Xiaorong, 2012) as the proxy of enterprise value.

2 Explaining Variable: At present, there are 9 methods to measure managerial overconfidence. However, considering the reality of Chinese Shanghai and Shenzhen A-stock market and the feasibility of obtaining data related, we take Jiang Fuxiu et al (2009)'s method as a reference, and measure the degree of managerial overconfidence by calculating the proportion of the sum of top 3 executive compensation in total executive compensation. Then we take the mid-value of the proportion as a benchmark to tell whether there exists overconfidence. Overconfidence is defined as 1, otherwise as 0.

3 Moderating Variable: As for the measurement of the ratio of independent director, we take the proportion of the number of independent directors in the number of board directors as measurement.

4 Control Variable: Referring existing, we take Scale of company, Asset-liability ratio, Ownership property, Earning power, Ownership centration, year, Industry as control variables.

Main variables and definition are as follow:

**Table 1 Variable definition**

Variable	Variable name	Sign	Calculation
Explained variable	Enterprise value	Tobin'Q	$(\text{price per share} * \text{tradable shares} + \text{net asset value per share} * \text{non-tradable shares} + \text{market value of their debt}) / \text{total asset}$
Explaining variable	Managerial over confidence	Con	Measure the degree of managerial overconfidence by calculating the proportion of the sum of the top 3 executive compensation in total executive compensation. Then we take the mid-value of the proportion as a benchmark to tell whether there exists overconfidence. Overconfidence is defined as 1, otherwise as 0
Moderating	The ratio of independent	Dir	The number of the independent director / The number of the board

variable	director		director
	Scale of company	Size	Total asset in natural logarithm at the end of year
	Asset-liability ratio	Lev	Asset /liability
Control variable	Ownership property	State	If it is state-owned enterprise, output 1; otherwise 0
	Earning power	Roa	Net profit/total asset
	Ownership centration	Top1	proportion of the largest shareholder
	year	Year	
	Industry	Industry	SEC report

### 3.3 Model setting

To testify the main effect of managerial overconfidence on enterprise value, we build mode 1:

$$Tobin'Q_{i,t} = \alpha_0 + \alpha_1 Con_{i,t} + \alpha_2 Size_{i,t} + \alpha_3 State_{i,t} + \alpha_4 Lev_{i,t} + \alpha_5 Roa_{i,t} + \alpha_6 Top1_{i,t} + \alpha_7 \sum Year + \alpha_8 \sum Industry + \varepsilon_{i,t} \quad (\text{model 1})$$

To testify the moderating effect of the ratio of an independent director on the relation between managerial overinvestment and enterprise value, we adopt hierarchical regression promoted by Wen Zhonglin, Hou Jietai & Zhang Lei (2005) to build model 2:

$$Tobin'Q_{i,t} = \beta_0 + \beta_1 Con_{i,t} + \beta_2 Dir_{i,t} + \beta_3 Con_{i,t} * Dir_{i,t} + \beta_4 Size_{i,t} + \beta_5 State_{i,t} + \beta_6 Lev_{i,t} + \beta_7 Roa_{i,t} + \beta_8 Top1_{i,t} + \beta_9 \sum Year + \beta_{10} \sum Industry + \varepsilon_{i,t} \quad (\text{model 2})$$

In model 1 and model 2, for managerial overconfidence is pseudo-variable and the ratio of independent director is a continuous variable, referring Wen Zhonglin, Hou Jietai & Zhang Lei (2005)'s method, before doing model 2 regression, we centralize the data of managerial overconfidence and the ratio of independent director, then we do the hierarchical regression.

## 4 Empirical Analysis

### 4.1 Descriptive statistics and correlation analysis

Table 2 is the descriptive statistics and the correlation analysis of the sample data. From table 2, we find that the mean value of enterprise value is 1.611 and the standard deviation is 1.804, which means that the enterprise value of listed companies in China different greatly; The mean value and the standard deviation both are 0.500, which means managerial overconfidence exists in half of listed companies. The mean value of the ratio of independent director is 0.368, which conforms to CSRC's requirement for listed company. The mean value of asset-liability ratio is 50.4%, which means most listed companies have reasonable liability-level. State-owned enterprise account for 65.6% of the

sample; the mean value of profitability is 0.034, which means that listed companies need to find a way to improve their earning power. The mean value of the percentage of the first major stockholder is 35.2%, which means listed companies have high ownership concentration. From the perspective of the correlation analysis, Scale of company, Asset-liability ratio, Ownership property, earning power, Ownership centration, year, Industry is significantly related with enterprise value, and their sign is consistent with previous study, which primarily proves that the control variables are valid. Managerial overconfidence is significantly positive related with enterprise value, which primarily proves the hypothesis 1; the ratio of independent director is positively related with enterprise value and managerial overconfidence but not significantly, which means the ratio of independent director is a pure moderator.

**Table 2 Descriptive Statistics and Correlation Analysis**

		Mean value	Standard deviation	1	2	3	4	5	6	7	8
1	Tobin'Q	1.611	1.804	1.000							
2	Con	0.500	0.500	0.139** *	1.000						
3	Dir	0.368	0.052	0.012	0.006	1.000					
4	Size	22.596	1.285	0.459** *	0.233** *	0.071** *	1.000				
5	State	0.656	0.475	0.219** *	0.188** *	-0.034*	0.219** *	1.000			
6	Lev	0.504	0.195	0.460** *	0.144** *	0.050** *	0.470** *	0.132** *	1.000		
7	Roa	0.034	0.053	0.210** *	0.048** *	0.058** *	0.015	0.108** *	0.414** *	1.000	
8	Top1	0.352	0.150	0.129** *	-0.010	-0.005	0.307** *	0.258** *	0.090** *	0.058** *	1.000

\*, \*\*, \*\*\* represent the significance at the 10%, 5%, and 1% levels, respectively.



#### 4.2 Regression analysis

Table 3 shows the regression result of the main effect of managerial overconfidence on enterprise value and the moderating effect of the ratio of independent director. The regression result of model 1 shows that, except for ownership concentration, other control variables pass the significance testing and their sign is consistent with previous studies; managerial overconfidence is significantly positively related with enterprise value, which further supports the hypothesis 1. In model 2, the cross term of managerial overconfidence and the ratio of independent director is significantly positively related with enterprise value, which means the ratio of independent director has positive moderating effect on the relationship between managerial overconfidence and enterprise value and supports the hypothesis 2.

**Table 3 Regression Analysis of Main Effect and the Moderating Effect**

variable	Main effect		Moderating effect	
	Model 1		Model 2	
		Step 1		Step 2
Constant term	13.909*** (1.066)	14.011*** (1.077)	14.032*** (1.077)	
Con	0.126*** (0.048)	0.111*** (0.043)	0.155*** (0.055)	
Dir		1.226 (0.774)	1.273 (0.791)	
Con*Dir			2.303* (1.377)	
Size	-0.533*** (0.053)	-0.539*** (0.053)	-0.539*** (0.053)	
State	-0.348*** (0.083)	-0.341*** (0.083)	-0.334*** (0.084)	
Lev	-1.611*** (0.365)	-1.560*** (0.365)	-1.593*** (0.364)	
Roa	4.966*** (1.134)	5.026*** (1.132)	5.010*** (1.120)	
Top1	0.446	0.449	0.428	

	(0.289)	(0.287)	(0.287)
Year	controlled	controlled	controlled
Industry	controlled	controlled	controlled
R <sup>2</sup>	0.430	0.431	0.432
Wald chi2	664.390***	665.930***	659.980***

\*, \*\*, \*\*\* represent the significance at the 10%, 5%, and 1% levels, respectively, and the numeral value in the parenthesis is a standard error.

### 4.3 Robustness examination

To testify the reliability of the consequence, referring stock or stock option method of Malmendier & Tate(2008) and based on relative compensation method of Jiang Fuxiu et al (2009), we take the ratio of the quantity of executive stock keeping and the quantity of management stock keeping as the proxy of managerial overconfidence and take the mid-value of it as benchmark. If the value of the sample is higher than the mid-value, the value of overconfidence is 1, otherwise is 0. The result of the robustness examination shows that the outcomes of robustness examination and formal regression consistent. In the robustness test, all the regression coefficients are smaller than those in Table 3, which may be related to the factors that affect the whole team's ownership status rather than the personal characteristics of managers. Although the regression coefficients are smaller, it does not affect the conclusions of this study.

## 5 Conclusion

Based on the adjustment function of the ratio of independent director, this paper chooses the sample of Chinese Shanghai, and Shenzhen A-stock listed companies from 2012 to 2015, using hierarchical regression to test the influence of managerial overconfidence on enterprise value. The study shows: (1) There exists a positive relationship between managerial overconfidence and enterprise value. (2) The ratio of independent director exerts a positive regulating effect on the relation between managerial overconfidence and enterprise value.

The outcome of empirical study provides reference for the practice of enterprise management from two aspects: First, since overconfident manager tends to create more enterprise value, when introducing and cultivating management talents, besides professional skill and experience, company should focus more on heterogeneous characteristics like the degree of over confidence; Second independent director contributes to correcting management inappropriate decision-making, company should properly increase the ratio of independent director. According to OECD international comparison report data, developed countries have higher ratio of independent director. For example, the ratio of independent director in the USA is up to 62%. Research report of Kom-Ferry shows that in top 1000 American companies, the ratio of independent director is up to 81.1%. But Wu Jianhua (Wu Jianhua, 2009) finds that the ratio of independent director in China is only 33.04%, which is far less than that in developed countries. According to theoretical research and practical experience, a company in China should properly raise the ratio of independent director to give full play to independent director's function in corporate governance, which will decrease the agent cost and improve the management efficiency and improve the enterprise value.

Based on the moderating effect of the ratio of independent director, the paper investigates the relation between managerial overconfidence and enterprise value, which enrich the research in relative fields, and provides reference for the practice of enterprise management. But for relative compensation method has its range of application, it is not the best proxy of managerial overconfidence. How we can build a more proper index to measure managerial overconfidence still needs further investigation.

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## **A Study on Strategic Change of Business Group Based on AHP: SWOT**

### **Method**

Kang Liwen<sup>1</sup>, Xu Xusong<sup>2</sup>

1School of Management, Wuhan University of Technology, Wuhan, P.R. China, 430070

2 Economics and Management School, Wuhan University, Wuhan, P.R. China, 430072

(E-mail: 1259050315@qq.com, xuxusong@whu.edu.cn)

**Abstract:** In the 21st century, the strategic environment enterprises facing have been undergoing tremendous changes. This study explores the direction of the Group's new strategy for strategic change in response to an increasingly changing environment. This study used the method of the AHP-SWOT and case study. According to the analysis of the strategic environment of the case Guangxi Geology and Mineral Huadi Industry and Trade Group (HD), the final determination of the strategic vector is located in the first quadrant of the strategic quadrilateral, indicating that HD should give priority to the growth-oriented SO strategy in the future, give full play to its advantages and grasp the opportunities in the environment.

**Key words:** Business Group; Strategic change; AHP; SWOT analysis

## **1 Introduction**

Nowadays, the technology and economic environment is changing. China gets great success in various aspects. Advanced technology has brought huge impacts on traditional enterprises, and it has also brought new development opportunities for traditional enterprises. However, as a comprehensive industrial holding company, the Business Group often needs to have a keen market insight in the face of rapid changes in the environment. And, the Business Group needs timely to adjust the strategy of the Business Group, and to better adapt to the environment and achieves rapid development. Since 2011, Chinese provinces have been beginning to implement the transformation of public institutions into corporate policies. This study aims to discuss the strategic change of the Business Group after

implementing the “transformation reform” policy, and guides strategic choice decision-making in the strategic change of the Business Group, which has certain practical significance. At the same time, this study uses the method of AHP-SWOT to provide a strategic choice analysis model in the strategic change of the Business Group. Therefore, this study has definite theoretical significance.

## 2 Literature Review

Corporate strategy is the means through which an organization establishes the fundamental relationship between its internal environment and the external environment (Murray, J A, 1984). An ideal corporate strategy is to not only achieving internal matching of various elements of the enterprise, but also to achieve external matching between the various elements of the enterprise and the business environment. According to the definition of corporate strategy, corporate strategic change includes updating or replacing the content, process and results of enterprise attributes (Agarwal, R and Helfat, C E, 2009). Specifically, strategic change involves two aspects of change. On the one hand, the external environment changes of the enterprise, such as: re-selecting the competitive strategy (Boeker, W, 1989), increasing or decreasing the number of existing businesses (Goodstein, J, Gautam, K and Boeker, W, 1994). On the other hand, to adapt to the new strategic objectives, the enterprise adjusts the internal organizational elements, such as: innovations in the organizational structure and management system of the enterprise (Johnson, G, 1992). In short, in order to cope with the ever-changing internal and external environment of the organization, and to seek sustainable development and combine its own resources and capabilities, the process of strategic adjustment of corporate goals and behaviors are strategic change (Agarwal, R and Helfat, C E, 2009). There are many driving factors for corporate strategic change, which can be roughly divided into two categories. One type is internal factors, such as: the resources and capabilities of the company (Li Xiaoyu, Xue Youzhi, Niu Jianbo, 2015), the length of tenure of the senior management team (Wiersema, M F and Bantel, K A, 1992) and so on. And the other is the external environment, such as the government's reform policy (Smith, K G and Grimm, C M, 1987) and technology innovation (Viki, S, 2003).

The Business Group is a large company with many productions and operating organizations, with parent-subsidiary companies as the main body. From the perspective of case analysis, the strategic change process of the Business Group is related to the lifecycle of the company. Different strategies are adopted in different stages of development of the

Business Group(Liu Shaomin, Wang Yingjun,2016). Group companies that lack competitiveness are capable to achieve sustainable growth through progressive learning and entrepreneurial strategies (Shi Shengmin and Xu Yanmei,2017).

Existing scholars have conducted a wealth of studies on strategic change. But many of them only have adopted the case analysis method from the perspective of qualitative analysis, while few studies have studied the strategic change of enterprises from both qualitative and quantitative perspectives. Moreover, most scholars regard the leader of a certain industry as the research object of strategic change. Few scholars put the comprehensive Business Group as the research object of strategic change. Therefore, this study takes the comprehensive Business Group as the research object, and sets qualitative SWOT analysis and quantitative analytic hierarchy process in HD as an example to study the strategic choice in the strategic change of the Business Group.

### 3 Method

SWOT analysis is one of the most commonly used strategic analysis methods. It analyzes the strengths (S), weaknesses (W), opportunities (O) and threats (T) in the internal and external environment. AHP is a quantitative comparative analysis method, which is suitable for multi-criteria, multi-objective and complex decision-making problem analysis. So do the strategic choice of strategic change of the Business Group. Combining qualitative SWOT analysis with quantitative AHP method can not only make up for the deficiency in using one method of, but also combine the advantages of both, and be more scientific. So it provides the basis of the strategic of the Business Group. The specific steps are shown as Table 1.

**Table 1 SWOT-AHP Strategic Analysis Process**

Steps	Operating items
1.DeterminetheSWOTanalysismatrix	Through live interviews, field research and literature search, the relevant materials are widely obtained, and the data are interpreted and analyzed in detail to determine the SWOT matrix.
2.Calculate the strength and total strength of each influencing factor	<p>Influential factors strength = Estimated strength of each influencing factor × Relative importance of each influencing factor</p> <p>(1) The estimated strength of each influencing factor was obtained by using the five-level Likert scale and scoring by experts.</p> <p>(2) AHP analysis model was established, and experts were asked to compare and score the influencing factors in pairs. Establishing an AHP analysis model, letting the experts compare the influencing factors.</p> <p>(3) The total strength of each influencing factor can be obtained by</p>

3. Calculate strategic factor strength	<p>summing the influence factors of each subordinate element.</p> <p>(1) Construct strategic coordinate system, where SW is the horizontal coordinate axis and OT is the vertical coordinate axis. And according to the total strength of each influencing factor, the positions of the four points S, W, O and T in the strategic quadrangle are determined, so as to determine the strategic quadrangle.</p> <p>(2) Calculate the center of gravity of the strategic quadrilateral, and calculate the formula as: <math>(x,y) = \left(\frac{x_s+x_w}{4}, \frac{x_o+x_t}{4}\right)</math>. Connect the center of gravity (x, y) and the origin (0, 0) into a line whose angle with the S axis is the strategic azimuth <math>\theta</math>, <math>\theta = \tan^{-1} \frac{y}{x}</math>.</p> <p>(3) Calculate strategic factor strength <math>\rho</math>, <math>\rho = \frac{U}{U+V}</math>, where U represents the strategic positive strength, <math>U = S_1 \times O_1</math>, and V is the strategic negative strength, <math>V = W_1 \times T_1</math>.</p>
4. Determine the final strategy	<p>In the strategic coordinate axis, the polar coordinate system is used to determine the point where the radius is <math>\rho</math> and the angle is <math>\theta</math>. The strategic type of the location of the point is the strategy that the enterprise ultimately prefers.</p>

## 4 Case Study

### 4.1 Strategic change analysis of HD

The case chosen for this study is a multi-industry Business Group, which was used as a case study object with certain typical significance. HD is a typical Business Group, which involves more than 10 subsidiaries in many industries including commercial, industrial, real estate and financial industries. The strategic change process of HD can be divided into four stages, as shown in Figure 1.

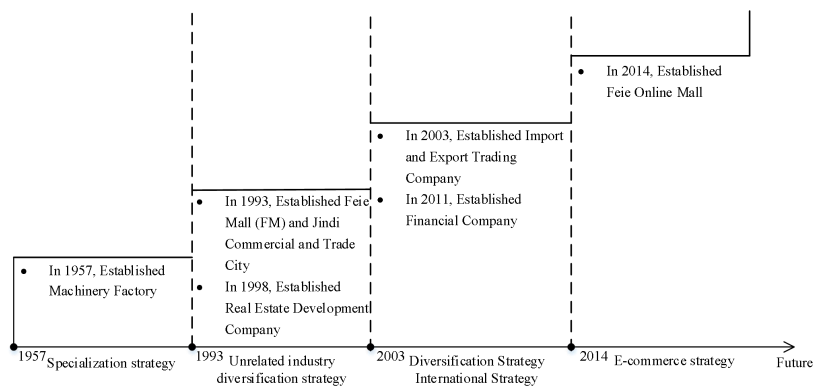


Figure 1 Strategic Change Process of HD



The first stage is the stage of specialization strategy. At this stage, HD actively responded to the call of the country for rapid development of industry, thus establishing the Prospecting Machinery Plant, which mainly produces test equipment, crushing and screening equipment. The second stage is the stage of irrelevant diversification strategy. HD made the decision of “returning two into three, the secondary industry and the tertiary industry together” and successively entered the commercial sector and the real estate industry. In 1993, the original factory was built into the Feie Mall Footwear Wholesale Center. In 1998, Real Estate Development Company was established, and the diversification strategy was initially realized. The third stage is the stage of internationalization strategy and diversification strategy. In 2003, in order to open up the international market and realize the internationalization strategy, Import and Export Trading Company was established. Moreover, at this stage, HD also continued to deepen the diversification strategy. And then in 2011, Financial Company was established. In the fourth phase, the E-Commerce phase was implemented. HD established Feie Online Mall in 2014.

## 4.2 SWOT analysis of HD

This study takes HD as a case. The following is the SWOT analysis matrix of the internal and external environment in which the Business Group is located, as shown in Table 1.

**Table 2 SWOT Analysis Matrix**

Target layer	Criteria layer	Sub-criteria layer
Strategic Change of HD	S	S1Brand strength S2 Location transportation strength
	W	W1Staff solidification, lack of high-level, innovative talent W2No outstanding expertise, lack of core competitiveness W3Multi-business at the same time, lack of main business lines W4Many systems, no uniformity, lack of operability
	O	O1Internet popularity, market expansion opportunities O2National policy orientation O3“The Belt and Road” initiative, trade scale opportunities
	T	T1More stronger competitors, and obvious competition for homogenization T2Customer demand is high-end

### 4.3 AHP-SWOT analysis of HD

Based on the SWOT analysis of the strategic change of HD, a total of 11 factors affecting the strategic change of HD were summarized. In this study, a Likert scale was designed to measure the estimated strength of each factor, in which the score of S and O was represented by positive numbers, and negative numbers show W and T. The larger the absolute value of the score, the greater the estimated strength. Inviting 11 employees of HD with rich strategic management knowledge and experience to form a team of experts to score the industry situation of HD. Finally, the weighted average of the scores of each factor given by each expert is calculated to determine the estimated strength of each influencing factor. Next, proceed from the results of the SWOT analysis. First of all, 11 experts with rich experience in strategic theory and strategic management. Using AHP's 1-9 evaluation scale, the relative importance scores of the same level factors affecting the strategic change of the Business Group and the sub-factors under the same factor are compared. Then, the judgment matrix is constructed and the consistency check is performed on the judgment matrix. When  $C.R < 0.1$ , it indicates that the consistency test passed. Under the condition of consistency test is passed, the feature vector can be used as the weight index of each level. The eigenvectors of the SWOT matrix are normalized and multiplied by the A matrix vector to obtain the total hierarchical ranking result, as shown in Table 3.

**Table 3 Strength of Each Influencing Factor**

Elements	Group weight	C.R	sub-factor	Estimated strength	Group weight	Overall weight	Strategic factor strength
A		0.0908					
S	0.4428	0.0000	S1	3.0909	0.75	0.3321	1.0265
			S2	3.6364	0.25	0.1107	0.4025
W	0.1864	0.0807	W1	-3.2727	0.3758	0.0701	-0.2294
			W2	-3.0909	0.3273	0.0610	-0.1885
			W3	-3.2727	0.1737	0.0324	-0.1060
			W4	-2.7273	0.1232	0.0230	-0.0627
O	0.2455	0.0517	O1	2.6364	0.4905	0.1204	0.3174
			O2	2.0000	0.3119	0.0766	0.1532
			O3	2.1818	0.1976	0.0485	0.1058

	0.1253	0.0000	T1	-3.5455	0.8	0.1002	-0.3552
T			T2	-3.5455	0.2	0.0251	-0.0890

According to the criterion C.R is less than 0.1, it can be seen from the table that all judgment matrices have passed the consistency test. Moreover, from the strategic factor strength of the sub-factors under various influencing factors, it can be seen that S1 is the biggest strength among the factors affecting the strategic change of HD ( $S1=1.0265$ ); the greatest weaken is W1( $W1=-0.2294$ ); O1 is the largest opportunity ( $O1=0.3174$ ); the maximum threat is T1 ( $T1=-0.0890$ ). The total strength of the influencing factors is the sum of the strengths of the sub-factors of each influencing factor. Therefore, according to Table 3, the total strength of each influencing factor can be calculated.  $S = S1 + S2 = 1.4290$ ,  $W = W1 + W2 + W3 + W4 = -0.5867$ ,  $O = O1 + O2 + O3 = 0.5764$ ,  $T = T1 + T2 = -0.4442$ . A strategic coordinate system is established here. The positive axis of abscissa of the strategic coordinate system represents S, and the negative is W. O and T are represented by the positive and negative half axes of the ordinate, respectively. Then, the total strength of each influencing factor is marked on the strategic coordinate system to form a strategic quadrilateral, as shown in figure 2.

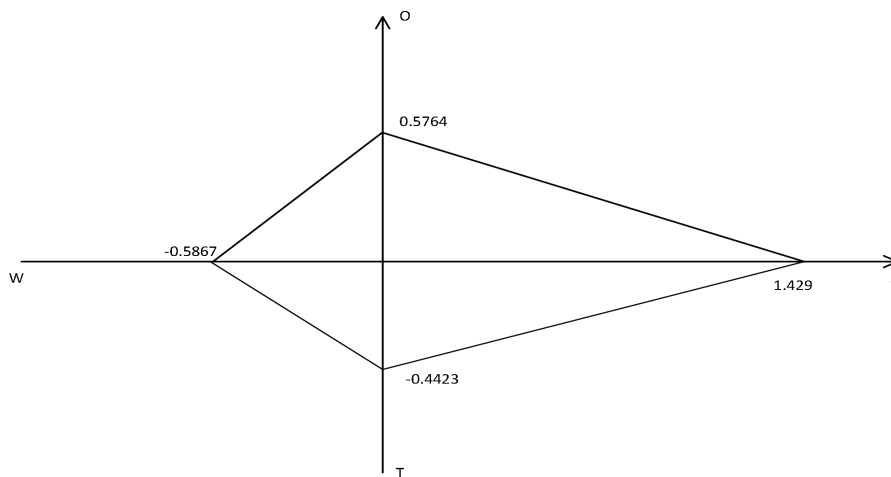


Figure 2 Corporate Strategy Quadrilateral

Calculate the formula according to the center of gravity:  $(x,y) = \left(\frac{x_S+x_W}{4}, \frac{x_O+x_T}{4}\right)$ , the center of gravity of the strategic quadrilateral is:  $(x,y) = (0.2106,0.0335)$ , thus the strategic

azimuth is  $\theta = \tan^{-1} \frac{y}{x} = \frac{1}{20} \pi \approx 9^\circ$ . At the same time, the strategic factor strength  $U = S \times O = 0.8237$ ,  $V = W \times T = 0.2606$ , so the strategic factor strength coefficient is  $\rho = U / (U + V) = 0.7597$ . Finally, the comprehensive strategic azimuth and strategic factor strength coefficient are obtained, and the strategic vector of HD is  $(\frac{1}{20} \pi, 0.7597)$ . This result is known that HD's enterprise strategic positioning is within the first quadrant of the strategic coordinate system. And because the strategic azimuth angle  $\theta \approx 9^\circ < 45^\circ$ , HD should show priority to strength-based growth strategy. This strategy requires the full use of the company's internal superior resources to seize opportunities in the external environment.

#### 4.4 Policy suggestion

Expand the dominant effect. First, focus on building brand influence. Among the internal strengths of HD, the strength of brand advantage is the largest, so it is possible to accelerate the expansion of the business market by expanding the brand effect. For example, the commercial brand "Feie" has strong brand influence throughout the Liuzhou area. From this strength, the brand influence is expanded through online advertising, online public relations, and news public relations. Second, digging into the location strength of radiation effects. HD is located in the transportation hub of Liuzhou City. This location is very convenient for transportation within and outside the city. Based on this advantageous condition, it caters to the changes in market demand and aims to differentiate new competition and open up new markets.

Grasp the three opportunities. Firstly, rely on Internet opportunities to expand the market. HD can make use of the sales force of the Feie Online Mall platform, construct good distribution channels, and then achieve the simultaneous development of advertising and channels. Ultimately, the business market will achieve substantial expansion. Second, seize the opportunity of national policy and make rapid changes. HD should actively call for the national policy, establish a unified modern company system for all departments, and make the cadre reserve plans. Finally, with the help of the "The Belt and Road", HD will go international. The quality of the machinery produced by HD enjoys great reputation in the industry, and this opportunity can be used to accelerate the market influence of the industry of HD in the international market.

## 5 Conclusion

In this study, the AHP-SWOT analysis method and the case study method were used. First a matrix is built based on SWOT analysis. After that building a judgment matrix based on AHP analytic hierarchy processes. Then calculate the strength of the strategic influence factors and construct strategic quadrilaterals and strategic vectors. In the end, it will be a strategy that should be preferred for HD. This study aims to study the strategic choices of group companies. This research breaks through the traditional single-deterministic strategy selection method. And through the case analysis, it proves that the combination of AHP and SWOT is a scientific strategic choice method. The above strategic choices for HD are for the entire Business Group, only analyze the overall strategy of the Business Group, but lacking specific guidance strategies for particular subsidiaries. In the future, by continuously improving the AHP-SWOT method, this method will be applied to guide the competition strategy of the subsidiaries of the Business Group.

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# **A Novel Urban Traffic Tunnel Flooding Control Solution: Liquid Air Spray/Vaporization Based Icing and Natural De-Icing**

Tang Li<sup>1</sup>, Zhang Cunquan<sup>2</sup>

1 Intelligent Transportation Systems Research Center, Wuhan University of Technology,

Wuhan, P. R. China, 430063

2 School of Energy and Power Engineering, Wuhan University of Technology,

Wuhan, P. R. China, 430063

(E-mail: 296287507@qq.com, zhangcqbox\_whut@126.com)

**Abstract:** With the increasing demand for urban flood control due to rapid urbanization and the traffic safety and environmental concerns, as well as convenience and services of air products, there is a shift towards liquid air as an emergent cooling source. However, its cryogenic operation and vigorous vaporization expansion restricts its widespread applications. This paper explores the conceptual application of liquid air spray/vaporization based icing and natural de-icing for urban traffic flooding control, whose conceptual developments including description of liquid air, road icing, conceptual liquid air based flash freezing of water for urban traffic flooding control and modeling and solution of natural road de-icing are described and analyzed in detail. The primary key techniques of our innovative scheme of application of liquid air spray/vaporization for urban traffic flooding control are presented specifically. Its economic estimation is performed by taking Wuhan downtown traffic flood control as an example so as to indicate our innovative scheme of application of liquid air spray/vaporization for urban traffic flooding control shall be practicable, pollution-free and cost-effective. Thus, our innovative scheme will be promising for flood control in modern cities.

**Key words:** Liquid air; Conceptual application; Liquid air spray/vaporization; Icing and natural de-icing; Urban traffic flooding control

## **1 Introduction**

Urban flooding occurs when rainfall runoff exceeds what the landscape can absorb or the drainage system can move (Louise Bertilsson et al., 2019). Since its reform and opening up dated back to 1978, China has become an increasingly urban society so that the whole country's economic growth, social advancement and life improvement shall be profoundly affected (Wei Zheng et al., 2019). Parallel to this process, however, the changes in land use associated with urban development affect flooding in many ways (Louise Bertilsson et al., 2019). As communities convert more land into roads, buildings, and other impervious surfaces, drainage systems - themselves often aging, undersized, and difficult to maintain - reach capacity faster, leaving flood waters to devastate homes and businesses. It was recognized that many cities such as Beijing, Shanghai, Wuhan, Guangzhou and Shenzhen in China are challenged by fragile infrastructure and vulnerability to flooding. Removing vegetation and soil, grading the land surface, and constructing drainage networks increase runoff to streams from rainfall and snowmelt. Common consequences of urban development are increased peak discharge and frequency of floods (ZW Kundzewicz et al., 2019; Na Zhang et al., 2019). Also, urban flooding has become more and

more severe and pervasive in China in recent years and it has historically been thought of as something that occurs in only a handful of major cities (Conrad Wasko et al., 2019; EuiHoon Lee et al., 2018).

Flooding has many impacts. It damages property and endangers the lives of humans and other species. Rapid water runoff causes soil erosion and concomitant sediment deposition elsewhere (such as further downstream or down a coast). The spawning grounds for fish and other wildlife habitats can become polluted or completely destroyed. Some prolonged high floods can delay traffic in areas which lack elevated roadways. Floods can interfere with drainage and economic use of lands, such as interfering with farming. Structural damage can occur in bridge abutments, bank lines, sewer lines, and other structures within floodways. Waterway navigation and hydroelectric power are often impaired. Financial losses due to floods are typically millions of dollars each year (C. Arrighi et al., 2019; Maochuan Hu et al., 2019).

Some of the common techniques used for flood control are installation of rock berms, rock rip-raps, sandbags, maintaining normal slopes with vegetation or application of soil cements on steeper slopes and construction or expansion of drainage channels. Other methods include levees, dikes, dams, retention or detention basins. Some methods of flood control have been practiced since ancient times. These methods include planting vegetation to retain extra water, terracing hillsides to slow flow downhill, and the construction of floodways (man-made channels to divert floodwater). Other techniques include the construction of levees, dikes, dams, reservoirs or retention ponds to hold extra water during times of flooding (Kelly Gunnell et al., 2019).

To the best of our knowledge, there is no any paper in the literatures specifically devoted to a study regarding application of liquid air for urban traffic flooding control. Although much attention has been given to new, fast and no pollution urban traffic flooding control innovation and practice, almost no information is available in the literature regarding the liquid air application for urban traffic flooding control. Therefore, application of liquid air spray/vaporization based icing and natural de-icing for urban traffic flooding control may be considered as a revolutionary contribution for urban traffic flooding control which takes something unusual advantages.

Except for the introduction and conclusions, the main body of this study is structured as follows:

Section 2: Conceptual developments;

Section 3: Innovation of application of liquid air spray/vaporization for urban traffic flooding control; and

Section 4: Economic estimation of our urban traffic flooding control scheme based on liquid air spray/vaporization by taking Wuhan downtown traffic flood control as an example

## **2 Conceptual Developments**

### **2.1 Description of liquid air**

Air consists of approximately 78% nitrogen and 21% oxygen, and thus has similar thermodynamics properties as nitrogen gas. Liquefying air reduces the volume of air by about 700 times. Liquid air is air that has been cooled to very low or cryogenic temperatures so that it shall be condensed into a pale blue mobile liquid, which is often used for condensing other substances into liquid and/or solidifying them, and as an industrial source of nitrogen, oxygen, argon, and other inert gases through a process called air



separation which is industrially to separate atmospheric air into its primary components, typically nitrogen and oxygen, and sometimes also argon and other rare inert gases based on fractional distillation as the most common method.

Liquid air has a density of approximately  $870\text{kg/m}^3$ , though the density may vary depending on the elemental composition of the air. Since dry gaseous air contains approximately 78% nitrogen, 21% oxygen, and 1% argon, the density of liquid air at standard composition is calculated by the percentage of the components and their respective liquid densities. The boiling point of liquid air is  $-194.35^\circ\text{C}$ , intermediate between the boiling points of liquid nitrogen and liquid oxygen. However, it can be difficult to keep at a stable temperature as the liquid boils since the nitrogen will boil off first, leaving the mixture oxygen-rich and changing the boiling point. Since liquid air vaporizes at  $-196^\circ\text{C}$ , the heat required to re-gasify liquid air can be wholly attainable from the environment or using low grade waste heat from the industry. Liquid air supplies can be located near demands (especially emergencies) in combination of the current market needs. Those separated air products are sometimes supplied by pipeline to large industrial users near the production plant. Long distance transportation of products is by shipping liquid products for large quantities, as Dewar flasks or gas cylinders for small quantities, or tanks for mid-short distance transport and distribution.

## **2.2 Road icing**

Accident, injury and fatality rates are much higher during freezing rain than any other type of road ice condition (including snow and sleet) due to its invisibility and element of surprise. Freezing rain/drizzle happens when raindrops in a warm air layer aloft (in the middle levels of the atmosphere) falls through a layer of subfreezing air at the surface. When the raindrops hit the ground, they freeze on contact - creating a smooth, solid glaze of ice that covers everything on the ground. This type of ice layer is the most slick of all precipitation types - creating nearly zero friction conditions with vehicle tires. Correcting a skid on black ice can be nearly impossible, as the vehicle tires will have close to zero traction. Loss of control on 'black ice' can occur even at slow speeds. 'Black ice' is so named because it appears dark, just like wet pavement. It is important to remember that 'black ice' will only appear 'black' on darker pavement surfaces such as asphalt. 'Black ice' on concrete pavement can appear gray or tan, for instance (the same color as the pavement surface) (Huaxin Chen et al., 2018).

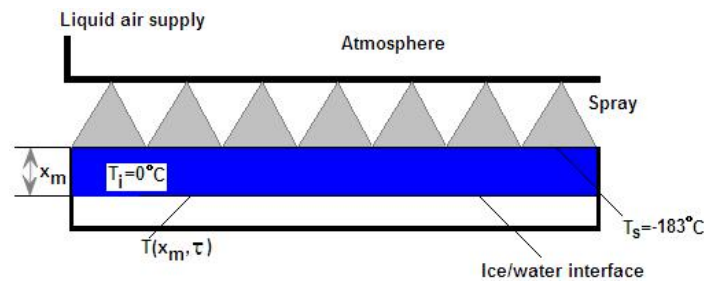
## **2.3 Conceptual liquid air based flash freezing of water for urban traffic flooding control**

Freezing is a phase transition where a liquid turns into a solid when its temperature is lowered below its freezing point. Flash freezing refers to the process whereby objects are frozen in just a few hours by subjecting them to cryogenic temperatures, or through direct contact with liquid nitrogen at  $-196^\circ\text{C}$ . When water is supercooled to temperatures below  $-48^\circ\text{C}$ , it must freeze. In physics and chemistry, flash freezing is a naturally occurring phenomenon used commonly in the food industry and by meteorologists for the purpose of forecasting. The process is also of great importance in atmospheric science, as its study is necessary for a proper climate model for the formation of ice clouds in the upper troposphere, which effectively scatter incoming solar radiation and prevent Earth from becoming overheated by the sun. Flash freezing is closely related to classical nucleation theory, which helps us understand many materials, phenomena and theories in related situations. The science of freezing water depends on multiple factors, including how water droplets freeze, how much water is in the atmosphere, if water is in a liquid or crystal state, at what temperature it freezes, and whether it crystallizes from within or from the surface. The freezing of nanoscale water or silicon liquid drops is initiated at a number of different distances from the center of the droplet, providing new insights on a long-standing

dispute in the field of material and chemical physics. When water is in a conventional freezer, a dynamic phase transition is triggered. The resulting ice depends on how quickly the system is cooled: If the water is cooled below its freezing point slowly, an ice crystal will result, rather than the polycrystalline solid that flash freezing results in (P. J. Fellows et al., 2016).

Liquid air is not only an effective and convenient refrigerant due to its availability, low cost and human and environment friendliness but also a practical cryogen for most low-temperature applications because of its extremely low flashing temperature (78.9K) and high refrigeration capacity at atmospheric pressure. Even at elevated pressures, its favorable thermal properties make it an effective refrigeration medium to rapidly cool processes to low temperatures. Several cooling techniques take advantage of refrigeration capacities of liquid air in batch or continuous processes, among which direct liquid air injection/spray cooling can be a good choice for urban traffic flooding control. Liquid air is injected or sprayed directly onto road flood areas so that accumulated water shall be cooled and solidified by the latent heat of vaporization of liquid air; depending on the design of the cooling system, the sensible heat capacity of the cold vaporized air may also contribute to the cooling. This is an efficient use of refrigeration value of liquid air.

As shown in Figure 1, water freezes and ice expands instantaneously while liquid air is sprayed onto a catchment region. Icing occurs initially at  $0^{\circ}\text{C}$  and then it is characterized by a single indefinable surface since ice expands to infinity in all but one direction. As such a sudden temperature drop is imposed at the surface, transient, one-dimensional conduction will occur within upper ice. Based on classical theory of heat transfer, the semi-infinite solid provides a useful idealization for many actual issues. At this point, it may be used to determine transient heat transfer effects near the surface of icing or to approximate the transient response of a finite ice block. For the latter, the approximation would be reasonable for the early portion of the transient, during which temperatures in the ice interior (well removed from the surface) are uninfluenced by the change in surface conditions.



**Figure 1 Schematic Diagram of Semi-infinite Icing for Spray Liquid Air onto Water**

In general, an ice block whose thickness is at least 20cm can safely support small cars or pickups. While sensible heat changes of liquid air, ice and water compared to their powerful latent heat ones, air flash freezing and icing processes would dominate the transmission of energy. Figure 2 reflects that the ice formation thickness would be up to 20cm after spraying liquid air for about 18 minutes. At this point, small cars or pickups can go through the ice coverage block. Such period would have been short enough while all conditions for spraying liquid air shall be ready in advance. Actually, the mean temperature of the ice coverage would be below  $0^{\circ}\text{C}$ ; and the liquid air based icing thickness would be more than 30cm to ensure safe passage of small cars or pickups while natural meltdown of the ice coverage shall be very slow.

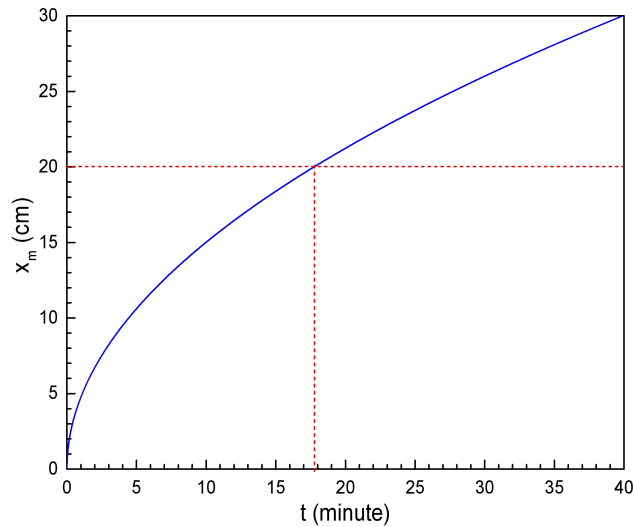
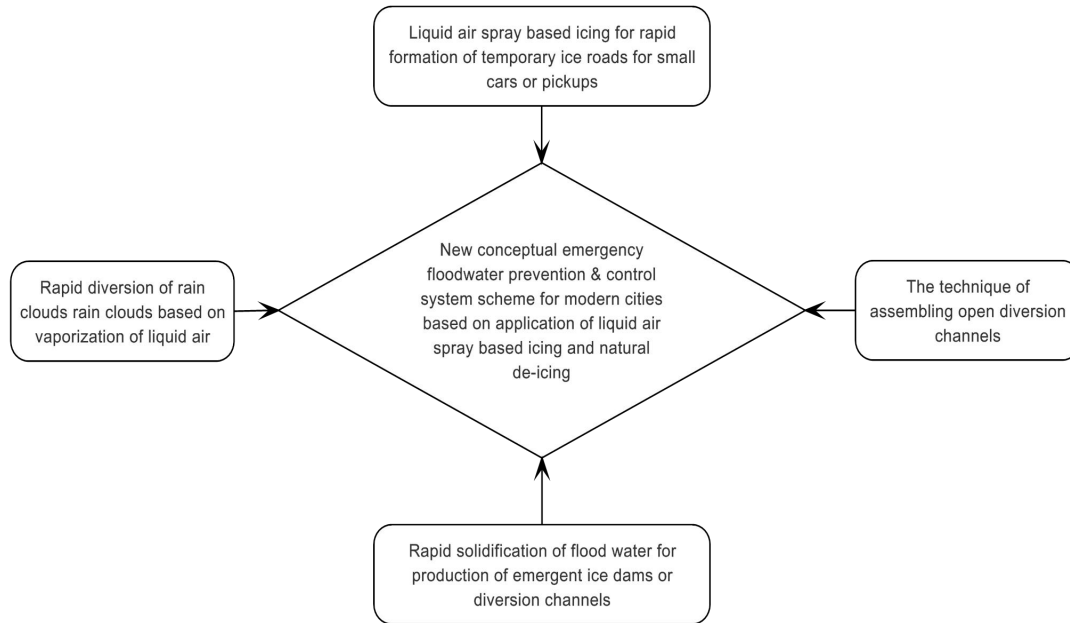


Figure 2 Icing Thickness (xm) vs. Time (t)

## 2.5 Natural road de-icing

De-icing of roads has traditionally been done with salt, spread by snowplows or dump trucks designed to spread it, often mixed with sand and gravel, on slick roads. Sodium chloride (rock salt) is normally used, as it is inexpensive and readily available in large quantities. However, since salt water still freezes at  $-18^{\circ}\text{C}$ , it is of no help when the temperature falls below this point. It also has a strong tendency to cause corrosion, rusting the steel used in most vehicles and the rebar in concrete bridges. Depending on the concentration, it can be toxic to some plants and animals, and some urban areas have moved away from it as a result. More recent snowmelters use other salts, such as calcium chloride and magnesium chloride, which not only depress the freezing point of water to a much lower temperature, but also produce an exothermic reaction. They are somewhat safer for sidewalks, but excess should still be removed.

## 3 Innovation of Application of Liquid Air Spray/Vaporization for Urban Traffic Flooding Control



**Figure 3 New Conceptual Emergency Floodwater Prevention & Control System Scheme for Modern Cities Based on Application of Liquid Air Spraybased Icing and Natural De-icing**

Here, some innovative applications of liquid air spray for urban traffic flooding control are presented. Thus, a new conceptual emergency floodwater prevention & control system scheme for modern cities based on application of liquid air spraybased icing and natural de-icing is presented in this study, which include the above four techniques and schematically shown in Figure 3.

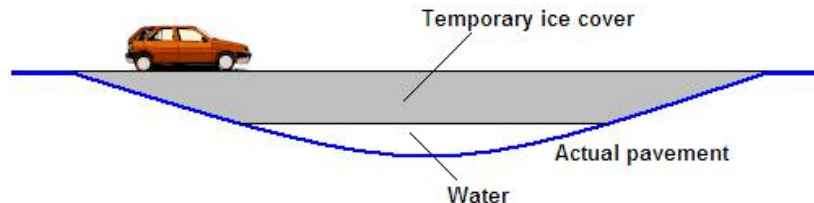
### **3.1 Liquid air spraybased icing for rapid formation of temporary ice roads for small cars or pickups**

As for any urban traffic flood point, an ice road may be rapidly formed by means of liquid air spraybased icing (especially filling liquid air into flood) to provide a flat, smooth driving surface devoid of trees, rocks, and other obstacles and allow temporary passage of small cars or pickups. Ice roads offer the best means for moving heavy equipment and workers through roadless areas while protecting the fragile ground beneath.

While any liquid air spraybased ice cover is over deep water, it is this buoyancy that helps support the weight of loads placed on the ice. As the ice cover itself bends under this load, it displaces a volume of water equal to the weight of the load based on Archimedes Principle. The size of the ice sheet and the volume of water theoretically have to be large enough to support the load on the ice sheet. However, while most bodies of water are not large enough in relation to the load that checking for buoyancy needs to be undertaken in practice. The critical issue is whether the ice cover is strong enough to resist temporary bending caused by the load.

Although an ice cover may appear to be rigid it will bend under loading. The amount of bending will depend on the flexibility of the ice and magnitude of the load. The ice flexibility (elasticity) depends on its temperature. Heavier loads will cause more bending and

displacement. For acceptable loads, the ice covers will rebound and return to the original position when the load is removed or moves away. The ice cover deforms and distributes the load over a larger area in these cases. The depression underneath the load is often described as the deflection bowl. Ice covers can fail for a variety of reasons. Some of more common reasons for failure are loading of ice that has poor ice quality, overloading of good quality ice, overstressing ice by operating at unsafe speeds and unintended stationary load on ice.



**Figure 4 A Conceptual Ice Road View**

In contrast, most liquid air spraybased ice covers is over shallow water so that there are a variety of hazards related to operating on ice covers. The primary ice cover hazards include: 1) Operating on an ice cover that has been damaged or where the integrity of the ice cover has been compromised, this damage could be localized or widespread, 2) Overloading an ice cover beyond its capacity to support a load, and 3) Operating on undetected areas of thin ice. These hazards can be controlled through a variety of engineering and administrative controls that will provide operators overall confidence in: 1) The integrity of the ice cover, 2) The knowledge of the load that is to be placed on the ice cover, and 3) The minimum ice thickness present.

With confidence in these three elements, operations on ice can be carried out very safely. In zones where a number of intersecting dry cracks over 10cm wide are observed, the area should be repaired by allowing them time to freeze fully by means of spraying or filling liquid air. Alternatively, a reduction in the maximum load limit should be considered. The decision to reduce the load limit will be based on the frequency, width, depth, and intersection of the cracks. Once a crack completely refreezes by means of spraying or filling liquid air, the ice can be considered as strong as the original.

Some ice roads which crack over very shallow water may be utilized to ensure the continuous stream of cars though driving on cracked ice would seem that over bumpy roads. Such driving may last longer since natural de-icing is a slow process. Moreover, liquid air spraybased icing may be repeated in case of performance of more ice melting.

Knowing how to drive in icy conditions is an extremely important skill. Ice-slicked roads create treacherous driving conditions that can lead to serious accidents. When driving icy conditions, a vehicle will not act according to the laws of physics. For example, a car will keep going straight on a curve, no matter how frantically the driver turns the wheel. The inertia keeps it going in that direction. Freezing tires help and there is a reason that the local transportation authorities present some cautions for drivers, however these often aren't enough when it comes to ice. Here are some practical driving tips such as no hitting the brakes, driving slowly, changing directions gradually, avoiding fishtailing, no following to close and taking emergency measures in worst case scenarios to help avoid getting into an accident in icy conditions.

### **3.2 Rapid solidification of flood water for production of emergent ice dams or diversion channels**

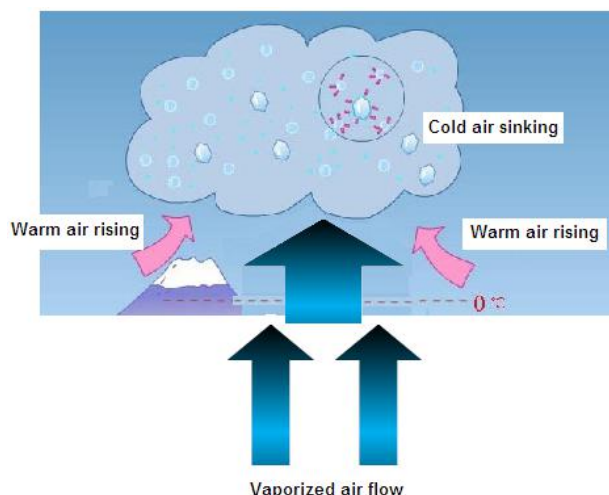
Normally, ice jams occur on rivers when floating ice accumulates at a natural or man-made feature that impedes its progress downstream. Ice jams can significantly reduce the flow of a river and cause upstream flooding - sometimes called ice dams. Ice jam flooding can also occur downstream when the jam releases in an outburst flood. In either case, flooding can cause damage to structures on shore. However, a diversion dam is here to divert all or a portion of the flow of a river from its natural course. Diversion dams do not generally impound water in a reservoir; instead, the water is diverted into an artificial water course or canal. There is something special about being able to extract floodwater from a traffic stagnant water point. Keeping floodwater out of urban traffic accumulated storm water locations is essential to preserve the smooth traffic from the destruction caused by flooding. While there is no surefire way to guard against flooding, flood diversion can improve traffic chances of surviving intact.

Liquid air spraybased freezing flood control and protection systems are designed to instantly control, protect and prevent flooding issues. Essentially, such a single flood control and protection system is equivalent to many sandbags. They are eco-friendly, reusable, modular and can protect up to the requested height. Ice dams or diversion channels may be rapidly produced based on rapid solidification of flood water due to the tremendous heat transfer temperature difference by means of vaporization of liquid air flowing through roadside pipe fences onto which floodwater is pumped. They may be utilized to pump accumulated floodwater out and ensure the smooth traffic. Moreover, such ice may be transferred to those application fields such as freezers, ice storage air conditioning systems and crematoriums for cold energy utilization.

### **3.3 Rapid diversion of rain clouds rain clouds based on vaporization of liquid air**

On a hot summer day the surface of the Earth is heated by the sun. The Earth's surface heats the air just above the surface through the process of conduction. The action of warm air rising and cold air sinking (convection) plays a key role in the formation of severe thunderstorms. If the warm surface air is forced to rise, it will continue to rise, because it is less dense than the surrounding air. In addition, it will transfer heat from the land surface to upper levels of the atmosphere through the process of convection. Two of the most important ingredients for thunderstorm formation are instability (unstable air) and moisture. There are three main types of thunderstorms; orographic, air mass, and frontal, which are described as follows:

- 1) Orographic thunderstorms are caused by air that is forced up by a mountain or hillside;
- 2) Air mass thunderstorms are the result of localized convection in an unstable air mass; and
- 3) Frontal thunderstorms occur along the boundaries of weather fronts (e.g. cold front).



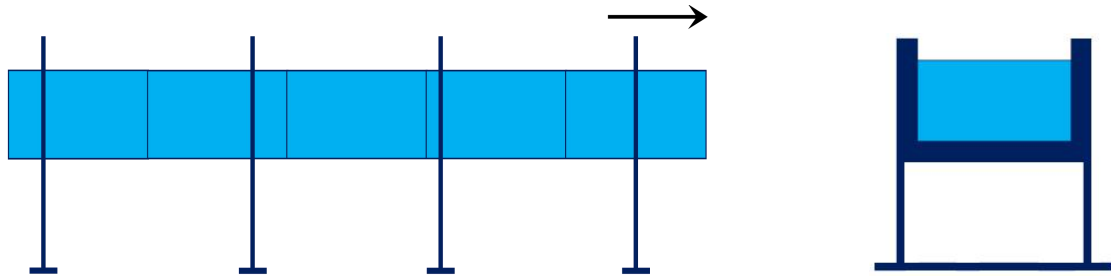
**Figure 5 Rapidly Dispelling Rain Clouds Based on Vaporization of Liquid Air**

Most commonly, rain clouds that produce a steady rain are referred to as nimbostratus clouds. These clouds appear low in the sky and are a medium to dark gray color. Sometimes stratus clouds are associated with a light drizzle. Stratocumulus clouds almost never produce rain, although they can turn into nimbostratus clouds if conditions allow. Mammatus clouds and green clouds are normally associated with severe weather, including hail or tornados. High types of clouds, above 18,000 feet, are known as cirrus clouds. Clouds above 6,500 feet to 18,000 feet are called alto clouds. Clouds below 6,500 feet are mainly the stratus clouds that may indicate rain.

Thus, timely dispelling rain clouds and prevention of cold air in contact with hot air shall be one effective way. Vaporization of liquid air or compound is an intensive phase transition from the liquid phase to air. The tremendous heat transfer temperature difference results in bulk boiling rather than surface evaporation. The vaporized air flow from the above rapid solidification of flood water for production of emergent ice dams or diversion channels is free of moisture so that its filling into the ambient air shall not only decrease the relative humidity of mixed ambient air but also drive the overall upward motion of air over the storm area; thus, the rain clouds integrating and interchanging hot and cold air streams may be dispersed or move away; moreover, local rainstorms cannot come off. This is called as the technique of rapidly dispelling rain clouds based on vaporization of liquid air schematically shown in Figure 5.

### **3.4 The technique of assembling open diversion channels**

Diversion channels or floodways are man-made channels built to offer a different route for excess water to flow further mitigating the effects of flooding and restoring rivers to their natural water level. Typically, diversion channels are built around communities or economic centers to prevent extensive flood damage. The diversion channels may be formed in a short period by means of rapid icing based on vaporization of liquid air. The modular diversion channels of ice (Figure 6) which may be assembled together or elevated overhead are coupled with a mobile modular pump assembly unit so that accumulated floodwater shall be pumped in a short time to any location which does not affect traffic. Such diversion channels of ice primarily take advantage of rapid modular production, no pollution and subsequent cleanup work, cooling down, convenient and flexible assembly, short construction period and reutilization of ice.

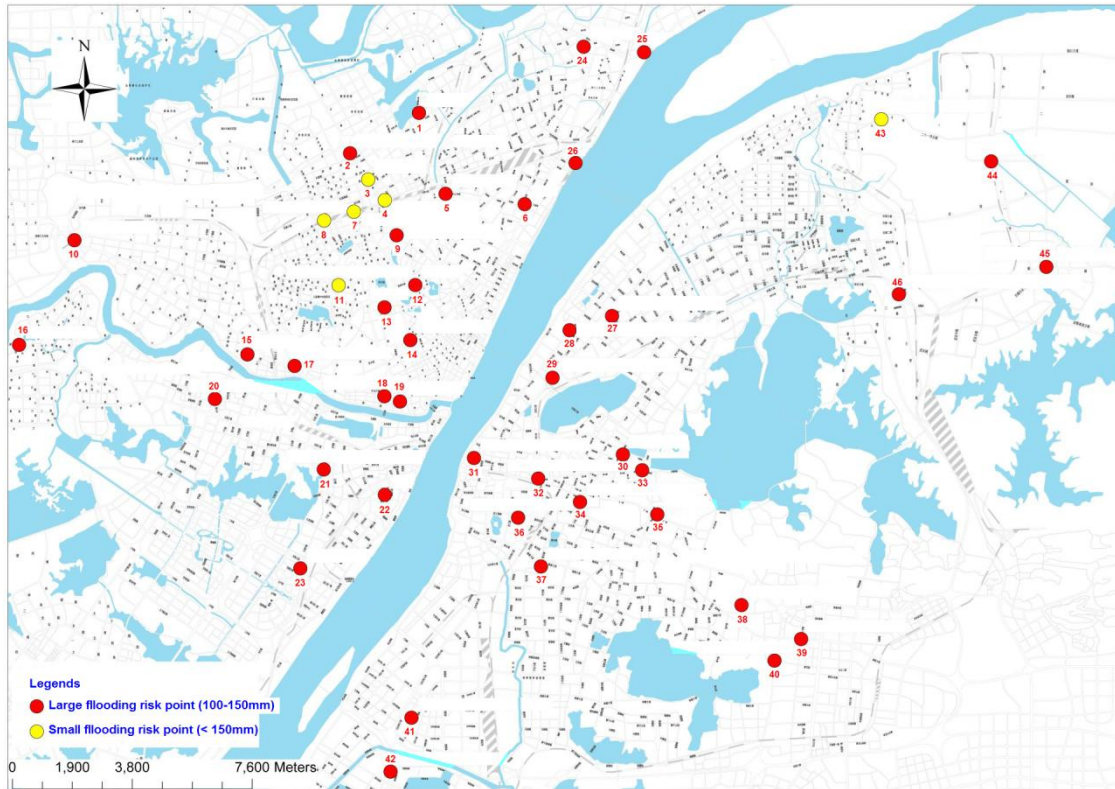


**Figure 6 Assembled Modular Overhead Diversion Channels of Ice**

#### **4 Economic Estimation of Our Urban Traffic Flooding Control Scheme Based on Liquid Air Spray/Vaporization by Taking Wuhan Downtown Traffic Flood Control as An Example**

As for our liquid air application based urban traffic flooding control scheme, Wuhan is taken here as an example for performance of its economic estimation, which is made up of the three towns of Wuchang, Hankou, and Hanyang and is the capital of Hubei Province. The three towns, separated by the Yangtze and Hanshui rivers, are linked by bridges, and because these municipalities are so closely connected by waterways, Wuhan is also called the "city on rivers." Being the largest inland port on the middle reaches of the Yangtze River and a major stop on the Beijing-Guangzhou Railway, Wuhan is one of China's most important hubs of water and rail transportation and communications. It has 46 easily flooded traffic locations (Figure 7) in urban area of Wuhan in accordance with 2019 Easily Flooded Risk Map released by Wuhan Institute of Water Sciences on March 16, 2019. It points out that Wuhan urban drain ability has been improved significantly in recent years so that the number of flooded locations, and flooding durations and areas shall fall remarkably under the same conditions of rainfall. There are many factors for its urban flooding. 40 and 46 locations may be flooded in case of torrential rains below 100-150mm and above 150mm, respectively, most of which are in low-lying urban areas. Except for those unfavorable flood drainage factors such as increasing extreme rainfall events due to climate change and special geographical/topographical conditions, those factors such as project construction related poor operation of its drainage pipeline networks, lagged support facilities, low standard drainage facilities and small drainage capacity primarily affects occurrence of flooding. The targeted emergency plans and measures are currently ready based on correspondingly conscientious analysis of Wuhan Water Authority.





**Figure 7 2019 Easily Flooded Traffic Locations in Urban Area of Wuhan**

Figure 8 presents a traffic flooding picture for a site in Wuhan on June 21, 2019, which indicates that cars were immersed in water deep about 50cm. As for such flooded site, it is assumed that one diversion channel of ice (length: 700m; weight: ~50 tons) is necessary for urgently pumping water away to a field that has nothing to do with traffic and ice sheets (area: 2000m<sup>2</sup>; thickness: 40cm; weight: 720 tons) are provided for emergency pedestrian paths. The total weight of the above two items may be magnified to 800 tons including an ample margin. Production of 800 tons of ice needs about 700 tons (~780m<sup>3</sup>) of liquid air which may release gaseous air of about  $800/0.81 \times 700 \approx 691,000\text{m}^3$  in standard state. Such amount of "boil-off" air may let the overhead rainclouds away from the sky of the flooded site. A buffer tank shall be equipped on the icing site considering such great gasification. Actually, a centralized production plant may be set up near the air separation unit so that the pipeline transportation may be taken for the required liquid air without tank transportation. A relatively small amount of liquid air needs supply to the site or reserved in a storage tank nearby the traffic flooding site according to the site needs. Thus, the main transport costs would drop and rapid release of a lot of vaporized air would cool down the hot weather and drive out the overhead rain clouds. WISCO Oxygen Industrial Gases Co., Ltd. located in Wuhan Qingshan District may provide the liquid air delivery and corresponding auxiliary services whose price is determined in accordance with RMB 1,000 Yuan/m<sup>3</sup> liquid air. 780m<sup>3</sup> of liquid air costs RMB 780,000 Yuan, which will be magnified to RMB 10,000,000 Yuan in total in consideration of labor costs and other incidental expenses. With reference to the total of such traffic flooding control case, 46 easily flooded traffic locations would cost RMB 460,000,000 Yuan per such worst flood disaster. Moreover, most of ice may be reused after flood control or naturally melt for urban cooling in steamy summer. While there had be 2 such level flood disasters every year at most in according the statistical analysis, the total costs of flood control based on our innovative approach coupled with application of liquid air spray/vaporization based icing and natural de-icing would be up to RMB 920,000,000 Yuan for Wuhan, such a metropolis in Central China, whose flood control funds are

planned for 12,985,000,000 Yuan during the period (2016-2018). RMB 920,000,000 Yuan only accounts for 21.3% of the planned flood control funds per year on average without being aware of benefits of reutilization of ice.

Further establishment of some air product supply stations can be integrated into existing flooding risk locations to reduce dependency on expensive emergency supplies. The integration of liquefied air into existing flooding risk locations addressed the grand challenge of setting up and improving the urban existing air product supply network. Liquefied gases can also be transported elsewhere to be used. A liquid air economy can also be integrated into the Central China logistics network. Wuhan, being a city with a hot climate in summer and autumn relies heavily on air-conditioning to regulate the indoor temperature. The integration of liquid air as a coolant would benefit largely from it as bulk of the cooling needs of business and organizations comes from air-conditioning. The use of liquid air in buildings as a cooling source in case of emergencies or to reduce dependence on the grid when extra power is required for excess air conditioning, the liquid air can be circulated around the building to reduce the ambient indoor temperatures.



**Figure 8 A Traffic Flooding Site in Wuhan on June 21, 2019**

There are many potential uses for liquefied air, but like all new technologies, it has to “cross the chasm” so to speak from the early adopters to the mass market for the technology to be widely accepted by the general public in China. To do this, industries and businesses must be well informed about the economic potential of employing liquefied air in their various business activities, the return on investment and the financial gains which may be expected.

## **5 Conclusion**

China has become an increasingly urban society over the past 40 years. The changes in land use associated with urban development affect flooding in many ways. Urbanization generally increases the size and frequency of floods and may expose communities to increasing flood hazards. Urban flooding is a national and significant source of economic loss, social disruption, and housing inequality. This study presents a conceptual application of liquid air spray/vaporization based icing and natural de-icing

for urban traffic flooding control, which includes some advanced and innovative techniques such as liquid air spraybased icing for rapid formation of temporary ice roads for small cars or pickups, rapid solidification of flood water for production of emergent ice dams or diversion channels, rapid diversion of rain clouds based on vaporization of liquid air and the technique of assembling open diversion channels. This paper explores the conceptual application of liquid air spray/vaporization based icing and natural de-icing for urban traffic flooding control, whose conceptual developments including description of liquid air, road icing, conceptual liquid air based flash freezing of water for urban traffic flooding control and modeling and solution of natural road de-icing are described and analyzed in detail. In addition, economic estimation of our urban traffic flooding control scheme based on liquid air spray/vaporization by taking Wuhan downtown traffic flood control as an example is presented to demonstrate that our innovative scheme will be promising for flood control in modern cities.

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## Application of Scem-Ua Algorithm in Financial Modeling Analysis

Chen Yubing

Finance Department, Wuhan University of Technology, Wuhan, P.R. China, 430070

(E-mail: 445229758@qq.com)

**Abstract:** A good financial analysis depends on a good financial model, and good results of the analysis cannot leave a reasonable estimate of the model parameters, this paper uses Scem-Ua algorithm in financial analysis, it is proposed based on SCEM - UA algorithm model parameter estimation, thinks to find global optimal point under the global search algorithm, the paper build a more reasonable and effective financial model, financial analysis of the result is more reliable, besides, it also provides reference for subsequent financial analysis model selection.

**Key words:** Scem-ua algorithm; Financial analysis; Global optimal point; Reliable

### 1 Introduction

In financial analysis, it is very important to estimate the parameters of financial model accurately and reasonably. The traditional estimation method gradient search technology is widely used, but this kind of traditional gradient search method can only obtain the local optimal solution for complex parameter estimation, and sometimes even does not converge, so the results are not comprehensive enough. Another kind of global search technology, such as genetic algorithm, has the advantage of obtaining the global optimal solution, but it also has major defects and the solution accuracy is not high (Metropolis, 1953).

#### 1.1 Advantages of Scem-Ua Algorithm

Scem-Ua algorithm is a sublimation of Sce-Ua algorithm, which is a global search algorithm (Hasting, Monte, 1970). Sce-Ua algorithm is a global optimization algorithm proposed by Duan (Duan, 2003) based on the direct compound algorithm, the algorithm is based on the evolution principle of natural selection in the free world (Smith J, 2008) and the method of compound shapes mixture. The biggest advantage of Sce-Ua algorithm is that it can find the global best, but the premise is that the randomly selected initial point set should have diversity (Holland, 2009). If the selected domain degree of the initial point set is insufficient, the result will fall into the awkward situation of local optimal. In addition, the solving efficiency of Sce-Ua needs to be further improved (Cao Feifeng, Xu Yuping, 2012).

Scem-Ua algorithm originates from Sce-Ua algorithm, which has been improved greatly. The Scem-Ua algorithm USES the Markov chain Monte Carlo (MCMC) theory (Wei Xiaojing, Xiong Lihua, 2015) using the Metropolis Hastings algorithm (MH) algorithm. Replace the SCE - UA

algorithm of gradient algorithm (Wu Han,2016)And the most probable parameter set and its posterior probability distribution are estimated to avoid the problem that the algorithm falls into local poles(Long Haifeng, Li Huaxiong,2017).

### 1.2The Role of Scem-Ua Algorithm

The Scem-Ua algorithm can realize parameter estimation of complex functions and has global search ability, which are not the advantages of traditional methods such as gradient search(Yu Hui,2018).Therefore, this paper studies the Scem-Ua algorithm to realize the estimation of financial analysis model parameters.

## 2 SCEM - UA Algorithm

### 2.1 Probability density calculation method

Before introducing the Scem-Ua algorithm, the calculation method of parametric posterior probability density in parameter estimation is firstly introduced.

Where,  $\hat{y}$  is the  $N \times 1$ -dimensional vector estimated by the model,  $\mathbf{X}$  is the  $N \times n$ -dimensional matrix of the input variable,  $\theta$  is the vector containing  $N$  unknown parameters, and  $y$  is the sample data.  $\hat{y} = \eta(\xi | \theta)$   $\hat{y} \xi \theta$  make

$$E(\theta) = \hat{y}(\theta) - y = \{e_1(\theta), e_2(\theta), \dots, e_N(\theta)\}, \quad (1)$$

Then we can optimize the objective function as follows

$$\underset{\theta}{\text{minimize}} \quad SLS = \sum_{j=1}^N e_j(\theta)^2 \quad . \quad (2)$$

If the irregular difference is assumed to be independent of each other and subject to exponential power distribution, then according to literature [10], the following equation is established:

$$p(\theta | \mathbf{y}, \gamma) = \left[ \frac{\omega(\gamma)}{\sigma} \right]^N \exp \left[ -c(\gamma) \sum_{j=1}^N \left| \frac{e_j(\theta)}{\sigma} \right|^{2/(1+\gamma)} \right] \quad (3)$$

Parameter posterior probability distribution density function  $p(\theta | \mathbf{y}, \gamma)$

$$\omega(\gamma) = \frac{\{\Gamma[3(1+\gamma)/2]\}^{1/2}}{(1+\gamma)\{\Gamma[(1+\gamma)/2]\}^{3/2}} \quad (4)$$

$$c(\gamma) = \left\{ \frac{\Gamma[3(1+\gamma)/2]}{\Gamma[(1+\gamma)/2]} \right\}^{1/(1+\gamma)}$$

In the above equation, represents the residual distribution model. If  $\gamma=0$ , it means that the residual error obeys normal distribution. If  $\gamma=1$ , it is a double-exponential distribution; If  $\gamma=-1$ , it is uniformly distributed. If we assume the prior probability distribution density function  $p(\theta, \sigma | \gamma) \propto \sigma^{-1}$  Literature [10] shows that the following formula is valid:

$$p(\theta | y, \gamma) \propto [M(\theta)]^{-N(1+\gamma)/2} \quad (5)$$

Among them,

$$M(\theta) = \sum_{j=1}^N |e_j(\theta)|^{2/(1+\gamma)} \quad (6)$$

The calculation process of the posterior probability density of the estimated parameters is illustrated.

### 2.2 SEM algorithm

Calculate  $C^k$  Mean value of all parameters in  $\mu^k$  and the covariance matrix  $\Sigma^k$  and will compound  $C^k$  M sample points are arranged in descending posterior probability density;

If the sequence  $S^k$  at least one of the latter T points currently has accepted offspring, then according to  $\theta^{(t+1)} = N(\theta^{(t)}, c_n^2 \Sigma^k)$  produce offspring  $\theta^{(t+1)}$ , including  $\theta^{(t)}$  With a posterior probability density  $p(\theta^{(t)} | y)$  and only depends  $\theta^{(t-1)}$ ,  $c_n$  Is equal to, go to PI (4), otherwise go to PI (3);  $2.4 / \sqrt{n}$

According to  $\theta^{(t+1)} = N(\mu^k, c_n^2 \Sigma^k)$  produce offspring  $\theta^{(t+1)}$ ;

Calculate  $p(\theta^{(t+1)} | y)$  Outside the feasible region, let  $p(\theta^{(t+1)} | y)$  to 0; Calculate ratio =  $p(\Omega \theta^{(t+1)} | y) / p(\theta^{(t)} | y)$ ;

Z is the random number generated by uniform distribution of 0-1. If Z, accept the offspring generated; otherwise, let  $\Omega \theta^{(t+1)} = \theta^{(t)}$ ;

Use the following steps to  $\theta^{(t+1)}$  Added to the  $S^k$ :

(a) Using  $S^k$  in the middle and the bottom half, the acceptance coefficient AR is calculated. The number of descendants received divided by the length of the sequence);

(b) If  $AR < AR_{min}$  as  $\theta^{(t+1)}$  Instead of  $C^k$  is the worst point, otherwise, rotate (c);

(c) If  $AR \geq AR_{min}$  And Z randomly replaces  $C \leq \Omega^k$  one of them.

### 2.3 The Scem-Ua algorithm

Initialization. Select sample group size parameter s and compound form number q, then the number of samples in each compound form  $m = s/q$ ;

Generate s samples, and calculate the posterior probability density of each sample point according to equation (3) or equation (5);

The sample points are sorted by decreasing posterior probability density and stored in array d [1: s, 1: n+1], where n is the number of estimated parameters, and the right-most column in the array stores the posterior probability density of each sample point;

Initialize q parallel sequences  $s^1, s^2, \dots, s^q$ . that  $s^k$  is d[k, 1: n+1], where  $k = 1, 2, \dots, q$ . D[1: s, 1: n+1] is divided into q compound  $c^1, c^2, \dots, c^q$ , each compound form contains m sample points, so that the first compound form contains the points in order of, the second compound form contains the points in order of, etc., where  $j = 1, 2, \dots, q(j-1) + 1$   $q(j-1) + 2$  m;

Select parameters l, t and  $ar_{min}, c_n$ . For every complex  $c^k$ , call Sem algorithm and run it l times;

Put all composite shapes into array d [1: s, 1: n+1], and arrange each sample point in descending order according to the posterior probability density;

Check the convergence criteria of gelman and rubin (gr). If the convergence conditions are met, the calculation ends; otherwise, go to step 4.

## 3 Estimation of Financial Analysis Model Parameters

In financial analysis, there is a certain relationship between various variables, but many times the

explicit form of this relationship is difficult to get. However, some mathematical models, such as Taylor's expansion of functions of multiple variables, can be used to fit the relationship between dependent variables and independent variables. Suppose the general form of financial analysis model is  $y=f(x_1, x_2, x_N)$ , using the Taylor expansion of multivariate function to fit, and

$$y = \beta_0 + \sum_{j=1}^N \beta_j x_j + \sum_{j=1}^N \sum_{i \leq j} \beta_{ij} x_i x_j + \sum_{j=1}^N \sum_{i \leq j} \sum_{k \leq i} \beta_{ijk} x_i x_j x_k + \dots$$

The parameter is to be estimated.  $\beta_0, \beta_j, \beta_{ij}, \beta_{ijk}, \dots$ . In general, the above expansion is accurate to second order. After estimating the parameters, financial analysis and calculation can be carried out according to the model.

### 3.1 The Sample

Select 12 annual data of a company as shown in table 1, and adopt first-order model to fit  $y_i$ . With  $x_i Y$  is equal to a plus  $bx$ , where  $x$  is equal to  $x_i$  is the number of new product r&d team of the company in year  $i$ ,  $y_i$  is the  $i$ th year company profit (in millions of us dollars),  $i = 1, 2, \dots, 12$ .  $A$  and  $b$  are the required parameters.

**Table 1 Financial Data**

	i	1	2	3	4	5	6	7	8	9	10	11	12
$X_i$		150	160	170	180	190	200	210	220	230	240	250	260
$Y_i$		56.9	58.3	61.6	64.6	68.1	71.3	74.1	77.4	80.2	82.6	86.4	89.7

In the Scem-Ua algorithm, let  $s=50, q=5, L=1, T=500, AR_{min}=0.001, =0$ , and using the Scem-Ua algorithm, the estimated parameters of the formula are:  $\gamma$

$A = 8.841741, b = 0.31082198$ .

The p

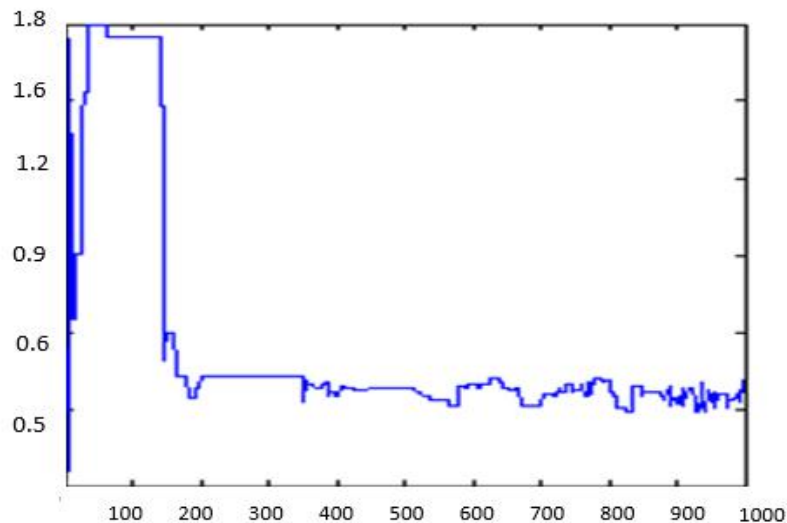


Figure 1 Estimation of Parameter b

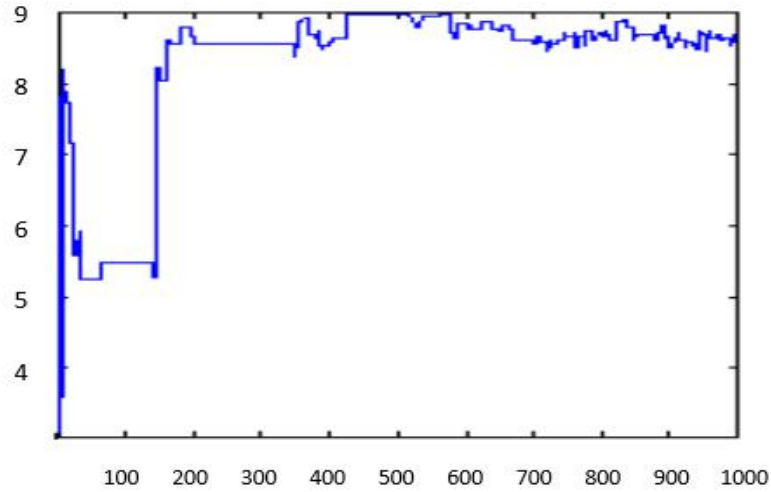


Figure 2 Estimation of Parameter a

### 3.2 Comparative Analysis Of Results

By using regression analysis, the obtained parameters are

$A = 10.282$ ,  $b = 0.3041$ .

The above parameters are estimated by hypothesis test, which shows that they accord with the actual situation expressed by samples.

Results are compared in table 2.

Table 2 Results Comparison

Methods	sum of absolute errors	mean of absolute error
SCEM-UA	3.82	0.32
Regression analysis	4.08	0.34

Table 2 shows that the Scem-Ua algorithm has better results than regression analysis in this example.



## 4 Conclusion

In financial analysis, it is important to estimate the financial model parameters accurately. Due to traditional methods such as gradient search, it is difficult to estimate parameters of complex models and easy to obtain local optimal solutions. This paper attempts to use Scem-Ua algorithm to realize parameter estimation of financial analysis model, so as to get more practical parameter estimation results.

Through actual data analysis, it is shown that the model parameters estimated by Scem-Ua algorithm are more accurate than those obtained by gradient search method, and more accurate and realistic results can undoubtedly enable financial analysts to make correct decisions and judgments.

The highlight of this paper is added the Scem-Ua algorithm into financial analysis model, as we know, Scem-Ua algorithm is mostly used in hydrological measurement research, Scem-Ua is better than the general regression analysis, and the optimal solution is relatively close to the fact, which provides certain reference value for future financial analysis and research.

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# Study on the Public Service Satisfaction Perception Structure and Its Differentials: Based on the Research Data from Tourism City of Guilin

ASC, China

Zhang Rui<sup>1,2</sup>, Wu Zhongjun<sup>1</sup>, Yu Bo<sup>3</sup>, Ning Yongli<sup>4</sup>

1 College of Tourism & Landscape Architecture, Guilin University of Technology, P.R. China, 541001

2 Guangxi Tourism Industry Research Institute, P.R. China, 541001

3 School of Management, Harbin Institute of Technology, P.R. China, 150001

4 College of Tourism and Sports Health, Hezhou University, P.R. China, 542800

(E-mails: sophiewu@yahoo.com, pzlr800@qq.com, yub@hit.edu.cn, 2544158166@qq.com)

**Abstract:** To build a service-oriented government that the people are satisfied with, since 2013, the Chinese government has proposed a series of innovation policies for transforming government functions and promoting the streamlining and delegating of power. The government administrative service center (ASC) is a new multi-functional and comprehensive service platform integrating public services to which the Chinese government has attached great importance. In order to assess the effectiveness of the government reform and explore the public satisfaction with the public service provided by the ASC, this paper conducts questionnaire surveys to investigate the satisfaction with the public service of 21 ASCs in Guilin and obtained 2690 valid questionnaires. The survey results shows that the perceived structure of satisfaction with public service remains 2 common factors, satisfaction with public service received at the service windows and satisfaction with public service resulting from complaint handling, and the overall score of the public satisfaction with the service of the ASC's public service window is higher than that of the public service complaint handling, and the difference is considerable. In terms of occupational differences, satisfaction with the dress code for government services vary significantly but the overall satisfaction perception is relatively high. Satisfaction among occupations regarding information disclosure on the processes of deliberation and approval, the content of government information disclosure, the timeliness of government information disclosure, and the satisfaction of the complaint handling results also vary significantly. The satisfaction of retirees is the lowest, which is significantly different from that of other occupational groups. According to the research conclusions, the next step of the ASC is to give emphasis to rule implementation by bringing the accountability system to bear on its efficacy in accordance with the law, and to provide personalized public services for retired people.

**Key words:** Administrative service center (ASC); Public service; Satisfaction perception; Differentials

## 1 Introduction

**Building a "service-oriented government with scientific functions, optimized structure, honesty and efficiency, and people's satisfaction" has become the focus of the party and government work since the 18th National Congress of the Communist Party of China (CPC). Standardizing deliberative and approval procedures and improving work related to them are important windows on and embodiment of building a service-oriented government. The report of the 19th CPC clearly points out that it is necessary to transform the functions of the government, deepen the process of streamlining administration and delegating power, innovate ways of supervision, enhance the credibility and enforcement of the government, and build a service-oriented government that satisfies the people.**

The government and researchers therefore have made the public service satisfaction a focus of attention. Park et al. investigate the current status of public perception, user satisfaction, and public relation on a free public collecting channel in Korea and the survey results indicates the most of the user express a positive opinion (Park et al.,2019). Mouwen demonstrates the influence of differences in customer characteristics on satisfaction with public transport services (Mouwen, 2015). Lindgren et al. contributes to e-government research and discuss how digitalization of public services has affected the interaction between citizens and government (Lindgren et al. 2019). Shirahada, Ho& Wilson identifies that aging satisfaction is the strongest factor in terms of influencing online public services usage, and this is developed through social interaction (Shirahada, Ho& Wilson, 2019).

Many researches that study the impact of individual characteristics on public service satisfaction have shown that factors such as residential area, income level, age group and education level have a significant impact on public service satisfaction (Guan,2017). Demographic characteristics such as age, income, education level, health status, gender, and occupation can also significantly affect public satisfaction with public services (China National Bureau of Statistics Fuzhou Investigation Team,2015). In terms of the impact of personal perception on public service satisfaction, existing research has proved that personal happiness, fairness and public service satisfaction have a significant positive correlation as well: the stronger the public's personal happiness and sense of fairness, the higher its satisfaction with public services (Feng et al.2016, Peng et al. 2016). Hu applies the fuzzy mathematics to construct the evaluation system of public service satisfaction and measures the membership degree in the four indicators of government public service based on the evaluation of public service (Hu, 2018). Zhang and Wang's research shows the satisfaction situation of public cultural service in 34 major Chinese cities that differ greatly in education, public cultural service, medical care and health, public cultural service, housing and social security, public safety and public infrastructure (Zhang & Wang,

2018).

Scholars have conducted extensive research on the perception, evaluation and influencing factors informing satisfaction with government public services from different angles. There is yet no research on public service satisfaction analysis for ASC, the newly integrated government function. ASC, as an organization integrating government functions, is the format and vehicle of government that concentrates in one location disclosure of information, convenience of services and deliberation and approval of petitions from enterprises and citizens. It ameliorates the fragmentation of traditional deliberation and approval processes, simplifies procedures and links, and enhances the efficiency of deliberation and approval altogether. ASC is an important channel of communication between the government and the masses, and an important window for the government to demonstrate the concept of service-oriented government construction. The ASC also functions as a platform to display the system of open administration. It accepts applications for government information disclosure in accordance with the law and responds to them as scheduled. It also deals with policy consultation and makes public the procedures, instructions and status of matters for deliberation and approval. Therefore, the ASC is a multi-functional and comprehensive service platform integrating all government departments, licensing agencies and public services, fully reflecting the purpose and nature of service-oriented government. In order to efficiently provide public services, to meet the public demand for public services, the Chinese government attaches great importance to the comprehensive ASCs by unifying the multilevel—viz. provincial, city and county, township-- ASCs under one standard that governs services, business transactions, supervision and management so as to provide "one window and one-stop service", which is taking shape nationwide. By April 2017, 3,058 ASCs have been set up by local governments at and above the county level covering 94.3 percent of the total (Survey on Nationwide Comprehensive Entity ASCs ,2017).

The new ASC of Guilin opened on January 25, 2016, housing 53 government agencies with a total of 229 service window. Due to space limitations that failed to accommodate more, the center set up three more branches to handle the extra workload. Six districts under Guilin and its 11 subordinate counties have also set up the corresponding ASCs. The public services defined in this study include administrative deliberation services and other services that provide conveniences for the people. In order to evaluate the effectiveness of the government reform and explore the public perception satisfaction with the public service by the ASCs, this paper conducts a case study based on the survey data of 21 ASCs in Guilin since 2013 when the Chinese government began to implement decentralization, information disclosure, accountability, immediate reply to inquiries, and scheduled deadlines for matters to be resolved all in keeping with the newly instituted systems in terms of public service satisfaction perception structure, analysis of the public satisfaction difference level, and clear ASC focus on public service in the future.

## **2. Exploration of Perceived Structure of Satisfaction with ASC's Public**

### **2.1 Sample data overview**

This study targets 56 departments of 4 municipal administrative centers in Guilin city, 6 districts and 11 county-level administrative deliberation and approval service units and windows that handle administrative deliberation and approval business and provide convenient services on the scene so as to obtain an evaluation of public's satisfaction with the government's public services. Time of the

survey ranged from November 1, 2017 to December 31, 2017. On the scene questionnaire was used as the survey method that researched respondents' satisfaction with the ASC's public services. In compliance with the policy of streamlining the administration and delegating power so as to better meet the needs of society, this study is designed according to the relevant policies and public service standard specifications at the government documents (*Decision of the Central Committee of the Communist Party of China on Some Major Issues Concerning Comprehensively Deepening the Reform*, 2013; *Notice of the State Council on Standardizing Administrative Examination and Approvals by Departments of the State Council to Improve Work Related to Administrative Approvals*, 2015; *Some Opinions of the People's Government of Guangxi Zhuang Autonomous Region on Standardizing Administrative Examination and Approval Behavior and Improving the Related Work of Administrative Examination and Approval*, 2015; *Guilin Municipal Administrative Approval Service "Immediately" Style Work Efficiency Implementation Plan*, 2014) and is categorized under four headings: "information", "service specification", "service etiquette", "accountability." Upon completion of the initial draft, a preliminary survey was conducted. After analysis of the preliminary survey results, the questionnaire was revised. The 11 administrative service satisfaction assessments that the Questionnaire ends up with includes: satisfaction with the information disclosure of the approval process, satisfaction with the content of disclosed information, satisfaction with the timeliness of information disclosure, satisfaction with the first responder accountability system, satisfaction with the immediate reply to inquiries system, satisfaction with the service window work efficiency, satisfaction with clerks' job initiative, satisfaction with the clerks' dress code, satisfaction with the clerks' language, satisfaction with complaint handling mechanism, and of satisfaction with complaint handling results. Likert 5 Scale is measurement used. Alternative key is: "1= very satisfied, 2= relatively satisfied, 3= indeterminate satisfactory, 4= dissatisfied, 5= very dissatisfied".

From 2014 to 2016, cases handled by all ASCs in Guilin totaled 179,045. The confidence interval is set at 0.95, e at 3% and P at 0.5. From the calculation formula for sample size:  $n = P(1-p) / (e^2 / Z^2 + P(1-p) / n)$  can be derived that sample size n should be no less than 1060. The sampling methods for data collection are random sampling and stratified random sampling. Stratified sample extraction is carried out according to the actual number of cases handled by the deliberation and approval departments at the municipal, district and county levels of government affairs centers in the previous year and in accordance with a certain proportion. 2810 copies of this questionnaire for this research were distributed on the scene, of which 2690 were retrieved with an effective recovery rate of 95.72%. Among those, 1584 came from the city proper ASC; 310 from its 3 branches; 663 from 11 county sites, and 406 from the 6 district locations. The Cronbach's Alpha coefficient of the 11 items in this survey is 0.936, which meets the reliability requirements. In order to facilitate the subsequent data analysis more smoothly, it is necessary to re-assign the five satisfaction variables and convert them into a definite ratio variable. The specific Assignment method is as follows: "100 = very satisfied, 75= relatively satisfied, 50 = not clearly satisfied, 25= dissatisfied, 0 = very dissatisfied". By calculating the average score of respondents' satisfactions with 11 public services, it can be seen that the public has the highest satisfaction score for the appearances and manners of the service personnel, followed by the satisfaction with the language use and job initiative of personnel involved. The least satisfaction came from the complaint handling mechanism as can see from the Table 1.

**Table 1 Public Service Satisfaction Score with ASC**

Items	Average Score	Standard Deviation
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Satisfaction with the Information Disclosure of the Approval Process	86.27	19.512
Satisfaction with the Content of Disclosed Information	86.64	19.244
Satisfaction with the Timeliness of Information Disclosure	85.49	20.404
Satisfaction with the First Responder Accountability System	87.86	19.392
Satisfaction with the Immediate Reply to Inquiries System	87.46	19.892
Satisfaction with the Service Window Work Efficiency	86.35	21.063
Satisfaction with Clerks' Job Initiative	88.21	19.786
Satisfaction with the Clerks' Dress Code	90.05	16.912
Satisfaction with the Clerks' Language	89.01	18.094
Satisfaction with Complaint Handling Mechanism	78.64	23.415
Satisfaction with Complaint Handling Results	78.37	23.756

## 2.2 Quest for the perception structure of satisfaction with ASC's public service

Through correlation analysis of 11 public service satisfaction variables, we can initiate a preliminary discussion on whether it is necessary to do an exploratory factor analysis. The results showed that there was a positive correlation at the significance 0.01 between respondents' satisfaction scores of various public services. Therefore, exploratory factor analysis could be used to extract the structure between variables. It can be seen from the results of exploratory factor analysis that the KMO and Bartlett test results show that the KMO statistic is  $0.915 > 0.7$ . Bartlett's sphericity test statistics have a Sig value lower than 0.01 and reject the null hypothesis, further reflecting the suitability of factor analysis for each variable. In the process of analysis, the common factor was extracted by principal component analysis, and it was found that the best extraction result could be obtained by determining the number of common factors as two after trying the setting of the extraction method of common factors. After iteration, the initial variables are no longer of complex structure, and the minimum value of the common degree is 0.560. Table 2 provides detailed statistics of the interpretation degree of the initial variables with two common factors.

**Table 2 Common Factor Variance Statistics**

Items	Initial Value	Extraction
Satisfaction with the Information Disclosure of the Approval Process	1.000	0.661
Satisfaction with the Content of Disclosed Information	1.000	0.646
Satisfaction with the Timeliness of Information Disclosure	1.000	0.649

Satisfaction with the First Responder Accountability System	1.000	0.692
Satisfaction with the Immediate Reply to Inquiries System	1.000	0.715
Satisfaction with the Service Window Work Efficiency	1.000	0.686
Satisfaction with Clerks' Job Initiative	1.000	0.670
Satisfaction with the Clerks' Dress Code	1.000	0.560
Satisfaction with the Clerks' Language	1.000	0.661
Satisfaction with Complaint Handling Mechanism	1.000	0.947
Satisfaction with Complaint Handling Results	1.000	0.949

The cumulative sum of variance explained by the two common factors is 79.635%, indicating that the two common factors can better explain the information contained in the original variables, and the degree of interpretation is up to 79.635%. The common factors were extracted by principal component analysis, and Kaiser standardized orthogonal rotation method was used. The rotation converges after 3 iterations. The component matrix after rotation shows the load distribution of each common factor, as shown in Table 3.

**Table 3 Rotating Component Matrix**

Items	Component	
	1	2
Satisfaction with the Information Disclosure of the Approval Process	0.812	0.235
Satisfaction with the Content of Disclosed Information	0.803	0.216
Satisfaction with the Timeliness of Information Disclosure	0.785	0.262
Satisfaction with the First Responder Accountability System	0.779	0.250
Satisfaction with the Immediate Reply to Inquiries System	0.770	0.262
Satisfaction with the Service Window Work Efficiency	0.760	0.290
Satisfaction with Clerks' Job Initiative	0.753	0.287
Satisfaction with the Clerks' Dress Code	0.751	0.286
Satisfaction with the Clerks' Language	0.680	0.311
Satisfaction with Complaint Handling Mechanism	0.301	0.927
Satisfaction with Complaint Handling Results	0.321	0.919

Factor loading value is the correlation coefficient between each variable and each common factor.

For the same variable, the larger the absolute value of the load is, the more the common factor can represent this variable. You can see that the common factor 1 is representative of "satisfaction with the deliberation and approval process", "satisfaction with the content of government disclosed information", "satisfaction with the timeliness of government information disclosure", "satisfaction with the first responder accountability system", "satisfaction with immediate reply to inquiries system", "satisfaction with the job efficiency at the service window", "satisfaction with the clerks' job initiative", "satisfaction with the clerks' dress code", and "satisfaction with clerks' use of language", a total of 9 variables out of 11. In turn, common factor 2 represents the "satisfaction with complaint handling mechanism" and "satisfaction with complaint handling results". According to the connotative characteristics of respective variables represented by the common factors, common factor 1 can be named as "satisfaction with public service received at the service windows", and common factor 2 as "satisfaction with public service resulting from complaint handling". The perceived structure of satisfaction with public service remains therefore satisfaction with public service received at the service windows and the levels of satisfaction with public service resulting from complaint handling.

### **3. Analysis of the Differentials Concerning Satisfaction with ASC's Public Service.**

#### **3.1 Perception structure differentials concerning levels of satisfaction with public service**

In the exploratory factor analysis, the two common factors of "satisfaction with public service received at service window" and "satisfaction with public service resulting from complaint handling" scored 87.48 and 78.51, respectively, reflecting the satisfaction of respondents in this dimension.

#### **3.2 Perceived difference level between age and public service satisfaction.**

In order to further explore the differences in the levels of satisfaction with public service of the ASCs, a cross-analysis was made according to the descriptive statistical variables of the survey -- age and occupation, to analyze whether there is a relationship between the two variables. The null hypothesis is that there is no relationship between the two variables. The age groups were "under 25", "between 25 and 35", "between 36 and 45", "between 46 and 60" and "over 60". Cross-analysis was carried out in different age groups and 11 survey items. When the Sig. value of Pearson Chi-square inspection was less than 0.05 and the phi value and V value were both greater than 0.1, it could be determined that there was a significant difference between different age groups in this satisfaction perception level. The results showed that the Sig value of Pearson Chi-square inspection was less than 0.05 for different age groups and the phi value and V value were both greater than 0.1, indicating that there was no significant relationship between different age groups and the satisfaction the 11 items surveyed.

#### **3.3 Perceived difference level between career and public service satisfaction**

The occupational groups were "administrative staff", "public institution staff", "enterprise staff", "freelancers", "migrant workers", "retired", "students" and "other". Cross-analysis was performed in different occupational groups with 11 survey items, when the Sig value of Pearson Chi-square inspection is less than 0.05 and the phi value and V value are both greater than 0.1, it can be judged that there is a significant difference between different occupations in this satisfaction perception. Calculation results show that the different occupations and their "satisfaction with first responder accountability



system", "system of one-time immediate reply to inquiries ", "satisfaction with service window work efficiency", "satisfaction with clerk initiative", "satisfaction with clerks' language use" and "satisfaction with complaint handling mechanism" did not satisfy Pearson Cartesian inspection of Sig value being less than 0.05 and phi and V were greater than 0.1, namely there was no obvious connection between the different occupational groups and the perception the 6 above referenced project satisfaction. In the difference analysis of perceived level between "occupation" and "satisfaction with information disclosure of deliberation and approval processes", the Sig value of Pearson Cartesian inspection is 0.007, the phi value is 0.195, and the V value is 0.101, as shown in Table 4, hence meeting the requirement that the Sig value of Pearson Cartesian inspection is less than 0.05 and the phi value and V value are both greater than 0.1.

**Table 4 Chi-Square Tests and Symmetric Metric between Occupation and Satisfaction with Information Disclosure of Deliberation and Approval Processes**

	Value	df	Asymp.Sig. (2-sided)
Pearson Chi-Square	49.674 <sup>a</sup>	28	.007
Phi	.195		
Cramer's V	.101		
N of Valid cases	2690		

a: 16 cells (40.0%) expected count less than 5. The minimum expected count is 0.27.

The results show that the perceived satisfaction with information disclosure of the approval process varies significantly among different occupations, as shown in Table 5.

**Table 5 Satisfaction with Information Disclosure of the Approval Process among Different Occupations**

Occupation	Very Satisfied	Relatively Satisfied	Not Clearly Satisfied	Dissatisfied	Very Dissatisfied	Average
Administrative Staff	68.0%	20.0%	8.0%	0.0%	4.0%	87.00
Public Institution Staff	48.7%	37.1%	12.5%	1.3%	0.4%	83.10
Enterprise Staff	51.3%	35.7%	11.0%	1.4%	0.6%	83.93
Freelancers	47.3%	28.9%	20.6%	2.2%	1.0%	79.83
Migrant Workers	47.4%	31.6%	18.4%	0.0%	2.6%	80.30
Retired	37.8%	27.0%	32.4%	2.7%	0.0%	74.93
Students	62.5%	21.9%	15.6%	0.0%	0.0%	86.73
Other	53.9%	28.7%	14.8%	1.7%	0.9%	83.25

In the difference analysis of perceived level between "occupation" and "satisfaction with government information disclosure", the Sig value of Pearson Cartesian inspection is 0.000, the phi value is 0.234, and the V value is 0.117, as shown in Table 6, meeting the requirement that the Sig value of Pearson Cartesian inspection is less than 0.05 and the phi value and V value are both greater than 0.1.

**Table 6 Chi-Square Tests and Symmetric Metric between Occupation and Satisfaction with Government Information Disclosure**

	Value	df	Asymp.Sig. (2-sided)
Pearson Chi-Square	71.644 <sup>a</sup>	28	0.000
Phi	0.234		
Cramer's V	0.117		
N of Valid cases	2690		

a: 14 cells (35.0%) expected count less than 5. The minimum expected count is 0.07.

The results show that the perceived satisfaction with government information disclosure varies significantly among different occupations, as shown in Table 7.

**Table 7 Satisfaction with Government Information Disclosure among Different Occupations**

Occupation	Very Satisfied	Relatively Satisfied	Not Clearly Satisfied	Dissatisfied	Very Dissatisfied	Average
Administrative Staff	70.0%	18.0%	6.0%	4.0%	2.0%	87.5
Public Institution Staff	47.3%	38.8%	11.6%	2.2%	0.0%	82.75
Enterprise Staff	53.7%	30.7%	14.2%	1.2%	0.2%	84.13
Freelancers	50.5%	25.7%	21.0%	2.5%	0.3%	80.90
Migrant Workers	55.3%	23.7%	13.2%	7.9%	0.0%	81.65
Retired	27.0%	27.0%	43.2%	2.7%	0.0%	69.53
Students	65.6%	21.9%	12.5%	0.0%	0.0%	88.28
Other	57.4%	25.2%	16.5%	0.9%	0.0%	84.78

In the difference analysis of perceived level between "occupation" and "satisfaction with the timeliness government information disclosure", the Sig value of Pearson Cartesian inspection is 0.000, the phi value is 0.213, and the V value is 0.107, as shown in Table 8, meeting the requirement that the

Sig value of Pearson Cartesian inspection is less than 0.05 and the phi value and V value are both greater than 0.1.

**Table 8 Chi-Square Tests and Symmetric Metric between Occupation and Satisfaction with the Timeliness Government Information Disclosure**

	Value	df	Asymp.Sig. (2-sided)
Pearson Chi-Square	59.566 <sup>a</sup>	28	0.000
Phi	0.213		
Cramer's V	0.107		
N of Valid cases	2690		

a: 14 cells (35.0%) expected count less than 5. The minimum expected count is 0.12.

The results show that there are significant differences in the perception satisfaction with timeliness of government information disclosure among different occupations, as shown in Table 9.

**Table 9 Satisfaction with the Timeliness Government Information Disclosure among Different Occupations**

Occupation	Very	Relatively	Not Clearly	Dissatisfied	Very	Average
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<sup>84</sup> Some Opinions of the People's Government of Guangxi Zhuang Autonomous Region on Standardizing Administrative Examination and Approval Behavior and Improving the Related Work of Administrative Examination and Approval. No. 31 Document in 2015 of Guangxi Government. <http://www.gxzf.gov.cn/zwgk/zfgb/2015nzfgb/d14q/zzqrmzfwj/20150716-474952.shtml>

<sup>85</sup> Guilin Municipal Administrative Approval Service "Immediately" Style Work Efficiency Implementation Plan. No. 56 Document in 2014 of the Guilin Municipal Government. (in Chinese) [http://www.guilin.gov.cn/zfwj/201408/t20140801\\_656647.htm](http://www.guilin.gov.cn/zfwj/201408/t20140801_656647.htm)

	Satisfied	Satisfied	Satisfied		Dissatisfied	
Administrative Staff	68.0%	16.0%	10.0%	6.0%	0.0%	86.5
Public Institution Staff	50.9%	33.5%	14.3%	0.9%	0.4%	83.4
Enterprise Staff	49.1%	34.3%	14.4%	1.8%	0.4%	82.48
Freelancers	46.7%	26.7%	23.8%	2.5%	0.3%	79.25
Migrant Workers	52.6%	26.3%	18.4%	0.0%	2.6%	81.53
Retired	35.1%	18.9%	43.2%	2.7%	0.0%	71.55
Students	59.4%	18.8%	21.9%	0.0%	0.0%	84.45
Other	53.0%	30.4%	15.7%	0.9%	0.0%	83.88

In the difference analysis of perceived level between "occupation" and "satisfaction with the clerks' dress code", the Sig value of Pearson Chi-Square inspection is 0.000, the phi value is 0.219, and the V value is 0.109, as shown in Table 10, meeting<sup>3</sup> the requirement that the Sig value of Pearson Chi-Square inspection is less than 0.05 and the phi value and V value are both greater than 0.1.

**Table 10 Chi-Square Tests and Symmetric Metric between Occupation and Satisfaction with the Clerks' dress Code**

	Value	df	Asymp.Sig. (2-sided)
Pearson Chi-Square	62.697 <sup>a</sup>	28	0.000
Phi	0.219		
Cramer's V	0.109		
N of Valid cases	2690		

a: 20 cells (50%) expected count less than 5. The minimum expected count is 0.05.

The results show that there are significant differences in the perception satisfaction with the clerks' dress code among different occupations<sup>4</sup>, as shown in Table 11.

**Table 11 Satisfaction with the Clerks' Dress Code among Different Occupations**

Occupation	Very Satisfied	Relatively Satisfied	Not Clearly Satisfied	Dissatisfied	Very Dissatisfied	Average
Administrative Staff	82.0%	10.0%	6.0%	0.0%	2.0%	92.50
Public Institution Staff	64.3%	29.9%	5.8%	0.0%	0.0%	89.63

Enterprise Staff	64.7%	28.1%	6.6%	0.6%	0.0%	89.23
Freelancers	62.9%	27.9%	8.9%	0.3%	0.0%	88.35
Migrant Workers	73.7%	15.8%	7.9%	0.0%	2.6%	89.50
Retired	56.8%	21.6%	21.6%	0.0%	0.0%	83.80
Students	75.0%	21.9%	3.1%	0.0%	0.0%	92.98
Other	73.0%	23.5%	2.6%	0.9%	0.0%	92.15

In the difference analysis of perceived level between "occupation" and "satisfaction with complaint handling results", the Sig value<sup>86</sup> of Pearson Cartesian inspection is 0.002, the phi value is 0.204, and the V value is 0.102, as shown in Table 12, meeting the requirement that the Sig value of Pearson Cartesian inspection is less than 0.05 and the phi value and V value are both greater than 0.1.

**Table 12 Chi-Square Tests and Symmetric Metric between Occupation and Satisfaction with Complaint Handling Results**

	Value	df	Asymp.Sig. (2-sided)
Pearson Chi-Square	54.557 <sup>a</sup>	28	0.002
Phi	0.204		
Cramer's V	0.102		
N of valid cases	2690		

a: 15 cells (37.5%) expected count less than 5. The minimum expected count is 0.15.

The results show that there are significant differences in the perception satisfaction with complaint handling results among different occupations, as shown in Table 13.

**Table 13 Satisfaction with Complaint Handling Results among Different Occupation**

<sup>86</sup> Survey on Nationwide Comprehensive Entity ASCs. Office of Government Information and Government Affairs of the General Office of the State Council, 2017 (in Chinese) [http://www.gov.cn/xinwen/2017-11/23/content\\_5241582.htm](http://www.gov.cn/xinwen/2017-11/23/content_5241582.htm)

Occupation	Very Satisfied	Relatively Satisfied	Not Clearly Satisfied	Dissatisfied	Very Dissatisfied	Average
Administrative Staff	62.0%	18.0%	20.0%	0.0%	0.0%	85.5
Public Institution Staff	37.1%	20.5%	42.0%	0.4%	0.0%	73.58
Enterprise Staff	44.3%	18.6%	35.3%	1.4%	0.4%	76.25
Freelancers	40.0%	16.2%	42.5%	1.3%	0.0%	73.73
Migrant Workers	39.5%	13.2%	39.5%	5.3%	2.6%	70.48
Retired	24.3%	8.1%	62.2%	2.7%	2.7%	62.15
Students	37.5%	28.1%	31.2%	3.1%	0.0%	74.95
Other	42.6%	19.1%	36.5%	0.0%	1.7%	75.18

## 4 Conclusion

Through the above study, it is found that the overall public satisfaction score on the public service received at service windows in ASCs is higher than that on public service rendered by complaint handling departments. Satisfaction with public service received at service windows in all their dimensions scores between 85.49 to 90.05 points. The rubric designed for the study is: 100=very satisfied; 75= satisfied. Therefore, the overall satisfaction with the public service received at service windows is relatively higher compared with satisfaction with public serviced rendered by complaint handling in its two dimensions which score respectively 78.64 and 78.37 points. Consequently, ASCs should attach more importance to the effectiveness of enforcement when implementing the accountability system in keeping with the rules and regulations.

From the perspective of occupational differences, significant differences exist in regard to various occupational groups' satisfaction with the dress code for government service personnel. The scores of each group are between 83.80 and 92.98, which is higher than the standard of "relatively satisfied score of 75" designed for the study. The public's perception of satisfaction with the dress code for government service personnel is evidently high.

Among all occupational groups, the score of satisfaction with information disclosure for the deliberation and approval es is 74.93, which is the lowest among retirees. The score from the other seven occupational groups is 79.83. Among all occupational groups, the score of satisfaction with the content of government information disclosure is the lowest among retirees, which is 69.53. The score from all other 7 occupational groups is 80.90. Among all occupational groups, the score of their satisfaction with the timeliness of government information disclosure is 71.55, which is the lowest among retirees. The score from the other 7 occupational groups is 79.25. Of all the satisfaction scores

from among all occupational groups for the complaint handling results, the lowest, 62.15 comes from the retired people while the score of the other 7 occupational groups is 70.48. The above four scoring results show that there are significant differences among occupational groups in their satisfaction with the approval process information disclosure, the content of government information disclosure, the timeliness of government information disclosure, and the satisfaction complaint handling result. The satisfaction retire is the lowest, far lower than that of other occupational groups. Therefore, for the above four public service projects, the needs of retirees should be addressed more to provide individualized public services.

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# Evaluation Theory of the Core Competence of Art Design Industry Based on “Four-Three Structure” Model

Wang Jun, Zhao Yiran, Yang Zhixuan

School of Art and Design, Wuhan University of Technology, Wuhan, P.R. China, 430070

(E-mail: wangjun1021@126.com, 595245514@qq.com, 749971088@qq.com)

**Abstract:** This paper takes the Chinese art design industry as the research object, in view of the development characteristics of the art design industry and the commonness of the traditional industry, constructs the four-three (main body, content, input and output) structure industrial core ability recognition system, evaluates the uniqueness, value, scarcity and sustainability of the art design industry in China; design efficiency contribution, design innovation, international competitiveness (referred to as three capacities) indicators, evaluate its industrial comprehensive level model, and based on the evaluation results, and build an effective core competence cultivation model and upgrading path.

**Key words:** Art design industry; Core competence; Four-three structure model; Three capacities evaluation model

## 1 Introduction

In recent years, national competitiveness has gradually become an important field of theoretical research, the formation of core competence is the key to competitiveness, and the source of sustainable development lies in whether it has the core competence to support its industrial development. For our country, in the new world competition situation, the division of labor in national strategic layout, regional strategic planning and other times of change, the emerging industries, including the art and design industry, reflect the high premium, sustainable innovation, cross-integration and other attributes, so it is of great significance to study the unique industrial development characteristics and paths in the process of industrialization. Its development has become a key factor in the new round of national competition.

From the theoretical research level, Adam Smith and David Ricardo, the representatives of classical economics, established the theory of industrial comparative advantage, Michael Porter established the theory of national and industrial competitiveness, and subsequent scholars based on the two theories, centering on the identification of industrial core competence (Li Yizhou et al.,2012), judgment (Jiang Changbao,2009) and evaluation (Wei Jiang et al.,2015), cultivation (Zhu Shuai et al.,2014) and so on launched a series of studies. In the unique field of art design industry, many scholars have discussed the differences from different angles, such as Ling Jiyao (Ling Jiyao, 2009), Li Yanzu (Li Yanzu, 2011) and Wang Shouzhi (Wang Shouzhi, 2014) combing the history of art design from the perspective of historical evolution, Lu Xiaobo Lu Xiaobo, (2012) and Xu Ping (Xu Ping, 2013) from the perspective of culture. Liu Guanzhong is engaged in exploring the common law of art design from the perspective of Neo-Confucianism (Liu Guanzhong,2008), and Lou Yongqi is engaged in exploring the development trend of art design industry from the perspective of innovation (Lou Yongqi,2016、Pan Yunhe,2016).



This article takes the Chinese art design industry as the research object, screens and explores its performance, the intrinsic cause from the value, the uniqueness, the scarcity and the sustainability and another core ability attribute. The research follows the research logic of the foundation support-object analysis- appraisal system- fosters the design, setting up five main research topics to carry on the theory and the real diagnosis, the qualitative analysis and the quantitative analysis.

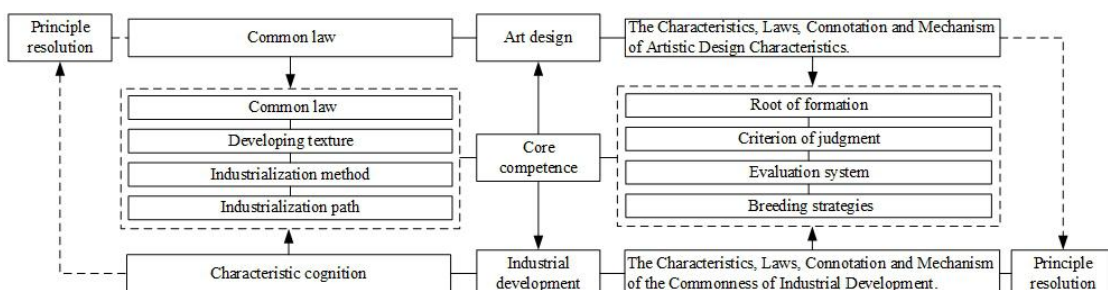
## 2 Practical Cognition of Art Design Industry

Today, with the emergence of new science and technology, new ideas and globalization, the world economy is facing a new round of industrial development direction adjustment. The development of art and design industry also shows a trend of efficient industrialization and rapid improvement of core capabilities, and it is very important to analyze the industrial development experience of typical countries and regions and the global industrial development. It is an important basis for correctly judging the development direction of China's art and design industry, and also a prerequisite for determining whether China can occupy a leading position in the new round of industrial development and global economic competition (Zou Qichang, 2014). Through comparing the development trend of the global art and design industry with the experience of typical countries, this paper summarizes the core characteristics and causes of international competitiveness of countries in the development of art and design industry, from the aspects of industry operation law, industry accommodation and policy formulation, design personnel training and innovation system, and design evaluation system, and summarizes and judges the new trend of global art design industry development.

Compared with the development of foreign mature art design industry, the overall competitiveness of China's industry is not strong, the core ability is not prominent, the problems are multifaceted. On the basis of systematic data collection, interview and research, a comprehensive survey of the status quo of China's art design industry development is done, through the historical evolution, professional accumulation, soil gestation and other multi-dimensional perspectives, revealing the current industrialization process of talent, technology, innovation ability, growth space and integration of internal and external industries, sorting out the current situation and practical difficulties of the development of China's art and design industry.

## 3 Development Principle of Art Design Industry

Compared with the general national economic industry, the art design industry and its industrialization process have the common characteristics of the existing industrial development law, and at the same time, due to its cultural elements, artistic elements and spiritual elements, the development of this industry naturally has have unique industrial characteristics, and the art design industry is also a collection of product art design, environmental art and art. Graphic art design and other comprehensive subdivisions are collectively referred to, and their subdivisions have the common characteristics of the art design industry. Based on the exploratory study of the development differences between art design industry and other national economic industries, as well as the common cognition of subdivided industries, this paper explores the formation root, judgment criteria and evaluation system of industrial development core competence, from the common law, development mechanism, industrialization method, the supporting platform system of industrial development principle should be built in terms of industrialization path and so on, through the blending principle of qualitative and quantitative analysis, the balance principle of artistic attribute and technical restriction. The unification principle of industrial commonness and industrial characteristics, the theoretical research model is

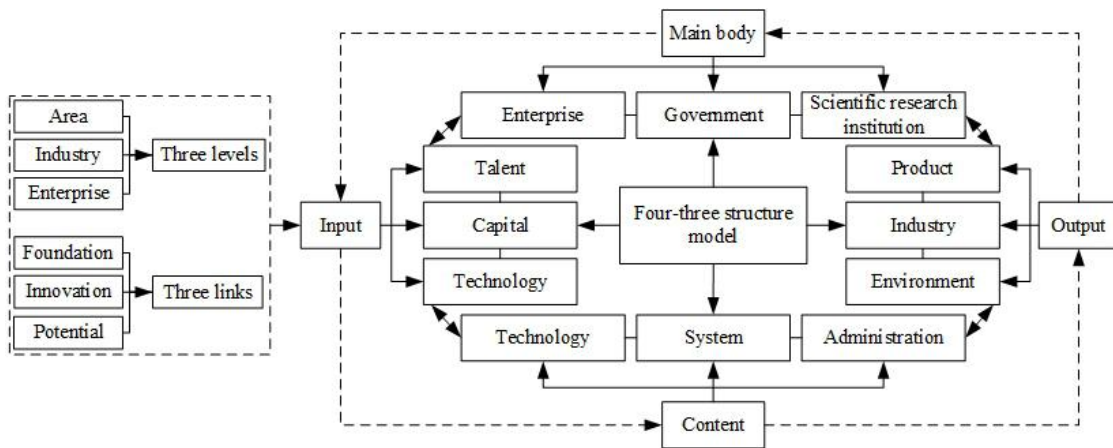


established to provide new ideas, new methods and new strategies for forming and cultivating the core competence of China's art and design industry. (Figure 1)

**Figure1 The Principle Diagram of the Core Competence of Art Design Industry**

#### 4 Cognition and Judgment of the Core Competence of Art Design Industry

Region is the soil of industrial development, and industry is the carrier of regional endogenous advantages. The development of any industry can't be separated from the cultivation of core competence, and the source of industrial sustainable development lies in whether it has the core competence to support its industrial development, so it is very important to identify the core competence and determine the factors affecting the formation of core competence in industrial development. The core competence has multi-subject, multi-content, multi-method and other systematic promoting attributes. Based on this, the four-three structure design of core competence identification in this paper constructs an internalized evaluation structure to comprehensively understand the core competence of China's art and design industry from the driving subject, innovative content and goal setting of industrial development.

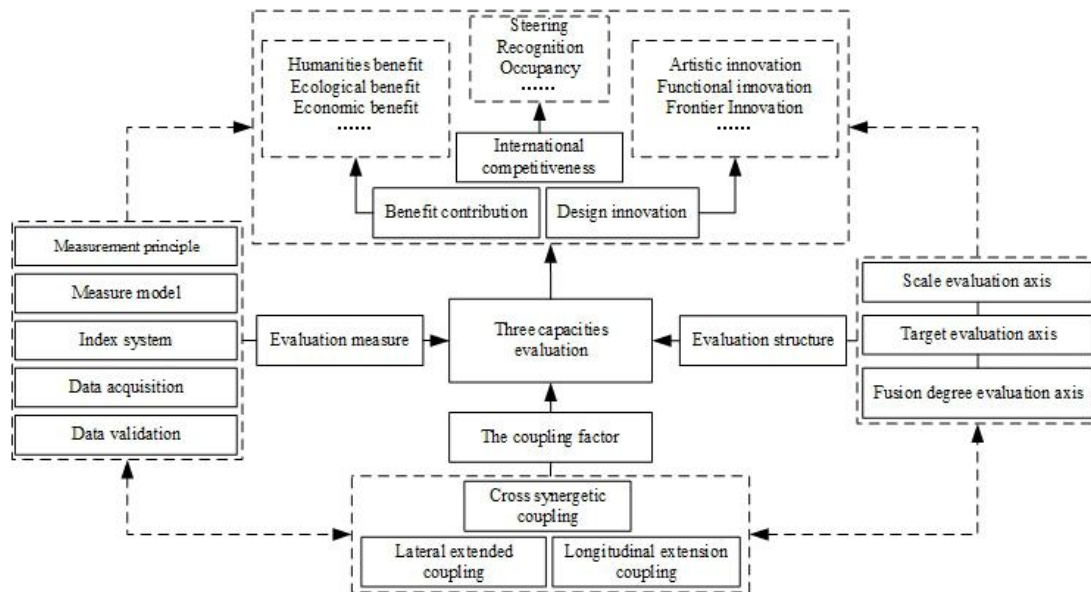


**Figure 2 The Cognitive Structure of Four-three Industrial Core Competence**

Based on the four-three structure, industrial development reflects the characteristics of systematicness, dynamics and synergy, the development of art and design industry is more obvious, and the uncertain factors such as spirituality, artistry and non-independence become the difficulties of the industry system research. From the three perspectives of design foundation, innovation and potential, the paper deduces the qualitative research on the development mechanism and internal components of core competence, and accurately reveals the composition of industrial core competence in the light of the external environment of industry, and launches systematic research from the theoretical perspective of comparative advantage, so as to provide a platform framework and strong supporting data for building an objective and mature multi-dimensional evaluation criteria. (Figure 2)

## 5 Construction of Three Capacities Evaluation Model for the Core Competence of Art Design Industry

The key to the development of a country's economy is the development of industrial economy and the promotion of industrial international competitiveness (Mu Renyan et Al., 2011). Innovation is the key to industrial upgrading and international competitiveness. Innovation is the motive force of modern economic development. Industry, as the main body of national economic development and the carrier of innovation means, whether it has core competitiveness, independent ability and sustained innovation ability of key technologies in key areas is the key factor for a country to gain competitive advantage in international competition (Hu Shuhua et Al., 2002). Industrial international competitiveness is the core of national competitiveness, and industrial core competence is an important manifestation of industrial international competitiveness, and industrial development homing is a beneficial contribution to national or regional economic development, especially in the art and design industry, the high premium performance of the art and design industry effectively promotes the income of traditional industries, and promotes the development of traditional industries. Industrial benefit contribution is the ultimate form of industrial international competitiveness and industrial innovation ability. In this study, the concept of benefit contribution is introduced to describe the degree of industrial benefit contribution. The three capacities of industrial international competitiveness, design innovation and benefit contribution



complement each other and jointly reflect the comprehensive strength of industrial development.

**Figure 3 Core Competence Assessment Model**

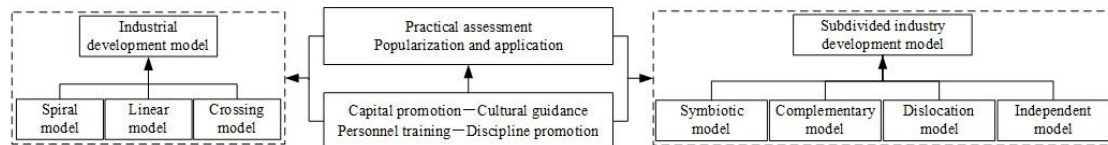
Therefore, the international competitiveness, innovation and contribution of industrial design can be taken as the three main indicators of industrial evaluation, so as to reflect the strength and development level of the industry more comprehensively and objectively. At the same time, due to the complex characteristics of evaluation factors, the implementation stage of evaluation and cultivation of core competence must be judged from the perspective of coupling of multiple aspects, scale evaluation axis (lateral expansion coupling), target evaluation axis (longitudinal extension coupling), fusion degree evaluation axis (cross-synergy coupling), etc., to comprehensively consider and collect art design specialty, industry and industrial classification. The coupling evaluation quantification and measurement

index (measurement principle, measurement model, measurement indices system, measurement data acquisition, verification) are set up. (Figure 3)

## 6 The Mode and Path of Cultivating and Promoting the Core Competence of China's Art Design Industry

From the perspective of predictable bottlenecks, the cultivation mode and path of promoting the core competence of art and design industry will be carried out under an interdisciplinary, cross-regional and cross-industrial framework, which is determined by the multi-disciplinary, divergent and cross-integrated industrial structure of the industry itself. The service objects of art design industry in China cover a large number of industrial categories, and the conditions and environment of each subdivision category are significantly different, so the degree and stage of integration with art design industry are different in the process of transformation and upgrading, and the interior presents a new stage of development from art design to art design industrialization, market demand and industrial development form a multi-level accumulation. In this case, how to use the core competence of art design industry to identify and evaluate the results, and design the cultivation mode and path under different conditions is the focus of research.

In this paper, we use the industrial development path and method in management science to design different industrial development strategies based on the short board of factors and environmental inferiority-spiral model, linear model and leapfrog model; Based on the subdivision characteristics of the art design industry and the advantages of design, the complementary development model of the



combination of design characteristics, speed and efficiency, the symbiotic development model, the independent development model and the dislocation development model. In terms of external environment, we should break down the barriers of traditional industries and industrial structure, establish multi-subject coordination among enterprises, governments and scientific research institutes, advocate the logic of coordinated cultivation and development of various elements of personnel cultivation, subject promotion, capital promotion and cultural guidance, realize a good institutional environment, policy environment and facility environment for the whole society, and form a balanced investment of resources, a reasonable division of labor in industrial chain. The scientific cultivation mechanism of industrial cluster layout is the key issue of whether the core competence of art design industry can be improved. At the same time, we need to consider that the success of other countries and regions has its profound historical and realistic basis, contingency and particularity, so while learning from excellent experience to design the path, we will fully consider the heterogeneity of the development of China's art and design industry, so as to avoid falling into the path dependence on successful precedent practices. (Figure 4)

Figure4 Road Map of Core Competence Cultivation

## 7 Conclusion

This paper is not only a theoretical inheritance study of industrial development under the new

situation, but also a strategic theory study combined with the actual needs, and its innovation is reflected in the following three points.

(1) It puts forward the cognitive system of four-three structures of the core competence of China's art and design industry. Although beneficial explorations have been made from the perspectives of art design, industrial development and evaluation system, it is still a key problem to enhance the core competence of industry by organically combining the three key perspectives. This article is an industrial evaluation research from the perspective of industrial development and artistic creation characteristics of the combination, and it launches in-depth research from the perspective of qualitative matching to explore the characteristics of industrial development and sub-industry common point of view to enhance the core competence of China's art and design industry.

(2) Establish the three capacities evaluation model of industrial core competence. Based on industrial cognition and judgment, China's industrial core competence is embodied in three aspects: benefit contribution (humanities, ecology, economy, etc.), independent innovation (artistic innovation, functional innovation, frontier innovation, etc.) and international competitiveness (leadership, cognition, share, etc.). It's the basis for judging the international advantages of China's industry and the evaluation system of core competence based on the evaluation criteria of three capacities. It sets up a three-level dimension of enterprise (product)-industry (industry)-region (country) and a three-link measurement model of foundation-innovation-potential to enhance core innovation ability.

(3) Design the core competence cultivation mechanism under the internal and external coupling mechanism of art design industry. Based on the comparison of the development history of global art design and the strategy of industrial development in today's countries, this paper studies the theoretical mechanism of industrial evaluation in China at this stage. From the three-dimensional perspective of industrial development, development goals and path promotion, this paper conducts an in-depth study on the evaluation and development path of China's art and design industry, breaks the traditional industry barriers and industrial structure, advocates the logic of coordinated cultivation and development of various elements of talent cultivation, subject promotion, capital promotion and cultural guidance, and provides theoretical guidance for promoting the transformation of China's art and design industry from a decentralized development, a complete but not strong island-type industrial form to a coordinated development and prominent advantages of grid-like industrial form.

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# Thematic Selection and Distribution in Management Academic English Writing

Xiao Xianming

School of Foreign Languages, Wuhan University of Technology, Wuhan, P.R.China, 430070

(E-mail: ericaxiao@whut.edu.cn)

**Abstract:** The trait of English for academic writing is the information exchange and idea transition. Knowing what to write will enable the flow of ideas, whereas knowing how to organize will be of help conveying the ideas in a logic clear way to the readers. Thematic progression is an effective tool to help novice learners know how to organize the information. This paper starts from combing the theoretical development of theme and rheme, and then extending the fixed three types of Thematic progression to four models. After that, the author adopts some discourses from business English to testify the hypothesized models. The result shows that theme and thematic progressions could help learners enhance their logic writing skills on argumentative articles.

**Keywords:** Theme; Rheme; Thematic progression; English for academic purpose

## 1 Introduction

Academic writing is a great challenge for the novices of academic researchers. One of the striking errors neglected by the novice writers in their English writing for academic purpose is the illogical arrangement of the discourse. This phenomenon, in the term of linguistic theory, is the unawareness of text coherence. However, coherence is the prominent characteristic for the academic writing discourse. Teun A. van Dijk argues convincingly that “coherence is a semantic property of discourse formed through the interpretation of each individual sentence relative to the interpretation of other sentences, with "interpretation" implying interaction between the text and the reader”. In the theory of the Systemic Functional Linguistics (SFL), Halliday proposes four levels to achieve the coherence in discourse, namely, from semantic level, lexical level, syntactic level and phonologic level. Among which, phonologic level belongs to the information structure. Semantic level and lexical level have been constructed to be the conventional cohesive devices while the syntactic level has been designed to be the cognitive schema consisting of two ways: the structure cohesion and the non-structural aspect. The former belongs to the grammatical category while the latter is a perceived degree of coherence in the intrinsic text ----thematic progressions.

In the grammatical category, cohesion and the five cohesive devices--- reference, ellipsis, substitution, conjunction and lexical nouns, are traditionally interpreted as the vital factors to determine whether a text is coherence or not. It is assumed that adequate cohesive device interactions will enhance the level of perceived coherence. However, cohesive ties themselves could not be naturally sufficient to build a coherent text. Therefore, some researchers hold the idea that the cohesive devices have been abusively used to judge a writing text “good” or “bad”. They argue that text connectivity should not be confined into the five linking devices, but extended to bind larger chunks of discourse throughout the text. The method for information structured in clauses and the way of combining larger chunks (the

structured information elements) shall be vital for achieving cohesion and coherence in English writing. Thematic Progression (TP) is the tool for binding larger chunks of discourse throughout the text. Studies of the relationship between genre and thematic selection are of use for deeper text connectivity. Theme and rheme, the two core concepts of TP, could be effective bricks of building the intra-clausally cohesion. Thematic progression, as the stretch of theme and rheme fanning out across in text, is a high degree of cohesive harmony, indicating the beginning and ending of topics and pointing up a text's underlying organization. Therefore, it is preferred by Hasan to account for coherence in terms of structural relations between cohesive chains.

A successful academic text is one which contains both 'certain obligatory structural elements appropriate to their purpose and context' and 'a harmonious collection of meanings appropriate to its context' (Butt et al, 2001). The purpose of this article is to apply the insights gained from combing the theoretical development of theme and rheme to help academic researchers on business and management English writing improve coherence at the discourse level. The article begins from combing the theoretical framework of theme and rheme to propose five patterns of thematic progression. And then, the quantitative analysis of the corpus data adopted from business and management research articles in English will be conducted and represented by statistic description. What's more, the research will explore the pedagogical significance of the thematic progression in business English teaching.

## **2 Literature Review**

It is a common consensus that the understanding and application of thematic progression could help writers, learners or students improve the cohesion in writing. The primary reason for this consensus lies in that thematic structure is a way of listener/reader-oriented information construction, which presented as what listener/reader already know or have at their disposal of the given information in the discourse. Therefore, if other elements being equal, readers would feel easier when the new information occurs in the rheme position, because "it is easier to make a connection to what one knows and then add some new information to it than to receive new information, store it, and then learn what it connects to". Ventola and Mauranen also pointed out that "thematic development is important for the readability and clarity of a text. In a well-formed text, the thematic patterns should reflect the organization of text-content and facilitate the reading process." Ultimately, coherence in writing is not only established by the cohesive devices in paragraphs but also created in the minds of the readers in their attempt to make sense of the writer's assumption through the smoothly information flow, namely, the TP patterns in the text.

Researchers have conducted quantitative research showing that there is correlation between students' writing quality and their consciousness of TP and their ability to use theme and rheme effectively and suggested that the thematic progression patterns should be recommended in English writing course to help learners write more coherently (Schleppegrell, 2004; Wei, 2014). Hawe and Thomas (Hawe and Thomas,2012) proposed that "there is a need for coaching in thematisation ... teaching at least rudimentary thematisation theory and giving students practice with an assortment of thematic options...based on our students' apparent inadequate familiarity with English information structure".

As for the TP theory in Chinese students' writing, Cheng (Cheng,2002) argued that TP theory could be an effective teaching method to solve the problem of coherence in Chinese college students' writing. Wang (Wang,2007) also claimed that Chinese teachers could apply theme, rheme and TP theory to diagnose students' difficulties in writing and the consciousness of TP could help students overcome



their lack of cohesion and coherence senses. Another Chinese researcher made a comparison experiment between students' scores of TEM and their ability to use TP patterns, and he concluded that the use of more multiple Themes, clausal Themes, and effective TP patterns, such as constant, linear, split Theme, and split—Rheme progressions, could make EFL/ESL English writing more coherent, based on a detailed analysis of three writings that were graded with high, medium, and low scores from TEM-41 writing sections (Wang, 2010). Wei initially conducted a quantitative research on how Chinese college students use TP in English essays before and after the construction of TP theory consciousness in her doctoral dissertation “Theme and Thematic Progression in Chinese College Students' English Essays” (Wei, 2016).

As demonstrated above, Theme and TP have been playing a prominent role in achieving coherence in academic writing by smoothly linking the ideas, sentences, and paragraphs together to be an integrated unity of a discourse. The center of research on the TP theory is around about how learners make choice of TP patterns. However, the pedagogic significance of theme and rheme in academic writing is in the need to be strengthened. There has been little more than theoretical research as to how teacher could take the TP theory into writing teaching. To put it further, a little attention has been attracted to study the teaching materials organized and compiled by TP theory.

### **3 Theoretical Development of Theme, Rheme and Thematic Progression**

#### **3.1 Theme and rheme**

Communication is the process of information/message exchange. This process will inevitably involve with the decision of how to choose a beginning point for the writers/ speakers' utterances. Whatever is chosen to be the initial place may have an enormous influence upon the hearer/reader's interpretation for the whole discourse, because the first place of the utterance will constitute the textual context that follows. In order to analyze the initial place of the utterance in discourse, Mathesius, the founder of Prague School, excavated the notion of “theme” from Germany linguist Weil in the 19<sup>th</sup> century to describe the structural division within a clause as three parts: theme, transition, and rheme (Xiao, 2017).

Mathesius defines theme as “point of departure and enunciation within a clause”. However, it is Halliday who inherited the idea of theme and rheme from Prague School and exerted the luminous attraction of the two items as the basic concept of clause within discourse in his Systemic Functional Grammar. Halliday defined theme as “what is being talked about, the point of departure for the clause as a message”. In his late research, Halliday extended this definition to be more widely scope as that: “the theme is the element which serves as the point of departure of the message; it is what locates and orients the clause within its context”. The theme orients the reader/listener to the information to be perceived and confines a framework for the interpretation of the oncoming message. For this function, theme is typically regarded to contain familiar given or old information, which might have already been mentioned in the text/conversation, or it would be a common sense, a shared or mutual knowledge understandable for the writer/speaker and reader/listener; Rheme, as the counter-partner, is defined by Halliday (2014: 64) as “the remainder of the message, the part in which the Theme is developed in the clause”. As the extension of the Theme, rheme is typically hypothesized to contain unfamiliar or new information, which a writer/speaker might assume the reader/listener may not know, but needs to obtain in order to understand the ongoing argument in the text.

### 3.2 Unmarked theme and marked theme

From the perspective of position, theme theoretically occupies the beginning of a clause and the rest part of which will be extended to be rheme. This structure might be similar with grammatical sentence structure. But theme is not surely equivalent to be the subject of a clause in grammar; nor is rheme to be the predicate. However, in unmarked sentences, theme, especially the topic theme, is generally conveyed through the grammatical subject. Halliday considers the mapping of theme on to the subject of a declarative clause as the unmarked theme; on the opposite, a theme separating from the subject of the clause is addressed as a marked theme, which contains pre-posed adverbial groups, prepositional phrase or even a dependent clause. The correspondence between unmarked theme, marked theme and grammatical subject could be identified as follows:

**Table 1 Unmarked Theme and Marked Theme**

Unmarked Theme Rheme	
It	was the German field marshal Fedor von Bock who  Foolishly repeated Napoleon's ill-fated attacked on Russia in 1812.
The lion decided to beat the unicorn to death.	
Marked Theme Rheme	
Napoleon's ill-fated attacked on Russia in 1812 was foolishly repeated by the German field marshal Fedor von Bock..	
All round the town,	the lion beat the unicorn.

According to the different function, the elements inside a marked theme can be divided into three parts: topical theme, textual theme and interpersonal theme. Theoretically, in the case of a sequence of themes, textual and interpersonal optional themes should come before the obligatory topical theme, as follow:

**Table 2 Sequence of Themes**

Therefore, it is possible that classical MAP kinase isoforms play a role in acute....			
	↓	↓	↓
<b>Textual Theme</b>	<b>interpersonal theme</b>	<b>topical theme</b>	<b>Rheme</b>
But clearly the reliability of God's statements ultimately depends on the author himself			
	↓	↓	↓
<b>Textual Theme</b>	<b>interpersonal theme</b>	<b>topical theme</b>	<b>Rheme</b>

### **3.3 Thematic progression**

As the devices for information organization, theme and rheme not only operates in a stable level merely indicating how a writer/speaker has chosen to order the information within the clause or conversation, but also exerts the dynamic force to structure the flow of information in ways that regulate the interpretation of texts logically (Martin,1995). This dynamic process of information exchange is signposted by placing elements from the rheme of the former clause into the theme of the subsequent clause, or by repeating the information (through reference and lexical reiteration) from the preceding theme and rheme. This consecutive flow of information exchange between successive themes and rhemes in a text is called “Thematic Progression” (Egins, 2004). Halliday defined it as “the method of text development” — “the choice of clause Themes plays a fundamental part in the way discourse is organized; it is this in fact, which constitutes what is often known as the ‘method of development’ of the text.” Peter Fries thought that “thematic content correlates with the method of development of a text and the nature of the text”, and he argued that thematic development dealt with the lexico-semantic contents of themes. In the core of those definitions, thematic progression is the inter-activeness of discourse foregrounding the information of the preceding theme and rheme and therefore, directing the development of the whole text.

### **3.4 Patterns of thematic progression**

Thematic Progression is the information flow exchanging between consecutive theme-rheme pairings in a text. The relations between succeeding themes and rhemes allow us to identify different types of theme-rheme progression. Daneš has been acknowledged to be the first to define the concept of Thematic Progression as “the choice and ordering of utterance Themes, their mutual concatenation and hierarchy, as well as their relationship to the hyper-themes of the superior text units (such as paragraph, chapter...). to the whole of text, and to the situation”. Furthermore, he has postulated three basic thematic progression patterns from analysis of scientific and other professional texts: linear progression, constant progression, and TP with derived Theme. Thereafter, many linguists have proposed various versions of TP patterns in terms of their selected language materials. McCabe (McCabe,1999) added split rheme pattern and multiple thematic progression. Egins categories three main patterns of TP: constant theme pattern, linear or zigzag theme pattern, and multiple theme pattern. In this article, we absorb the ideas from different schools of TP patterns and propose a modified version of TP as five patterns: linear progression, constant progression, TP with derived Rheme, and Hyper theme progression pattern.

## **4 Data and Method of TP Analysis**

Theme in a text provides the clue about that text and about the nature of the place within that genre at which the readers or listeners are on. In order to testify the five patterns of TP in academic English writing of business and management, we download and select some research articles from journals in the field of business and management to build a small scale corpus for Business and Management Academic English Writing. After then, we pick out some paragraphs or sentences as the materials for analyzing different types of TP.

### **2.1 Linear Progression**

Simple linear theme progression pattern is also called zigzag progression: The rheme of the previous clause becomes the theme of the succeeding clause, as illustrated below: (T stands for Theme and R for Rheme, N for the numbers of clauses)

**T1→R1**



**T2 (=R1) →R2**



**Tn=(Rn-1) →Rn**

Eg.: European support (T1) is one thing he might be able to offer on his return (R1). He (T2=R1) also needs to assuage the fears about Soviet involvement in the Middle East (R2). This (T3=R2) would be implicit in any conference held under the aegis of the Security Council (R3).

## 2.2 Constant progression

Constant progression refers to the theme of the first clause will be repeated to be the themes in the succeeding clauses. This pattern is easy to be considered as a monotonous way of the repetition of the same theme. However, it is helpful to make the text clear focus. The pattern of constant progression can be simplified as:

**T1→R1**



**T2(=T1)→R2**

...

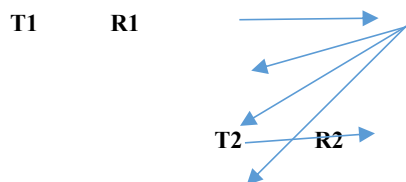


**Tn=(T1)→Rn**

Eg.: The marketing mix (T1) is generally accepted as the use and specification of the ‘four Ps’ describing the strategy position of a product in the marketplace (R1). The marketing mix (T2=T1) is a set of controllable, tactical marketing tools that work together to achieve company’s objectives (R2). One version of the marketing mix (T3=t1) originated in 1948 when James Culliton said that ....

## 2.3 TP with derived Rheme

TP with derived Rheme, also known as split rheme progression, refers to a paragraph organization when a previous rheme consists of a number of different pieces of information, each of which might be used as the theme in the same number of subsequent clauses as demonstrated below. This pattern indicates a strong sense of planning from the writer for the whole paragraph development, showing the writer’s strategic ideas conducted prior to the writing activity (Emilia, 2010).



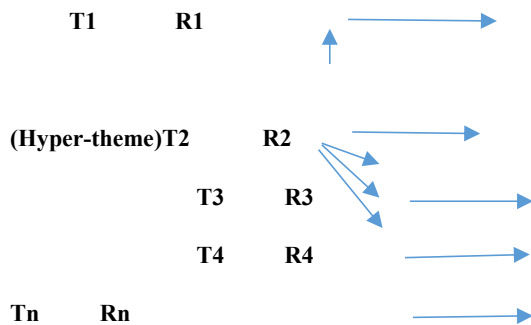
T3 → R3 →

T4 → R4 →

Eg.: SAPARD (T1) will finance 11 measures in Romania between 2000-2006 (R1). Out of these 11 measures (T2=R1), 6 are expected to be launched in 2003, namely (R2). The other measures (T3=R1) could also be launched depending on their accreditation process (R3).

## 2.4 Hyper-theme progression pattern

Hyper-theme progression pattern is characterized when the particular themes from the subsequent clauses are derived from a hyper-theme or from the same overriding theme. This pattern is always likely to take some cohesive devices, such as reference, reiteration, substitution, etc., to avoid the problem of unnecessary repetition of the same words when the same theme is repeated in the succeeding clauses. These characteristics are the featuring distinction from the constant progression. The pattern schema can be illustrated as below:



Eg.: *Spack and Zamel* (1983), studying ESL writers, corroborated *Hayes and Flower's* findings about the writing process for their populations. (2) *Raimes* compared ESL students' composing processes with other researchers' findings on L2 basic writers, and concluded that the two groups of students had much in common. (3) Both *Krapels* (this volume) and *Friedlander* (this volume) continue the discussion of ESL writing process research.

In this example, each individual clause theme is different from the shadow meaning---- they each refer to a different person who is a language researcher. However, in the deeper sense, they are all related under the super-theme of researchers on writing, referring to Spack, Zamel, Raimes, Krapels and Friedlander. The writer takes substitution, one of the cohesive devices, to avoid the direct repetition of researchers in the paragraph.

## 5 Conclusion

Theme and rheme are the blocks of building meaningful texts in terms of what occurs first, and what follows second. When theme is fixed to be taken as the point of departure for each clause and rheme follows as the development of information, a pattern of thematic progression can be established contributing to the coherence of a text by determining the way thematic elements succeed each other. This is one of the most important functions that thematic progression can take both hands of clause and text--- to direct a clause development is to orient the text coherently, as what has been perceived by Halliday:

“It is no accident that it is possible to illustrate so many of the relations in a text by reference to relations in a clause. ... In showing that the text has structure, coherence, function, development and character, we cannot help at the same time showing that a clause has all these things too, though in an interesting variety of different ways. Presumably this is how clauses evolved — as the most efficient means of encoding text.”

The four types of TP patterns are designed to wave the deeper coherence in texts. The findings of this article have confirmed Halliday’s insights of absorbing the concepts of theme and rheme into SFL. Without the theory of theme and TP, our understanding of how clauses are organized to be a coherent text would be much paler. Thematic progression is surely not a panacea for all our questions in language teaching and writing. However, it is a powerful and down-to-earth way of structuring the crucial characteristics of discourses, enriching them to be a logic coherent text. Therefore, Theme and TP should be taken into account by teachers of L2 writing.

### **Acknowledgement**

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# Evaluation of Wushu Tourism Synergic Development Based on Fuzzy Hierarchy Analysis

Yang Wei<sup>1</sup>, Yi Peng<sup>2</sup>

1 School of Economics, Wuhan Donghu University, Wuhan, P.R.China, 430212

2 Sports Department, Wuhan University of Technology, Wuhan, P.R.China, 430070

(Email: 763684285@qq.com, 13476188559@163.com)

**Abstract:** Wushu tourism is a new industry with the characteristics of Wushu and tourism. It is becoming an important part of sports tourism and a new growth point of national economic development. It is deeply loved by the people. The Wudang Wushu tourism synergic development evaluation index was constructed by using the analytic hierarchy method. The visual value, cultural value, tourism conditions, and environmental conditions were used as the secondary indexes, and the three indicators of fighting skills, novelty degree, aesthetic feelings, and practical efficacy were selected to establish a systematic and scientific evaluation system. Using fuzzy level analysis and expert weight calculation method, Wudang Wushu cultural tourism was evaluated comprehensively.

**Key words:** Wushu tourism; Synergic development; Fuzzy analytical hierarchy process; Evaluation system

## 1 Introduction

In recent years, with the healthy, sustainable and stable development of China's national economy, more and more residents have a higher demand for leisure and entertainment from visual to participatory. Wushu tourism is an important part of the sports industry and tourism industry, and has gradually become China's sunrise and emerging industries. The Wushu tourism industry is characterized by green, environmental protection, low energy consumption, high returns, and sustainable development. It is deeply loved and concerned by domestic and foreign tourists. The birthplaces of traditional Wushu schools around China make use of local scenic resources with Wushu culture as the feature to exert the function of tourism and to promote the development of sports, exhibitions, accommodation and other related industries. For example, the "Dengfang Shaolin Wushu Tourism Festival" held in Henan Province, the "Hubei Wudang International Tourism Festival" held in Hubei Province, and the "International EmeiWushu Festival" held in Sichuan Province.

Jiang Rui (2014) pointed out that Wudang Mountain has very good foundation for the development of Wushu tourism, and she gave the corresponding strategies for the development. Ezwani Azmi (2016) made a study of cultural heritage and tourism, the synergic development of which had got remarkable achievements. Peng Peng (2018) reviewed Wudang Wushu cultural heritage which has been deeply rooted in Taoist culture for a long time under the social background of the returning of Chinese traditional culture and the continuous improvement of the national cultural soft power construction. Zeng Shuai et al.(2019) pointed out that the internal advantages of Wudang Wushu resources are ecological environment, cultural background and brand effect, while the internal disadvantages are inadequate management, scattered resources and low efficiency.

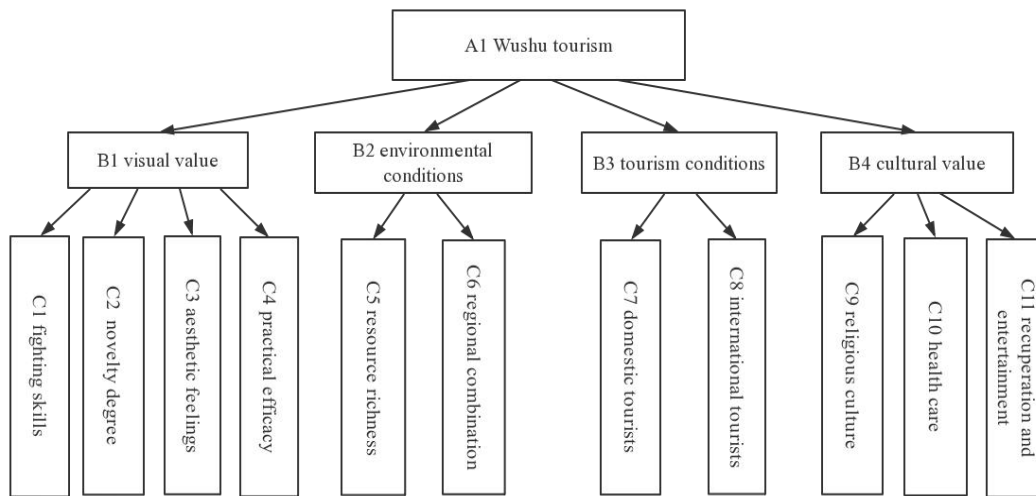


On the base of the research results of comprehensive evaluation of sports tourism at home and abroad, the evaluation index system of Wudang Wushu tourism synergic development including Weights of each index and total score were constructed by carrying out online questionnaire surveys in various places, inviting experts to evaluate, and using analytic hierarchy process (AHP) and fuzzy comprehensive evaluation method to make overall evaluation of Wushu tourism.

## 2 Construction of Evaluation Model for Wushu Tourism synergic development

### 2.1 Building a hierarchy model

The development of Wushu tourism is the integration force generated by various factors. In order to achieve the overall goal, the problem is decomposed into different components and membership structure to form a structural model. The AHP model is mainly divided into three levels. First, the highest target level is the value of Wushu tourism resources (a1). Second, the middle level is the standard level which includes visual value (b1), environmental conditions (b2), tourism conditions (b3), and cultural value (b4). Third, the lowest level r is the scheme level which includes fighting skills (c1), novelty degree (c2) aesthetic feelings(c3), practical efficacy (c4), resource richness (c5), regional combination (c6), domestic tourists (c7), international tourists (c8), Religious culture (c9), health care (c10), recuperation and entertainment(c11).



**Figure 1 Model of Wushu Tourism Synergic Development**

### 2.2 Constructing a pairwise comparison matrix

According to the expert evaluation method, the importance degree of the relationship between the elements of each level is scored. By determining the importance of the lower level indicators to the actual upper level indicators, the “1-9” scale method is used to score and construct a judgment matrix of pairwise comparison. We use the importance of AHP to assign scores to the judgment matrix of Wushu tourism synergic development.

### 2.2.1 The judgment matrix analysis on the evaluation of Wushu tourism development

Wushu tourism is a sunrise industry with characteristics of Wushu and tourism which integrates and derives from Wushu and tourism. It is gradually becoming a new bright spot of modern tourism after ecological tourism, a new growth point of national economic development, and an important part of tourism. The evaluation index system on Wushu tourism synergic development consists of four parts: visual value, environmental conditions, tourism conditions and cultural value.

**Table 1 Judgment Matrix of Secondary Indicators B1, B2, B3, and B4 for A1**

A1	B1	B2	B3	B4
B1	1	3	3	1
B2	1/3	1	3/4	1/5
B3	1/3	4/3	1	1/4
B4	1	5	4	1

### 2.2.2 The judgment matrix analysis on the evaluation of visual value

The visual value is the external appearance of Wushu performance. And the essence of Wushu performance is a way of entertainment. The audience gains an aesthetic experience and psychological satisfaction by watching Wushu performances such as: WudangKungfu Group, Shaolin Wushu Performance Group, and Wudang Taoist Kungfu Group. The evaluation index system of Wushu visual value consists of fighting skills, novelty degree, esthetic value and practical efficacy.

**Table 2 Judgment Matrix of Secondary Indicators C1, C2, C3, and C4 for B1**

B1	C1	C2	C3	C4
C1	1	3/2	2	5
C2	2/3	1	3/2	3
C3	1/2	2/3	1	5/2
C4	1/5	1/3	2/5	1

### 2.2.3 The judgment matrix analysis on the evaluation of tourism environmental conditions

The tourism environment is a harmonious combination of mountains, water, forests, deserts, Gobi, buildings, weather changes, and humanities. The Wushu tourism environment generally consists of good natural environment, humanistic environment and Wushu cultural products. Specifically, the tourism environmental conditions are composed of resource richness and regional combination.

**Table 3 Judgment Matrix of Secondary Indicators C5, C6 for B2**

B2	C5	C6
C5	1	1/2
C6	1/2	1

#### 2.2.4 The judgment matrix analysis on the evaluation of tourism conditions evaluation

The tourism conditions are generated by the evolution of the residents themselves and the process of social development, as well as the expression of human beings' pursuit of a better life. The basic conditions are the development of human consciousness, the improvement of diversified needs, and the development and progress of society, economy, culture, etc. The tourism conditions as an important part of Wushu tourism, consist of domestic tourism and international tourism.

**Table 4 Judgment Matrix of Secondary Indicators C7, C8 for B3**

B3	C7	C8	
C7	1	5	0.691
C8	1/5	1	0.309

#### 2.2.5 The judgment matrix analysis on the evaluation of Wushu culture environment conditions

Culture is a fertile ground for the Chinese nation to continue, to develop and to grow. It plays an important role in the continuation of Chinese civilization, the promotion of human civilization and the promotion of mutual exchanges. And as an important part of China's intangible cultural heritage<sup>[3]</sup>, Wushu culture is attached to the basic thoughts of ancient traditional Confucianism and Taoism. The index system of cultural environment consists of religious culture, health care, recuperation and entertainment.

**Table 5 Judgment Matrix of Secondary Indicators C9, C10, C11 for B4**

B4	C9	C10	C11
C9	1	1/5	1/3
C10	5	1	3
C11	3	1/3	1

### 2.3 Determining the Weight Value of Each Indicator

The evaluation index system of Wushu tourism co-development consists of various elements. The design of each index system and the selection of evaluation indicators must be scientific, systematic and dynamic, which can objectively and truly reflect the characteristics and conditions of the environment, the economy and social development of Wushu, and should objectively and comprehensively reflect the

real relationship between each indicator. Through systematic calculation,  $w_1=(b_1,b_2,b_3,b_4)=(0.3537,0.0966,0.1178,0.4319)$ ;  $w_2=(c_1,c_2,c_3,c_4)=(0.424,0.283,0.205,0.088)$ ,  $(b_5, c_6) = (0.5, 0.5)$ ;  $w_3 = (0.146, 0.566, 0.288)$ .

**Table 6 Table of Wushu Tourism Synergic Development Index System**

Indicator domain	Weights	Indicator domain	Weights
Visual value	0.3537	Fighting skills	0.424
		Novelty degree	0.283
		Practical efficacy	0.205
		Aesthetic feelings	0.088
Environmental conditions	0.0966	Resource richness	0.5
		Regional combination	0.5
Tourism conditions	0.1178	Domestic tourists	0.691
		International tourists	0.309
Cultural value	0.4319	Religious culture	0.146
		Health care	0.566
		Recuperation and entertainment	0.288

#### 2.4 Consistency test on the judgment matrix

When experts judge the importance of indicators, they should guarantee the consistency of their judgments and avoid contradictory results. Therefore, in order to ensure the conclusions obtained by the application of AHP analysis are reasonable, it is necessary to conduct consistency test on the constructed judgment matrix. The specific formula is:  $cr=ci/ri$ . And by doing that, we get:  $CR(A1) = 0.009 < 0.1$ ,  $CR(B1) = 0.0018 < 0.1$ ,  $CR(B2) = 0 < 0.1$ ,  $CR(B3) = 0 < 0.1$ ,  $CR(B4) = 0.037 < 0.1$ .

**Table 7 Judgment Matrix of Order, RI Values**

Matrix order	R·I	Matrix order	R·I	Matrix order	R·I
1	0	4	0.89	7	1.32
2	0	5	1.12	8	1.41
3	0.58	6	1.24	9	1.45

### 3 Fuzzy Evaluation of the Synergic Development of Wudang Wushu Tourism

#### 3.1 Data collection

This paper takes the Wushu tourism in Wudang mountain scenic as the research object and constructs the fuzzy evaluation of the synergic development of Wushu tourism. Ten experts were invited to evaluate the decision-making indicators in the indicator system according to the five levels of very good, good, normal, bad and very bad. The very good level represents that the experts highly praise the project and believe it is worthy of vigorous promotion. And the good level means that the project deserves to be recommended, but there is some need to improve in a small aspect. The general degree is relatively inferior and needs to be improved more. The poor result indicates that the project is not suitable for promotion and needs to be reformed. The very poor degree means that the project needs to be solved urgently, and even deleted and rectified. The judging statistical results are shown as follows:

**Table 8 Fuzzy Comment Evaluation Form**

Indicator domain	Weights	Indicator domain	Weights	Comment level domain v				
				Very good	Good	General	Poor	Very poor
Visual value	0.3537	Fighting skills	0.424	0.6	0.3	0.1	0	0
		Novelty degree	0.283	0	0.2	0.8	0	0
		Practical efficacy	0.205	0.2	0.3	0.4	0.1	0
		Aesthetic feelings	0.088	0.1	0.7	0.1	0	0
Environmental conditions	0.0966	Abundant resources	0.5	0	0.9	0.1	0	0.1
		regional combination	0.5	0	1	0	0	0
Tourism conditions	0.1178	Domestic tourists	0.691	0.4	0.5	0.1	0	0
		International tourists	0.309	0	0.3	0.6	0.1	0
Cultural Value	0.4319	religious culture	0.146	0.9	0.1	0	0	0
		health care	0.566	0.8	0.2	0	0	0
		Recuperation and entertainment	0.288	0.3	0.5	0.2	0	0

#### 3.2 Solution of the model

Fuzzy comprehensive evaluation is to provide some evaluation methods for practical comprehensive evaluation problems by means of some concepts of fuzzy mathematics. The specific calculation process includes: (1) giving a set of evaluation factors; (2) finding a decision set of the

evaluation level,  $Y = (y_1, y_2, \dots, y_m)$  Etc.; (3) Obtain a fuzzy relation matrix of x to y, etc. According to the above data, the following fuzzy evaluation matrix can be obtained:

$$c_1 = \begin{bmatrix} 0.6 & 0.3 & 0.1 & 0 & 0 \\ 0 & 0.2 & 0.8 & 0 & 0 \\ 0.2 & 0.3 & 0.4 & 0.1 & 0 \\ 0.1 & 0.7 & 0.1 & 0 & 0.1 \end{bmatrix} \quad c_4 = \begin{bmatrix} 0.9 & 0.1 & 0 & 0 & 0 \\ 0.8 & 0.2 & 0 & 0 & 0 \\ 0.3 & 0.5 & 0.2 & 0 & 0 \end{bmatrix}$$

$$c_2 = \begin{bmatrix} 0 & 0.9 & 0.1 & 0 & 0 \\ 0 & 1 & 0 & 0 & 0 \end{bmatrix} \quad c_3 = \begin{bmatrix} 0.4 & 0.5 & 0.1 & 0 & 0 \\ 0 & 0.3 & 0.6 & 0.1 & 0 \end{bmatrix}$$

Calculating the evaluation result of the scheme, and we can get:

$$[0.424 \ 0.283 \ 0.205 \ 0.088] \begin{bmatrix} 0.6 & 0.3 & 0.1 & 0 & 0 \\ 0 & 0.2 & 0.8 & 0 & 0 \\ 0.2 & 0.3 & 0.4 & 0.1 & 0 \\ 0.1 & 0.7 & 0.1 & 0 & 0.1 \end{bmatrix}$$

$$=[0.3042 \ 0.3069 \ 0.3596 \ 0.0205 \ 0.0088]$$

In the same way:

$$[0 \ 0.95 \ 0.05 \ 0 \ 0]$$

$$[0.2764 \ 0.4382 \ 0.2545 \ 0.0309 \ 0]$$

$$[0.6706 \ 0.2718 \ 0.0576 \ 0 \ 0]$$

Based on the above results, the fuzzy evaluation matrix is further constructed:

$$B = \begin{bmatrix} 0.3042 & 0.3069 & 0.3596 & 0.0205 & 0.0088 \\ 0 & 0.95 & 0.05 & 0 & 0 \\ 0.2764 & 0.4382 & 0.2545 & 0.0309 & 0 \\ 0.6706 & 0.2718 & 0.0576 & 0 & 0 \end{bmatrix}$$

According to the above calculations, the overall evaluation results are obtained:

$$A = [0.3537 \ 0.0966 \ 0.1178 \ 0.4319] \begin{bmatrix} 0.3042 & 0.3069 & 0.3596 & 0.0205 & 0.0088 \\ 0 & 0.95 & 0.05 & 0 & 0 \\ 0.2764 & 0.4382 & 0.2545 & 0.0309 & 0 \\ 0.6706 & 0.2718 & 0.0576 & 0 & 0 \end{bmatrix} = [0.4298 \ 0.3693$$

$$0.1869 \ 0.0109 \ 0.0031]$$

In order to integrate the comprehensive fuzzy evaluation A into a number, each numerical value is

given a weight according to the opinions of experts, the five levels are 100, 80, 60, 40 and 20, respectively. The total value of the evaluation is

$$Sum = \sum_{j=1}^4 a_j \times W_j = 100 \times 0.4298 + 80 \times 0.3693 + 60 \times 0.1869 + 40 \times 0.0109 + 20 \times 0.0031 = 84.236.$$

It can be concluded from the above results that WudangWushu tourism is still good in the overall evaluation system, which is consistent with the actual situation. Wudang Mountain is a world cultural heritage site and a national AAAAA scenic spot. It is also famous for Taoist mountain and the birthplace of WudangWushu which has the prerequisites for WudangWushu tourism and has unique advantages compared with other similar products.

## 4 Conclusion

The WudangWushu tourism cooperative evaluation index was constructed by using the analytic hierarchy process(AHP)and fuzzy evaluation method .In order to evaluate the WudangWushu tourism, the visual value, cultural value, tourism conditions, and environmental conditions were used as the secondary indexes, and the three indicators of fighting skills, novelty degree, Aesthetic feelings, and practical efficacy and etc. were selected as the third-level indexes to establish a systematic and scientific evaluation system, combined with the expert experience to establish the weight of each index .After evaluation, WudangWushu is still good in the overall evaluation system. The result can accord with the actual situation. At the same time, WudangWushu tourism needs further development, and the following aspects need to be achieved, including: doing WudangWushu tourism brand promotion, digging the cultural connotation of WudangWushu, improving WudangWushu tourism infrastructure, and training compound Wushu tourism talents.

## Acknowledgement

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## **A Research on Innovative Teaching Practice:**

### **A Net-based Case Study of Culture and Translation Course**

Yang Jing, Wang Aijun\*, Li Lihua

School of Foreign Language, Wuhan University of Technology, Wuhan, P.R.China,430070

(E-mail: yangjwhut@126.com,waj011@126.com, Lilihua@126.com )

\*Corresponding author: Wang Aijun, email: waj011@126.com

**Abstract:** New requirements are put forward on the contemporary outstanding talent cultivation in this new era, the development of modern education technology provides new methods for talent training. This research focused on the innovative reform of the subsequent stage course of college English, Culture and Translation. In the innovative teaching and reform practices, blended learning and teaching methods were employed, teaching resources were integrated, network platform was constructed, and learning paths were optimized. Feedback of questionnaires, tests and interviews show that the reform is effective and successful, which provides a feasible way to the cultivation of professional high-level talents with cross-cultural communication ability and humanistic qualities.

**Key Words:** Culture and Translation; Blended learning; Network platform construction; Learning path optimization; Innovative reform

## **1 Introduction**

Presently, humanities education is greatly challenged by the call of strengthening the new engineering construction to cultivate outstanding talents. However, domestic science and engineering universities and colleges, the training bases of high-tech talents, do not attach sufficient importance to humanities education. Current higher education should aim at cultivating all-round intellects with the support of modern education and network technology, enhancing the students 'comprehensive quality and innovative thinking (Xi, 2018). Among the college curricula, "College English is not only a language course that provides basic knowledge about English, but also a capacity enhancement course" (Higher Education Department of Ministry of Education in China, 2007), it provides a perfect platform for humanity cultivation.

With the development of technology and the change of education concept, college teaching mode is undergoing an historical transformation of digitization, networking and globalization in which blended learning and teaching is undoubtedly its focus. In the early 1990s, Professor Mazur in Harvard claimed the importance of computer as a tool in teaching (Mazur, 1991) and founded a brand-new teaching method, i.e., by means of peer interaction to facilitate learning, using physical environment to stimulate learning, imitation, peer teaching and modeling, and collaboration. Then the concept of flipped classroom began to take shape (Lage, et al, 2000). In 2002, by introducing e-learning into traditional learning, Garrison& Vaughan (2008) proposed the concept of Blended learning.

In China, relevant research has been made in the course of College English. Students' attitudes towards flipped classroom model were investigated and analyzed through quantitative and qualitative research (Hu&Wu, 2014). And Zhu's empirical research proved the effectiveness of blended teaching over traditional means of teaching (Zhu, 2016).However, previous researches on blended teaching of

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College English mainly focused on the construction of teaching model (Ma & Zhang, 2011), or the improvement of listening, speaking, reading and writing skills (Liu, 2016; Huang & Li, 2015; Zhang, 2013). Comparatively, corresponding studies on translation are much less, and the limited researches are restricted to the construction of test-oriented teaching mode (Zhang, 2018; Xiang, 2017). Though “culture in language learning is never an expendable fifth skill, it’s always in the background to make sense of the world around the learners” (Kramsch, 1993), few studies have been made on cultural knowledge extension courses targeted at non-English majors in the subsequent stage of College English, let alone researches on integrating culture appreciation, cross-cultural communication and translation ability cultivation through college English course learning, which, nevertheless, is seriously inconsistent with the requirements of talent cultivation for the construction of knowledge system and the improvement of humanistic quality.

## **2 Net-based Culture & Translation Course Teaching and Reform Practices**

In line with the outstanding talents international training strategy, taking science and engineering undergraduates as the subject, this research, on the ground of network platform technology, introduced flipped classroom practice into translation teaching, combining intercultural communication ability training and humanistic quality cultivation. Up to now, nearly 4 consecutive rounds of teaching practices have been fulfilled in the course of Culture and Translation as subsequent stage course of College English, and the result has proved to be positive and notable.

The reform practices are listed as follows:

### **2.1. Integrating high-quality teaching resources**

Authentic materials were selected and culture modules were properly set. While collecting and editing teaching materials, researchers attach great importance to intercultural communication knowledge accumulation and text translation skills practice, and 8 modules were set, covering language, food, movie, tourism, art, philosophy and religion, etc.

### **2.2 Constructing net-based teaching and learning platform**

Online Culture and Translation course was built to expand learning resources. Teaching videos which were well-selected and recorded, accompanied by a number of corresponding learning resources based on each culture module were shared on the platform; exercises and assignments were systematically delivered and evaluated on the network platform as well.

### **2.3 Exploring effective teaching modes**

The course adopted blended teaching methodology, which combines online and offline teaching and learning. Online course was problem-driven and task-driven, mostly inquiry-driven, focusing on the accumulation of basic translation skills, and the extension of humanistic knowledge. Students’ learning status was monitored automatically online with self-assessment. Offline activities were mainly output driven, focusing on stimulating learners’ motivation, taking discussions and case study as the main forms of classroom organization. Various authentic cross-cultural communication texts were employed for translation exercises, classic translation appreciation and evaluation via program decomposition or interactive cooperation to cultivate students’ awareness of equal dialogue in cross-cultural communication so as to accumulate professional experience. The in-class teaching activities emphasized the cultivation of students’ critical thinking and problem-solving ability. Students were required to translate authentic materials and explore solutions to various translation problems.

## 2.4 Optimizing the learning path

To maximize the provision of learning resources, BBS interactive activities and email interaction were also adopted to provide students with learning materials and communication channels in addition to releasing video teaching resources and homework exercises on the online teaching platform.

## 2.5 Establishing a multi-evaluation mechanism

A blended teaching evaluation system was established, a multi-evaluation mechanism which involved both evaluation forms and parameters, emphasizing stage-dependent evaluation, evaluation indicators and comprehensive elements, while comparatively restricting the subjectivity and increases the objectivity and impartiality of evaluation as far as possible.

## 3 Results and Analysis

In this research, qualitative and quantitative methods were adopted to probe into the application of online translation tools, learners' motivations and basic translation ability before taking the course, factors influencing the learners' translation proficiency, effectiveness of the course, students' degree of approval when the course ended and students' evaluation to the course. Corresponding data were collected in the form of questionnaire, interview and test for analysis.

### 3.1 Pre-course data and analysis

Pre-course data (Fig.1) shows that only 49.61% of students translate all by themselves and refer to translation tools only when it's necessary before taking the course, which indicates that students have limited theoretical knowledge and practical skills of translation, and lack of translation practice, resulting in their limited translation ability, which has a great impact on their confidence in translation. Nearly half of the subjects expect that this course, which is for the subsequent stage of college English, will be of some help for them to pass CET-band 4 and CET-band 6, while most students taking this course desire to improve their language skills and broaden their horizon, which demonstrates that their lifelong learning desires and expectations are far more significant rather than utilitarian test-oriented study ( Fig.2).

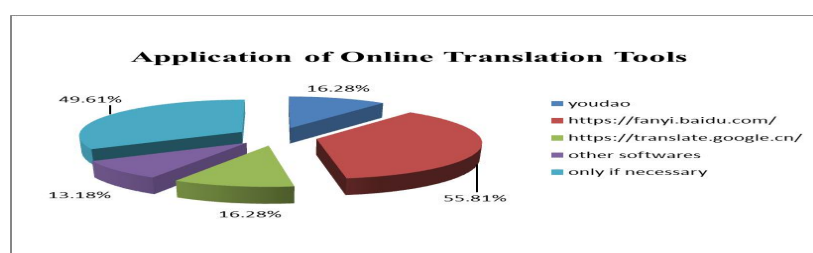


Figure 1 Application of Online Translation Tools

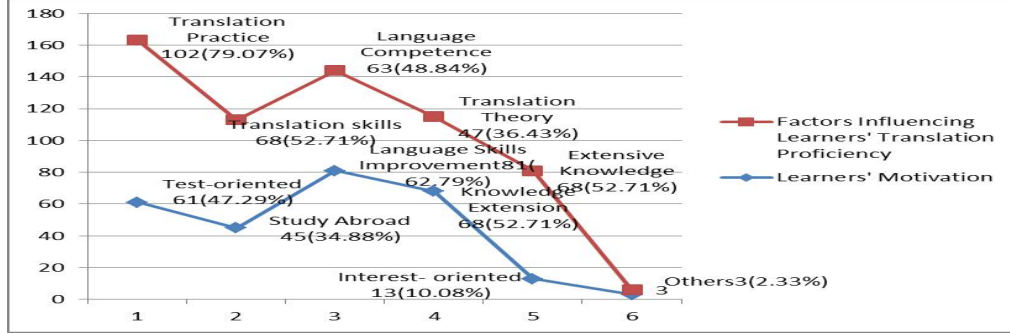


Figure 2 Learners' Motivation vs. Factors Influencing Learners' Translation Proficiency

### 3.2 Post-course data analysis

#### 3.2.1 Effectiveness of the Course

The post-course data on the effectiveness of the course indicates students have a better understanding of translation. They've learned that the improvement of translation ability depends on many factors, translation practice, translation skills and extensive knowledge, language competence and theoretical knowledge, all of which are indispensable for the improvement of translation competence.

As Fig.3 shows, all learners admit that the course is helpful to the improvement of their translation ability, and about 1/3 of the learners think the course is very effective; and a corresponding 1/3 of the learners agree the course is very effective and half think it is effective in broadening their knowledge and horizons. In the aspect of communication ability, 97.67% of the students admit that this course is beneficial to the improvement of their cross-cultural communication ability. As to the cultivation of critical thinking ability, about 60% of the subjects believe it is of great help, but about 9% of the learners have no awareness of the objective of the course, especially in the aspect of cultivating critical thinking.

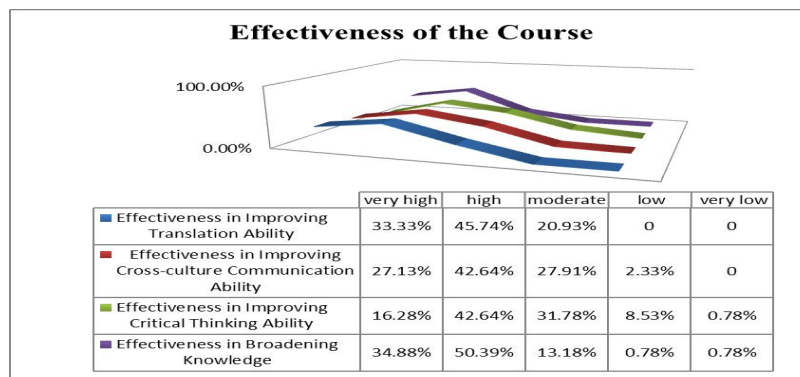
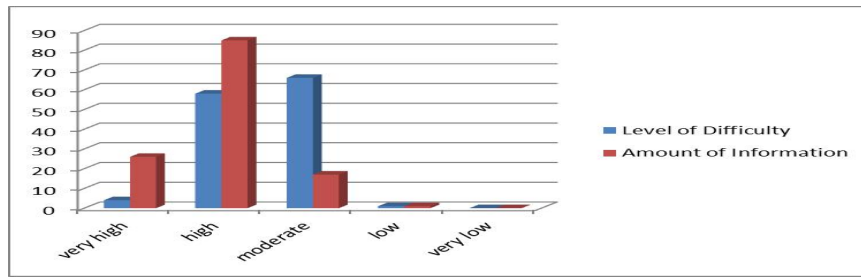


Figure 3 Effectiveness of the Course

#### 3.2.2 Level of Difficulty & Amount of Information

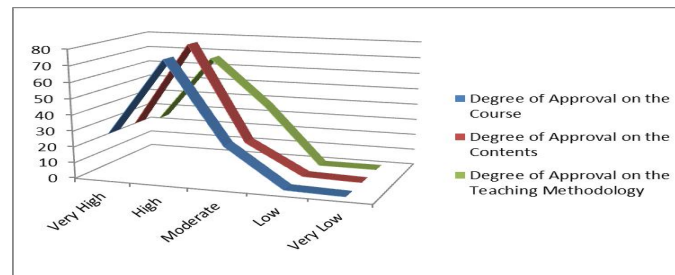
Investigation indicates, although most subjects agree this course is informative, only about 3% of the subjects think it is very difficult, half of the learners think it is quite difficult, but more than half of



**Figure 4 Level of Difficulty vs Amount of Information**

In total, 86% of the subjects think that the course is very informative, above average level, but less than half of the subjects think that the course is difficult, which proves that in the process of lecture preparation and course teaching, it is necessary and feasible to be highly informative to motivate the learners without much negative influences.

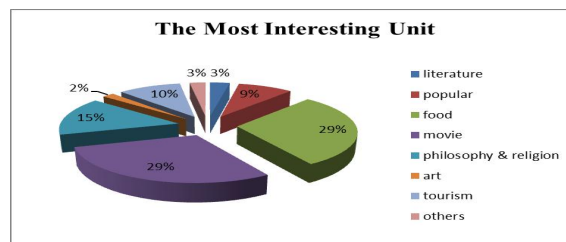
All the subjects agree the course is impressive, the contents of the course are well chosen and interesting, and the teaching method is effective. Only 0.78% of the subjects show no interest in the course. Figure 5 shows, the data curves of the three fit well, which suggests the three parameters are significantly corresponding and proportional to each other, proving the validity and effectiveness of the investigation. The results proved net-based innovative teaching supported with abundant materials and blending teaching practices is positively effective.



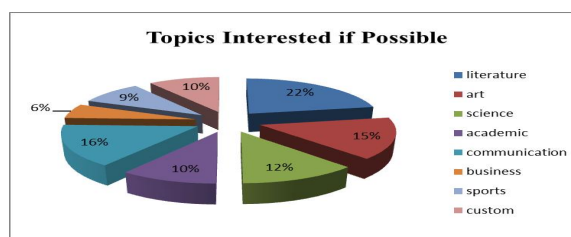
**Figure 5 Degree of Approval on the Course, the Contents & the Teaching Methodology**

### 3.2.3 Suggestions & Feedback

Open interviews and questionnaires were made focusing on learners' interest in each existing cultural module and learners' expectations for more culture modules.



**Figure 6 The Most Interesting Unit**



**Figure 7 Topics Interested if Possible**

Figure 6 & Figure 7 reveal the interest of the students. The feedback provides useful guidance for the selection of teaching materials and will play a certain reversal role in future teaching for students can always be active participants in assessing their own achievements and in planning how they will study the language (Genesee & Upshur, 1996), while teachers' reflections based on students' feedback about the most impressive and interesting culture module reveal a clue about the influence of limited in-class teaching time. With sufficient in-class time, online and offline interactive activities would be much more effectively guided and fulfilled so as to promote learners' motivation and achievements.

#### 4 Conclusion

Under the background of constructing new engineering disciplines, the present education scheme has made it harder and severer for the survival and flourishing of humanity disciplines, especially in science and technology schools which has no profound and holistic humanities education concept yet. This research shows that contemporary college students have a higher demand for the improvement of cross-cultural communication ability, knowledge extension and humanistic quality cultivation. Culture and translation course is exactly in line with the needs of the learners and the requirement of the society.

In the innovative course reform of Culture and Translation, an online platform of culture and translation was constructed to realize blended teaching and learning, by which knowledge internalization is better obtained and the combination of cultural information input and translation practice drills effectively stimulate the learners' motivation and interests, improve the learners' English translation and the output capacity. Meanwhile, learners' ability of intercultural communication and culture transmission has been significantly improved, and their awareness and concept of equal dialogue in intercultural communication are greatly strengthened.

The research shows the innovative course reform practices of Culture and Translation were highly evaluated and welcomed by learners, for the practices highlight the importance of language as a carrier of human spirit, knowledge (Xu, 1991) and an international communication tool. The reform promotes the transformation of learners' practical ability to intercultural communication ability and even scientific research ability. Finally, it may provide a feasible way to train professional and high-level intercultural communication talents that meet the needs of the society.

In addition, the research has proved that college English teaching under the network environment must attach great importance to the aspects listed as follows: the importance of breaking through the limitation of traditional teaching mode which emphasizes too much on the training of basic language

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## College Students' Social Entrepreneurship:

### Status Quo, Determining Factors and Training Channels

Xiang Yongkun

Academic Affairs Office, Wuhan University of Technology, Wuhan, P.R.China, 430070

(E-mail: xyksky@whut.edu.cn)

**Abstract:** Guided by the concept of social public welfare, there exists a new mentality which integrate economic effectiveness with social efficiency, and widening the Employment path of College students. Built upon the existing theories and the experience drawn from other countries' useful experiences, this paper studies the status quo, business environment, and determining factors of college students' social entrepreneurship in China, aiming to explore the training ways and pluralistic supporting Mechanism of Public Welfare Entrepreneurship for College students in China.

**Key words:** Social Entrepreneurship; Status Quo; Determining Factors; Training Channels

## 1 Introduction

Under the background of mass entrepreneurship and public innovation, entrepreneurship has been paid attention by colleges and universities which they have been responding to national policies and carrying out entrepreneurship education. Colleges and universities would favor Public welfare entrepreneurship because that can not only achieve economic benefits, but also create social benefits in the operation.

Social entrepreneurship, commonly defined as “entrepreneurial activity with an embedded social purpose” (Austin, 2006), has become an important economic phenomenon at a global scale (Dacin, 2010). Some striking social entrepreneurship innovations originate from developing countries and involve the deployment of new business models that address basic human needs (Seelos and Mair, 2005). As a new form of practice, public welfare entrepreneurship has achieved good social and economic benefits in Western countries. Social Entrepreneurship is the ability of entrepreneurs to optimize the integration of the resources they own or the resources they can have through efforts to create greater social value (Tang Yayang, 2009). Unlike traditional entrepreneurship, which measures results through profitability and return on investment, the achievement of public-business entrepreneurship comes mainly from the impact of the project on society (Yuan Wen, 2018). As a social innovation process that emphasizes both righteousness and benefit, Social entrepreneurship plays a significant role in promoting economic growth, ensuring employment and maintaining social equity (Ayob, 2016). Therefore, college students participate in social entrepreneurship. While cultivating the challenge spirit of the entrepreneurial and innovation, they can also cultivate the spirit of entrepreneurs to take the initiative to assume social responsibility and disseminate mainstream values.

In recent years, with the development of China's social economy and the continuous improvement of the entrepreneurial environment, many non-profit organizations and social welfare enterprises have emerged (Wang Zhong, 2015). And the social entrepreneurial activities of college students have

## 2 The Current Situation of College Students' Social Entrepreneurship

Wuhan, Hubei Province, as a city of science and education, the number of college students have exceeded 1.3 million. In order to understand the cognition and practice of college students on social entrepreneurship, this paper selects 11 colleges and universities to conduct a questionnaire survey in Wuhan, such as Wuhan University, Huazhong University of Science and Technology, Wuhan University of Technology, Hubei University, Hubei University of Traditional Chinese Medicine, Wuhan University of Science and Technology etc. The subjects included college students, organizers of public welfare teams and teachers engaged in innovation and entrepreneurship education. A total of 860 questionnaires were sent out, 836 questionnaires were collected, and 827 valid questionnaires. Through the analysis of the questionnaire, this paper summarizes the current characteristics of college students' social entrepreneurship.

### 2.1 Lack of awareness and participation

Voluntary activities are good carrier activities for college students to participate in social practice, dedicate personal strength and exercise character by means of volunteer service. Among the effective questionnaire, 652 college students chose to participate in volunteer activities regularly, accounting for 78.84% of the number of people surveyed, 138 college students attend occasionally, accounting for 16.69% of the surveyed population, both add up to more than 90%, see figure 1.

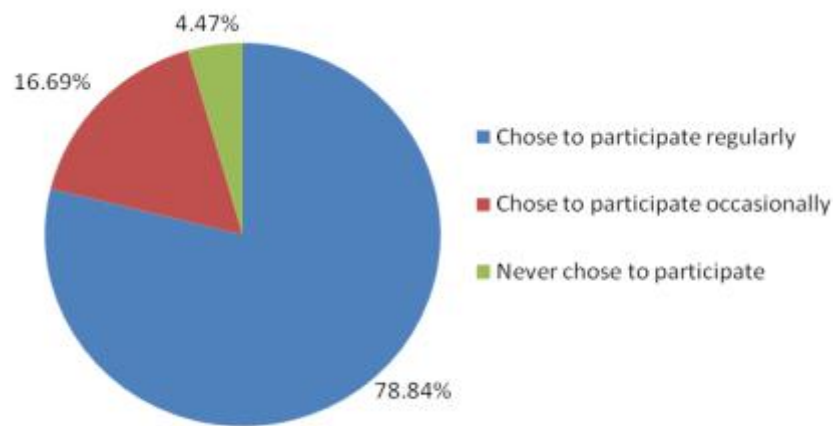
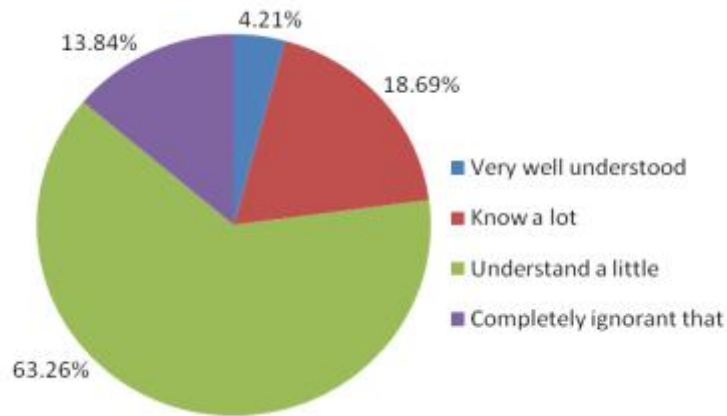


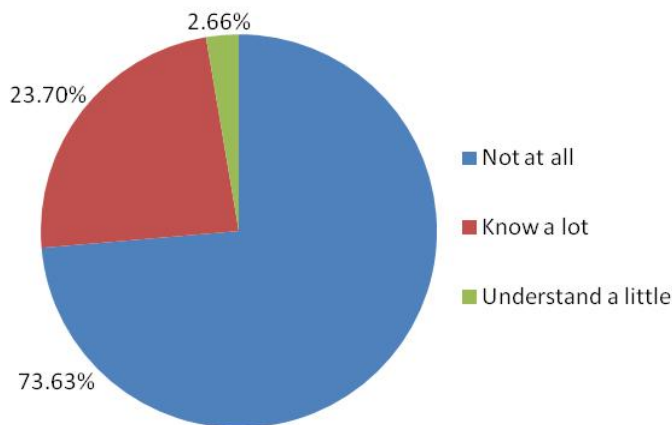
Figure 1 Status of College Students with Volunteer Activities

However, the college students' awareness about social entrepreneurship is low. They lack the understanding of the concept, connotation and value of social entrepreneurship, and participation in social entrepreneurs is rare. When the survey respondents answered the question "Do you understand the concept and characteristics of public welfare entrepreneurship", the survey statistics are shown in Figure 2.



**Figure 2 The Formation Process Model of Social Entrepreneurship Intention Activities**

When asked about “what are the works of the university's award-winning in the college students' social entrepreneurship competition” the number of people who chose “unclear” was 609, it is 73.64 percent. However, the college which the author works has achieved excellent results in social entrepreneurship in the national college students' entrepreneurship Competition in recent years. In recent years, the college which the author works has ranked first in the national college students' entrepreneurship Competition(Challenge Cup) in Hubei Province, some of the public welfare projects won national and provincial awards, but even that only 196 students know these works and achievements, accounting for 23.7% of the number of people surveyed. In the concept of public welfare entrepreneurship, 683 students have never considered social entrepreneurship, accounting for 82.59% of those surveyed. 74 students are planing their entrepreneurship projects, accounted for 8.95% of the surveyed population. 167 students said they had considered it, but they felt very difficult, accounting for 20.19% of the surveyed, see figure 3.



**Figure 3 College Students' Career Planning for the Future Intention Activities**

It can be seen that college students have a strong sense of participation and enthusiasm about volunteer activities, and they can also gain a lot by participating in volunteer activities, but their understanding of public welfare entrepreneurship is very inadequate. Even if there is an idea, due to the

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 lack of formal, systematic social entrepreneurship education and the cultivation of entrepreneurial ability, they can't properly carry out social entrepreneurship activities.

## 2.2 Lack of motivation and rationality

Among college students' choices for future career there are 631 students who chose to work or take the postgraduate exam or get to be civil servants, accounting for 76.30% of the surveyed. Only 97 people chose entrepreneurship, accounting for 11.73% of the survey. This result is combined with the actual situation of college students. In fact, it has also shown that college entrepreneurship education and social entrepreneurship have had a certain influence in college students in recent years, see figure4.

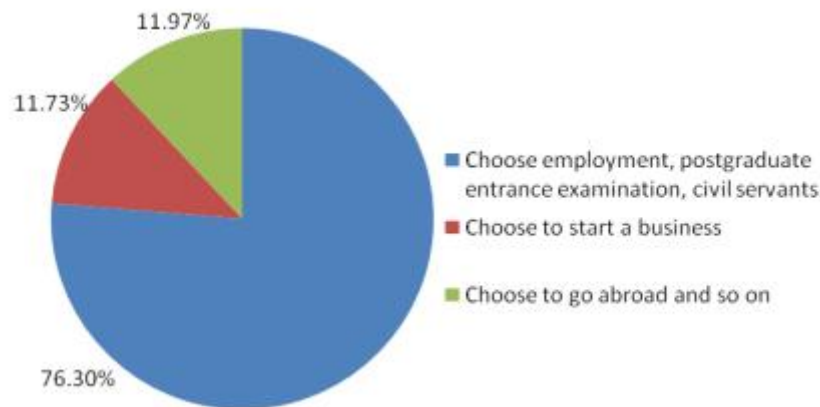


Figure 4 Understanding of Award-Winning Works about College' Social Intention Activities

Factors aspects of promoting social entrepreneurship students: 358 respondents who chose affected by entrepreneurs success people, accounting for 43.29 percent of those surveyed, 119 people choose to be influenced by their families, accounting for 14.39 percent of those surveyed. 194 people influenced by education and the school, accounting for 23.46% of the number of people surveyed, see figure 5.

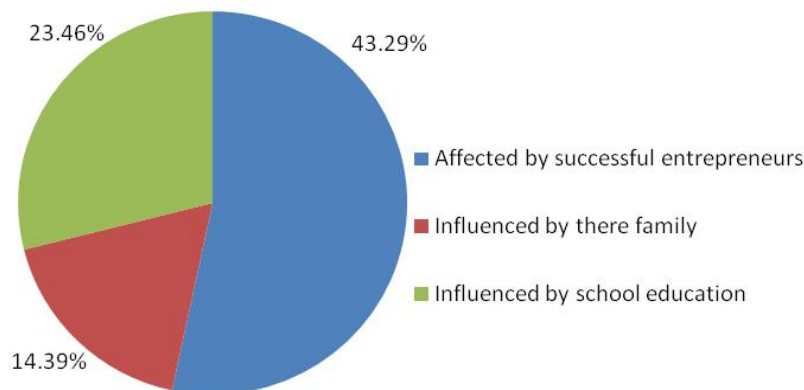


Figure 5 Understanding of Award-Winning Works about College' Social Intention Activities

Most of the motivations for college students to choose social entrepreneurship are influenced by individuals, with more enthusiasm but less rationality; the entrepreneurial process is not scientific, and

### 2.3 The difficulty of public welfare entrepreneurship

When asked about the main difficulties and obstacles in carrying out social entrepreneurship for college students, the statistics of multiple choices are shown in Table 1.

**Table 1 The Main Difficulties and Obstacles in Carrying out Social Entrepreneurship for College Students**

Alternatives	Quantity	Proportion (%)
Lack of entrepreneurial experience	625	75.57%
Lack of funds	671	81.14%
Social connections are not enough	534	64.57%
Lack of necessary reserves of knowledge and capacity	649	78.48%

The national entrepreneurial policy seems to be far away from college students. Which also shows that the knowledge and policy reserved by college students' entrepreneurship are insufficient, and there is a certain blindness. It's necessary to increase information services, policy services and entrepreneurship guidance.

### 2.4 Lack of effective operation mode

In the survey, we found that the content and scope of college students' public service entrepreneurship is too simple, and they often choose projects according to their own professional characteristics. For example, most college students majoring in normal schools are mostly concerned about the education of children left behind in rural areas and urban migrant workers in cities. Medical college students are mostly concerned about voluntary blood donation, the construction of bone marrow bank and other social issues. Due to the professional characteristics and the limitations of running schools, the existing public welfare organizations cover a relatively small scope, lack of grasp of market demand and social hot spots, and focus on the selection of public welfare projects, and the development prospects are not broad enough.

The investigation of the existing public welfare organizations of college students found that , 82% of the organizations surveyed are inspired by the voluntary activities of college students, by research on market needs are only 17%. Because college students do not investigate the social needs, the sensitivity to social problems is not positive enough, the transmission and acquisition of information are relatively single, leading to social entrepreneurship project features selected students are often high substitution, uniqueness, single project form, etc. Such as rural left-behind children, autistic children, public welfare blood donation and other projects are popular choices for social entrepreneurship among college students, and the repetition rate of the project is high.

In terms of the operation of existing public welfare organizations, most of them adopt non-market operation methods such as donation and fund raising. Therefore, the source of funds is limited, the operation difficulty is large, an effective commercial operation mode has not yet been formed, the sustainable development power is insufficient.

In summary, college students' public welfare organizations and volunteer activities are inseparable. They get inspiration through volunteer activities, and the establishment of public welfare organizations is the main mode. And established public welfare organizations can only rely on social donations to maintain the operation of the organization. Poor organizational stability, lack of business operation

### **3 The Main Influencing Factors**

#### **3.1 Society: the atmosphere has not yet been formed**

The development of social entrepreneurship in China is still in its infancy, and there is still a long way to go between college students' enthusiasm for social entrepreneurship and the support of the public and public opinions. The public has mistakenly equated social entrepreneurship with ordinary commercial entrepreneurship, and they lack an in-depth understanding of the social significance and value of social entrepreneurship, or even skepticism.

#### **3.2 Government: policies and systems are not yet in place**

The development of social entrepreneurship organizations cannot be separated from the support of policies and regulations. China's social entrepreneurship is currently in the initial stage of development, and the government's leading role in the development of public welfare organizations is lacking, so the support for public welfare entrepreneurship is extremely limited. At the same time, China's laws and regulations on social entrepreneurship are still incomplete, especially the rules of the entry of the social entrepreneurship is too harsh.

#### **3.3 Colleges and Universities: the entrepreneurship education system is not perfect**

Under the background of "mass entrepreneurship and innovation", entrepreneurship education has ushered in the spring of development. As a demonstration area for entrepreneurship education, the Hubei Provincial Department of Education requires the establishment of entrepreneurship colleges in the provinces and universities, and promotes the "professional + entrepreneurship" learning model to facilitate the cultivation of innovative and entrepreneurial innovative personnel. However, since social entrepreneurship is in the early stage of development in China, the understanding of social entrepreneurship is still inconsistent. So far, few colleges and universities have brought it into the entrepreneurship education system, let alone curriculum setting, teaching staff construction and other development measures. The ways for college students to participate in public welfare entrepreneurship are still limited to the regular volunteer activities such as public welfare organizations and social practice. The realistic conditions for the transformation of volunteer service into social entrepreneurship are not yet available. The lack of top-level design of public welfare education in colleges and universities, social entrepreneurship is not included in the mainstream entrepreneurial education system in colleges and universities, and it is a great constraint to promote social entrepreneurship.

#### **3.4 Individual: lack of entrepreneurs with public welfare personality**

According to Charles Leadbeater, a qualified social entrepreneur must have three abilities: entrepreneurial ability, innovation ability, and the ability to change the status quo (Charles Leadbeater, 2006). In addition to the entrepreneurial ability, a social entrepreneur should also have the characteristics of a special social welfare person. People with public welfare personality are often especially willing to help others, have significant dedication, have a low degree of desire for personal material return and enjoyment, and have a considerable tendency to share and encourage others to participate. Social entrepreneurship calls for entrepreneurs who are sensitive and capable of catching social problems, willing to give and altruistic.

#### 4 Searching and Structure the Support Patterns and Training Paths

Guided by the concept of social public welfare and taking into account the unity of economic benefits and social benefits, college students' social entrepreneurship is a new idea that entrepreneurship drives employment and broadens the employment path for college students. From the process of social entrepreneurship (see Figure 6), according to the analysis of Mair and Nobaa, the intention of social entrepreneurship requires a process, and entrepreneurial aspirations are influenced by two factors: personal social emotion and cognitive attitude. The feasibility of entrepreneurial cognition also needs the support of entrepreneurs' individual self-efficacy and social support (Yan Zhonghua, 2008). The organic combination of entrepreneurial desire and entrepreneurial cognitive feasibility results in entrepreneurial behavior. According to the process analysis of social entrepreneurship by Mair and Nobaa, the generation of social entrepreneurship is a process influenced by various factors. Based on the cognitive characteristics of college students, it adopts targeted encouragement and incentive measures to protect the entrepreneurial intention and promote the development of social entrepreneurship.

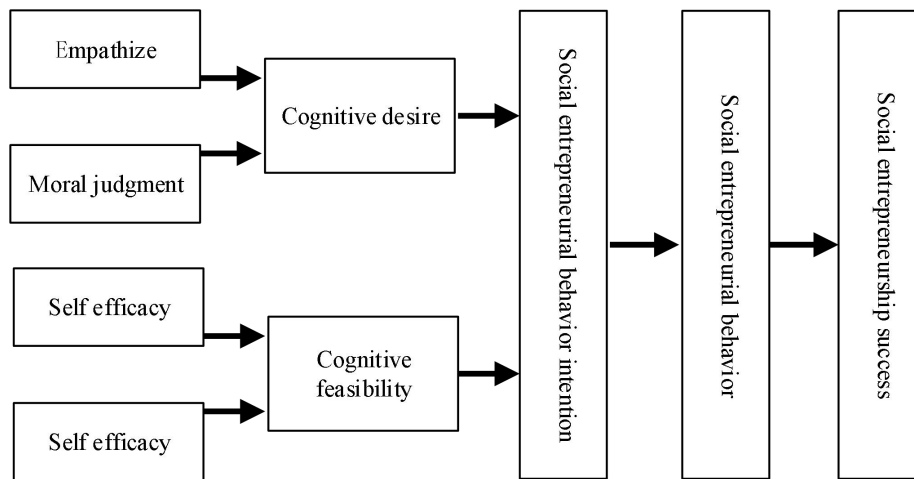


Figure 6 The Process of Social Entrepreneurship Intention Activities

##### 4.1 Strengthen the cultivation of college students' sense of social responsibility

Social mission is the inexhaustible motive force for the development of social entrepreneurship, and cultivating social responsibility awareness is the most important foundation for college students' social entrepreneurship. At present, college students have strong self-awareness, superior life, and attach great importance to personal interests, personal values, and personal futures. This has also led to the dilution of their sense of their social ownership. Therefore, in the construction of campus culture, it is necessary to pay more attention to the cultivation of college students' sense of social responsibility, expand the vision of career choice, establish a sense of citizenship, social risk awareness, charity awareness and self-discipline of fulfilling social obligations, and enhance public welfare. Therefore, broadening the social horizon, taking root in society, and tracking people's livelihood and public opinion have become the only way for college students to start a social entrepreneurship.

##### 4.2 Accelerate resource integration and increase capital investment

In recent years, the development of college students' social entrepreneurship has benefited a lot

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from the support and promotion of social enterprises and charitable organizations, including capital and technical support, information services, and personnel training, etc. The practice of foreign social entrepreneurship proves that enterprises and social organizations have incomparable advantages in the aspects of capital project docking, scientific research achievements transformation, industrial chain construction, and public welfare project financing and so on (Pan Jiajun, 2012). We can consider setting up a university student social entrepreneurship venture fund, supporting the entrepreneurial planning competition, conducting large-scale training and continuous resource tracking support for college students, conducting performance evaluation, and forming a cultural atmosphere that supports all-round social entrepreneurship.

#### **4.3 The Government formulates the supporting policies**

Social entrepreneurship is a new entrepreneurial model that has sprung up in China in recent years. The government should improve the construction of laws and regulations for the intellectual property protection system and entrepreneurship of college students. Clarify the social nature, status and role of college students' entrepreneurial organizations, safeguard the legitimate rights and interests of college students' entrepreneurship, and protect the enthusiasm and motivation of college students' social entrepreneurship. To create a good atmosphere of "everyone's support for entrepreneurship, everyone benefits", so that the whole society to care for, support and fund the entrepreneurial projects of college students, and constantly inject fresh blood into the project, but also let the successful project feed back the investment groups and individuals, forming a benign interaction.

#### **4.4 To Build a perfect educational system for public welfare in colleges and universities**

Universities are the gathering place of talents, and college students are the main body and main force of the future society. The overall quality of their entrepreneurship determines the future of Chinese society. Driven by mass entrepreneurship and innovation, universities should conscientiously implement the "Implementation Opinions on Deepening the Reform of Innovation and Entrepreneurship Education in Colleges and Universities", and comprehensively deploy and deepen the reform of innovation and entrepreneurship education in colleges and universities. Entrepreneurship education has become a positive choice for the concept and mode of innovative personnel training for local colleges and universities based on the development needs of the times and the personal development needs of students (Huang Zhaoxin, 2012). According to the actual situation, colleges and universities should formulate and implement plans in the aspects of innovative personnel training mechanism, improve the innovation and entrepreneurship curriculum system, strengthen the innovation practice

### **5 Conclusion**

First of all, in order to construct the path of public welfare entrepreneurship for college students, we must encourage college students to cultivate a sense of social responsibility and fulfill their obligations as a social ownership from the source. At the same time, they also need help and support from the society and colleges and universities in the capital, system and education system. Only in this way Only in this way can college students start social entrepreneurship easily, develop steadily and make achievements for it.

Secondly, colleges and universities should integrate various resources inside and outside the university to build a platform for innovation and entrepreneurship for college students. From the perspective of the school classroom, it is necessary to construct a scientific and innovative education curriculum system to form a benign interaction between academic and entrepreneurial education. From



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the perspective of practice, multiple extracurricular practice and training platforms are built, such as the off-campus practice education base for college students, science and technology incubation park, creative space and so on. Encourage students to start a business while learning, and cultivate students' spirit of quest for doubt, courage to explore and innovate. In the practice of innovation and entrepreneurship, develop keen market judgment and capture the vision and courage of market opportunities.

Thirdly, the construction of the team of social entrepreneurship instructors. College students have ideas and a little bit of experience, but they are still insufficient in terms of management methods and social experience. If there is no good guidance team, the project is easy to die in the early stages of development. Therefore, it is extremely urgent to build an experienced and capable social entrepreneurship guidance team. Universities are endowed with abundant teacher resources, as well as abundant social practice opportunities and platforms. Therefore, it is most appropriate to build an education system of social entrepreneurship in universities. At the same time, it can also provide a steady stream of university students' resources for the social entrepreneurship organizations that have already successfully operated, and alleviate the current severe employment burden of college students.

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## Study on Ideal and Faith Education Effectiveness of University Student Backbone Team Based on Attitude Theory

Wang Xiao

School of Navigation, Wuhan University of Technology, Wuhan, P.R. China, 430070

(Email: 75170909@qq.com)

**Abstract:** Attitude theory offers a new study path to students' ideological and political education, among which attitude change and persuasion avail to promote education effectiveness. There is an internal consistency between attitude change process and university students' ideal and faith education. While the present studies at home and abroad rarely make deeper researches on their relationship and application. Therefore, this paper reviews the previous studies, makes an empirical study on ideal and faith education effectiveness of university student backbone team and then puts forward strategies for promoting education effectiveness based on attitude persuasion process of attitude theory.

**Key Words:** Attitude theory; University student backbone team; Ideal and faith; Education effectiveness

### 1 Introduction

Theories of attitude change are widely applied into the studies of sociology, economics, education, etc. The overseas researches about attitude theory and education mainly involve the following 2 aspects: the application of attitude change into various educational disciplines, for instance, moral education (Hughes et al., 1979), medical education (Wolf et al., 1991), and the application of attitude change into various educational phases, for instance, sustainable development (Arbuthnott et al., 2009). The domestic researches about attitude theory and education mainly involve the following 2 aspects: the application of attitude change into ideological and political education, for instance, study of application value (Nie et al., 2002; Zou, 2007); study of education effect (Tian, 2011; Chen, 2016), and the application of attitude change into value system education (Lin, 2018).

Theories of attitude change mainly include cognitive dissonance, cognitive balance theory and cognitive persuasion theory (Yang & Hu, 2008). Attitude change and persuasion are among the most studied topics in social psychology (Bechler et al., 2019). C. I. Hovland, an American psychologist, proposed a model of persuasion process including the external stimuli, the target, intervening process, and the response based on information communication process, and S. E. Taylor et al. simplified the model (Freedman, 1985). In essence, the process of persuasion is a process of information transmission, that is, the persuader transmits information to the receiver in a certain situation, so as to spur the corresponding psychological changes, thus change the receiver's attitude. The persuasion process includes the persuader, the receiver of persuasion, the contents, the situations etc. (Ren, 2016). Its process and factors are in consistent with the ideal and faith education of university students.

Therefore, promoting ideal and faith education effectiveness could be achieved through the interaction between the educational subject and the educational receiver, by inputting new cognition or changing the existing values and notions that fail to meet the requirements of ideal and faith educational purpose based on attitude persuasion process.

## 2 The Empirical Study of Education Effectiveness of University Student Backbone Team

### 2.1 Questionnaire design and distribution

Based on the internal consistency between attitude change process and university students' ideal and faith education, "The University Student Backbones' Ideal and Faith Education Effectiveness Questionnaire" is designed and formed by 5 influential aspects of attitude persuasion process, namely, educator's diatheses, education content, education method, education environment, the overall evaluation of educatee. The questionnaire has 20 questions of structured multiple-choice with partially Likert scale ones to ensure its objectivity and comprehensiveness.

The survey samples are student backbones in Wuhan University of Technology. During the survey, 388 questionnaires were issued and 372 valid ones were collected. The ratio of students majoring in literature, history and philosophy 9%, students majoring in science 16%, students majoring in engineering 74%, and students majoring in arts 1% is a moderate proportion in university mainly of science and engineering normal, with male accounting for 82% and female 18%.

### 2.2 Questionnaire analysis and summary

The survey results are shown in the following table.

**Table 1 Survey Results of University Student Backbones' Ideal and Faith Education Effectiveness**

Item	education concept		educator's aptitude		educator's attractiveness		helpful for personal growth	
Percentage	people-oriented	8.6%	common	35.48%	common	24.73%	very useful	44.35%
Percentage	personality-oriented	7.53%	low	2.96%	low	5.91%	useful	46.77%
Item	emotional education		volitional education		behavioral education		overall evaluation	
Percentage	uncertain	40.59%	uncertain	38.98%	uncertain	31.45%	boring & old	27.42%
Percentage	invalid	0.27%	invalid	2.42%	invalid	4.03%	improvement	59.68%
Item	infusing method		modern method		experiential education		self-education	
Percentage	uncertain	36.83%	uncertain	15.32%	uncertain	10.48%	uncertain	11.29%
Percentage	invalid	0.81%	invalid	7.26%	invalid	4.84%	invalid	3.22%
Item	by campus activities		by campus ethos		by campus culture		prominent problem	
Percentage	valid	87.91%	valid	85.49%	valid	83.87%	content	31.72%

#### 2.2.1 From the Perspective of Educator's Diatheses

Firstly, people-oriented idea and personality development are neglected. The ultimate effect of ideological education is to form or change attitudes, ideas, notions, and then to guide actions, more

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vividly, to achieve the effect of penetrating into brain, heart and causing action. Fundamentally, the final effect is the formation or change of thoughts, the guidance and abidance of actions. Therefore, ideological education should adopt the people-oriented educational idea and pay attention to the development of students' personalities. However, the survey shows that only 8.6% and 7.53% of them think the university takes people-oriented idea and personality development as educational concepts.

Secondly, it's lack of educators' aptitudes and attractiveness. The survey shows that 38.44% and 30.64% of student backbones respectively think educators' abilities and attractiveness are insufficient respectively. On one hand, there are some existing problems such as "attaching more importance to teaching and less importance to educating", "insufficient credibility and trustworthiness", "insufficient personal charm" and 'weak authority and prestige". On the other hand, it reflects students' higher expectation for ideological education than before.

#### 2.2.2 From the Perspective of Education Content

Emotional, volitional, behavioral educations are neglected. The survey shows that 40.86%, 41.4% and 35.48% of the respondents believe that they are uncertain to obtain or can't obtain the power and appeal for struggle, the willpower for consciously overcoming difficulties and good behavioral habits during education of ideals and faith respectively.

#### 2.2.3 From the Perspective of Education Method

Firstly, infusing method is not well received with student backbones. 37.64% of them think that it is of uncertain effect, basically invalid or invalid, which reflects the traditional methods, such as party knowledge lectures, centralized training, panel discussions and seminars, mainly adopt top-down cramming method which neglect students' enthusiasm and involvement.

Secondly, modern method is widely recognized, but more emphasis should be placed on its innovation. Only 22.58% of respondents believe that modern education method is of uncertain effect, basically invalid or invalid, which indicates that more than 2/3 of them believe that the modern method of new-media platform attracts and improves students' attention, preference and participation, and helps to make better use of fragmented time, more flexible learning and assessment methods, and more vivid and visualized learning materials.

Thirdly, experiential education and self-education are most recognized. The survey shows that only 15.32% and 14.51% of respondents respectively think the two methods are uncertain effect, basically invalid or invalid, which shows that students are looking forward to taking more experiential and self-education methods.

#### 2.2.4 From the Perspective of Education Environment

Firstly, creating an ideal and faith education environment through campus activities is approved as the highest rank. The survey result shows 87.91% of them believing its validity, which shows that holding ideal faith themed activities, including speech contests, composition contests, dramas, opuscula, etc., can enrich campus life, and achieve a subtle heart-touching effect. More qualified and innovative ideal and faith themed campus activities should be held to favor students' likings and

Secondly, creating an ideal and faith education environment by improving campus ethos is approved as the second rank. The survey result shows 85.49% of them believing its validity, which shows that carrying out grass-roots party building and outstanding students' guidance, playing their pioneering role and peer models can effectively improve campus ethos and spur campus positive energy.

Thirdly, creating an ideal and faith education environment by refining campus culture is approved as the third rank. The survey result shows 83.87% of them believing its validity, which shows that compared with the widely accepted environmental factors such as campus activities and campus ethos, campus culture's promotion and attention are yet to be improved.

#### 2.2.5 From the Perspective of Educatee's Evaluation

The survey shows that the proportion of university student backbones' believing ideal and faith education promoting their personal growth is 91.12%. However, the education contents, methods, environments need to be improved. 27.42% of them think that the education contents and methods are boring and old-fashioned. 59.68% of them feel common and hope the change. 31.72% of them think that the education contents are not sound enough. This shows that many students are still not satisfied with the contents, methods and environments of ideal and faith education, calling for more diversified contents, colorful methods and pleasant environments.

### **3 Strategies for Promoting Ideal and Faith Education Effectiveness of University Student Backbone Team**

#### **3.1 Insisting student-oriented education concept**

At present, many problems in ideal and faith education of university student backbones are rooted in educator-centered rather than student-oriented. Educators always teach based on their own knowledge and feelings while ignore students' needs. This traditional educational concept doesn't meet the students' expectations. Student-oriented education aiming to satisfy students' needs should be established. Combining the solution of ideological problems with the solution of practical problems should be persisted to (Zhang, 2015).

First, it's necessary to change the educators' role. An equal, two-way and interactive relationship should be established between students and teachers. Teachers should be "scholars trusted in knowledge, tutors trusted in learning, friends relied on in living, and guiders relied on in life experience" (Qu & Zhao, 2013).

Second, it's necessary to meet students' actual needs. It's necessary to make endeavors in education methods and environments. Make more use of students' favorite educational methods, and create more education environments for students' growth and development. Besides, it's useful to permeate the education into students' daily study and life in order to achieve the effect of subtle and silent transformation effect.

Third, it's necessary to stress students' personality development. Try to guide them to set up political and moral ideals and faiths that are compatible with socialist ideals and faiths, and set up

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professional and life ideals and faiths that are consistent with social expectations according to their own personality development and characteristics. Only by this compatibility and consistency can they establish a firmer and sounder personal ideal and faith.

### **3.2 Promoting multi-aspect education capabilities**

First, it's necessary to improve teachers' attractiveness and comprehensive abilities. The attractiveness achieves the goal of attitude change by means of emotional components (Aronson et al., 1963). Students' good impression on their teachers helps to achieve mutual emotional resonance, which proposes high requirements for the educational contents, the application of educational methods, language application, logical thinking, interactive communication and other comprehensive abilities.

Second, it's necessary to strengthen teachers' ideological guidance ability and credibility. At present, in colleges and universities, there is a general notion of "attaching more importance to teaching and less importance to educating", that is, importance is attached to knowledge conveying rather than ideological guidance. Meanwhile, credibility mainly depends on the professional level of the persuader. Professional information sources are more convincing than non-professional sources (Norman, 1976). Therefore, professional ability of teachers should be improved.

### **3.3 Improving multi-dimension education contents**

First, it's necessary to attach importance to the emotional, volitional and behavioral education of university student backbones. It is not enough only to stress the target education because it's unstable and its unsustainable education effect. Great targets of ideals and faiths should be realized step by step through the struggle motive, strong willpower and good behavior habits. The status quo lies in stressing the target education instead of emotional, volitional education, and lacking behavioral education. The teachers should teach students the willpower to overcome difficulties, the motive to struggle, and sound behavior.

Second, it's required to attach importance to all aspects of the target education of university student backbones. The complete education contents help to satisfy actual expectation of students. It's necessary to strengthen the education of moral ideals and faiths so as to promote the sense of social responsibility, collective concept and approval of socialist values; It's necessary to strengthen the education of political ideals and faiths so as to promote understanding of the party's basic theory and knowledge, cultivate the righteous motivation to join the party, and well behave as a member; It's necessary to strengthen the education of occupational ideals and faiths so as to make right occupational plan and choice, and set up the dedicating, hard-working, pioneering spirits; It's necessary to strengthen the education of life ideals and faiths so as to treat the income disparity reasonably, and understand work and life relations.

### **3.4 Adopting multi-angle education methods**

In the new era, more diversified education methods, especially experiential, independent and modern education methods, are more favored by students.

First, it's necessary to make use of immersing, edifying education methods. Educators should

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infiltrate Marxist positions, viewpoints and methods into educational management and services. The statues of revolutionary martyrs and industry pioneers, the ancient motto and stone carvings of wise sayings should be displayed on campus to edify students with humanistic spirit and campus culture.

Second, it's necessary to make use of experiential, lifelike education methods. Political beliefs and faiths will be established through experiential activities, such as visiting old revolutionary bases, memorial halls, etc.; True feelings and improvements will be obtained by performing social practices such as voluntary services, teaching and supporting border areas, and poverty alleviation in rural areas; Lofty ideals and tenacious will should be obtained through lifelike political activities. These methods make the ideal and faith education "reaching the ups, and connecting the downs", make students feel the vivid political history and figures, feel the affinity and charisma, thus achieve the practical effect of education unconsciously.

Third, it's necessary to make use of independent, flexible education methods. Learning enthusiasm, initiative and commitment will be spurred through individual autonomous learning, group autonomous learning, reading books and newspapers, watching documentaries, etc. with more flexible learning time, and learning methods. Students will be improved in spontaneous learning, in self-demand, in self-realization.

Fourth, it's necessary to make use of networking, new-media education methods. Ideal and belief education will be carried out catering to "network generation" characteristics of the post-90s and post-00s. It's necessary to build theme websites, and promote independent learning by timing and scoring; It's necessary to use microblog and WeChat to educate based on wide range of loyal audiences.

### **3.5 Creating multi-platform education environments**

First, it's necessary to increase students' favorite campus activities. Practical effect of ideal and faith education will be achieved through drama, opusculum, dance and other colorful platform bearing the theme elements of ideals and beliefs, which can enrich students' life and instruct them with delight.

Second, it's necessary to refine widely spread campus culture. It's necessary to strengthen the refinement, promotion and attraction of campus culture; It's necessary to abstract university spirit, university ideas, university motto, song, emblem and other soft culture elements so as to encourage progress; It's necessary to build cultural walls, propaganda columns, widely collect buildings, roads, sculptures' names so as to edify character with humanistic spirit; It's necessary to make campus culture the spiritual homeland of self-improvement and ideals and faiths through extensive participation and comprehensive promotion.

Third, it's necessary to improve the campus ethos with positive energy. It's necessary to raise moral integrity by the party's pioneer guidance and assistance activities, etc. so as to make ideal and faith awareness widely recognized, and make ideal and faith spirits widely spread among the students; It's necessary to adopt accurate drip irrigation notion and heart-touching method so as to achieve the satisfactory educational effect.

## **4 Conclusion**

Based on the internal consistency between attitude change process and university students' ideal and faith education, this paper makes a survey of ideal and faith education effectiveness of university student backbones from 5 influential aspects of attitude persuasion process, namely, educator's



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diatheses, education content, education method, education environment, the overall evaluation of  
educatee, and puts forwards strategies for promoting effectiveness accordingly. In the future, more  
studies will be carried out applying attitude theory to education, producing more interdisciplinary  
researches as well as guiding educational practices.

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# James Joyce's *Araby* in Interarts Perspective of Chinese Classical Art Theories

Hu Min

School of Foreign Languages, Wuhan University of Technology, Wuhan, P.R. China, 430070

(E-mail: 48032797@qq.com)

**Abstract:** This paper explores the states of Chinese classical art theories in James Joyce's *Araby*, revealing the idea resonance beyond visual and language media. The research method is Ekphrasis, a burgeoning interdisciplinary humanity in the 90s of the 20th century, providing opportunities for interarts researches, not only pictures in the poetry or the poetry in pictures, but multidimensional appreciation methods. James Joyce's *Araby* is analyzed in this paper by enlightenment from calligraphy theories of Cai Yong, an official and scholar of the Eastern Han dynasty, to create interarts appreciation.

**Key words:** Interarts; Ekphrasis; James Joyce; *Araby*; Chinese classical art theories; Cai Yong

## 1 Introduction

This paper introduces Cai Yong's Chinese calligraphy theories in connection with James Joyce's *Araby* by case studies of embodiment of eastern calligraphy wisdom in western English literature. The innovative study can help better understand English literature with enlightenment from visual arts.

Chinese classical art theories include theories on paintings, calligraphy, seals, art crafts, music and dramas. The foundation is the combination of Confucianism, Buddhism and Taoism, encompassing the elements of beauty and ugliness, elegance and vulgarity, emotion and will, form and spirit, literary grace and essence, deficiency and excess, mental state, indoctrination, pleasing functionality and artistic conceptions to perfect and systemize the theories. Chinese classical art theories span five stages: Pre-Qin and Han Dynasties, Six Dynasties, Tang Dynasty and Five Dynasties, Song and Yuan Dynasties and Ming and Qing Dynasties, which include Lao Tzu's "Iridescent colors causing blindness", Gukaizhi's Painting Thesis, Xie He's "Six Techniques of Painting", etc. (Zhou Jiyin, Chen Shining, 2010)

### 1.1 Literature review

Chinese classical arts, like all arts, are the soul of China. The interarts study began early with Feng Zikai in 1920's. He published on journals articles on connection of Chinese painting and Chinese literature, like the expression of space, subjective and objective observation, and complementary coexistence of visual and literary elements (Feng Zikai, 2015). In 2007, Kuang Haoyuan comparatively studied Su Shi's theories of literature, painting and calligraphy (KuangHaoyuan, 2007). In 2010, Liu Fengxia explored the relationship between art and literary theories in Six Dynasties (Liu Fengxia, 2010). In 2013, She Zhenhua analyzed French Chinese-born author Cheng Baoyi's Chinese painting theories by his literary works (She Zhenhua, 2013). In these studies, Chinese literary works are associated with Chinese classical art theories. In this paper, Chinese classical art theories will enlighten English literature. This is the difference between this paper and the former researches.

The research method is ekphrasis. Ekphrasis in poetry has been used in the eighth century B.C. In

Homer's epic *The Iliad*, ekphrasis, has been used to describe the shield borne by the hero Achilles as a rhetorical technique. It depicts matters coming before court of law in a peaceful city and battling Troy, the home of a King, dancing young men and women, field, vineyard, sheep farm, a herd of cattle, and the earth, sea, sky, the moon and the cosmos (Heffernan, 2004). The past coexists with the future in the painting in a circle on the shield. Ekphrasis is not just rhetorical technique but a vital literary tradition related to visual arts, which perfects the aesthetic experience of perceiving the world in multidimensional perspective.

The interdisciplinary research into visual and verbal arts, ekphrasis, became a burgeoning interdisciplinary humanity in the 90s of the 20<sup>th</sup> century, exploring art of painting in language arts. Like other literary genres, ekphrasis entered postmodern times after classical, neoclassical, Romantic, Modern times. (Tan Qionglin, 2010) *A Song Handscroll Streams and Mountains Without End and Gary Snyder's Ekphrastic Poem "Endless Streams and Mountains": Perspectives on GuoXi's Essays on Landscape and its Embodiment in Modern American Painter Poems* by Tan Qionglin in 2010 analyzed American oriental ekphrasis which means American poems depict ancient Chinese landscape paintings with the form of Chinese classical poetry and Japanese haiku. Tan Qionglin put forward the term American oriental ekphrasis for the first time and developed modern ekphrasis. (Tan Qionglin, 2010)

Western authors have explored in interdisciplinarity since the 20<sup>th</sup> century.

*Pictures of Romance: Form Against Context in Painting and Literature* was written by Wendy Steiner in 1991. It was discovered that literary romance had unrealistic suspense outside of time because Renaissance and post-Renaissance paintings depicted suspended moment of perception with extraordinary clarity and condensed meaning, both of which departed from reality. The difference is that painting is the art of space while literature the art of time. The conclusion was arrived through analyses of works of Keats, Hawthorne, Joyce, and Picasso, while a return to conventions appeared later in 20<sup>th</sup> century both in painting and literary works (Wendy Steiner, 1991). Interconnection between literature and the visual arts is discovered in this book by Wendy Steiner.

Stephen Cheeke conducted the first study to offer a useful general survey of the larger philosophical and theoretical questions arising from the encounter of literary texts and artworks. (Stephen Cheeke, 2011)

The latest studies of Ekphrasis are as follows. In *Ekphrasis, Imagination and Persuasion in Ancient Rhetorical Theory and Practice*, Ruth Webb enables listeners and readers see in their imagination through words alone. The author emphasizes the importance of the visual imagination in ancient responses to rhetoric, poetry and historiography. This study includes a full analysis of the ancient technical sources. (Ruth Webb, 2016)

*Fictional Artworks: Literary Ekphrasis and the Invention of Images* compiled by Valeria Cammarata studies images in painting, photography and cinema invented by literature, the relationship between text and image, between verbal and visual in modern and contemporary literature from the point of view of aesthetics, visual culture and literary theory, trying to build a map of the notional ekphrasis. (Valeria Cammarata, Valentina Mignano, 2017)

Visual experience alone is not sufficient for the synthesis or the communication of meaning, but that a verbal answer that in turn sparks your vision. Art is not isolated but an amalgamation of varied media. (Claire Barbetti, 2011) Ekphrasis also sheds light on pictographic Chinese calligraphy.

## 1.2 Chinese calligraphy origin and theories

Cangjie, the inventor of Chinese characters, is an official historian of the Yellow Emperor. He has four eyes and four pupils, exceptional insight into the essence of everything. His invention of Chinese characters brings forth immortal wisdom, because of which ghosts cry and the sky rains millet. Cangjie observes characteristics of all things, including the sun, the moon, stars, clouds, lakes, oceans, manners of birds and beasts, as well as he himself to create pictographic Chinese characters. The outside and the inside cosmic worlds correlate. Thus visual and verbal arts are interlinked.

Chinese calligraphy theories emerge in the period of two Han Dynasties after the existence of Chinese calligraphy. The period of two Han Dynasties is between the pre-Qin period and Wei-Jin period, prospering in seal script, clerical script, semi-cursive script and cursive script, as well as calligraphy

Proceedings of the 16th International Conference on Innovation & Management - 1573 - theories by Cai Yong, Wang Xizhi and Wei Shuo, etc. The shape, size, stretch, and type of hair in the brush, the color and density of the ink, speed and surface texture of the paper are the main physical elements; while the connection of universe and calligraphy is revealed.

## 2 Cai Yong's Calligraphy Theories

Cai Yong, an official and scholar of the Eastern Han Dynasty was a master in calligraphy, music, mathematics and astronomy. One of his daughters, Cai Yan, was also a famous poet and musician.

In his *The Theory of Writing Brush*, because of the correlation of the outside and the inside cosmic worlds, one should follow the natural law. Before practicing calligraphy, one should abandon all the distractions, free from mundane affairs, concentrating. Forced to do so, one cannot practice well even with the best brush. Filled with awe and silence, sit still and contemplate as if facing the supremacy. One does not talk improperly or pant fiercely. That is the way to practice calligraphy.

In *Calligraphy Nine Potential*, calligraphy also follows the law of nature with Yin and Yang, which forms the motion of the brush.

The trace of the beginning and ending of the brush should be hidden in the character. With or without the brush on the surface of the paper, the tension and power stays within the character and the appearance is formed outside. When the force comes, it cannot be stopped; when the force is gone, it cannot be restrained. The softness of the brush decides the various changes. The upper and the lower part of the character should support each other.

There are nine ways to construct Chinese characters.

- (1) Turning of the brush should be connected and disconnected; the disconnected part should not be isolated.
- (2) The movement of the tip of the brush should be the opposite before start writing.
- (3) When the stroke starts, the middle of the brush stays right in the middle of the stroke.
- (4) The tip of brush should be hidden within the stroke when the stroke ends.
- (5) Short and quick movements of the brush are adopted to form the rhythm of series of strokes.
- (6) Contraction and release are used in the process of movement.
- (7) Resistance coexists with dynamic advances.
- (8) Horizontal strokes look like fish scales.
- (9) Vertical strokes look like reining in the horse.

(Zhou Jiyin, Chen Shining, 2010)

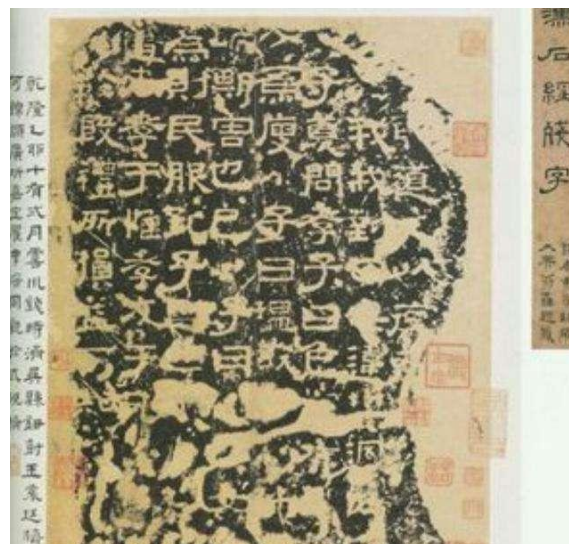


Figure 1 Cai Yong: Xiping Classics Inscription

### 3 Ekphrasis Analysis of *Araby*

James Joyce is an Irish novelist, short story writer, and poet, one of the most influential and important authors of the 20<sup>th</sup> century. As a self-imposed exile, Joyce's psychological and fictional world is always in Dublin, the city which provides the settings for all his fictions.

James Joyce's *Dubliners*, a collection of fifteen short stories, deals successively with events of childhood, youth and adulthood. All of the short stories are set in Dublin, Ireland on the themes of death, disease, and paralysis, interconnected by symbols and moods, exploring the subtleties of experiences that are common to all. All the characters in the stories struggle in minor, yet meaningful, events in everyday life with morality, personal frustrations, or restless desires. These stories contain no melodramatic conflict but those quiet moments in the characters' lives when they come to a sudden realization of the meaning of their existence (an epiphany).

The Epiphany is primarily associated with the birth of Jesus and the visit of the magi; in literature it is a sudden revelation of spiritual or moral meaning, an intellectual illumination of the nature of a thing.

Dublin is the living, symbolic backdrop of *Araby*. The gloomy atmosphere of North Richmond Street that actually sets the scene at the start of the story is an anticipation of what lies ahead for the little boy in the bazaar of Araby. The first sentence of the story begins with "being blind" and in the last sentence, the boy "saw" himself.

*Araby* is a story about a boy who wants to buy something for a girl on whom he has a crush. He looks forward to going to the bazaar. Unfortunately he misses the time for lack of money. He stands in the dark hall when he suddenly realizes that he himself is only a pitiful creature, an epiphanic moment in the end.

The story can be illustrated by Cai Yong's calligraphy theories.

#### 3.1 Dualism of Yin and Yang

In Cai Yong's *Calligraphy Nine Potential*, because of the correlation of the outside and the inside cosmic worlds, one should follow the natural law. In Chinese characters, Yin and Yang coexist. So does *Araby*.

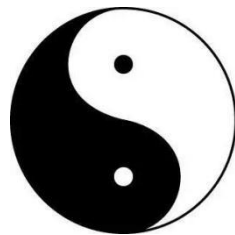


Figure 2 Yin and Yang<sup>87</sup>

Dualism of Yin and Yang can be found in the first love story *Araby*.

*Araby* is a romantic term for the Middle East, but there is no such place. The word is used to express the romantic view of the east that had been popular since Napoleon's triumph over Egypt throughout the 19<sup>th</sup> century. And, of course, it is a romantic irony.

The beginning and the ending of the story also present the changes of Yin and Yang. The story begins with a blind street, which describes the condition of the boy's relation to reality. It is also Joyce's presentation of the Irish soul, uninhabited and detached with hopeless and discouraged color brown. In

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<sup>87</sup> Retrieved May 29, 2019 from [https://www.ancient.eu/Yin\\_and\\_Yang/](https://www.ancient.eu/Yin_and_Yang/)

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the end of the story, the boy sees himself as the reader has seen him for some time, and he realizes that there is no Araby in Ireland.

The contrast of light and darkness is used to describe the boy's encounter of the girl and his inner world. The people of Dublin seem to be living ghosts; the boys, who are very much alive, are surrounded by shades of people. And the girl's basking in a halo is but an illusion. All the boy's unrestrained lusts are released at night.

These arrangements in the story are just like the construction of Chinese characters which are invented by observing Yin and Yang in nature.

### 3.2 Hidden Forces

In Cai Yong's *Calligraphy Nine Potential*, the tip of the brush is hidden within the stroke when the stroke ends. As for James Joyce's *Araby*, the symbolic details are made for Joyce's convenience, lying around in the streets of Dublin waiting for him to pick them up.

The opening paragraph has prepared us both for a story as well as for an allegory, the priest as the former tenant of the house, carries several messages, which implies that the religion is dead. The three books found in the house are not simply books. The contents of the books insinuate the boy's confusion of romantic love, religious love and materialist love. As the story proceeds, we find that he deceives himself about the sexual, spiritual, and the financial realities.

Modernist technique of showing but not telling is also applied to describe the conversation between the boy and the girl. The boy's words are fragmented to imply that he has lost his self when facing the girl, stunned and confounded. According to the boy's answer, he can hardly tell the overtones of envy and bitterness in the girl's expression, so wrapped up in his own fantasy.

The boy promises to go to Araby and to bring something for the girl. It is not just a promise but a vow which he will be unable to fulfill in the mundane world just like other wishful thinking.

All the hidden parts in the story are just like the hidden power within strokes of Chinese strokes.

### 3.3 Tranquility and Wisdom

In Cai Yong's *The Theory of Writing Brush*, before practicing calligraphy, one should abandon all the distractions, free from mundane affairs, concentrating. In tranquility, answers to all the questions can be seen clearly, just like a clean mirror reflecting clearly the world.

The moment of truth appears at the end of the story. Joyce used epiphany as a literary device within each short story of his collection *Dubliners* (1914) as his protagonists come to sudden revelation that changes their view of themselves or of their social condition.

In *Araby*, after listening to a seemingly ordinary scrap of conversation, the boy is left alone in the hall, gazing up into the darkness. The boy is totally defeated: his quest has failed and he has not achieved his aim, which was to buy a present for the girl. This is a moment of tranquility, the Joycean epiphany, no distraction from the girl and the outside world. And he suddenly realizes his irony of romantic love, religious love and materialist love, his own worthlessness, his own foolishness, his unprofitable use of time and money, and the illusive opinion he has of himself.

Just like the art of Chinese calligraphy is created in tranquility.

## 4 Conclusion

The wisdom from Chinese classical art theories will be a treasure-house to interpret English literature. Various art forms are governed by universal human moral codes, which are not decided by mankind but rather the rules of the universe, such as kindness, honesty, agreement of thoughts and behaviors. When in tune with nature, human beings' wisdom will be discovered again in all arts.

In the Republic, Book X, Plato discusses artistic forms adopted by carpenters and painters to represent the epitome of beauty by God. There are three artists: God, the maker of the bed and the painter; the latter two are creator and imitator of the appearance. This sheds light on ekphrasis. No matter which art form has been adopted, the essence created by God is beyond the apparent art form.

Considering ekphrasis, the bond of visual arts and language arts, more teaching practices of literature or painting should be conducted in a new way.

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## **Original Family: An Analysis of the Key Factors Influencing the Ideological and Moral Education of Adolescents**

Cheng Gaojie

School of Marxism, Wuhan University of Technology, Wuhan, P.R. China, 430063

(E-mail: cgj2418122972@163.com)

**Abstract:** The adolescent period is the formation period of the outlook on life, world outlook and values, as well as the important period when the adolescent breaks away from the original family and enters the society. The ideological and moral education of the original family, as a prerequisite, plays a crucial role in the ideological and moral education of young people. Based on the cognitive behavioral theory, this paper focuses on the analysis of the impact of the original family on the ideological and moral education of adolescents and draws the conclusion that the impact of the original family on the adolescents in three aspects: family structure, family relationship and family education. This paper puts forward the corresponding countermeasures which introduced Satya for psychotherapy treatment mode for innovation.

**Key words:** Original family; Adolescent; Ideological and moral education; Cognitive behavior theory

# **1 Introduction**

## **1.1 Raising of the problem**

In China, the number of adolescents is huge so the task of ideological and moral education is heavy and urgent. About 30 million children and adolescents under the age of 17 in China suffer from various emotional disorders and behavioral problems, according to the latest data released by the national health commission for world mental health day on oct 10, 2018. With the acceleration of the process of social modernization, the pressure of adolescents on the adaptation to the surrounding environment, the choice of interpersonal relationship, learning and other aspects has increased exponentially. However, the quality of ideological and moral education is worrying. Original family is the main front of adolescents' ideological and moral education. Once there is a problem, the bad effect on adolescents will be lifelong.

## **1.2 Literature review**

There are some foreign studies on the influence of the original families on the ideological and moral education of adolescents. Foreign studies first focus on the close relationship between the original families and the ideological and moral education of teenagers, and then put forward some suggestions on how to improve the relationship between parents and children. Some scholars found that parents' external morality and principles play an important role in shaping children's external morality and principles, and play a significant predictive role. This study shows that there is a close and inseparable

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relationship between original families and the ideological and moral education of teenagers (Fiona A. White, Ph.D. and Kenan m. Matawie, Ph.D. , 2004). Some scholars studied the Brazilian adolescent data and found that the contribution of teenagers to family resources when they grow up will be affected by the structure of original families. Their results indicate that adolescents provide resources to the family in different ways and to a different extent depending on birth order and gender; an additional sibling has significantly different implications for boys and girls. And this illustrates the importance of family structure (Leticia J. Marteleto and Laetícia R. de Souza, 2013). A series of methods and means to improve the parent-child trust relationship were put forward, and proposed to combining the uniqueness of parent-child emotion in China, which has important reference value in improving the ideological and moral education of teenagers (Shek, Daniel T. L., 2010). The influence of original families on teenagers is indelible, but some scholars also hold a more optimistic attitude, that is, how to treat the influence brought by original families is their own attitude and choice in life and learning to reconcile with original families is the most important problem (Qin Wang, Jiangjing Xia, Rui Lv, 2019).

Domestic research on this aspect firstly focuses on the relationship among original families and adolescent personality development and interpersonal relationship. Some scholars analyzed the influence of original families on the development of the next generation's personality and marital relationship from the perspective of chaos theory (Lu Jing and Cao Lili, 2011). Wu Yuwei proposed using the family system theory to analyze the impact of the original families on individual development, which includes psychological behavior problems, marital relationship and the parent-child relationship. And she also emphasized that self-differentiation is one of the key personality variables for individual maturity and mental health (Wu Yuwei, 2018). Other scholars discussed the impact of the original families on the interpersonal relationship of college students (Shen Yanting, Zheng Shu, 2018).

In terms of psychology, the influence of schoolmate relationship and self-efficacy on the mental health of college students with left-behind experience was enhanced after entering the university, while the influence of the original family environment was weakened (Zhan Liyu, Lian Qin, Wang Fang, 2017). Liu Chengxiu (Liu Chengxiu, 2018) and Liang Qi (Liang Qi, 2019) respectively explored the impact of the original families on the mental health of college students, the corresponding problems and solutions. Wang Yan and Chen Binbin (Wang Yan and Chen Binbin, 2018) studied from the perspective of the life history theory and concluded that the life history strategy plays a complete intermediary role between the democratic parenting style of the mother in the family of origin and the cooperative parenting style of the adult daughter. This result further confirms the profound influence of family of origin on individuals.

Only one discussed the influencing factors of original families on the psychological problems of adolescents with the case of psychological counseling as the carrier and proposed some countermeasures for the ideological and political education in colleges and universities based on this, indicating that there is a deep connection between original families and the ideological and political education in colleges and universities (Li Haichun, 2017).

Original family plays an important role in many aspects of adolescent individual development, among which the psychological and interpersonal problems are the most important. However, through reviewing the existing literature, it is found that domestic scholars lack studies on the relationship among the adolescent's original family and ideological and moral education. Therefore, this study attempts to analyze the impact of the original families on the adolescent's ideological and moral education from the perspective of the original family, which is of great value and significance.

## **2 The Connotation of Ideological and Moral Education of Adolescents and Original Families**

Ideological and moral education of adolescents refers to the education workers in accordance with the requirements for the development of the society and the needs of the development of adolescent physical and mental, using traditional Chinese excellent culture and socialist core values, through the education practice, purposeful, planned and organized for moral education on adolescents. It can help them to form a ideal firm belief and right ideology, to improve the ideological and moral quality of young people. (Zhang Yaocan, 1988)

The so-called original family refers to the family of parents. That is, the family where individuals were born and grew up and the family where their children were raised, which is opposite to the new family formed after marriage. New families do not include both parents. Compared with the new family, the original family is a place where individuals initially grow up and receive family education from their parents, while the new family is often the place where individuals live after they grow up.

## **3 The Necessity of Strengthening the Ideological and Moral Education of Adolescents**

### **3.1 Far-reaching significance of strengthening ideological and moral education of young people**

In the 2016 national conference on ideological and political work in colleges and universities, general secretary Xi Jinping stressed: “Ideological and political work must focus on students, care for students and serve students, constantly improve students' ideological level, political consciousness, moral quality and cultural literacy, so that students can become talents with both political integrity and all-round development.” Health is the foundation of people's comprehensive development. Therefore, college students' mental health education is the most important part of their ideological and political work.

The ideological and moral education of adolescents and their families is an important part of the ideological and moral education system. First of all, young people are the focus of ideological and political education in China and they are the main force in the construction of socialism with Chinese characteristics. Moreover, youth is also the period when people's physical and psychological development changes most rapidly, which requires proper grasp and guidance. In a sense, family environment determines a person's character and conduct, which not only plays an important role in the formation of children's ideological and moral character, but also restricts the ideological and political education in schools in the future. According to Freud's theory of personality development, the age of 5-6 is a period when individual personality is formed. At this time, family education has a great influence on children. For most adolescents, this is the time when their personality has already been formed, and the ideological and political education in school can only play an indirect role. Therefore, students with good family education tend to have more sound psychological quality and personality cultivation, and children living in the absence of appropriate ideological and moral education in the family tend to have paranoid, withdrawn behavior, which makes it difficult for children to enter the school and get the correct guidance and education.

### **3.2 Serious psychological problems among adolescents**

Contemporary adolescents' delinquency is a serious problem, among which suicide and interpersonal communication caused by psychological problems are particularly prominent. In recent years, a number of malignant adolescents' delinquency cases have occurred frequently. The reasons are all related to a variety of psychological problems of adolescents to some extent. For example, the "poisoning case of Fudan University" and "murder case of Peking University student" that shocked the whole country are all related to interpersonal relationship disorders of adolescents: hostility, extreme and indifference. According to the investigation of the case, various problems exist in the adolescents' original family to varying degrees, such as parents' neglect of discipline, doting on and family conflicts, which result in the absence of ideological and moral education in the family. From the perspective of psychology, Satya, a famous American "family therapist", believes that the occurrence and appearance of any psychological disorder are in the final analysis closely related to the original family.

970 students were investigated in the research on the correlation between interpersonal relationship disorders of college students and their original families. The investigation shows that the students with mild interpersonal disorder account for 36.9%, and those with severe interpersonal disorder account for 3.9%. The interpersonal relationship between rural and urban college students is significantly different. Only children have better interpersonal status than non-only children, and middle children have the worst interpersonal status. Parental rearing style also has influence on college students' interpersonal relationship psychology. It can be seen that the basic situation of the original families, such as the number of children, parenting style and residence location, has an important impact on the interpersonal relationship of adolescents (Shen Yanting, Zheng Shu, 2018)

## **4 Analyze the Impact of Original Families based on the Cognitive Behavior Theory**

Cognitive behavioral theory holds that people's thoughts, behaviors and feelings are interrelated, and behaviors are influenced by a person's thoughts and ideas on the world. Appropriate thoughts generate appropriate behaviors; and it is necessary to change people's psychology and thoughts to change people's inappropriate behaviors. The structure of people's ideological and moral character is mainly composed of three parts: psychology, thought and behavior. And the psychological state is mainly formed in the family environment. Adolescents just separated from original families, at this time the psychological characteristics are mainly affected by the original families. It laid a foundation for the future psychological development. Specifically, the following factors of the original families have great influence on the ideological and moral education of adolescents:

### **4.1 Family structure**

Family structure refers to the composition of family members and their interaction and mutual influence. It includes two basic aspects: family population elements and family pattern elements. The unbalanced family structure mainly includes single parent families, divorced families and so on.

From the perspective of cognitive theory, the imbalance of family structure will directly impact on the life and psychological status of adolescents, leading to deviation in thinking and abnormal behavior (Huang Ding, 2018). In addition, the parents in the unbalanced family structure are under greater financial burden and are prone to emotional depression, which will have a negative impact on their children's emotions. Because the focus of life is more on the children, parents will be more demanding of their children and the children's psychological pressure will increase.

Thirdly, adolescents living in these families will suffer from psychological malformation, self-abandonment, self-abasement and social isolation due to the lack of parental love and neglect of care. Psychological inferiority makes it difficult for adolescents to form a correct understanding of themselves, and also difficult to deal with the intimate relationship in the future, that is, from the psychological impact to the behavior. The imbalanced family structure leads to the low quality of ideological and moral education.

## **4.2 Family relationship**

Family relationship plays a very important role in the growth of adolescents. Family relationship includes the relationship between parents and the relationship between parents and children. After a person is born, his or her early interpersonal relationship is the relationship with the parents. The way parents treat their children and their interpersonal relationship patterns will have a great impact on their children's future interpersonal relationship cognition and behavior. These interpersonal relationship patterns will produce initial communicative cognition for children, which will then be projected into their daily life through behaviors.

If the parents are tense, often quarrel or there is a lot of domestic violence in the families, then the children who are exposed to these at a young age are also prone to violence and have a common temper problem. Secondly, if the role playing of parents is absent or conflicted, the inner needs of children will be easily neglected, resulting in that children cannot feel their parents' love and attention. When they grow up, their personality will easily be defective, which is reflected in their behaviors, that is, they are difficult to deal with the intimate relationship with others.

It can also be seen from many studies that the parents of teenagers with good interpersonal relationship then the teenagers also have good interpersonal processing patterns. Parents respect their children's ideas at home and are good at taking letters and other reasonable ways to communicate with children. Parents will let the child to participate in family matters of opinion and discussion. Try not to hurt the child's self-esteem and pay attention to cultivating their confidence and ability to communicate with people. Adolescents can maintain self in communication, face up to themselves. They are not excessively self-abased or arrogant, and they are decent and modest in their communication with others.

## **4.3 Family education**

Parents are the primary teachers of children. Parents' words and deeds have a huge impact on children. The way of doing things and temperament can be reflected in children, which is crucial to the formation of children's personality, ideology and morality.

Parents who adopt biased parenting methods, such as authoritarian, permissive and neglectable, are prone to problems: excessive autocracy makes children unable to give play to their own selectivity, personality repression, etc.; Permissive children tend to be overly dependent on their parents and have little regard for the feelings of others. Neglect can cause a child to lack love and turn to the outside world for attention. From the perspective of life history theory, some scholars have concluded that different mothers' parenting behaviors have different influences on daughters. The maternal democratic parenting style in the family of origin shows a more accepting and tolerant interpersonal interaction mode for children, and realizes intergenerational transmission through observation and learning(Wang Yan, Chen Binbin, 2018). Thus, it can be seen that problems in education methods will lead to extreme, dependence and indifference in adolescents' characters. Adolescents' interpersonal situation indeed has connected with the original family, verify the conclusions of classic psychology, especially Freud psychoanalysis: Adult relationships are shaped by childhood experiences.

The family tradition, is a kind of performance of the family education. The main content is the family discipline and the family rule. It carries on the profound influence to the child in the imperceptible influence. On the one hand it can influence person's thought and the behavior, on the other hand the family tradition also helps to form the social good custom.

## **5 Improving the Quality of Original Families to Optimize Education**

Although the impact of the original families on a person is profound and lifelong, we cannot blindly attribute all the failure to family education, nor can we blindly immerse ourselves in the past and refuse to face the future. No family is perfect and people also can't live in the original family for a lifetime. Adolescents are in the stage of breaking away from the original family and entering the society, at this time, they can be given appropriate guidance and help to make them accept the original defects and have the courage to overcome the pain or bondage brought by the original family, then embrace their own future and grow into a more sound personality.

### **5.1 Based on Satya treatment model**

First, the Satya family therapy model can be used as a starting point. Satya treatment model is a kind of psychological treatment method with humanism as the core and no emphasis on pathology. It aims to improve the level of individual self-esteem, improve communication and help individuals live more "humanized" instead of just blindly pursuing the elimination of symptoms(Chen Jing, 2017). Specifically, it is to link individual problems into the system of family and society to solve them as a whole. That's because the first step for a traumatized teen is to "reconcile" with original families, go back in time and open up about the past. On this basis, let other subjects use a reasonable way to intervene in the ideological and moral remodeling of young people.

A counselor can help the work get started. In the stage of parent-child relationship reconstruction, help parents and children understand the importance of mutual trust between each other, and reflect on the individual and cultural beliefs that parents and adolescents trust. The adolescents were then assessed for their level of trust in their parents and their barriers. On this basis, the relationship is built. Then psychological counselors should pay attention to the basic method of learning the Satya treatment model. When adolescents are depressed due to the original families and other similar situations, counselors can first adopt this treatment model, strengthen the practice, attempt, timely follow up and record the treatment effect. Through the use of Satya treatment model and group counseling, the interaction between students and their families will be enhanced and guide students to establish confidence. They can separate from the pain of native families and trauma, differentiate into more independent and complete self, which can reduce the expectations of others, get higher happiness, free from barriers of the original families and realize maximum personal potential.

After the treatment model of Satya achieves the effect, self-treatment and intervention of others can be adopted to carry out ideological and moral education.

### **5.2 Self-adjustment and self-rescue**

Self-regulation. Self-help is the most effective and difficult way. If a person is always immersed in the past and is not willing to climb out, then the people around him to try to pull or help him, the effect is weak. The person should develop his hobbies and interests and find his own shining points in the process of doing things, try to forget the pains brought by his original family and firmly believe that the future is in his own hands, giving himself positive psychological hints. At the same time, adolescents

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should understand parents who are not perfect and have to bear a lot of pressure of life. It is difficult to do everything in the process of family education. If adolescents feel it is really difficult to overcome, take the initiative to seek the help of psychological consultants, or to friends, parents talk, reduce personal psychological pressure.

### **5.3 Pay Attention to children and inherit good family traditions**

From the perspective of parents, they should improve their own quality, pay more attention to their children, communicate with them and enhance their feelings. Family education for children should not be neglected since childhood. Parents actively explore a good family relationship model and create a warm and good family atmosphere. When necessary, parents can participate in the relevant courses to learn. At the same time, parents should pay attention to the child's emotional changes in life. Because when children encounter problems in life, they may talk to their friends first, and hide their worries from their parents. It should be believed that teaching children how to live a positive life is more important than giving them a rich material life. In addition, since the inheritance of family traditions and family ideological and moral education have the same goal(Zhao Shuang, 2019), parents can combine the ideological and moral education with family traditions through the inheritance of excellent family traditions. The two complement each other. Parents lead children to explore the roots, learn family traditions and teach them by words and deeds, so as to achieve better results.

### **5.4 Home-school alliance to improve psychological courses**

The inspiration for college psychological teachers and counselors is to pay special attention to the family situation and growth background of college students with interpersonal problems. They should connect more with their parents and realize home-school connection; And give different attention to their special background; Colleges and universities also need to improve the level of mental health courses, the teacher in class can take the way of psychological test, interactive games, role playing to make the course more interesting. And they should update the treatment method and mode, introducing Satya treatment mode. In this way, students will be guided to correctly understand their own interpersonal interaction mode, develop interpersonal communication skills and try to reduce the inherent thinking restrictions brought by their original families.

## **6 Conclusion**

Through the discussion of the importance of ideological and moral education for adolescents, we can further understand the urgency and importance of ideological and moral education for them. The research on the specific aspects and countermeasures of the impact of the original families on the ideological and moral education of adolescents is conducive to a better understanding of the deep connection between them, that is, the original families has an extremely important and fundamental impact on the ideological and moral education of adolescents. The improvement of the original families can help improve the quality of ideological and moral education of adolescents and help contemporary them break away from the barriers of the original families, so as to better adjust themselves, accept themselves and integrate into the society.



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# **China Standards "Going Out" Strategy to Improve the International Discourse Power of Chinese Enterprises: Take Infrastructure Construction as An Example**

Mao Shisi<sup>1</sup>, Chen Shu<sup>2</sup>

1 School of Management, Wuhan University of Technology, Wuhan, P.R.. China, 430070

2 School of Foreign Studies, Wuhan Vocational and Technical College, Wuhan, P.R. China, 430074

(E-mail: 15271857896@163.com, 2758611533@qq.com)

**Abstract:** Promoting China standards "going out" is conducive to improving the compatible system of "one belt and one road" standard. This paper uses case analysis method to put forward the problems facing the China standards' "going out", which is proposed to help enhance the international competitiveness of Chinese enterprises and provide institutional and normative support. Finally come to a conclusion that under the rising background of anti-globalization, not only invisible trade barriers increase the difficulty of China's standard export, but also the lack of innovative new standard is an intrinsic factor hindering China's standard "going out"

**Key words:** China standard; Going-out; International discourse power; Infrastructure; Interconnection

## **1 Introduction**

Generally speaking, China standards system has four levels: national standards, industry standards, local standards and enterprise standards. The China standards discussed in this paper mainly refer to national standards. With the development of globalization and the reform and opening-up, China has begun to pay attention to the current situation and development problems of globalization at the micro-level supporting elements. Among them, the China standards' "going out" has aroused widespread concern and discussion. As one of the important elements of enterprises' upgrading and transformation, standards can not only enable enterprises to obtain management channels of the mainstream market, but also contribute to create a world brand, thus enhancing their market value and help cultivate enterprises' first-class talents, so as to comprehensively upgrade the development model of Chinese enterprises.

### **1.1 The current situation and research summary of China standards "going out"**

China joined the International Organization for Standardization in 1978. In October 2008, China formally became a permanent member of the General Assembly of the International Organization for Standardization, and lead the formulation of many international standards.

**Table 1 International Standard Statistics Issued by China up to March 2017**

International Standards Made and Published by China	ISO	IEC
Number	218	116

In the fields of high-speed railway, nuclear power, telecommunication and automobile, the international acceptance of the standards formulated by China is getting higher and higher, which is a typical successful example of China's standard output. However, according to the open data provided by the National Standards Committee, China's official standards submitted to ISO and IEC still account for only 1.58% of the international standard system.

At present, many scholars at home and abroad have made a thorough and detailed discussion on the "going out" of China standards. Wang Quanyong believes that, on the whole, the field and application scope of China standards' "going out" are relatively small, and coordinating the strategy of "going out" of Chinese standards and "introducing" advanced foreign standards is an important way to enhance the internationalization of standards (Wang Quanyong, 2015). While Zhi Shuping (2014)'s study emphasizes the need to deepen the standardization system reform, and identify key points to support economic transformation in a more effectively way (Zhi Shuping, 2014). Heng Hong et al. (Heng Hong et al., 2013) analyze the reasons why China standards' "going out" has been in an inferior position from the aspects of insufficient technological research and development innovation ability, low market maturity and the lack of business negotiation experience. At the same time, they pointed out that Chinese standards' "going out" should be based on independent innovation to achieve the transformation from "traditional Chinese manufacturing" to "Chinese innovation and creation" (Heng Hong, 2013).

China standards' "Going out" means that all walks of life should break away from the inertia dependence on foreign standards, develop their own standards, and constantly integrate with international standards by means of communication, sharing and innovation, until these standards exceed the existing international ones, thus gaining recognition and wide application in the international market (Yang He, 2018). In the period of economic transformation, this is the only way for China to deepen the traditional industries reform, maintain the integration and balanced development of manufacturing industry and modern service industry, and accelerate the construction of a strong socialist modernization country (Bai Nan, 2019).

### **1.2 International discourse power**

Jiang Zhaoli et al. (Jiang Zhaoli et al., 2017) hold the view that international discourse power means the right for sovereign states to know, express and participate in the international discourse platform in matters of state affairs and related international affairs (Jiang Zhaoli, 2017). Generally speaking, discourse power refers to the component of decision-making made by a small number of participants in the process of communication and cooperation with other parties, and it is an important factor leading the development of events and the direction of business decision-making.

## **2 The Role of China Standards' "Going Out" in Improving Enterprises' International Discourse Power**

### **2.1 Enhance the international discourse power of Chinese enterprises**

From the point of economic transformation, implementing standardization strategy, as well as leading the replacement of new and old kinetic energy and comprehensively assisting the upgrading of industries by standards is benefit for strengthening the international competitiveness of enterprises and participate in international collaboration (Fang Zheng, 2018).

### **2.2 Reduce Chinese enterprises' risk in the "one belt and one road" trading country**

With the gradual acceleration of Chinese enterprises' "going out" speed and the deepening of transnational cooperation projects, the risk of investment along the "one belt and one road" area has begun to emerge. After going abroad with great confidence, some enterprises' study of business rules and industry standard language in the host country is not attentive enough, and the strategic docking of standardization between the two sides is sketchy, as a result, both of them have paid high tuition fees for this.

### **2.3 Cultivate enterprises' internationalized talents**

Overseas operation involves complicated factors that should be considered carefully by every part, like laws, financial systems and industry rules of different countries. All of this requires enterprises to have a sufficient international talent reserve. Excellent composite international talents can help enterprises make correct business decisions in the complex international market and help enterprises improve their comprehensive international strength (Yu Hongjun, 2017).

## **3 Existing Problems of China Standards' "Going Out"**

Chinese standards' "going out" is an internationalized road, involving different countries and regions in the world. There are political, legal, civilized and other differences exist in these countries. What is more, China's standard system is not mature enough when compared to the international standard system. And it has a relatively short development process. There are still some problems in the aspect of perfecting China's standard system. Realizing the interconnection between national standards, as well as breaking through invisible trade barriers and shaping China's new standards are all problems waiting to be settled.

### **3.1 Needs of Chinese standards system's improving and updating**

During the rapid development of China's economy, Chinese enterprises, relying on the advantages of lower labor cost, undertook a large number of processing tasks, all with low scientific and technological content. So their ability of independent R&D and innovation was at a low level in the global industrial chain, which increased the cost burden of enterprises and the risks of production and operation (Mi Jinsheng, 2012). Nowadays, China's social and economic structure has undergone tremendous changes. The current standards are not fully applicable to the needs of enterprises in high-level development, which need to be updated and reformed as soon as possible.

### 3.2 Failure of realizing interconnection

During Chinese standards' "going out" process, some enterprises are eager to make quick achievements and fail to do standard docking work with international partners, but overemphasize the concept of Chinese standards to the host country. However, lack of international translations and timely comparative analysis documents with Western standards system makes it rather difficult for the host country to really understand the connotation and advantages China standards.

**Table 2 Current Situation of Translation of Foreign Versions of National Standards**

National Standard Items	Foreign Language Version under Translating	Foreign Language Version under Reviewing	Foreign Language Version under Approving	Published Standard Foreign Language Version	Current National Standards of China
Number	357	11	69	531	36538
The Proportion of National Standard Stock (%)	0.977	0.03	0.19	1.45	100

### 3.3 Invisible trade barriers

During the construction period of "one belt and one road", the world is at a slower pace of economic growth. Some countries begin to tend to nationalism and trade protectionism on economic and political issues. In the process of participating in the "one belt and one road" economic construction process, there are some reservations in terms of opening level, depth of cooperation, enforcement and so on, and countries' setting up invisible technical barriers for trading making it more difficult for Chinese standards to be accepted in the best sense by the host country (Liu Zhiyang, 2017).

### 3.4 Shaping new China standards

Many industries in China still depend on the standards of developed countries in technology, and lack independent innovation ability in science. Multinational enterprises often present the state as "large but not strong". Zhu Jiejun, chairman of the BRICS National Research Center, believes that "concept + system" are the two key factors in shaping new standards. The so-called new standards are the contents covered by which need to be innovative, distinguishable from the existing ones, and have irreplaceable advantages. Secondly, these "ideas" must be upgraded to a mechanism, which can work in practice (Mao Fang, 2018).

## 4 Analysis of Chinese Infrastructure Construction Standards' "Going Out"

Since 2015, China's foreign direct investment (FDI) has become the second largest foreign investor in the world in 2016. As an important part of FDI, Chinese standard infrastructure output has also experienced a rapid increase.

After 2015, China's investment in the "one belt and one way" project begins to focus more on energy, infrastructure construction and other industries. Chinese enterprises in these industries have

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 been well integrated into the international trading system through continuous upgrading and transformation.

**Table 3 China's Outward FDI Grouped by Industry in 2009-2016 Unit: \$10 million**

year industry	2009	2010	2011	2012	2013	2014	2015	2016
Mining	13343	571.5	1444.6	1354.4	2480.8	1654.9	1125.3	193.0
manufacturing	224.1	466.4	704.1	866.7	719.7	958.4	1998.6	2904.9
Production and supply of electricity, gas and water	46.8	100.6	187.5	193.5	68.0	176.5	213.5	353.6
Construction	36.0	162.8	164.8	324.5	436.4	339.6	373.5	439.2
Transportation, Warehousing and Postal Service	206.8	565.5	256.4	298.8	330.7	417.5	272.7	167.9
Finance	873.4	862.7	607.0	1007.1	1510.5	1591.8	2424.6	1491.8

#### 4.1 Market demand

On the whole, the overall economic construction of most countries along the "one belt and one road" is lagging behind, and the risk of infrastructure construction is high. Infrastructure in Europe, America and other countries also needs to be renovated because of its long history and low transport efficiency.

**Table 4 In efficient supply of infrastructure construction assessment of countries along the one belt and one road**

country	(1) Rank of risk from the insufficiency supply of infrastructure in the assessment system	(2) Scores of the risk assess	(3) TP of investment risk for each country	Proportion (%):(2)/(3)
Russia(criterion)	10	3.9	15	26
The Philippines	2	17.9	20	89.5
The Niger	1	20.0	25	80

The People's Republic of Bangladesh	2	14.4	20	72
India	5	7	10	70
Sri Lanka	8	6.6	12	55
Liberia	5	10.7	20	53.5
Laos	5	7.5	15	50
Iran	4	9.9	20	49.5
Cambodia	4	8.4	20	42

#### 4.2 Construction strength and technology skills

Since the reform and opening up, China's infrastructure construction has achieved rapid development. The technology level of infrastructure construction is in the leading position of the world. The high-speed railway made in China has won praise from all over the world. Yaji Railway, Mongolian Railway and Indonesian Yawan High-speed Railway are the symbolic achievements of Chinese railway standards' "going out".

#### 4.3 Case study: Yawan High Speed Railway

China's high-speed railway has become a successful model of China's standard "going out". The joint venture between Chinese and Indonesia governments is the first project of Chinese high-speed railway construction industry chain standards "going out" in the "one belt and one road". The whole construction of the Yawan high speed railway is based on China's technical standards, which has epoch-making significance for China's high-speed rail technology to move towards the international stage.

##### 4.3.1 Active consultation for cooperation opportunities

Both China and Japan are powerful countries in high-speed rail. Before the formal signing of the Yawan High-speed Railway Cooperation Agreement, the competition between the two sides was very fierce. China's struggle for the right to build Yawan High-speed Railway was tortuous. However, the Chinese government has been actively negotiating with Indonesia with sincere determination and strong technical confidence, and finally successfully took down the medium-speed railway plan.

##### 4.3.2 Project construction period

The construction difficulties of Yawan High-speed Railway are mainly concentrated upon the exploit of tunnels and land expropriation. Because of the complex geology of local tunnels, it is very difficult for the construction team to work onwards. However, using advanced techniques and high-end reliable domestic excavation equipment, the Chinese Railway Team finally completed the overall tunnel penetration work. In terms of land expropriation, China has actively communicated with local governments and citizens by appeasing the interests and needs of relevant parties. By March 2019, the land expropriation process of Yawan High-speed Railway has been completed by 92%, and the construction of the project has entered into the final stage.

This 150-kilometer high-speed rail line made by China is an important symbol of the "going out" of China's high-speed rail card. The construction of the Yawan high-speed railway provides a good foundation for the economic construction of countries along the "one belt and one road" and help China's high-speed rail construction technology attain a high reputation in the world. The international discourse power of Chinese enterprises will be greatly improved, which provides support for the extensive use of China's advanced standard system in the future international cooperation of Chinese enterprises. The key to the success of China's railway "going out" lies in it combines the core advantages with the urgent needs of the host country, adjusting measures to local conditions. on the premise of comprehensive investigation of local economic situation, in-depth analysis of local market demand and accurate assessment of regional investment risks, this forms a standard system of production mode with Chinese characteristics

## 5 Conclusion

Based on the internal relationships and interactions between the "going out" of China standards and Chinese enterprises, this paper proposes that the "going out" of China standards helps enhance the international discourse power of Chinese enterprises and reduce enterprises' trading risk when participating in the "one belt and one road" construction, and takes China's typical infrastructure construction standards "going global" as an example to analyze the demand of Chinese standards in the international market.

Based on the analysis and research above, this paper puts forward the following policy suggestions: firstly, enterprises should take active part in the formulation of Chinese standards, which including increasing investment in R&D, training compound international talents, encouraging scientific and technological innovation and focusing on the development of company's core competitiveness; secondly, the government should guide Chinese enterprises to participate in the construction of "one belt and one road" project and cultivate accurate recognition of the international standard language and market rules, Building a friendly bridge between transnational cooperative enterprises is also necessary ;finally, the Chinese standards' "going out" should strengthen cooperation and set up win-win goal, highly hold the banner of economic globalization, and break the restrictions of invisible trade barriers. Above all, Chinese enterprises should put the significance of implementing Chinese standards on improving the economic situation of the host country, enhance their overseas responsibility consciousness, promote the construction and development of the community of human destiny and establish a good international image of Chinese enterprises.

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## **Analysis on the Mode of Medical Care and Pension Support in Rural Areas Based on "Healthy China"**

Wu Qian, Qiu Yinggui

School of Management, Hubei University of Chinese Medicine, Wuhan, P.R.China, 430070

(Email: 1481109871@qq.com, qiuyinggui@126.com)

**Abstract:** The process of aging in China has aggravated, which is exacerbating the situation of rural pension. It is an inevitable trend to implement the mode of medical care and pension support in rural areas, and its construction requires the multi-participation from the government, the pension institutions, elderly, hospitals and private enterprises. On this basis, this paper will construct a pension mode and explore from the perspectives of policies, funds, technology and personnel to find out the countermeasures to help solving old-age problems. It will provide a reference for alleviating the pressure of rural pension and promoting the development of "Healthy China".

**Key words:** Integration of medical care and pension support; Pension mode; Rural areas; Countermeasures

### **1 Introduction**

According to the National Bureau of Statistics of China, the population over 60 years old reached 249 million at the end of 2018, of which nearly 60% were distributed in rural areas. It is estimated the population over 60 will reach 300 million by 2025, making China become a super-old country. The rapid progress of China's aging process and severe situations make the entire society have to face the bigger pressure. At the same time, with the phenomenon of "empty nest elderly" is increasing, it is forecast that the number of elder lies living alone will up to 118 million by 2020. And most of the elderly are suffering from chronic diseases, which result in the number of disabled and semi-disabled elderly are increasing year by year. Therefore, the problem of pension for the elderly in rural areas has received much attention. The elderly not only need the daily care but also medical treatments. At the 19th National Congress CPC, President Xi also pointed out that the integration of medical care and pension support is the core content of the old-age services, and medical care is the foundation of pension. Under the strategy of "Healthy China", the integration of medical care and pension support will be the greatest opportunity for the development of the old-age services.

The concept of integrated health and social care which put forward in the fifth EU framework plan in the 1990s was similar to China's current concept. It means the integration of health and social care, with the aim of forming structural, organizational, economic and social factors into a care system that is sustainable for all participants (Andy,2003). In China, Guo Dong first proposed the concept of "integration of medical care and pension support": Through the multiple combination between medical

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<sup>88</sup>Statistical Bulletin of National Economic and Social Development, HTTP: WWW. Stats. Gov. CN / TJSJ / PCCJ / RKPC / 6rp / index ch,2017[1],2018-02-28

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institutions and pension institutions, it can share resources and complement bilateral advantages, so as to solve the problems caused by the aging of the population (Guo Dong,2005). The essence of the concept is to realize the integration of medical care and pension support.

## 2 Research Status Quo at Home and Abroad

This paper mainly uses literature research and expert consultation to collect and sort out the literature related to rural medical care in recent years by searching CNKI, Elsevier SD and other databases. Meanwhile, we also consult relevant authoritative experts, which aim to fully understand the status quo of old-age care at home and abroad, and lays a theoretical foundation for the construction of rural medical care and pension support mode.

### 2.1 Status quo at home

In China, based on the theme of “the mode of medical care and pension support in rural areas” in CNKI, we found that there were 199 academic papers by the end of 2018, and the number of literature studies were small (Figure 1). The main research contents are as follows: (1) Influencing factors. Ye Wei believes that the choice of pension mode is influenced by economic conditions, social support systems, medical needs and psychological needs (Ye Wei,2018). Lu Jianhua investigates and analyzes the willingness and influencing factors of living in a combination of medical and nursing institutions from three aspects: personal characteristics, family characteristics and old-age willingness (Lu Jianhua,2016). (2) Research on necessity. Liu Wenjun considers it is necessary to establish a long-term care insurance system for the elderly and strengthen the construction of safeguard measures such as policies and regulations (Liu Wenjun,2016). (3) Problems and countermeasures. Geng Aisheng thinks that there are problems such as insufficient financial input, backward service facilities, lack of social financing mechanism and insufficient professional talents in rural areas (Geng Aisheng,2017). Xu Guanghao talks about the development of rural medical care and pension support mode is facing the problems of backward pension concept, heavy economic burden and small number of pension institutions and so on, and explores ways from the aspects of changing the concept of old-age care, improving the medical insurance mechanism and broadening financing channels(Xu Guanghao,2018).

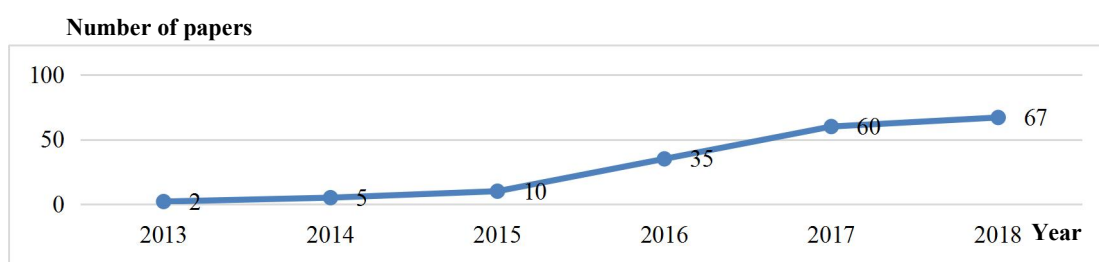


Figure 1 Number of Papers about the “Mode of Medical Care and Pension Support” in Rural Areas

### 2.2 Status quo at abroad

In foreign countries, through the databases such as Elsevier SD and Springer Link, there are a large number of papers under the theme of “Medical Care”, “Pension mode” and “Pension in rural areas”. If the medical care and rural pension are searched together, the number of related papers has

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been greatly reduced. Lin Chen says that the study of nursing modes is relatively mature and stable at abroad, but it has shown a downward trend in recent years. Meanwhile, the research tends to be four modules of nursing education, management, clinical practice and theoretical studies, and nursing modes in communities may become the main research direction in the future (Lin Chen,2017). Henk Nies et al. believe that the comprehensive services provided by the mode of medical care and pension support refer the seniors' lives, mentalities and social values, especially those who suffer from chronic diseases, mental illnesses and those requiring complex treatments or emergency care. This will provide an excellent and healthy environment for them (Henk Nies,2004).

In summary, it can be found that the number of papers on rural medical care and pension mode are relatively small both at home and abroad, and the theoretical analysis is worth further exploration. At the same time, it is also recognized that the current situation of rural pension in China is severe, and there is a long way to develop the integration of medical care and pension support.

### **3 Construction of the Rural Medical Care and Pension Support Mode in China**

When exploring the mode of medical care and pension support in rural areas, this paper will further refine it from a conceptual perspective. For rural pension groups, the elderly can be divided into two categories: the rural indigenous elderly and the immigrant elderly. In exploring the rural pension mode, we can start from two aspects of medical care and pension support. This refinement can better understand and meet different needs of the rural seniors, providing reasonable suggestions and theoretical supports for the construction of rural medical treatments and health-care institutions, alleviating the rural pressure of pension to achieve the goal of "Healthy China".

#### **3.1 The concept of design**

The construction of rural medical care and pension support mode is mainly based on the two theories: hierarchy of needs and welfare pluralism. The former was proposed by American psychologist Maslow, who divided human needs into five levels: physical needs, security needs, love and belonging, respect and self-realization. The levels are from low to high, from meeting basic material needs to spiritual needs. The latter shows that government is no longer the sole provider of welfare, it emphasizes multi-participation, and social welfare can be shared by profit organizations, non-profit organizations, families and communities.

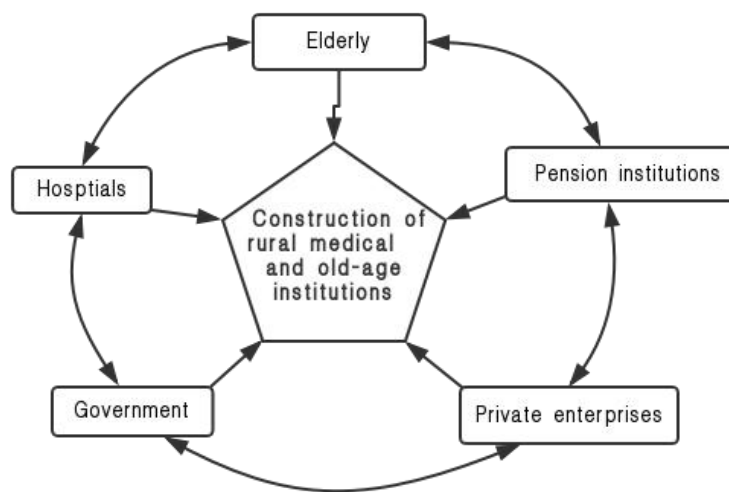
With the continuous improvement of living standards, people's medical needs are more diverse. In the process of building rural old-age care institutions, we should not only pay attention to the basic physiological and security needs of the elderly, but also improve their spiritual needs. At the same time, with the aging problem becoming more and more serious, the reform of the rural pension mechanism is imminent. To innovate the pension model, we must focus on welfare diversification and integrate the market into the rural pension. For example, some non-profit organizations and enterprises can respond to the national PPP call and invest in the construction of rural old-age institutions to provide more high-quality services for the elderly.

#### **3.2 Framework and implementation path of the mode**

Yi Cai thinks that most of the rural areas have practical problems such as insufficient economic development, inadequate social security mechanisms and scarce public services, which result in poor living conditions for the elderly (Yi Cai,2014). Liu Wenjun says that many families present a "4 + 2 + 1" mode, many adults have to support four elderly and raise at least one child, the burden of providing

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 for the aged is too heavy (Liu Wenjun,2016). Xu Guanghao points out that most rural elderly are not willing to go to pension institutions because of the backward concept (Xu Guanghao,2018).It can be seen that the current situation of rural pension is grim and many problems still need to be overcome in the process of building rural medical and old-age institutions, such as backward concept of pension, heavily economic burden, outdated institutional facilities and single service.

Based on the above theory and taking into account the current situation of rural pension, it is not enough to rely on one side to solve the old-age problem. It requires multi-participation and cooperation. Developing the mode of medical care and pension support in rural areas and constructing rural medical and old-age institutions require a large amount of funds, technology and manual labor, which are inseparable from the support of the government, private enterprises, hospitals, pension institutions and elderly. Based on this, the following mode is constructed (Figure 2).



**Figure 2 Schematic Diagram of the Mode of Medical Care and Pension Support in Rural Areas**

### 3.2.1 Elderly

The main purpose of constructing the mode of medical care and pension support in rural areas is to alleviate the pressure of rural pension. The elderly's demands for pension point out the direction for the construction of medical and old-age institutions. Rural elderly mainly includes indigenous elderly and immigrant elderly. For the indigenous elderly, because they are mostly “empty nest elderly” and their physical conditions are not good, they have greater demands for medical treatments and health-care. For the immigrant elderly, mainly refer to those retire in cities or stay in the countryside temporarily, they pay more attention to the qualities and kinds of services provided by medical and old-age institutions, and pursue the comfort and satisfaction of life styles. Therefore, the needs of different groups should be fully considered in the construction of rural medical and old-age institutions. Meanwhile, take notice of the balanced development of old-age services and medical care, constantly innovate medical care mechanisms and provide a variety of old-age services, such as setting up entertainment centers and sports places for the elderly. Of course, we must also fully consider the local cultural development and actual situation. Eileen Griffin believes that the introduction of medical care and pension support mode

### 3.2.2 Government

The government plays an important role in the construction of the rural medical care and pension support mode, which is mainly embodied in policy and funds.

In terms of policy, the State should strengthen the promulgation of policies which benefit the people. On the one hand, the rural medical security mechanism should be improved, incorporating pension costs into the ranks of rural medical insurance and realizing the effective link between pension costs and medical insurance. On the other hand, exploring the establishment of rural social endowment insurance system. It is necessary for the state to explore a social insurance system suitable for rural endowment insurance, especially to provide effective protection for the elderly when they encounter acute or serious diseases.

In terms of funding, the government should regard the construction of rural medical and old-age institutions as its own work scope and give them economic support. At the same time, it is necessary to increase subsidies for the seniors' pension expenses and reduce the economic burden of them.

### 3.2.3 Private Enterprises

The construction of rural medical and old-age institutions requires a lot of capital investment. Funds mainly come from government and society, while social capital mainly comes from private enterprises. In order to attract foreign investment, rural medical and old-age institutions can lease to enterprises to operate, implement public construction and private operation, and can also attract investment by reducing the collection of corresponding taxes and fees and increasing the point of taxation. Lau JY indicates that difficulties in coordinating health-care and social services should be addressed when working with private enterprises (Lau JY, 2018). At the same time, rural areas can also use their own advantages, such as the development of ecotourism to attract foreign investment.

### 3.2.4 Hospitals, Pension Institutions

In the process of building the rural medical care and pension support mode, hospitals and pension institutions mainly focus on the requirements of personnel and technology.

On the technical side, hospitals and pension institutions should rely on each other to share medical resources and pension resources by building "Internet + pension" mode. Xing Yanan believes that the construction of rural medical and old-age institutions can learn from the "Internet +" to increase the intensity of intelligent medical care, intelligent pension and spiritual activities, which will enhance the people's recognition of the integration of medical care and pension support (Xing Yanan, 2018). Wang Mengjie thinks that it is important to implement "Internet + medical care combined with old-age service", it can realize the functions of remote reminder and control, automatic alarm and disposal, dynamic monitoring and recording (Wang Mengjie,2018). "Internet +" can be used to construct rural medical and old-age institutions by building information network platform, setting up information files for rural elderly, tracking the health conditions of the elderly and updating their information in real time.

In terms of talents, the biggest advantage of the medical care and pension support mode is to provide comprehensive services, which require the professional nursing workers. Scholars such as Jan Reed points out that the needs of the elderly are complex and diverse, they need different professional service providers and institutions to look after in the meantime (Jan Reed, 2005). Nursing workers mainly include living staffs, medical staffs and full-time staffs. Only by professionally training them and

### **3.3 Function of the mode**

#### 3.3.1 Strengthen the consciousness of pension and emancipate backward ideas

The backwardness of concept and weak consciousness are the first breakthrough to solve the problem of rural pension. By constructing the rural medical care and pension support mode, and giving full play to the leading role of the government. Grass-roots organizations such as township governments should do a good job in propaganda and implementation, such as convening village committees and inviting experts to give lectures to villagers, which helps to liberate the backward concept of old-age support in rural areas, so that make people know its meanings and benefits.

#### 3.3.2 Reduce the expense of pension and alleviate the burden of old-age care

The support of government policy funds and the introduction of social capital provide material security for the establishment of rural medical institutions, which will greatly alleviate the pressure of rural pension funds. The reduction of pension expenses is conducive to alleviating the life and spiritual burden of the elderly, and has positive significance for improving the sense of satisfaction and happiness of life.

#### 3.3.3 Improve service levels and meet diverse needs

In the process of building the rural medical institution, complete equipment and staffing are of great benefit to improving the level of pension services. Advanced medical equipment, diversified old-age care facilities and high-tech medical staffs can not only enrich the lifestyle of the elderly and increase their fun, but also meet their spiritual needs and continuously improve their quality of life.

#### 3.3.4 Strengthen teamwork and achieve mutual benefits

The problem of rural old-age support needs the participation and efforts of the elderly, the government, enterprises, hospitals and pension institutions. Only through cooperating together can we promote the smooth development of the rural medical care and pension support mode, and achieve the goal of "healthy China" as soon as possible.

## **4 Conclusion**

Rural pension is the most important aspect of China's old-age care. This paper explores the problem of rural pension through the construction of mode. The content is more systematic and comprehensive, which provides a theoretical reference for the construction of rural medical and old-age institutions. As for the shortcomings, this paper pays more attention to theoretical analysis and lack of empirical research, which will further exploration in the future.

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# Impulse Response Analysis of Collaborative Performance to Synergy Degree in Comprehensive Design

Fang Jun, Wu Dingyuan, Zai Yue

School of Civil Engineering and Architecture, Wuhan University of Technology, Wuhan, P.R. China, 430070

(E-mail: whutfj@126.com, woodian@163.com, fnjqmy@163.com)

**Abstract:** Based on the data of comprehensive infrastructure design of a typical industrial park, the data of synergy and collaborative performance of each subsystem of the project are calculated. This paper uses vector auto regression methods, impulse response analysis and variance decomposition to analysis the impact response of collaborative performance to synergy degree of the duration subsystem, quality subsystem, resource subsystem and information subsystem in the comprehensive infrastructure design of the large-scale park. In this paper, we use vector auto regression methods, impulse response analysis and variance decomposition. The results indicate that, there are significant responses in the collaborative performance to shocks in the synergy degree of four subsystems in the collaborative mechanism, and it shows a clear relationship between them. Considering the overall synergy of the project in the comprehensive design of large park infrastructure can enhance the competitive advantage.

**Key words:** Comprehensive design; Synergy degree; Collaborative performance; Impulse response analysis

## 1 Introduction

With the acceleration of China's new urbanization process, various large-scale parks have sprung up in many cities, and more and more attention has been paid to the management of the infrastructure construction process in large parks, especially in the design stage. Feng Zhijun, et al put forward that the infrastructure of large-scale parks relies on large-scale parks, with the aim of serving the economy, production and life of the park (Feng Zhijun, et al, 2008). Therefore, the designers of the infrastructure design in the large-scale parks need to consider the design of each major, taking into account the coordination and organic combination of various subsystems and sub-projects of the entire project.

The comprehensive design is a complex large system. According to the complex large system theory, the complex large system can be decomposed into multiple independent and interacting subsystems. The comprehensive infrastructure design management of large-scale

park is characterized by large scale and complex structure, unpredictable goals, and difficult task specificity. Therefore, it is necessary to establish a scientific collaborative mechanism. In recent years, many researchers have applied collaborative management research to comprehensive design, with fruitful results. Feland J pioneered the discipline of Integrated Design Engineering (CDE) in conjunction with economics, sociology, and technology, and described its use framework (Feland J, Leifer L, Cockayne W, 2004). Gao Zuoren et al. proposed a logical model of the collaborative design mechanism of architectural design. Based on this, the authors established a common platform for remote collaborative design work (TH-CSCDP) to help collaborative resource management of architectural design (Gao Zuoren, Wu Weiyu, Fang Qingzhou, 2004). Gao Bo et al. established the quality control process for the three-dimensional collaborative design of water conservancy and hydropower projects, and realized the collaborative arrangement and quality control of different construction environments and complex tasks in the design project (Gao Bo, Zhao Yinghong, Li Peng, Wang Ying, 2014). Scholten D and Kunneke R. propose a design framework for energy infrastructure design that links engineering and economic perspectives to energy infrastructure design to help system and market design work better coordinate (Scholten D, Kunneke R, 2016).

In recent years, the research of collaborative management has developed rapidly, which provides theoretical support for perfecting the collaborative mechanism of the comprehensive design. Fu Yuanlue et al. discussed the synergistic management effect of enterprise cluster costs, using the regression analysis verified the importance of collaborative management awareness, enterprise full cooperation, and cluster core enterprises (Fu Yuanlue et al, 2009). Nan Xingheng et al. constructed a model of intellectual capital collaborative management effect measurement from the perspective of cash flow, which provided a new perspective for the measurement of synergy degree (Nan Xingheng et al, 2013). On the theoretical basis of collaborative management, the establishment of a reasonable performance evaluation system can ensure the smooth operation of the collaborative mechanism. Wang Xujia et al. built a comprehensive evaluation method based on NSFDS urban elderly residential project design elements, and comprehensively considered each design element (Wang Xujia, Zhang Jing, Gao Qianqian, 2011). In view of the complex project design of multi-professional participation, Ren Z. et al. developed a collaborative design performance evaluation matrix (CDPM) to evaluate the performance of the building's collaborative design, which provides guidance for the improvement of the design results (Ren Z., Anumba C. J., Yang F., 2013).

The above-mentioned research shows that, many scholars have studied the collaborative management of engineering construction collaborative design and established a collaborative mechanism. The in-depth analysis of the synergy degree and collaborative performance in the collaborative mechanism will help the establishment and improvement of the collaborative mechanism. Based on the above situation, this paper takes the comprehensive infrastructure design of an industrial park as an example, and analyzes the relationship between collaborative performance and the subsystem synergy degree in the project

## 2 VAR Model Construction

In order to study the relationship between synergy degree and collaborative performance, this paper uses the method of constructing vector autoregressive model to conduct empirical analysis. The vector autoregressive model (VAR) was originally applied to macroeconomic system analysis in the field of econometrics. In 1980, Sims proposed the model in his article "Macroeconomics and Reality". It has since evolved into one of the most widely used models in empirical economics and one of the main analytical methods for studying macroeconomic systems. In 2011, Xia Yeliang et al. used the relevant data from 1949 to 2008 in Beijing to dynamically analyze the interaction between Beijing's infrastructure construction and its economic growth by establishing VAR model, cointegration test, and establishing vector error correction model (Xia Yeliang et al, 2011). In 2014, Rui Xueqin et al. used the panel data VAR measurement analysis method to study the interaction between industrial cluster upgrade and industrial transformation based on the data of 30 provinces and cities in China from 2001 to 2010 (Rui Xueqin et al, 2014). In the same year, Zhang Huan et al. selected the national data from 1992 to 2012, and built a VAR model to analyze the foreign investment, environmental pollution, environmental governance investment, and economic growth. Based on this, they conducted an in-depth study using impulse response and variance decomposition (Zhang Huan et al, 2014).

Before the VAR model was proposed, the mainstream econometric data analysis method was a simultaneous equation model. Both the model and the VAR model are unstructured multi-equation models. By introducing variables and equations, these two models attempt to simulate the real operation of the economic system. They are widely used in economic structure analysis, economic forecasting and policy evaluation. However, the economic prediction effect of the simultaneous equation model is not satisfactory, and the assumption of the zero-constraint assumptions and the division of variables are often criticized. According to Sims, the VAR model has fewer constraints when studying the relationship between macroeconomic variables than the simultaneous equation model. The method assumes that all variables are endogenous variables, and these endogenous variables are subjected to regression processing on the lag variables of all endogenous variables including themselves, so that the transition from the univariate autoregressive model to the VAR models composed of multidimensional time series to more accurately simulate the dynamic processes of economic systems.

VAR models belong to the category of multidimensional stationary time series models, which are modeled by the statistical properties of data, thus simulating the dynamic process of multiple variables. By analogy with the definition of a single-variable time series,

Let  $T = \{\dots, -2, -1, 0, 1, 2, \dots\}$ , for any fixed  $t \in T$ ,  $Y_t$  is an n-dimensional random vector, which can be expressed as a formula  $Y_t = (Y_{1t}, Y_{2t}, \dots, Y_{nt})'$ , and the whole  $\{Y_t; t \in T\}$  is recorded as  $\{Y_t\}$ ,  $\{Y_t\}$  is the n-dimensional time series on T.

Assume that the comprehensive infrastructure design collaborative performance of large-scale park is continuously optimized with the increase of target synergy. At the same time, the optimization of collaborative performance will drive project stakeholders to pay attention, invest and improve the comprehensive design collaborative mechanism, thus accelerating the goal synergy. It can be seen that the synergy and collaborative performance of the comprehensive design of the infrastructure design of large-scale parks complement each other and are related to each other. There is a two-way causal relationship between the two. The target synergy and collaborative performance of the integrated design are regarded as two sets of single time series, wherein the target synergy consists of four subsystems, namely the duration subsystem ( $D$ ), the quality subsystem ( $Q$ ), the resource subsystem ( $R$ ), and the information subsystem ( $I$ ), each subsystem can obtain the corresponding synergy degree. Collaborative performance ( $CP$ ) is composed of collaborative performance indicators. The subsystem synergy degree and collaborative performance index change with time. The synergy degree of the four subsystems and collaborative performance constitute five endogenous variables. Introduce a standard p-order vector autoregressive model, as shown in Equation 1 (Shang Hongtao, Huang Xiaoshuo, 2018).

$$Y_t = C + \sum_{i=1}^p \theta_i Y_{t-i} + \varepsilon_t \quad (1)$$

$$Y_t = (D, Q, RC, I, CP)^T \quad (2)$$

$$Y_t = \begin{pmatrix} D_t \\ \vdots \\ CP_t \end{pmatrix}, C = \begin{pmatrix} c_1 \\ \vdots \\ c_9 \end{pmatrix}, \theta_i = \begin{pmatrix} \theta_{11,i} & \cdots & \theta_{19,i} \\ \vdots & \ddots & \vdots \\ \theta_{91,i} & \cdots & \theta_{99,i} \end{pmatrix}, \varepsilon_t = \begin{pmatrix} \varepsilon_{1t} \\ \vdots \\ \varepsilon_{9t} \end{pmatrix} \quad (3)$$

$Y_t$  represents the vector consisting of endogenous variables in the t month, C is the intercept, p is the lag order,  $\theta_i$  is the regression coefficient matrix, and  $\varepsilon_t$  is the random disturbance term.

The VAR model is mostly used to analyze the interaction between variables, and the impulse response function (IRF) focuses on analyzing the impact of the innovation change impact model on various variables of the system. In this paper will use EViews software to

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build a multi-dimensional VAR model in combination with *IRF*. After each time series passes the ADF test and the model passes the AR root test, we use IRF to analyze the impact of synergy degree disturbance of each subsystem on the collaborative performance in each period, when each endogenous variable is subject to a change in the standard deviation of the innovation rate. Finally, using variance decomposition to analyze the variance contribution rate of different endogenous variables (Lei Tian, Xu Jinliang, Shan Donghui, Jia Xingli, 2016).

## 3 Variable Selection and Data Collection

### 3.1 Variable selection

The synergy degree refers to the degree to which each subsystem cooperates, and the self-organization evolves into a collaboratively developed, efficient, and orderly complete system. The comprehensive design synergy degree is a measure of the synergy of the whole process of the comprehensive infrastructure design of the large-scale park. It is an assessment of the consistency of the synergy degree in the development and evolution of each subsystem in the comprehensive design system.

Comprehensive design collaborative performance evaluation is based on the comprehensive design pattern task attributes, set specific evaluation index system. It uses scientific comprehensive evaluation method to reflect the cooperation status, work quality and operational efficiency and quality of the comprehensive design mode. This paper uses overall satisfaction to measure the comprehensive design collaborative performance.

### 3.2 Data collection

Based on the data of comprehensive infrastructure design of an industrial park in 2013, this paper selects the semi-monthly synergy degree of each subsystem and collaborative performance as a research sample.

#### (1) Comprehensive design synergy degree

The construction process of synergy degree model of the comprehensive infrastructure design of large-scale park is mainly based on the system order degree, selecting the metrics closely related to the system order degree for power evaluation. Then, the differences and degree of dispersion between the orderliness of subsystems are measured. Finally, we use mathematical methods to analyze synergy degree of comprehensive infrastructure design of large-scale park under different schemes.

The conceptual model of collaborative target system for comprehensive infrastructure

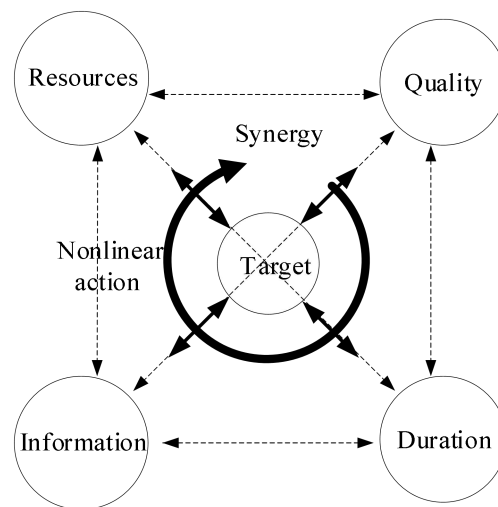


Figure 1 The Conceptual Model of Collaborative Target System

Based on the model, the multi-objective system can be divided into four interactive subsystems: duration ( $D$ ), quality ( $Q$ ), resources ( $RC$ ), and information ( $I$ ). Based on the data of an industrial park Project in 2013, this paper selects the metrics closely related to the order degree of each subsystem, evaluates the efficacy of each metric, and measures the difference and dispersion degree of subsystem order. Through the calculation and comparison, we can obtain the synergy degree data of each subsystem in 2013 under the optimal scheme.

## (2) Comprehensive design collaborative performance evaluation

This paper analyzes the collaborative performance of infrastructure design of an industrial park through fuzzy analytic hierarchy process (FAHP). In order to facilitate the rapid collection of evaluation information and to objectively reflect the real situation of integrated design collaborative management, this paper sets the overall satisfaction  $U$  as the overall target variable, internal satisfaction  $U_1$  and customer satisfaction  $U_2$  are the primary target variable. Internal satisfaction  $U_1$  is divided into cooperative attitude evaluation  $U_{11}$ , design process evaluation  $U_{12}$ , and design achievement evaluation  $U_{13}$  three secondary target variables. Customer satisfaction  $U_2$  is divided into design progress evaluation  $U_{21}$ , professional collaborative evaluation  $U_{22}$ , and design achievement evaluation  $U_{23}$  three secondary target variable. Combined with the idea of AHP, the performance evaluation system of comprehensive design on the collaborative mechanism is shown in Table 1.

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**Table 1 Performance Evaluation System of Comprehensive Design on the Collaborative Mechanism**

Evaluation target	Primary variable	Weights	Secondary variable	Weights	
Overall satisfaction $U$	Internal satisfaction $U_1$	$w_1$	Cooperative attitude evaluation	$v_{11}$	
			$U_{11}$		
			Design process evaluation	$v_{12}$	
				$U_{12}$	
				Design achievement evaluation	$v_{13}$
				$U_{13}$	
				Design progress evaluation	$v_{21}$
				$U_{21}$	
		Customer satisfaction $U_2$	$w_2$	Professional collaborative evaluation	$v_{22}$
			$U_{22}$		
			Design achievement evaluation	$v_{23}$	
			$U_{23}$		

In the form of questionnaires, the importance of the indicators in different periods is investigated, and the results of the indexes weight can be calculated in different periods as shown in Table 2.

**Table 2 Index Weight Calculation Results in Different Periods**

Periods	$w_1$	$w_2$	$v_{11}$	$v_{12}$	$v_{13}$	$v_{21}$	$v_{22}$	$v_{23}$
1	0.50	0.50	0.33	0.33	0.33	0.45	0.45	0.10
2	0.50	0.50	0.10	0.45	0.45	0.33	0.33	0.33
3	0.50	0.50	0.10	0.45	0.45	0.33	0.33	0.33
4	0.50	0.50	0.10	0.45	0.45	0.33	0.33	0.33

For evaluation indicators that affect  $U_1$  and  $U_2$ , set the evaluation set to  $B = \{b_1, b_2, b_3, b_4, b_5\} = \{\text{very good, good, average, poor, very poor}\}$ . The value corresponding to the evaluation set is represented by  $X$ , and the corresponding score set =  $\{x_1, x_2, x_3, x_4, x_5\} = \{90, 75, 60, 45, 30\}$ . Questionnaires were distributed to professionals in owner's unit and construction units,

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and the results of the survey were processed using FAHP to obtain the overall satisfaction  
survey results as the result of performance evaluation.

### 3.3 Data summary

By collating the data collected above, each variable from January to December 2013 are summarized as the initial data of the research variables in this paper, as shown in Table 3. It can be seen from the table that the synergy degree of each subsystem is directly proportional to the synergy performance and grows together.

**Table 3 Summary of Initial Data of Each Variable From January to December 2013**

Periods	<i>D</i>	<i>Q</i>	<i>RC</i>	<i>I</i>	<i>CP</i>
2013.01 <sup>a</sup>	0.30	0.77	0.82	0.79	0.74
2013.01 <sup>b</sup>	0.31	0.78	0.83	0.80	0.75
2013.02 <sup>a</sup>	0.32	0.79	0.83	0.81	0.75
2013.02 <sup>b</sup>	0.34	0.80	0.84	0.81	0.78
2013.03 <sup>a</sup>	0.35	0.81	0.85	0.82	0.78
2013.03 <sup>b</sup>	0.37	0.82	0.86	0.83	0.79
2013.04 <sup>a</sup>	0.39	0.83	0.86	0.84	0.80
2013.04 <sup>b</sup>	0.40	0.83	0.86	0.84	0.81
2013.05 <sup>a</sup>	0.42	0.84	0.87	0.85	0.82
2013.05 <sup>b</sup>	0.43	0.85	0.88	0.87	0.82
2013.06 <sup>a</sup>	0.45	0.86	0.89	0.88	0.83
2013.06 <sup>b</sup>	0.46	0.87	0.90	0.89	0.84
2013.07 <sup>a</sup>	0.48	0.88	0.90	0.90	0.85
2013.07 <sup>b</sup>	0.49	0.89	0.91	0.90	0.85
2013.08 <sup>a</sup>	0.51	0.90	0.92	0.91	0.86
2013.08 <sup>b</sup>	0.53	0.91	0.91	0.92	0.87
2013.09 <sup>a</sup>	0.54	0.92	0.92	0.93	0.88
2013.09 <sup>b</sup>	0.56	0.93	0.93	0.94	0.88
2013.10 <sup>a</sup>	0.58	0.94	0.94	0.94	0.89
2013.10 <sup>b</sup>	0.60	0.95	0.95	0.94	0.90



2013.11 <sup>a</sup>	0.61	0.95	0.95	0.95	0.91
2013.11 <sup>b</sup>	0.63	0.96	0.95	0.96	0.93
2013.12 <sup>a</sup>	0.64	0.97	0.96	0.97	0.94
2013.12 <sup>b</sup>	0.65	0.98	0.97	0.98	0.95

Superscript <sup>a</sup> indicates first half of the month, and <sup>b</sup> indicates second half of the month.

## 4 Empirical Test and Result Analysis

### 4.1 ADF test

The stability of a time series means that the shock or accidental change is temporary, and its effect disappears with the passage of time. Extending its meaning to the comprehensive design collaborative mechanism can be understood that the subsystem synergy degree and collaborative performance have changed due to some sudden and unexpected impact, but with the passage of time, they will eventually return to some normal baseline value. Conversely, if the time series is nonstationary, sudden and unexpected shocks will result in permanent changes in subsystem synergy degree and collaborative performance levels, and variance will change without constraints (Ewing BT, Thompson MA, 2008).

The stationary stochastic process is the premise of establishing a VAR model. If the time series in the VAR model analysis is a nonstationary time series, the obtained results will deviate from the real situation and affect the stability of the impulse response and variance analysis. Therefore, before establishing the subsystem synergy degree and collaborative performance VAR model, the time series stability should be tested first. There are various detection methods. In this paper, this paper selects the Augmented Dickey-Fuller (ADF), uses the AIC minimum criterion to judge the optimal lag period. If the time series cannot pass the stationarity test, the data may need to be differential (Nadia Benbouzid, et al, 2018). Let X be any endogenous variable in the text, then use LX to represent the data sequence of original variable X, and DX to represent the data sequence of the variable X after the first-difference. The results of the ADF are shown in Table 4.

**Table 4 The Results of ADF**

Variable	ADF	Test critical values	Prob.	Conclusion
LD	0.0306	-3.7529 <sup>b</sup>	0.9523	nonstationary
LQ	0.4268	-3.7529 <sup>b</sup>	0.8887	nonstationary
LRC	0.0574	-3.0049 <sup>b</sup>	0.9545	nonstationary

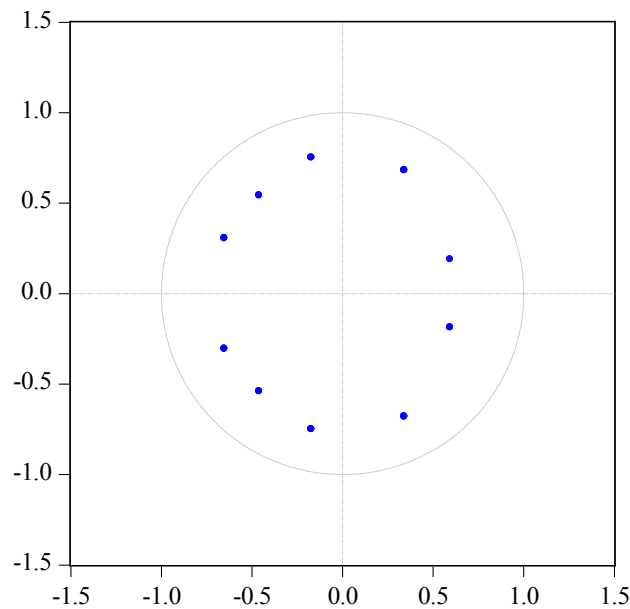
LI	0.3856	-3.7529 <sup>b</sup>	0.8962	nonstationary
LCP	0.1480	-3.0049 <sup>b</sup>	0.9622	nonstationary
DD	-7.4162	-3.7696 <sup>a</sup>	0.0000	stationary
DQ	-4.9441	-3.7696 <sup>a</sup>	0.0007	stationary
DI	-4.2465	-3.7696 <sup>a</sup>	0.0043	stationary
DRC	-4.4548	-3.8315 <sup>a</sup>	0.0027	stationary
DCP	-7.0482	-3.7696 <sup>a</sup>	0.0000	stationary

Superscript <sup>a</sup> indicates significance at the 1% level, and <sup>b</sup> indicates significance at the 5% level.

It can be obtained from the data in Table 4 that the original sequences of the five variables are nonstationary, and become stationary sequences after the first- difference.

#### 4.2 VAR model stability analysis

VAR model stability is a prerequisite for impulsive response analysis. Analyzing the stability of VAR models for *DD*, *DQ*, *DRC*, *DI*, *DCP*, the results are shown in Figure 2. The 10 inverse roots of AR characteristic polynomial in the figure are all located in the circle, which shows that the VAR model established in this paper has stability.



**Figure 2 Inverse Roots of AR Characteristic Polynomial**

The IRF is a causal analysis method for studying the relationship between different variables of a system under certain random disturbances. This method is used to describe the process of the system deviating from equilibrium and then restoring equilibrium when the equalization system is damaged by some kind of interference. In other words, the IRF is a method of analyzing the relationship between each variable under the dynamic impact by studying the response of a certain variable in the system to a certain pulse. These functions are widely used in many fields such as econometrics, signal transmission, and engineering monitoring. In the field of econometrics, they are often used in conjunction with VAR models.

Based on the previous VAR model, the impulse response analysis of collaborative performance to each subsystem synergy degree in the collaborative mechanism is carried out to reflect the future short-term dynamic relationship between the four subsystems synergy degree and collaborative performance. The results are as shown in Figure 3.

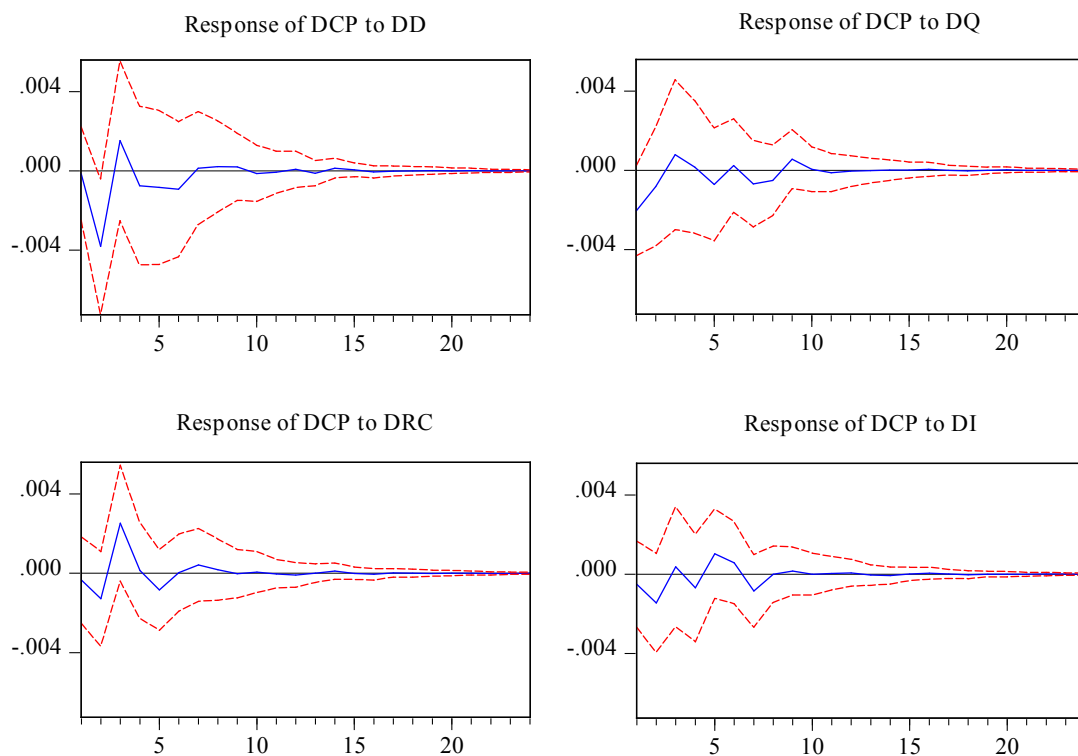


Figure 3 Impulse Response of CP to Each Subsystem Synergy Degree

The response of collaborative performance to synergy degree of duration subsystem is shown in the upper left corner of Figure 3. It can be seen that although there is no immediate response, there is a significant negative impact effect in the 1 ~ 3 periods, reaching a minimum in the 2nd phase, then rising rapidly, returning to the zero point, and reaching the

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maximum in the 3rd phase, and then the curve is in the 4 ~ 9 periods. There was only a small fluctuation, and it was stable after the 9th period. Overall, collaborative performance has the most obvious response to the impact of synergy degree of duration subsystem.

From the upper right corner of Figure 3, we can see the response of collaborative performance to the synergy degree of quality subsystem. At the beginning, collaborative performance immediately made a large negative impact response. In the 0~2 periods, there was a significant negative impact effect, and gradually fell back. After the second period, it returned to zero and continued to rise. In the third period, it reached the maximum value and then continued to fall. Then the curve continually fluctuates back and forth and tends to stabilize after the 10th period.

As can be seen from the lower left corner of Figure 3, the response result of collaborative performance to the synergy degree of resource subsystem is shown. We can see that the collaborative performance does not respond immediately, and the negative impact effect occurs in the 1~2 periods, and falls back to the lowest point in the second period. It quickly rose back to the highest point in the third period, and the small curve fluctuated near the zero point in the 4~8 periods curve, and it became calm after the 8th period.

The bottom right corner of Figure 3 shows the response of the collaborative performance to the synergy degree of information subsystem. At the beginning, the collaborative performance did not immediately respond, and there was a significant negative impact effect in the 1~3 periods, reaching the maximum in the 2nd phase. Then quickly rose back to the high point in the fourth period and then fell back again, then the curve continued to fluctuate back and forth, reaching the highest point in the fifth period. After a large fluctuation in the 1~8 periods, there was only a small fluctuation in the 8~10 periods, and after the 10th period, it returned to the zero level and stabilized. The synergy degree of information subsystem has the least impact on collaborative performance compared to others.

#### 4.4 Variance decomposition

Using the method of variance decomposition to analyze the contribution of the synergy degree of each collaborative mechanism subsystem to collaborative performance (Zhang Yihua, Wang Yuan, 2018). The results are shown in Table 5. In Table 5, the Period column is the periods of variance decomposition. The S.E. column is the standard deviation of the collaborative performance forecast. The *DCP* column is the percentage of the variance of the forecast variation of collaborative performance change caused by itself. The remaining columns are the percentage of the variance of the forecast variation of collaborative performance change caused by the each subsystem synergy degree in the collaborative mechanism.

As can be seen from the data in Table 5, the standard deviation for the first phase of the collaborative performance forecast is 0.003959, and the standard deviation for the second

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 period forecast is 0.005064, slightly greater than the forecast standard deviation for the first phase. Compared with the forecast in second phase, the degree of the four subsystems synergy of duration, quality, resources and information is slightly enhanced by the uncertainty of the first phase prediction. In addition, the standard deviation of collaborative performance prediction increases gradually with the number of forecast periods.

**Table 5 Variance Decomposition Result**

Period	S.E.	<i>DCP</i>	<i>DD</i>	<i>DQ</i>	<i>DRC</i>	<i>DI</i>
1	0.003959	84.374480	0.072289	14.237100	0.423462	0.892667
2	0.005064	51.820910	29.833370	9.866928	3.658422	4.820367
3	0.006348	44.218720	28.587970	9.204579	13.773870	4.214858
4	0.006633	43.447970	28.989300	9.078618	13.552490	4.931622
5	0.006726	41.662410	28.603650	9.406486	13.968990	6.358469
6	0.006839	41.451870	29.091790	9.218328	13.564440	6.673563
7	0.006868	40.646760	28.500300	9.719810	13.532460	7.600664
8	0.006902	40.444010	28.426200	10.054040	13.512920	7.562832
9	0.006915	40.218120	28.325450	10.459230	13.437750	7.559450
10	0.006920	40.211270	28.339030	10.458140	13.435700	7.555852
11	0.006924	40.198250	28.338000	10.475340	13.432870	7.555544
12	0.006926	40.202100	28.330610	10.471910	13.437380	7.557994
13	0.006927	40.193140	28.344310	10.469650	13.433620	7.559274
14	0.006927	40.177600	28.353190	10.463980	13.442290	7.562934
15	0.006928	40.176080	28.355430	10.463800	13.441850	7.562849
16	0.006928	40.170090	28.355550	10.465110	13.444240	7.564995
17	0.006928	40.169980	28.355630	10.465040	13.444300	7.565051
18	0.006928	40.168780	28.354770	10.466660	13.443910	7.565882
19	0.006928	40.168610	28.354910	10.466740	13.443880	7.565858
20	0.006928	40.168320	28.354700	10.467330	13.443840	7.565803
21	0.006928	40.168320	28.354650	10.467310	13.443870	7.565856
22	0.006928	40.168270	28.354590	10.467310	13.443900	7.565924

23	0.006928	40.168220	28.354590	10.467300	13.443940	7.565948
24	0.006928	40.168190	28.354570	10.467310	13.443950	7.565970

In the first-phase forecast, 84.37% of the collaborative performance prediction variance is caused by itself, 0.07% is caused by the duration subsystem synergy, and 14.24% is caused by the quality subsystem synergy. 0.42% is caused by the resource subsystem synergy, and 0.89% is caused by the information subsystem synergy. In the second forecast, 51.82% of the collaborative performance forecast variance is caused by itself, 29.83% is caused by the duration subsystem synergy, and 9.87% is caused by the quality subsystem synergy. 3.66% was caused by the resource subsystem synergy, and 4.82% was caused by the information subsystem synergy. Excluding the contribution of collaborative performance, we can see in the early stage that the contribution degree of duration subsystem synergy is large, and the contribution degree of resource subsystem synergy is small.

The results are basically stable in the 15th period. 40.1761% of the collaborative performance forecast variance is caused by itself, 28.3554% is caused by the duration subsystem synergy, and 10.4638% is caused by the quality subsystem synergy. 13.4418% was caused by the resource subsystem synergy, and 7.5628% was caused by the information subsystem synergy. The duration subsystem synergy has the greatest contribution to the collaborative performance, followed by the resource subsystem synergy, followed by the quality subsystem synergy, and the contribution of the information subsystem synergy is the smallest. The same result of can also be obtained from the variance decomposition graphs, as shown in Figure 4.

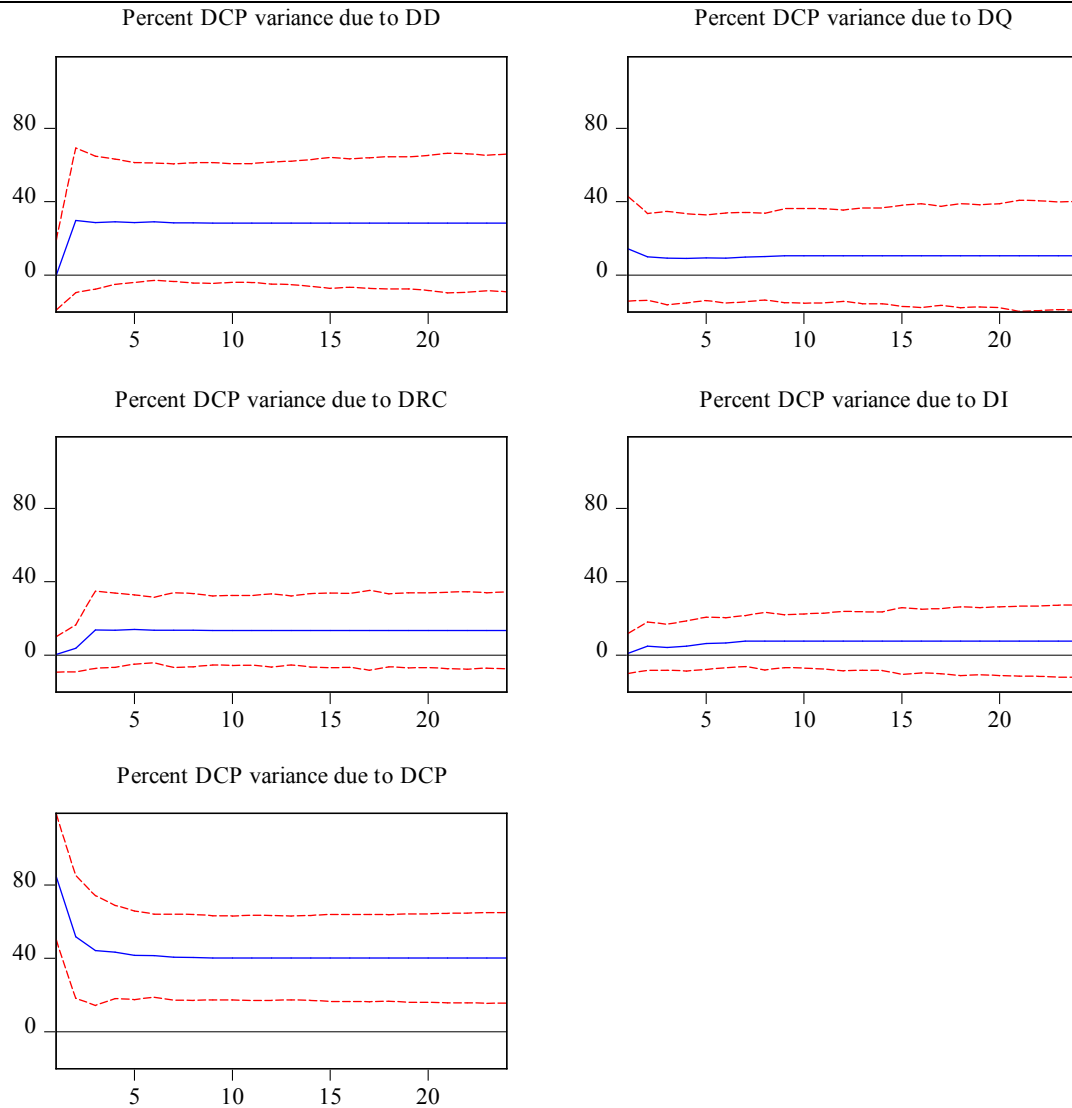


Figure 4 Variance Decomposition Result

## 5 Conclusion

This paper utilized VAR methods, impulse response analysis and variance decomposition to improve our understanding of the interdependencies that exist among the synergy degree of four subsystems in the collaborative mechanism and the collaborative performance. In general, it provides empirical evidence as to the extent to which the unexpected changes in the synergy degree are transmitted to collaborative performance of the project. The results show that the higher the synergy degree of the collaborative mechanism subsystem, the better the collaborative performance. In other words, the synergy degree is closely related to the merits of the project results. Among them, the duration subsystem synergy has the most obvious influence on the collaborative performance. The information subsystems synergy has the least impact on synergy performance. Therefore, the results of this paper support the generalization that it is an inevitable trend to establish a collaborative mechanism in the comprehensive infrastructure design of the large-scale park.

Although the existing research put forward the concept of collaborative design, it theoretically introduced the advantages of collaborative management application to construction project design, but lacked quantitative evidence on the impact of synergy degree on the comprehensive design work of actual construction projects. This paper studies the example of comprehensive design of infrastructure in an industrial park. This paper studies the example of comprehensive infrastructure design in an industrial park. The result shows that it is necessary to understand the impact of the various subsystems on the collaborative performance, and the overall synergy of the project needs to be considered when designing the comprehensive infrastructure construction of large-scale parks.

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## **Learning English and Learning about English:**

### **Some Thinking on Non-English Major Graduate English Teaching**

Wu Lan

School of Foreign Studies, Wuhan University of Technology, Wuhan, P.R. China, 430070)

(E-mail: 21984559@qq.com)

**Abstract :** As a part of graduate education, non-English major graduate English teaching should focus on not only developing the students' language skills but also cultivating their' comprehensive quality and competence. For a long time, graduate English teaching and learning has been a little far from satisfaction. A questionnaire survey shows the graduate students' general English proficiency, how they know about English language and linguistics, and their attitudes on learning about English. This article introduces the major problem of graduate students' learning English as well as the current situation of graduate English curricula design, discusses the importance of learning about English and suggests offering general linguistics courses for non-English major graduate students .

**Key words:** Non-English major graduate English teaching; Learning English; Learning about English; General courses of linguistics

## **1 Introduction**

Graduate education is the highest level in higher education. Non-English major graduate English teaching should accordingly reach a high level. However, in China, for a long time, in most universities or colleges, non-English major graduate English teaching is the simple continuation of college English teaching; students only have the required English courses such as intensive reading, listening and speaking, writing, etc. They are still busy in memorizing English words and dealing with all kinds of exams. Graduate students are higher-level talents with more mature mentality as well as better ability of thinking and learning compared with undergraduates. Nevertheless, on the whole, their English proficiency is a little far from satisfaction and their comprehensive quality needs improving. We don't say that training the basic English language skills (listening, speaking, reading, writing and translating) is not important; we think there should be something more we can do to better improve their English and comprehensive quality. The course contents are single and outdated, so is the idea of course design.

Facing the problems in graduate English teaching, in order to explore new ideas of graduate English teaching, a number of graduate English teachers or researchers have made surveys and proposed suggestions on how to reform graduate English teaching. Over the past decade, the reform ideas and measures have mainly fallen into six types: (1) level-based teaching or classification teaching (Wang, 2013; Ding & Ding, 2015; Gao, 2017), (2) ESP-oriented teaching (Li & Zeng, 2013; Mu & Zhang, 2014; Ding & Ding, 2015; Wang, 2016; Hao, 2018; Lin, 2018), (3) theory-based teaching including constructivism learning, PBL (project-based learning), CBI (content-based instruction) and effective teaching theory (Yuan, 2018; Mu & Zhang, 2014; Wang, 2018; Lan & Jiao, 2016; Ming & Tian, 2017; Gan, 2017), (4) modern-information-technology-assisted teaching such as MOOC (Massive Open

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Online Course), SPOC (Small Private Online Course), blended learning, Flipped Classroom, Microlecture, etc. (Zhao, Tan & Kou, 2015, Yu, 2016, Wang & Pan, 2018, Sun, Zhang & Zhang, 2018), (5) self-study (Gan & Wu, 2012; Lan & Jiao, 2016), and (6) diversified course design. Diversified course design, also related to other reform ideas and measures, has been widely regarded and applied to change the single and outdated course contents and course design ideas. In the past years, many university graduate English teachers and researchers have been calling for offering different types of English courses, which could be individualized elective courses, general courses, ESP courses, the combination of basic English skill courses, academic courses and cultural courses, etc. (Lin, 2005; Ju, 2010; Gan & Wu, 2012; Yu, 2016; Gan, 2017). Some have explored the teaching reform of "specialization of foreign language teaching". Their surveys show that the postgraduate students hope that besides the basic English skill courses, they can also have some practical courses or courses that can cultivate their interest, quality and professional skills such as International Conference English, Western Culture and Etiquette, News English, Popular Science Lectures, English and American Literature, English Film and TV Drama Appreciation, Brief Introduction to Britain and America, Cross-cultural Communication, English Public Speaking, English Academic Writing, Translation, etc. (Sun, 2005, Han, 2010). Another survey on the graduate English teaching system (for non-English majors) in four key universities in China shows that these universities not only offer traditional required comprehensive English courses but also diversified and individualized elective English courses including Translation, Writing, American and British Culture and Public Speaking (Han, 2010). Some other universities also have reformed the graduate English course design. One of the universities of science and technology in Northern China requires its graduate students to have five English courses: Appreciation of English Masterpieces in Literature and Film, English Newspaper Reading, English for Academic Communication, Scientific English Translation and Practice, and English Oral Communication (Xu, 2007). In our university, since 2011 some graduate students have elective English courses in the second semester, which include Cross-cultural Communication, English Film Appreciation, Translation, and Writing.

To sum up, there are almost no linguistics courses that have been offered or suggested for non-English major graduate students in China. The author of this article holds that graduate students lack linguistic knowledge and it's important for them to not only learn English but also learn about English.

## **2 Learning English**

### **2.1 Schumann's acculturation model and second language learning**

In a second language situation learners are faced with both the target language and the target culture. According to Schumann's Acculturation Model proposed in 1978, second language learning is one aspect of acculturation and there are two main variables that account for differences in the way language learners approach and acquire language: social factors and psychological factors. Schumann held that acculturation is the social and psychological integration of the learner with the target language group (Zaker, 2016). Learners' rate of development and ultimate level of language achievement is a function of the "social distance" and the "psychological distance" between learners and the second-language community. Psychological distance relates to how comfortable a learner is in relation to the surrounding social factors (Zaker, 2016). Schumann lists five affective factors that may increase the psychological distance. They are: (1) language shock (disorientation caused by learning a new linguistic system), (2) culture shock (stress, anxiety, and fear resulted from entering a new culture), (3) culture stress (prolonged culture shock), (4) motivation (instrumental and integrative), and (5) ego permeability (the degree to which an individual gives up their differences in favor of the target language

## 2.2 Learning English in China

To students in China, English is learned as a foreign language rather than a second language. Learners have no direct contact with English language community, so that their psychological feelings (the role of psychological distance) about the target language and target culture may become more pronounced (Duan, 2014). To Chinese students, English is a totally new and strange linguistic system, which is greatly different from their mother tongue, Chinese in some aspects. What's more, English is only taught and used in classroom teaching but not in a real and natural environment. Most Chinese students learn and use English to deal with various exams in almost all their life. Even if they can understand and use some English, in some sense, most of them actually are not clear about the characteristics of English and do not really accept English; they subconsciously fear and reject the language. Language shock is prevalent among Chinese students learning English. Wu's questionnaire survey shows that in her classroom English teaching, 67.9% of the students sometimes and 17.4% of the students always feel nervous when speaking English, 72.5% of the students sometimes and 24.8% of the students always have thinking blank when using English, 80.7% of the students don't know how to answer the teacher's question in English or what to say in English speaking tasks, and 60.6% of the students sometimes, and 18.3% of the students always worry that they can't speak English correctly in class. Without English language awareness and thinking pattern, Chinese students can hardly be the real master of English language; especially in speaking and writing they often fail to express themselves in accurate, natural and rich English (Wu, 2014).

## 3 Learning about English

Language as a common social phenomenon among human beings is closely linked with human social life. Language, which transmits knowledge, information, culture, etc. and expresses human thoughts and feelings, is the highest and most important cognitive ability of human beings. Halliday writes "language is at the centre of all human knowledge and human understanding". "...all our learning, and all our understanding, is grounded in language." "That is why linguistics needs to take a central place among sciences—because while all sciences share the same dependence on language, linguistics is the only one that can unify all the rest." Halliday believes there is the value of knowing about language; it's important to "understand the nature and functions of language itself" or "to have a clear picture of what a language is and how it works"(Halliday, 2015).

### 3.1 A survey: how graduate students know about English and linguistics

#### 3.1.1 Subjects

In order to know how our graduate students know about English and linguistics, the author of this article has conducted a questionnaire survey among 116 first year non-English major graduate students of Wuhan University of Technology. All the questionnaires were analyzed by SPSS; frequency and percentage have been calculated. Table 1 shows the basic information of the subjects.

**Table 1 Basic Information of the Subjects**

	Sex		Major		English Level		
	male	female	arts	science	CET-4	CET-6	others
Frequency	69	47	40	76	48	61	7

3.1.2 Results

**Table 2 Main Difficulty in English Learning**

	Frequency	Percent	Valid Percent	Cumulative Percent
Understanding	21	18.1	18.1	18.1
Expressing	48	41.4	41.4	59.5
Weak English Foundation	45	38.8	38.8	98.3
Others	2	1.7	1.7	100.0

**Table 3 Knowing about English Language**

	Frequency	Percent	Valid Percent	Cumulative Percent
Well	33	28.4	28.7	28.7
Not Well	82	70.7	71.3	100.0
Missing System	1	.9		

**Table 4 About Linguistics**

	Frequency	Percent	Valid Percent	Cumulative Percent
Knowing Well	23	19.8	19.8	19.8
Knowing Little	87	75.0	75.0	94.8
Having Never Heard of	6	5.2	5.2	100.0

**Table 5 Hearing of or Taking a Linguistics Course**

	Frequency	Percent	Valid Percent	Cumulative Percent
Having Taken	15	12.9	13.0	13.0
Having Heard of But Not Taken	70	60.3	60.9	73.9
Having Neither Heard of nor Taken	30	25.9	26.1	100.0
Missing System	1	.9		

**Table 6 Linguistics and English Learning**

	Frequency	Percent	Valid Percent	Cumulative Percent
Closely Related	86	74.1	74.1	74.1
Not Closely Related	29	25.0	25.0	99.1
Not Related	1	.9	.9	100.0

**Table 7 Necessity of Knowing about English Language**

	Frequency	Percent	Valid Percent	Cumulative Percent
Necessary	98	84.5	84.5	84.5
Not Necessary	15	12.9	12.9	97.4
I Don't Care	3	2.6	2.6	100.0

**Table 8 Necessity of Offering General Courses of Linguistics**

	Frequency	Percent	Valid Percent	Cumulative Percent
Necessary	73	62.9	62.9	62.9
Not Necessary	15	12.9	12.9	75.9
I Don't Care	28	24.1	24.1	100.0

**Table 9 Benefits of Learning Linguistics**

	Frequency	Percent	Valid Percent	Cumulative Percent
Helpful to Learning English and Other Foreign Languages	70	60.3	60.3	60.3
Helpful to Self-improvement	42	36.2	36.2	96.6
No Apparent Benefit	4	3.4	3.4	100.0

**Table 10 Students' Greatest Hope from Learning Linguistics**

	Frequency	Percent	Valid Percent	Cumulative Percent
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Acquiring Basic Linguistics Knowledge	49	42.2	42.6	42.6
Understanding Differences between Chinese and English	18	15.5	15.7	58.3
Improving Language Skills and Communicative Ability	48	41.4	41.7	100.0
Missing System	1	.9		

According to the survey results, 18.1% of the students have understanding, 41.4% expressing, and 38.8 weak English foundation as their main problem in English learning ; 1.7% have other problems (shown in Table 2). 28.4% of the students know English well, while 70.7% not well (shown in Table 3) Only 19.8% of the students know linguistics well, 75.0% know little about it, and even 5.2 % have never heard of it (shown in Table 4). 12.9% of the students have taken a linguistics course, 60.3% have heard of but not taken a linguistics course, and 25.9% have neither heard of nor taken the course (shown in Table 5). As for the relationship between linguistics and English learning, 74.1% of the students think they are closely related, 25.0% think they are not closely related and 0.9% think they are not related (shown in Table 6).According to Table 7, 84.5% of the students consider it necessary to know about English language, while 12.9% think it not necessary, and 2.6% don't care about the issue. According to Table 8, we know that 62.9% of the students consider it necessary to offer general courses of linguistics, while 12.9% think it not necessary, and 24.1% don't care about the issue. Table 9 shows how the students think of the benefits of learning linguistics. 60.3% of the students think learning linguistics is helpful to learning English and other foreign languages, 36.2% are not sure whether it's helpful to learning English but think it helpful to self-improvement, and 3.4% hold that it has no apparent benefit. From Table 10 we can know students' greatest hope from learning linguistics. 42.2% of them hope to acquire basic linguistics knowledge, 15.5% hope to understand differences between Chinese and English, and 41.4% hope to improve their language skills and communicative ability.

### 3.1.3 Discussion

As far as the author of this article is concerned, this questionnaire survey indicates at least two things related to English learning of graduate students in China. The first is students' general English proficiency and how they know about English language. Although more than half of the students have passed CET-6, there are much more students who have expressing problem (speaking and writing) than those with understanding problem (listening and reading ) in English learning. They have been learning English for more than ten years (most students started English learning in primary school), but nearly three-quarters of them don't know English language well. As has discussed above, English is learned as a foreign language rather than a second language in China. Most students only use English in classroom teaching environment, and more importantly they are often busy in dealing with various exams. It's almost impossible for the students to know about English ; also it seems that there is no necessity for them to know about English. As Halliday cited Joan Maw in his work, "when you are learning a new language you are learning a new reality... the foreign-language learning is constructing a new reality, a reality in which people exchange different meanings"(Halliday, 2015) Schumann's Acculturation Model (also mentioned above) believes that there are the "social distance" and the "psychological distance" between learners and the second-language community, and learners' rate of development and ultimate level of language achievement is a function of the "social distance" and the "psychological distance". In a foreign language learning environment, most Chinese students actually do not know much about English and may subconsciously fear and reject the language. Without English languageawareness and

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thinking awareness, they are unable to express themselves accurately, naturally and fully. How can you master a language if you do not know about it ?

The second thing related is how graduate students know about and think of linguistics. Three-quarters of the students know little about it and very few students have ever taken a linguistics course. More than a quarter of them have neither heard of nor taken the course. This is because linguistics courses are mainly offered to English majors in China. With the recent English teaching reform in some universities or colleges (such as WHUT), some undergraduate students might have the opportunity to take elective courses about linguistics (according to the survey result, only a very small number of students did that). However, in graduate English teaching, few universities or colleges have offered such elective courses. At the same time, we learned from the survey that a great majority of the graduate students understand the importance of knowing about English to English learning, and most of them believe that learning linguistics is helpful to learning English so that it's necessary to offer some general courses of linguistics.

Graduate education is the highest level in higher education. Generally speaking, graduate students are more mentally mature and have better ability of thinking and learning than undergraduates. Their study should be more concentrated on improving their academic level, developing their research ability, and more importantly cultivating their comprehensive quality, thus making them inter-disciplinary talents. As for language learning, they should be able to know more about the characteristics even history of the language, compare English and Chinese, and study the differences between the two languages. In this way, the students could not only overcome cultural shock and language shock, be closer to English psychologically and do better in English learning but also enhance their comprehensive quality and competence. What's more, some scholars believe linguistics takes a central place among all disciplines, for it contains rich linguistic knowledge, knowledge of language use, rigorous thinking mode, critical thinking potential and broad research space. Graduate students are more engaged in academic study and scientific research. Therefore acquiring some linguistic knowledge would be beneficial to their study and work.

### **3.2 What to do**

Based on what has been discussed above, the author of this article suggests offering general courses of linguistics among non-English major graduate students. The courses may include Introduction to Linguistics, Language Origin and Evolution, History of English, Comparison of English and Chinese languages and cultures, etc. (one or more than one courses can be offered in one semester.) Since the students are non-English majors, the textbook or teaching materials chosen should avoid being too difficult and abstruse, for fear that the students may dislike and reject the courses ; the related teaching materials and works should be appealing and comprehensible with plain language and abundant examples, which enable the students to understand and memorize the knowledge of language easily.

As for teaching, multiple methods and modes can be used : teacher's lecture, discussion, classroom interaction, self-study, bilingual teaching, and so on. In lectures, the teachers try to use simple and lively language and adopt the teaching method that is welcomed and easily accepted by the students, which can stimulate students' learning motivation and maximize the learning effect. It's important for the teachers to notice whether the students are satisfied with and can adapt to the teaching, and whether they can successfully finish the in-class or after-class tasks. If necessary, another questionnaire survey could be conducted at the end of the courses for the teachers to know what the students have learned about English language and linguistics, and what the teachers need to do to improve their teaching.

Though these courses are offered to non-English major graduate students, this initiates the trend of the "specialization of foreign language teaching", which puts forward some requirements for the ability



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and development of the teachers involved. Graduate English teachers need to improve themselves by both extensive and intensive reading and study to broaden their horizon and be well-versed in more areas as much as possible.

#### 4 Conclusion

Non-English major graduate English teaching is faced with challenges in the new era. As a part of graduate education, graduate English teaching should aim to not only improve the students' language skills but also enable them to acquire linguistic knowledge, and to learn about English language as well as the differences between English and Chinese. Linguistic knowledge is especially helpful to enhancing the students' language awareness, cultivating their critical thinking ability and research ability, and improving their comprehensive quality. In addition, linguistic knowledge does not only belong to linguists or language researchers; it benefits a lot of people in their work and life. Therefore graduate students should not only learn English but also learn about English. Offering general courses of linguistics is expected to be helpful and effective. However, this is a general idea on improving non-English major graduate English teaching; there's a lot to be done and considered to put it into practice, such as the specific and detailed teaching plan design, how to make use of various teaching resources and facilities, how to qualify the teachers involved, etc.

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## **Research on Service Level Improvement Strategy of Basic Nursing Management in College Hospitals based on PDCA Cycle**

Yu Wen

Affiliated Hospital, Wuhan University of Technology, Wuhan, P.R. China, 430070

(Email: 1545997390@qq.com)

**Abstract:** The objective is to analyze the service improvement strategy of the basic nursing management based on the PDCA Cycle in college hospitals. The clinical data are collected from the 60 nursing staff and 60 patients in college hospitals from January 2017 to February 2018. During January 2017 to December 2017, the PDCA (Plan-Do-Check Action) Cycle nursing management were not applied so that the clinical data collected were regarded as control group contained 30 patients and 30 nursing staff during this period. Those data of other 30 patients and 30 nursing staff collected from January 2018 to December 2018 were taken as study group which the PDCA cycle were implemented in the nursing management. The level of nursing service, adverse events and satisfaction evaluation are analyzed among these two group. The results of the study shows that the scores of environmental management, management monitoring, document management, and nursing safety were  $(23.98 \pm 0.63)$ ,  $(23.76 \pm 0.56)$ ,  $(23.03 \pm 0.61)$  and  $(23.12 \pm 0.71)$  respectively, all improved after the PDCA Cycle carried out ( $P < 0.01$ ). The incidence of adverse reactions was 3.33% in the study group lower than 30.00% of the control group ( $P < 0.01$ ). The clinical satisfaction evaluation in the study group was 96.67% which was higher compared to the control group ( $P < 0.01$ ). The application of basic nursing management based on the PDCA Cycle in college hospitals can enhance the quality of nursing and clinical satisfaction of patients. Beyond that, the incidence of adverse events can also be reduced as well. Therefore, it is significant in clinical applications.

**Key words:** College hospitals; PDCA cycle; Basic nursing management; Service level improvement.

### **1 Introduction**

The basic nursing is referred as the most normal regulations and nursing care work (Jing, 2018). The clinical nursing is significant work in the college hospital. The efficient and accurate diagnosis and treatment associated with clinical nursing details are the basic requirement in order to ensure the satisfied clinical effect (Yingzhu, 2018). Related research shows that the level of the basic nursing management can influence the patient's clinical effect and the prognosis of the recovery quality directly as well as specialized nursing level (Qiong, 2018). Consequently, the improvement of the basic nursing level should be taken seriously. The PDCA Cycle includes the planning, doing, checking and action was proposed firstly in 1950s (Fen, 2018) which ensured the content of nursing management routinized, standardized and scientific in order to promote the nursing management level. With the purpose to further study, this paper intended to analyze the influence of the PDCA Cycle nursing management focused on the patients and nursing staff during the period from January 2017 to December 2018 in college hospital.

Some previous studies have indicated that caregivers have enough knowledge of nursing care

Proceedings of the 16th International Conference on Innovation & Management - 1628 - health (Yangisawa, 2018). Lili evaluated the effects of the blended learning applied in the course of Fundamentals of nursing utilizing the compared group (Lili, 2018). The effect of PDCA circulation model on the standardization of emergency treatment in department of neurosurgery and seek the way to improve the nursing was explored by the Ruiqi (Ruiqi, 2018). The Joanna Briggs Institute Practical Application of Clinical Evidence System and Getting Research into Practice audit and feedback tools were utilized in a evidence implementation project of Huashan Hospital, Fudan University, Shanghai (Huahua, 2016). It aims to improve nursing management of dysphagia in acute stroke patients and prevent the occurrence of aspiration in patients admitted to the neurology ward. It also shows that the PDCA cycle system can reduce the false rate of occupational exposure evidence (Qingning, 2017). Through the PDCA cycle system, the medical staff had improved the enthusiasm of occupation exposure reporting. Application of PDCA cycle system can effectively reduce the false rate of occupational exposure and remove the obstacles for occupation protection work. The training method and application effect of standardized patients in the fundamental nursing was also discussed by Qian (Qian, 2016). The nursing care system was developed as system theory through participating management with action research following the Deming Cycle (PDCA) divided into 3 phases (Mongkonthawornchai, 2012). The characteristics of best and worst clinical educators were investigated (Edwards, 2009). The effect of PDCA cycle on control of the hospital infection management quality was provided. The hospital infection rates were reduced with the PDCA which should be utilized in the clinical promotion (Lin, 2017).

## **2 Data and Method**

### **2.1 Data**

The clinical data were collected from the 60-nursing staff and 60 patients in college hospitals from January 2017 to February 2018. The control group contained 30 patients and 30 nursing staff from January 2017 to December 2017 in which the PDCA (Plan-Do-Check Action) Cycle nursing management were not applied. However, the other 30 patients and 30 nursing staff's data from the January 2018 to December 2018 were referred as study group which the PDCA cycle were implemented in the nursing management including plan, executing, inspection and conduction. The 30 nursing staff in the control group are all female aging from 20-55. The mean and deviation of the age are 29.35 and 9.25 years old respectively. As for the education background, there are 6 staff having bachelor degree or above, 12 staff with college degree in control group while other 6 staff graduated from technical secondary school. In the study group, all the staff are female ranging from 21 to 55 years old. The mean and deviation of the age are 30.34 and 9.34 years old respectively. As for the education background, there are 11 staff having bachelor degree or above, 14 staff with college degree in control group while other 5 staff graduated from technical secondary school. There are 16 male patients and 14 female patients in the control group with average age of 56.25 and deviation is 12.25. The number of male and female patients are both the 15 in the study group. The average and deviation of the age is 55.34 and 13.34 years old. So the data is the same basically ( $P>0.05$ ). There are some other standards such as integrity of information, initiative of the staff and patient's compliance. Some conditions should be excluded for example the malignant, severe liver and kidney disease, psychological and mental disease and drop out patients. Beyond that the research meet the standard of the related medical ethics. All the patients signed the informed consent before treatment.

### **2.2 Method**

All the patients were conducted routine examination and symptomatic intervention. PDCA cycle was not applied in the control group which was only provided routine basic nursing including common

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first-aid measures (aspiration of sputum, provisions, transfusion, artificial respiration, gastric lavage, common first-aid outfit and so on), general nursing (bed-making, psychology nursing, body temperature, respiratory and oral care), conventional specification (duty, ward round, sterilization, sanitary control), basic nursing knowledge and operation and so on. The PDCA was applied in the study group including four stages namely planning, implement, inspection and conducting. The planning means analyze the problem, affecting factors and causes according to the situation. Meanwhile the nursing care plan could be drawn up and conducted. Inspection refers to comparing the anticipation and actual situation. The conduction refers to discovering the problem and settling it. The nursing efficacy is stabilized as well. The standard and experience has also analyzed and evaluated. The details conducted in the basic nursing management contains plan, setting up cycling management group and combined with the data analysis. So that the detail nursing problem can be found out which are bed sheet and insufficient of the publicity and education. The reasons is analyzed to be the staff lacking of the nursing concept, poor nursing technique and unskilled operation and so on. It need to appreciate the management level and draw up related objectivity of nursing management correctly. The conducting stage the nursing staff need to be trained in group aimed at handling details problem. The educational propaganda and punishment mechanism need to be paid attention so that the staff would attach importance to basic nursing quality. The quality supervision group is necessary in the check stage. The detail performance is checked in the field investigation. Random sampling and entire check is conducting at regular intervals. The problem should be handled just after it was discovered. The related nursing training manual is studied among the staff. The periodic questionnaire survey is followed as well. The evaluation of basic nursing quality is conducted every months and seasons. So the problem can be discovered and analyzed timely. The nursing plan can also be adjusted according to the situation. The staff and department with excellent performance should be rewarded. After such improvement the basic nursing quality is raised in the end.

### **2.3 Observation target**

The scores of the nursing quality of these two group are analyzed. The nursing adverse event includes the omission, mistake, accident, disputing and unsatisfactory of patients.

### **2.4 Therapeutic evaluation**

The nursing quality of these two group is scored according to the related survey. The management evaluation contains environment, management, file and safety with 25 scores each. Higher scores means the better nursing quality. The degree of the satisfactory of patients were assessed according to the schedule of survey which includes environmental nursing, disease nursing, nursing altitude and nursing effect. The total score is 100. With the score above 90 the patients can be regarded as satisfied very well. With the score between 90 and 60 the patients can be regarded as satisfied basically. With the score below 60 the patients can be regarded as unsatisfied.

### **2.5 Statistics**

The statistics were dealt with SPSS 20.0. the related metering statistics such as age and nursing quality are repressed as  $(\bar{x} \pm s)$  which were inspected by t. The related enumeration data such as gender, education background, adverse event and satisfaction degree are illustrated as n which were inspected by  $\chi^2$ . The statistics has the significance only when the  $P < 0.05$ .

### 3 Results

#### 3.1 The scores of the nursing quality

After the intervention, the environmental management, management monitoring, file management and nursing security were all improved compared to the control group. Each scores are listed in Table 1 and  $P < 0.01$ .

**Table 1 The Scores of the Nursing Quality ( $\bar{x} \pm s$ , n=30)**

Group	Environmental management	Management monitoring	File management	Nursing security
Control group (n=30)	19.23±3.28	18.58±2.96	18.56±3.59	18.16±3.25
Study group (n=30)	23.98±0.63	23.76±0.56	23.03±0.61	23.12±0.71
t	7.7896	9.4181	6.7235	8.1665
P	<0.01	<0.01	<0.01	<0.01

#### 3.2 The adverse events

The nursing omission and the dispute of the study group is 3.33%. The adverse event is reduced from 30% after the intervention and the detail scores are listed in Table 2 and  $P < 0.01$ .

**Table 2 The Adverse Events[n(%)]**

Group	Nursing omission	Nursing mistakes	Accidents	Nursing dispute	Others	Adverse events
Control group (n=30)	2 (6.67)	3 (10.00)	1 (3.33)	1 (3.33)	2 (6.67)	9 (30.00)
Study group (n=30)	0	0	1 (3.33)	0	0	1 (3.33)
$\chi^2$	0.5172	1.4035	0.5172	0.0000	0.5172	7.6800
P	>0.05	>0.05	>0.05	>0.05	>0.05	<0.01

#### 3.3 Clinical satisfaction degree

The clinical satisfaction degree is raised to 96.67% in the study group after the intervention. The detail scores are listed in Table 3 and  $P < 0.01$ .

**Table 3 Clinical Satisfaction Degree [n(%)]**

Group	Satisfied very well	Satisfied basically	unsatisfied	satisfaction degree
Control group (n=30)	21(70.00)	8(26.67)	1 (3.33)	29 (96.67)
Study group (n=30)	11(36.67)	10(33.33)	9 (30.00)	21 (70.00)
$\chi^2$	6.6964	0.3175	7.6800	7.6800
<i>P</i>	<0.01	>0.05	<0.01	<0.01

#### 4 Conclusion

The PDCA cycle mode is also referred as quality cycle mode which belong to the general model of management theory. It was constituted by four stages namely planning, doing, check and action. The related science procedures were conducted just after this cycle sequence. The basic nursing is one of the most part of the hospital nursing work which affect the specific nursing and nursing quality entirely and directly. Therefore, the hospital should pay attention to the management of basic nursing quality, basic nursing skill's improvement and nursing quality. In such way, the patients can be supplied with better service. Recently, the PDCA cycle mode has been applied in the clinical nursing work extensively with effective results. In order to improve the basic nursing management level, this research focus on the effect of PDCA cycle mode's application in the college hospital's basic nursing management. It may also supplied somewhat reference to related research.

The result of this paper shows that the environmental management, management monitoring, file management and nursing security in the study group have higher score compared to the control group respectively. The results illustrate the application of PDCA cycle mode can help college hospital's basic nursing management to enhance the nursing quality and service's level. The PDCA cycle mode group can draw up and act nursing plan according to the situation and analysis the problem. If there is problem came up, it should be settled down as soon as possible. So the nursing effect can be assured. So that the detail nursing problem can be improved by establishing the cycle management group and analyzing combined with statistics which are bed sheet and insufficient of the publicity and education. The reasons is analyzed to be the staff lacking of the nursing concept, poor nursing technique and unskilled operation and so on. It needs to appreciate the management level and draw up related objectivity of nursing management correctly. The reward and punishment mechanism is also necessary to enhance the basic nursing quality. Meanwhile the supervise team should check the basic nursing entirely by field survey and random sampling. The evaluation of basic nursing quality is conducted every months and seasons. Thus, the problem can be found and figured out timely. The nursing quality can also be improved with new nursing plan. The clinical nursing effect and be enhanced with the improvement of the staff's basic nursing skill. The nursing omission and dispute events is 3.33% in the study group in this research less than in the control group. The satisfaction degree of patients is 96.67% in the study group higher than in the control group. It also proves that the application of PDCA cycle mode can help college hospital basic nursing management to improve the nursing service and reduced the adverse incident. Beyond that, the clinical effect is marked. However, the long term influence of the PDCA cycle mode is still need to be research.

Above all, the application of PDCA cycle mode in college hospital basic nursing management can improve the nursing quality and patients' satisfaction degree effectively and reduced the adverse incident. It worth certain degree of clinical application.

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## **Study on the College French Teachers' TPACK Level and the Influence Factors under the Background of "Internet + Education": Taking Wuhan Universities as the Example**

Bai Yanyuan

School of Foreign Languages, Wuhan University of Technology, Wuhan, P.R. China, 430070

(E-mail: lucie629@163.com)

**Abstract:** In order to have the understanding of college French teachers' TPACK level and its influencing factors in the era of "Internet + Education", this paper adopts a mixed research method to carry out a questionnaire survey on 30 French teachers who works at colleges and universities which locate in Wuhan, and choose 4 teachers among them to have the interviews. The results of the quantization indicate that: College French teachers' TPACK level is relatively low, and TK knowledge is weak; TPACK of male teachers is obviously higher than that of the female teachers; the older the teachers' ages, the higher the level of CK and PK, the lower the level of TK; in fact, training conducted for teachers has played a certain role in promoting teachers' knowledge such as TK; There are three main context factors which will have the impact on TPACK of French teachers namely, teachers' professional attitudes, the learning and communication between teachers and students as well as those existing among their peers, the teaching facilities. In the light of the results of the study mentioned above, this paper brings forth some suggestions from the respects of peers' mutual assistance, educational technology training and hardware facilities guarantee, in the hope of providing inspiration for the development of TPACK for college French teachers.

**Key words:** Internet + Education; TPACK; French teachers; Influence factors

### **1 Introduction**

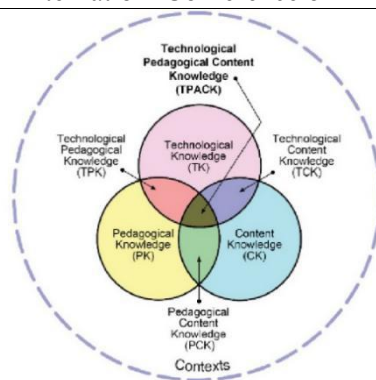
In April 2018, the Ministry of Education promulgated the "2.0 Action Plan for Education Informatization" which puts forward the "actively promoting Internet + Education, and holds the core concept of deep integration of information technology with education and teaching". In the field of foreign language teaching, the Syllabus of French Teaching for French Majors in Colleges and Universities which points out that " College French teachers shall keep pace with the times, keep up with the development of new technologies, in order to improve their awareness, knowledge and capability of using information technology in a constantly manner, so that they are able to integrate and rationally adopt the information technology elements in the process of specific class teaching design and implementation". In the era of "Internet + Education", French teaching conducted in the Colleges and universities is closely related with the information technology. The technological pedagogical content knowledge (TPACK) has become an important factor in the knowledge system of teachers and an important standard for carrying out the evaluation teachers' teaching level.

At present, many scholars have carried out researches on TPACK at home and abroad, the main results of which are as follows. First, some mainly study the theoretical framework of TPACK. For example, Joshua M. Rosenberg and Matthew J. Koehler (Joshua M. Rosenberg and Matthew J. Koehler,2015) discuss how context has been avoided or has referred to different constructs among educational technology research, especially among research on the Technological Pedagogical Content Knowledge (TPACK) framework. Second, some focus on the application of TPACK in the course of information and communication technology, such as DY Wu who (DY Wu,2015) aims to illustrate two cases of applying TPACK framework into CALL lesson design, in hope that language teachers can apply TPACK into their pedagogical development. Third, others notice the cultivation of teachers' TPACK ability, such as Wang Xuemei believes that (Wang Xuemei,2018) teacher beliefs, teachers' learning and communication, and teaching facilities are the three main contextual factors affecting college English teachers' TPACK. Besides, Cox C.R. Graham (Cox C.R. Graham,2013) focuses on the use of educational technologies by educators in their teaching methodologies. However, in accordance with the present research situation, there are many macroscopic studies, lack of microscopic studies, which focus more on generalization, but lack any deeper investigations. The empirical research on TPACK in the field of foreign language education is very insufficient both at home and abroad, especially the study on the influencing factors of college French teachers' TPACK level.

In view of the importance of the application of information technology in respect of college French teachers, it has become imperative to improve the TPACK level of French teachers who work at Colleges. Based on the current status of TPACK level of 30 French teachers who are from 7 universities in Wuhan, this study carries out an analysis on the factors affecting the TPACK of college French teachers, in the hope of providing inspiration for improving TPACK level and their informatization teaching capabilities.

## 2 Concept of TPACK and Relevant Study

TPACK initially root in the "pedagogical knowledge" (PCK) which was proposed by Shulman, and has been regarded as an important indicator of teachers' professional development. Afterwards, Koehler and Mishra defined it as "the knowledge integrated carrier of information technology integration and class teaching", which refers to the interaction and connection of knowledge relating to the contents contained in subjects (knowledge of a specific subject which is to be taught), technical knowledge (computer, internet, digital video, etc.), teaching knowledge (practice, process, strategy, procedure and method which are involved in the process of teaching and learning), and the transformation of the integration of the three respects. TPACK framework includes three core elements including the subject content knowledge, pedagogical knowledge and the technical knowledge; and four compound elements including the subject pedagogical knowledge, subject content knowledge of integrated technology, pedagogical knowledge of integrated technology, subject pedagogical knowledge of integrated technology, as well as the context factors. (shown as Figure 1)



**Figure 1 TPACK Framework**

From the viewpoint of pedagogy, foreign scholars have made certain achievements in the field of study on the theoretical framework of TPACK (Joshua M. Rosenberg, 2015), the research on the development strategy (Kohetal, 2014), the empirical research on TPACK (Chaietal, 2018) and the application of TPACK in the course of information and communication technology. Domestic scholars have carried out some relevant studies on the theoretical summary of TPACK (Li Jianzhen, 2015), the cultivation of teachers' TPACK ability (Chen Junxian, 2018), and the study on the application of TPACK combined with specific course (Ran Quanyou, 2014).

In the field of education on foreign language, studies on TPACK conducted by the foreign scholars mainly focus on two respects: on the one hand, it is the empirical research: Huseyin has conducted an investigation on the TPACK level of 76 English teachers in Turkey, as a result, it is discovered that the TPACK level of girls is higher than that of the boys; on the other hand, it is the application of TPACK theory in English teaching (Debbagh, 2016). However, the contents contained in the studies on TPACK of foreign language teachers conducted by the domestic scholars only include the analysis on structure of TPACK of English teachers (Wang Xuemei, 2018).

In a word, the empirical research on TPACK in the field of foreign language education is very insufficient both at home and abroad, especially the study on the influencing factors of college French teachers' TPACK level. However, under the background of "Internet +", the integration of the information technology with teaching knowledge of foreign language teachers who work at colleges and universities must be enforced in order. At present, French teaching in colleges and universities is in the rising period as there are more than 160 colleges and universities across the country offer the major in French with 1500 teachers teaching French. If aiming at the realization of the all-round informatization of higher education in China, the cultivation of the informatization capability of college French teachers shall not be neglected. Therefore, the study is conducted with the purpose of carrying out the investigation on the current situation of TPACK level of 30 French teachers who work at 7 universities in Wuhan, and analyzing its influencing factors and conducting the thinking about ways to improve teachers' TPACK capabilities.

### 3 Design for the Study

#### 3.1 Questions involved in the study

Conducting of the analysis and exploration on the influencing factors of TPACK is the premise in terms of improving the level of TPACK. With regard to the shortcomings existing in the current studies, this paper has made the confirmation on the following questions for the study:

- (1) How is the current situation of TPACK level of French teachers who work at colleges and universities in Wuhan?
- (2) What is the impact of demographic variables on college French teachers' TPACK?
- (3) What are the contextual factors which have the influences on college French teachers' TPACK?
- (4) How to build the framework of TPACK of college French teachers under the background of "Internet + Education"?

#### 3.2 Subjects of the study

The subject of this study is the French teachers who work at seven colleges and universities in Wuhan. The types of colleges and universities include the comprehensive universities, university and college of science and technology and normal universities, in addition, the subjects of the study have a certain representativeness. Among them, there are 9 male teachers and 21 female teachers; from the perspective of teaching age, new teachers (teaching less than three years) account for 13.3%, skilled teachers (4-15 years of teaching) account for 73.4%, experienced teachers (teaching longer than 15 years) account for 13.3%, teachers who have participated in the trainings for teachers account for 90%, and teachers who fail to take part in the trainings for teachers account for 10%. In view of the distinctiveness of French as a subject, there are fewer teachers who have received the normal education, only accounting for 6% of the total. According to the gender, teaching age, professional title and colleges and universities where they work, four teachers were selected to have the interviews among the teachers who have participated in the questionnaire and agreed to take part in the interview conducted later. (Table 1).

**Table 1 Basic Information of the Interview Participants**

Name	Gender	Educational background	Professional title	Teaching age	School where he/she works
Tao Yulin	Male	Master	Assistant teacher	2	The university and college of science and technology
Wang Qiong	Female	Master	Professor	30	The university and college of science and technology
Wang Jing	Female	Doctor	Lecturer	10	Normal universities
Zhang Ling	Male	Doctor	Associate professor	15	Comprehensive universities

### **3.3 Tools adopted in the study**

The questionnaire adopted in this study is revised on the basis of the TPACK questionnaire designed by Schmidt for pre-service teachers together with the questionnaire designed by Archambault for the online teachers. The revision mainly adds or reduces some professional questions in accordance with the characteristics owned by college French teachers. The questionnaire is divided into two parts: the first section is the background information of teachers, including gender, age, teaching age, professional title, regular college course education background and participation of teacher in trainings; the second part is the TPACK level evaluation table (the evaluation table adopts the form of Richter five-level scale, ranging from 1 = strongly disagree to 5 = totally agree).

### **3.4 Date collection**

During this empirical study, the questionnaires are distributed to 30 French teachers who work in seven selected colleges and universities through the Internet Tool Questionnaire Star. In order to ensure the authenticity and effectiveness of the study, the answering time for each questionnaire is designed to be not less than 5 minutes. A total of 30 questionnaires were delivered, with a total of 30 questionnaires were collected, among them, there are 30 valid questionnaires. The quantitative analysis on the data obtained from the questionnaire is conducted by adopting SPSS20.0. On the basis of quantitative results, four teachers are chosen as the subjects of the interviews.

## **4 Findings of the Study**

### **4.1 Analysis on college French teachers' TPACK level**

In order to have a measurement on college French teachers' TPACK level, this study has carried out the descriptive analysis on quantitative data. The results indicate that the average values of each dimension of TPACK for teachers who teach French at seven colleges and universities in Wuhan are  $PK = TCK > PCK > CK > TPK > TK > TPACK$ . Among them, the levels of PK and TCK are higher, while the levels of TK and TPACK are relatively lower. Because most of the teachers who are chosen as the subjects of this study have the long teaching ages and rich teaching experiences, the overall level of PK is relatively high. As a result, if the level of TCK is high, then it indicates that teachers who teach French at colleges and universities are able to use information technology to better shown the subject content knowledge, but if the level of TK and TPACK are low, then it means that college French teachers have weak technical knowledge, lacking of the capability of effectively integrating information technology and French teaching. The result of this kind is similar to the results of study conducted by Wang Xuemei (Wang Xuemei, 2018).

### **4.2 The influence of demographic variables on the elements of college French teachers' TPACK**

According to the basic information of teachers set forth in the questionnaire, the descriptive statistical analysis on the data of teachers' gender, age, teaching age, professional title and participation in the trainings for teachers is carried out in order to compare the differences of TPACK of

(1) The average value of TPACK of each dimension of male teachers is higher than that of female teachers. Except there is a small difference in PK level, the male teachers have obvious advantages in TK, CK, TPACK and other knowledge levels. The reason for this is that the male teachers have stronger practical ability in respect of computer operation, causing the difference between male and female teachers in terms of TK. Moreover, in the respect of the acquisition of subject knowledge, the male teachers have more positive attitudes and wider interests than that of the female teachers. It is known through interviews that, Tao Yulin, a male teacher, likes to read classic books of foreign languages, browses French websites of other countries and pay attention to current affairs and news. While, the female teachers mostly say that they are "totally unable to read a book" or "only focus on the books which are closely related to the teaching tasks", which may be related to the needs for female teachers to take more responsibility for taking care of their families. TPACK is the integration and transformation of TK, PK and CK, and it is the superiority of male teachers in terms of TK, CK and PK levels that make the TPACK level of male teachers become higher than that of female teachers.

(2) With the increase of the teaching ages of the teachers, the levels of CK and PK are getting higher and higher. The longer the teaching time is, the more subject knowledge and teaching experience are obtained in an accumulatively way. The results of this study are in line with certain objective laws. The compound knowledge level of PCK, TCK, TPK are on the rise with the increase of teaching age, which shows that the mutual integration and transformation of teachers' knowledge are inseparable from the passing of time and the accumulation of experience. Because the new teachers have strong adaptation and receptive ability to the information technology, as a result, the TK level of new teachers is the highest, while that of the skilled teachers and experienced teachers are relatively low. The backward TK level of skilled teachers and experienced teachers also, to some extent, reflects that they have not updated their technical knowledge in time in order to apply the latest technology to the process of teaching.

(3) Teachers who have participated in the trainings often have a slightly higher level of knowledge related to TK, TCK, TPK and TPACK than those who fail to take part in the trainings. In the era of Internet and big data, the development of information technology has the never-ending changes and improvements. The emergence of mini class, mu-class and flip-over class is changing the traditional French teaching paradigm. The teachers who teach French at colleges and universities must have a training for their knowledge of educational technology on regular basis in order to keep up with the development of and changes in the times and become qualified for the requirements of French teaching at colleges and universities in the information age.

#### **4.3 The influences of context factors on college French teachers' TPACK**

Through the questionnaire on 30 teachers who teach French and the face-to-face interviews with 4 teachers, we are able to draw the conclusion that the context factors of TPACK for college French teachers mainly include three aspects: teachers' professional attitude, communication and learning between teachers and students as well as that existing among peers, and the teaching facilities provided by school.

Firstly, teachers' professional attitude is an important factor which acts to promote the development of TPACK. Teachers who have participated in the study said that, the profession of being teachers requires us to live and learn. As Mr. Wang Qiong mentioned in the interview: The knowledge

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of computer operation I own is relatively deficient. However, if schools offer the opportunities to learn, I'd love to learn.

Secondly, communication and learning between teachers and students and that existing among peers is a dynamic factor which acts to promote the development of TPACK. It includes the communication between the teachers and students, that existing among the peers, and the communication in forms of teaching competitions, teacher training, lectures and study and training. Teaching will benefit the teacher as well as the students, we are also able to learn a lot of new knowledge from students. Four teachers who were interviewed unanimously mentioned that the PPT presentation showed by students in class was excellent. "At present, the students who are studying in universities are much better at information than ours." Zhang Ling pointed out that "In my opinion, I feel that I have learned a lot of technical knowledge from students".

Thirdly, teaching facilities are the external environmental factors which can ensure the development of TPACK of teachers. In the interview, all of the teachers held the opinion that it is an important problem that "classrooms cannot be connected to the Internet". In addition, with the development of flipped classroom and mixed teaching method, more and more courses start to have a try with the "online + offline" teaching mode. There is some feedback that teachers thought the stability of the system of network teaching platform provided by school shall be improved, and the incompatibility of some functions have the influences on the effectiveness of tutoring for students conducted by teachers on line as well as the students' voluntary learning.

## **5 Construction of TPACK Framework for College French Teachers**

The construction of TPACK for college French teachers belongs to a dynamic process. In this process, teachers should not only be proficient in applying the technical knowledge, but also ensure to be able to create flexible teaching methods by adopting technology to attract students to participate in the teaching process. The higher the TPACK level of teachers, the higher the participation of students, as a result, the better the teaching quality of the course of French. In view of the study mentioned above, we put forward the following suggestions for the improvement of TPACK ability of teachers who teach French at colleges and universities:

### **5.1 Teachers' learning and communication**

We should promote the concepts of "peers' mutual help" or "old teachers give some guidance to the new teachers" and establish a learning community. In the framework of the TPACK of courses of foreign languages, CK, as a precondition, contains the basic concepts and skills of foreign languages, including linguistic and literary related knowledge, as well as social and cultural knowledge of the targeted language. The teachers who teach French at colleges and universities are required to have a mastery of the knowledge of disciplines such as the acquisition of the second language, analysis on text, sociolinguistics, etc. At the same time, they should integrate their teaching knowledge, such as the integration of the contents of the teaching methods, curriculum development and test, in order to form a PCK which is suitable for the course of foreign language. Therefore, in practical application, we are able to improve the teachers' professional knowledge by means of teacher workshops, young teachers acting as the assistant teachers or have the lesson preparation in a collaborative manner, encourage teachers to pay attention to updating the subject content knowledge at any time, and keep

### **5.2 Educational technology training**

According to the actual demands of the teachers who teach French, the colleges and universities shall aim at conducting the training for teachers' educational technology. For the teachers who lack enthusiasm for technology themselves, it is necessary for the school to help them to build a clear understanding and open the door for the construction of TPACK framework. For the teachers who have weak knowledge of educational technology, schools shall provide regular training and guidance on the educational technology.

### **5.3 Teaching facilities**

Schools shall provide network technical support for the development of TPACK of teachers who teach French with the guidance of the concept of "Internet + Education". French teaching is required to have the basic hardware environment such as language lab and network voluntary learning center, and it is available to be made full use of other computer and network equipment to meet the basic needs of French teaching at colleges and universities. In addition, strength the popularity of online teaching in the form of Mu class and flipped class, and introduce more advanced online teaching systems and enhance the cooperation with computer professional teams, by doing these, they will help French teachers to improve their technical knowledge and make the organic integration of technology and French teaching become realization, in order to promote the development of college French teachers' TPACK level.

## **6 Conclusion**

With the development of the concept of "Internet +" in China, the French language teaching conducted at colleges and universities become more and more hardly to exist without the network information technology. Based on a survey on 30 teachers who teach French at seven colleges and universities in Wuhan, this paper carries out an analysis on the influencing factors of college French teachers' TPACK, and provides some inspiration in terms of exploring the development path of TPACK. It is shown on the study that the TPACK of teachers who teach French at colleges and universities in Wuhan is at a low level, especially TK knowledge is weak; among the demographic variables, TPACK of male teachers is obviously higher than that of female teachers; the longer the teacher's age, the higher the level of CK and PK, but the lower the level of TK; the trainings for teachers have a certain role in respect of promoting TK and other technology-related knowledge. And among the context factors, the teachers' professional attitude is the most important factor, followed by the influencing factors such as the learning and communication between teachers and students as well as that of peers, and the teaching facilities, etc.

Because there is the limitation on the time and space, this study is limited to have the analysis on TPACK level and its influencing factors of some teachers who teach French at colleges and universities Wuhan. We can predict that under the overall trend of the development of the national information, more and more colleges and universities will focus on the cultivation of teachers' TPACK abilities, and the teachers are going to pay more and more attention to the self-improvement of integration capabilities on their own. From the construction of TPACK framework for teachers who teach the



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foreign languages to all of the teachers who teach at colleges and universities will become a subject for our further study.

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Lv Qingtian

School of Art and Design, Wuhan University of Technology, Wuhan, P.R. China, 430070

(E-mail: qingtianlyu@qq.com)

**Abstract:** This paper examines the exhibit ability of popular music in terms of how popular music is interpreted in an exhibition and how the subject engages with museum audiences. It firstly discusses the debates around the changing role of museums in regards to the representation of popular music, and later investigates the current issues of popular music interpretation and museum audience. The paper recognizes the value of exhibiting popular music and proposes appropriate ways for the improvement of museum experiences through a case study by researching through site visits, archival research and ethnographic interview

**Key words:** Curation; Exhibition; Popular music; Audiences; Museum innovation

## 1 Introduction

The term 'exhibit ability' which initially stands for the suitability for being exhibited, now conveys a broader range of meanings in museology. In this paper, exhibit ability denotes the assessments of exhibiting object. It can be evaluated through audience communication, exhibition interpretation and exhibition design. There is an ongoing debate around the issues of exhibit ability of popular music in museums which is entwined with both the cultural studies and museum discourse. Some scholars expressed their doubt of the representativeness of popular music and the purpose of museums. More than two decades ago, as the traditional role of a museum was normally conceived as "preservation of artifact" and "education of facts and knowledge", this has now been challenged by studies on museology. Meanwhile, the emergence of popular music museum and other types of popular culture museum is also challenging the function of museums. One writer questioned the functions of popular music museums, by criticizing The Rock and Roll Hall of Fame for their primary purpose, as he stated, "is awards and thus promotion" (Buckley, 2003). He might not be the only person who holds suspicions, and it is a topic that would be worthwhile to examine. The present paper is rather on exhibiting popular music in traditional museum which normally has a wide range of core collections in its field.

The collection and interpretation of objects related to popular music in traditional museums have been doubted by some scholars. A former V&A curator<sup>89</sup> stated that the original contexts of performer and performing stage was lost when musical instruments entered a museum space. He further questioned the aesthetic value of exhibiting mass-produced pop music instruments in the V&A museum. Indeed, as popular culture inevitably relates to mass-production and consumerism, the problem with exhibiting this material needs to be excavated. A growing number of professionals begin to recognize the value of popular culture exhibitions. The former director of the National Football Museum has stated in *Around Museums and Popular Culture*, "Museums offer an environment to explore the meanings of popular

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<sup>89</sup> <http://www.popular-musicology-online.com/issues/03/edge.html>

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 culture in ways that academic texts cannot, primarily because the material culture can be directly experienced” (Moore, 1997). While museums have always been able to provide exhibition space for high culture such as Renaissance paintings or Chinese ceramics, it has been argued that museums can also develop representation of popular culture, even though there is limited existing literature that examines this issue, a growing number of curatorial practices are setting out examples to respond to the debate in a rather practical way.

## 2 Examining the Exhibit ability of Popular Music Exhibition

### 2.1 The contextual transformation of contemporary museums and pop music

One reason for the emergence of an increasing number of exhibitions around popular music and its relating culture in museums could be out of the attempt by many museums to engage new audiences. It seems obvious that the reason for doing this is to bring economic benefits to museums, but it is not the only reason. For many years, museums have been taken as a place to collect, display, research and educate, yet this traditional role of museums faces many challenges. Questions have been raised around the function of a museum, it is no longer considered as a sort of temple of knowledge, but instead museums can be thought of as a place to create experiences. In an essay focused on museum studies in the early twenty-first century, one scholar stated: “Museums, being public places where one does not usually require special qualifications to enter, have been more open to the pressure of mass democracies and have had to address more directly issues of experience” (Chakrabarty, 2002).

Museums are putting efforts to engage more audiences in the past twenty years, For people who have never set their foot in a museum or gallery, it does not necessarily mean that they are not intellectually efficient enough, it may be that they just defy the concept of a museum or they just do not agree with the value of exhibition making. Popular music could be an entry point for museum to attract new audiences, music is a language without nationality or classification, and it can communicate with many people all over the world. As Eithne Nightingale, a previously V&A Head of Access, Social Inclusion and Community Development has commented, ‘...to keep music at the door of museums seems nonsense. It cuts off an important aspect of people’s cultural and social heritage and deprives museums of one of the most effective ways of bringing in new audiences...’ (Clarke, 2008). This shift in thinking about the role of museums has not just come from within the institutions themselves, but has been motivated by wider social and political agendas. As in nowadays, museums have an important role to play in contemporary society through educating the public about social history, demonstrating community engagement and in maintaining dynamic collections which speak to and reflect today’s diverse communities. Music can be interpreted as an important part of human society and culture, while museums can serve as windows to showcase and display such significant cultural heritages. In this paper, the exhibit ability of popular music will be examined as shown in Figure 1, through audience communication, exhibition interpretation and exhibition design.

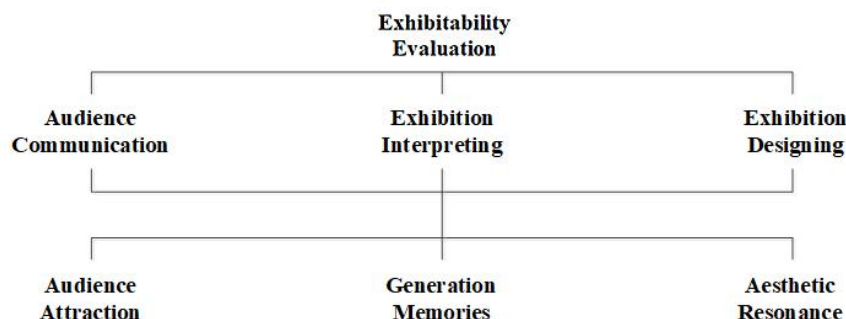


Figure 1 The Diagram of The Exhibit ability Evaluation

## 2.2 Exhibiting popular music in the Victoria and Albert Museum

The presentation of popular music in museums had started quite early in London. In 1973, the V&A became the first museum in Britain to present a rock concert. The contemporary presentation of popular music in the V&A attempted to connect the music with cultural contexts provided from its own collection. Since it is a museum dedicated for the representation of contemporary art and design, one requirement of the objects both in exhibitions and collections in the V&A would always tend to be connected with its culture evaluation, as stated by Victoria Broackes, Head of the Exhibitions for the Department of Theater and Performance at the V&A,

“In a museum of art and design where many objects are wonderful and fascinating, but may have no direct connection to people’s lives and interests, it is exciting to deal with material that is not only hugely creative but also connects with our visitor. And it has a direct relationship to many areas that we already collect and exhibit, such as costumes, such as fashion, graphic design, posters, set-design, photography... These are all things that are traditional subject matters for exhibitions. But music brings those things together and connects them in a form that people already understand, but are also eager to know more about.” (Victoria Broackes, 2017)

Indeed, with the already established categories of art and design collection, it would require some innovative elements to make an intriguing narrative of an exhibition, in order to attract new audiences. The fact that many objects in the V&A temporal popular music exhibitions were loaned from other institutions, for example musician’s archive, also indicates that inviting popular music components into the museum opens a new gate for the dialogue between modern art and traditional classic art temple.

The Victoria and Albert Museum has its collection for the popular music since the 1960s, as part of the Theater and Performance collection. The first exhibition dedicated to a pop star in the V&A is “Kylie - The Exhibition” (2007), the commercial success of this exhibition reveals the fact that this exhibition could actually attract new visitors to the museum, as shown in table 1, the table only includes the visitor number in the V&A South Kensington venue.

**Table 1 A List of Visits to Popular Music Exhibitions in the V&A Museum**

Exhibition Title	Date	Visits
Kylie - The Exhibition	Feb, 2007 – June, 2007	271,100
David Bowie Is	March, 2013 – Aug. 2013	312,000
You Say You Want a Revolution? Records and Rebels 1966-1970	Sept. 2016 – Feb. 2017	243,387
Pink Floyd: Their Mortal Remains	May 2017 – Oct. 2017	352,189

Source: data collected from V&A Annual Report and Accounts

The results of its commercial success almost simultaneously brought praise and denunciation by different commentators. Even though "Kylie" exhibition has led to many criticisms of the V&A museum, as some described it as “dumbing down<sup>90</sup>”, the museum did not seem to be defeated by these critics. In 2013, the “David Bowie Is” exhibition was held at the V&A museum as its second exhibition dedicated to a pop star. At that time, the exhibition broke the record for the V&A ticket selling and once became the most-visited show in the museum’s history, not to mention that after 5 years of this exhibition touring exhibited in more than 9 venues worldwide, it has been seen by more than 2 million visitors.

<sup>90</sup> <https://www.theguardian.com/music/2007/feb/07/kylieinogoue>

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While there are still suspicions around the appropriateness of exhibiting popular music within a museum space, it is the high time to start recognize the value of exhibiting popular music and its utilization for visitors' attraction.

### **3 “Pink Floyd: Their Mortal Remains”: Audience Communication**

While a growing interest has shown in museums around the research of popular music, what has been left out from the investigations is, how music displays can be interpreted as ways to attract new or under represented audiences. The exhibition Pink Floyd: Their Mortal Remains was held at the Victoria and Albert museum (V&A) in London, from 13th May to 1st October 2017, during which it became the V&A's most visited music show exhibited in the venue (2017). In as early as 2006, a visitor surveys conducted for Museums Libraries Archives partnership had pointed out that the subject a museum or its collection on display is one major factor that draws visitors to a museum (Ipsos Mori, 2006). It seems hard to deny that the subject matter of popular music could have been an important motivator for attracting new and hard to reach audiences.

The Pink Floyd exhibition covered the music and cultural material of the band from its early psychedelic experimentation in the early sixties to the present day, including music, hand-written lyrics, the album design, stage design, reproduction of the installations which used to be presented on their performance stage, instruments from the members, and even technology from the original live stages of Pink Floyd. In the words of one of the co-curators, the focus of this exhibition is on visual and sound, not only in consideration of the creative representation of Pink Floyd, but also for the cultural contexts that the V&A has to present (Personal Conversation with Victoria Broackes, 2017).

The journey of this exhibition starts with a psychedelic 'groovy' telephone box (design based on the original British red telephone booth), and many of its kind continue to be a part in the exhibition, everyday material from the relevant eras were displayed in them. It seems like those telephone boxes are becoming a kind of symbolization of each period of the band's life and they help to build connection with the social events, they can be interpreted as the kind of Time Machine which reminds visitors of the significant historical event throughout this journey of time traveling in Pink Floyd's music world. In the first room, a time table named 'Pink Floyd Family tree' which shows the history of Pink Floyd is printed on the wall. For some people, it could be a brief introduction to this band, while for others, it could be an unforgettable calendar of the days that are important in their lives. The exhibition is divided into ten sections following the chronological order, the main part of each exhibiting sections presented several representative albums, such as a large space dedicated to "The Wall (1979)", and a room for the visual and sonic art creations from "The Division Bell (1994)", while the last section is dedicated to show the band's music video and concerts footage.

In the David Bowie Is, You Say You Want a Revolution and Pink Floyd exhibitions at the V&A, there is one section dedicated to the stage of artists which contains live stage scenes, concert footage and music videos. It gave many visitors the multi-sensory experience to be surrounded by music in the crowd as if they were in one concert. The section of live stage performances can be think of as a retrospect of an artist's life achievements, the communication within music itself sounds more powerful than words. When the live performance of Jimi Hendrix, the Who and Sam Cooke were presented in the Revolution exhibition, their voice does not just represent themselves, but rather represents a voice of a generation who shared the same experiences.

The reasons for creating multi-sensory interpretive tools and to choose live performance as exhibiting sections, are in a way, existing to enhance stronger connection with the audience. As stated by the exhibition's co-curator Victoria Broackes, "I actually do believe that the Live AV show could work as an experience - and that we've uncovered that rather unexpectedly as a by-product of these

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exhibitions. The theatrical, immersive techniques we see in theatre now, and that we've employed in our exhibitions, really do give the ability to have an exceptional 'live-performance' experience (Victoria Broackes, 2017)." Music exhibitions allow people to be indulged in a multi-sensory, highly immersed environment and they allow a lot of shared knowledge and experience to be exchanged.

#### **4 Pop Music Exhibitions: Designing and Interpreting**

The traditional ways of interpretation in exhibitions has long been updated by modern technologies and a new generation. Instead of using the text panel as the main interpretive tool, more tools have been used in the exhibition making, especially when dealing with the subject around music, a multi-sensory tour with sound is an inevitable concern. The questions concerning about sound interpretation lies in: how to translate this intangible cultural form into an object and to place it under different contexts.

In the case of Pink Floyd exhibition, the whole narrative was presented in the carefully designed space, in a room where you were able to carefully read specific written material of one object and possibly feel as if building up intimate relationship with it, then in the next moment, you could be impressed by larger-than-life (scale) installations that connected with the object and the music you are listening to. This arrangement brings contrast and tension to the experience, because it allows visitor to get closer to the exhibition, allows them to feel like they became a part of this exhibition and then this could lead to positive emotional response. This kind of highly engaging interactions with the visitors worth to be examined. In the previous studies, the former director of Curatorial and Collections at Experience Music Project (EMP, in Seattle) argued, "the driving objective is to have visitors feel like they have been 'inside' the content, so the experience is more immersive and conversational than passive and professional" (Bruce, 2006). Storytelling type of exhibition helps to build connection with visitors, it doesn't just allowed people to be impressed but also to be educated.

There is another section in the Pink Floyd exhibition that has created immersive experience for visitors. A space dedicated to the album 'The dark side of the moon' was in the middle of the exhibition as a junction from their earliest practices to their later performances. The hologram of the album cover for 'The dark side of the moon' was placed in a room in which the floor, walls and ceiling were completely dark, only the three-dimensional prismatic pyramid rotating in the centre were in sight, while visitors were immersed in the moving image, their experience was also accompanied by the songs from the album on their personal headphones, however, without any label or explanatory text. This special section is said to have created the atmosphere of a cinema. This kind of visual and sonic immersive exhibition tend to create highly effective multi-sensory response from the visitors, which reflects the previous studies on the possibility to take the museum as having long been a context for multi-sensory, multi-dimensional communication (Henning 2006). It allows visitors to have a thoroughly communication with the band but also to oneself, to reflect on the previous objects, connect oneself with the past time and present, and perhaps to reach more thorough understanding of life. Moreover, when this experience is shared by a group of people from different generations together, potentially, personal memory was then transferred into a kind of collective culture which has its significance in society.

To conclude, taking the stance that exhibitions should create experience for visitors, many aspects around the use of technologies could be learned from the curatorial practices in the V&A, especially from the Pink Floyd, Revolution and David Bowie exhibitions. In order to create an immersive, multi-sensory exhibition, curators should always consider the viewpoint from visitors and to give them the space and time to think instead of being didactic. When using the right way to present music, it has the power to build connection between people and the past times.

## 5 Conclusion

Under the path of rapid development of mass media, it is important to examine the subject of an exhibition, for museums should have the responsibility to provide visitors with a reinterpretation of established collections under new critical approaches, especially when in a sense, the subject has broader audience. It was argued that the values of exhibiting popular music and its related cultural materials reflects in its materiality, emotional effects and its positive influence on attracting museum audiences. While admittedly, popular music exhibitions should not be represented as solely a celebration around music celebrities, it is high time for museums to make use of advanced technology to develop a web of popular culture which presents a diversity of experiences.

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## Analysis on the Reports of French Media on People-to-People Exchanges between China and France

Zhang Rui

School of Foreign Languages, Wuhan University of Technology, Wuhan, P.R. China, 430070  
(E-mail: ruizoe\_zhang@126.com)

**Abstract:** Since the China-France High-Level People-to-People Exchange Mechanism has been in operation for five years, the scope of cooperation in people-to-people exchanges of the two countries has gradually expanded, resulting in a lot of substantial progress. This article aims to understand France's views on China by studying from the perspective of the recognition of French media on people-to-people exchanges between China and France. The methods of content analysis and frame analysis have been used in this article to conduct a quantitative and qualitative study on the reports on people-to-people exchanges between China and France from *Le Monde*, one of France's most influential media. This article argues that *Le Monde*'s coverage of the people-to-people exchanges between China and France is relatively friendly. At the same time, however, all the critical framework in *Le Monde*'s reports is related to politics featuring a tendency of pan-politicization. To better promote people-to-people exchanges between China and France and remove France's misunderstandings and doubts towards China, we should pay attention to the exchanges and cooperation between the media of both sides.

**Key words:** People-to-People exchanges; French media; China-France High-Level People-to-People Exchange mechanism; Content analysis; Frame analysis

### 1 Introduction

In September 2014, which marked the fiftieth year of Sino-French diplomatic relations, the China-France High-Level People-to-People Exchange Mechanism was officially established, becoming the third vice-premier-level annual dialogue mechanism between the two countries following the High-Level Strategic Dialogue and the High-Level Economic and Financial Dialogue. In the past five years, the people-to-people exchanges between the two countries have continued to operate at a high level, with the scope of cooperation gradually expanding to 10 areas including education, technology, culture and sports<sup>91</sup>. Driven by the overall promotion of the high-level dialogues, exchanges and cooperation in various related fields have been flourishing, which results in a lot of substantive progress.

With the promotion of the China-France High-Level People-to-People Exchange Mechanism, domestic media and scholars have been paying more and more attention on people-to-people exchanges between China and France, but mainly focusing on the origin, achievements and significance of this mechanism in news. Some research institutions have held think-tank conferences themed with that but haven't published any relevant research reports or papers. "Analysis of the Cognitive Tendency of

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<sup>91</sup>News on Chinese government website, the fourth meeting of the China-France High-Level People-to-People Exchange Mechanism was held, [http://www.gov.cn/guowuyuan/2017-11/24/content\\_5242045.htm](http://www.gov.cn/guowuyuan/2017-11/24/content_5242045.htm) (In Chinese)



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French Think Tank on Sino-French 'People-to-People Exchanges'" published by the scholar Cheng Ping is the only academic paper on Sino-French people-to-people exchanges up to now. This paper summarizes the articles, interviews and research reports on people-to-people exchanges between China and France of French experts and opinion leaders engaged in the think tank of international relations, and it analyzes the cognitive tendency of French think tank about Sino-French people-to-people exchanges (Cheng Ping, 2019). In fact, understanding France's views can help us establish effective communication to resolve the misunderstandings and doubts of France on us in time and design more pragmatic cooperation programs to enhance the role of the China-France High-Level People-to-People Exchange Mechanism. Besides, analyzing the French media's reports on Sino-French people-to-people exchanges is another important perspective to understand the French society's attitude towards such exchanges.

The domestic academic researches associating journalism with construction of national image dated from 1990s. The paper "National Image in International News Communication" (Chen Xiaou, 1996) is a representative one. The overseas researches on national image mainly focus on public relations, and Images of Nations and International Public Relations (Michael Kunczik, 1997) is a classic work. After entering the 21<sup>st</sup> century, there have been more and more domestic academic researches on the national image of China in the world, which gradually focus on public relations. In recent years, Chinese scholars have carried out a great number of researches on the national image of China in the world by analyzing the overseas media's reports on China. Researchers keep track of the researches on the national image of China displayed in the mainstream media of countries such as the United States, the United Kingdom, Russia, France, Germany, Japan, and South Korea. For the study on the national image of China built by French media, the scholars mainly carry out their researches by focusing on French mainstream media's reports on a certain aspect of China, such as analyzing the reports on the environmental issue (Chai Ling, 2005) or Diaoyu Island issue (Luo Xin, 2013) of China the French media's interpretation for the "China Dream" (Wu You, 2016), Chinese females' image (Cheng Bo, 2017), Hongkong's image (Lv Ying & Ruan Shuhui, 2015), China's Economic image (Zheng Lisha, 2015) and China's Economic Reform image (Hong Hui, 2018) in the French media. This article presented will analyze the French media's news reports on Sino-French people-to-people exchanges to get knowing of the French media's reporting attitude towards it and the image of China built in the reports.

## **2 Data and Methodology**

We have chosen Le Monde (French: The World), one of the most important newspapers in France, to conduct a study to decode the image of China in the eyes of French media. Le Monde enjoys a high international reputation, representing the French government's position in the reports of international issues. As a mainstream medium, Le Monde reflects the consciousness and values of the mainstream French society. It is convincing and significant for the study of the Chinese image in French mainstream values.

In addition, as the concept of "people-to-people exchanges" is relatively abstract, we referred to the list of the fields covered by the people-to-people exchanges in the China-France High-Level People-to-People Exchange Mechanism - education, science & technology, culture, health, news media, sports, tourism, local cooperation, youth and women - and we made judgments based on the lexical connotation of the "people-to-people exchanges". We believe that the news in the fields of the people-to-people exchanges is the sum of all news except political, economic, and military ones.

In this study, the paper medium of Le Monde in the Europresse Database was selected as the search

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source, and the keyword China or Chinese was searched throughout the articles, with the time span of from May 14, 2017 to August 31, 2018. May 14, 2017 marks the time when the centrist independent candidate Macron became the president of France, representing the change in France's domestic political ecology and constituting a new background for the French policy towards China. After the full-text search of the keywords, the Europresse Database finally presented a total of 3,337 articles covering China or Chinese news reports. Based on the definition of the fields covered by people-to-people exchanges, the method of exclusion was used to screen these reports. In the end, we have selected 56 news reports dated from May 14, 2017 to August 31, 2018 of Le Monde that are closely related to the topic of people-to-people exchanges between China and France. We conducted content analysis and frame analysis to study these reports.

The content analysis is a research method based on various literatures, which converts non-quantitative materials into quantitative data and makes inferences based on the data. The frame analysis is a common method in communication. We summarize the words, narratives and other elements in the news to get the points of views, attitudes and corresponding emotional connotations revealed in the report writing, that is, the implicit framework of the news text.

### 3 Results

#### 3.1 Results of quantitative analysis

We conducted the content analysis from the three aspects of news writing: report content and tendentiousness. We obtained the following results:

(1) Le monde's reports on people-to-people exchanges between China and France are mainly in a detailed and in-depth form. Le Monde's most important report genres on people-to-people exchanges between China and France are press release and survey report, accounting for 51.8% of the total reports, followed by people features and exclusive interviews, accounting for 21.4%. These two genres share the common characteristics of emphasizing narrative and description to conduct detailed and vivid reports on the report objects, which, together, account for 73.2% of the total reports. (see Figure 1)

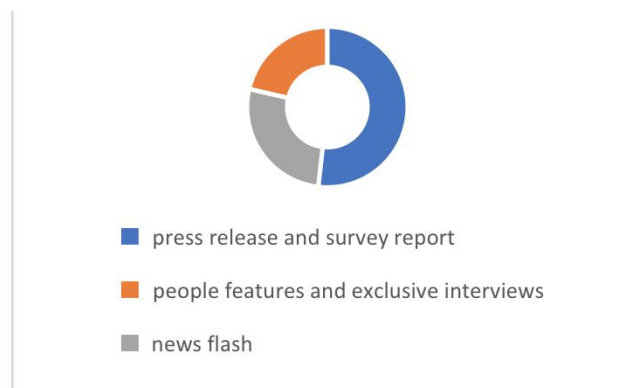
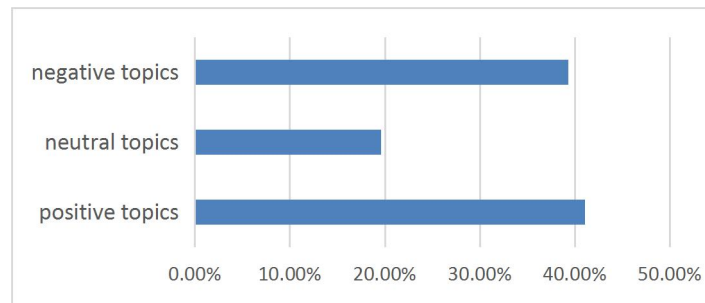


Figure1 News Forms of the Reports

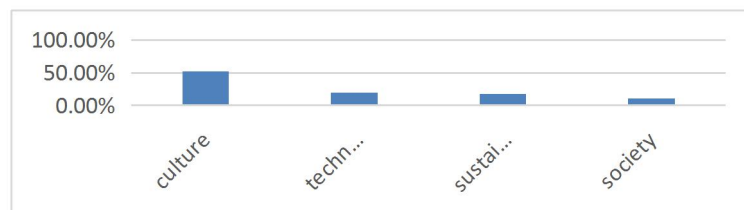
(2) In terms of the report topic types, Le Monde's coverage of people-to-people exchanges between China and France is relatively friendly. With the positive and negative topics accounting for 41.1% and

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 39.3% of the total reports respectively, the two types of reports are basically in the same amount, and the positive reports are slightly more than negative ones. The sum of the basically neutral and positive reports accounts for 60% of the total. (see Figure 2)



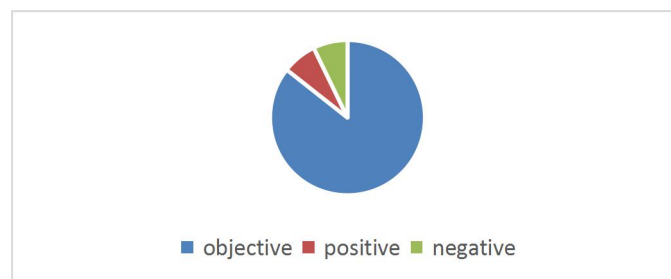
**Figure 2 Topic Types of the Reports**

(3) Le Monde’s news related to people-to-people exchanges between China and France in the studied period are concentrated in four fields: culture, technology, sustainable development and society, accounting for 51.8%, 19.6%, 17.9%, and 10.7% of the total reports respectively. Among them, the culture field sees the most reports, accounting for more than half of the total, with the most abundant topics. It is worth noting that Le Monde is very concerned about the development of China’s science and technology, which has become the second most concerned field followed by the culture. (see Figure 3)



**Figure 3 Topic Fields of the Reports**

(4) The tendentiousness of the report refers to the author’s attitude in the report. Le Monde’s reporting on people-to-people exchanges between China and France is dominated by neutral reports featuring being “objective and neutral”, accounting for 85.6% of the total reports; objective and positive reports account for 92.8% of the total. Le Monde’s reporters hold a friendly attitude towards people-to-people exchanges between China and France. (see Figure 4)



**Figure 4 Tendentiousness of the Reports**

### 3.2 Results of frame analysis

Based on the overall results of the previous section, we conducted a detailed analysis on the news reports in various fields, and found that they are of different characteristics.

#### 3.2.1 Culture field

There is a wide range of reports in the culture field. Le Monde's reporting interests cover Chinese art, humanistic values, architecture and Sino-French cultural exchanges and cooperation events. As a country with a long history and profound artistic background, France has maintained a high degree of attention to Chinese culture. From the perspective of the timeline, both traditional and contemporary Chinese cultural issues are involved presenting a more open and modern China. The most reported topics focus on Chinese modern movies and filmmakers, accounting for half of the reports in the field; in addition, the attention to the Sino-French cultural exchange and cooperation events and Chinese young architects is also a feature of the reports in the culture field.

In terms of films, Le Monde's interest in Chinese modern movies is concentrated on independent films, documentaries and literary films, and it pays special attention to Jia Zhangke, an independent film director and screenwriter, with nearly half of the film reports related to him. As introduced in a report that "the symbolic violence of Chinese society has always been the great subject of Zhang keJia's film"<sup>92</sup>, Le Monde's great interest in Jia Zhangke's films represents its concern about the tragedy in Chinese society to some extent. In fact, Le Monde's coverage of Chinese films features mostly negative topics, which mainly reflect the tragic and helpless fate of nobodies in Chinese society, as well as the restrictions on free expression that creators are facing and other similar issues.

The development of Chinese contemporary art and young architects has also received much attention. All reports on these two topics are positive. Le Monde outlines the group image of contemporary Chinese young architects who are professional, confident, international, open-minded and respecting traditions.

#### 3.2.2 Science & technology field

The reports of Le Monde in the science & technology field are of extensive interests and wide visions. The aspects involved are from automatic drive technology to the development of aerospace, from the world forefront quantum communication to the mobile payment which is closely connected to the convenient life of the civilians. "Today's China is a strong country in science and technology research" is the basic viewpoint of Le Monde reporting on China's Science & technology field. This condition is reported in most of the reports which have not only introduced the advanced technology strength of China, but also delivered the attitude in the articles that France and Europe need to reinforce the cooperation with China to realize win-win situation. The reports say that China's scientific and technical level is catching up with and surpassing the European and American powerhouses. Spending less than 10 years to surpass 10 countries, China has currently become the 2nd technology research powerhouse in the world<sup>93</sup>. They have confidence in China's future<sup>94</sup> and they think that "in the future

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<sup>92</sup>Isabelle Regnier. And the gentle Jia Zhangke unsheathed her sword[N]. Le Monde, 27/05/2017:TEL20 (In French)

<sup>93</sup>Sylvestre Huet. China overturns the world scientific chart[N]. Le Monde, 07/04/2018: SCQ1 (In French)

<sup>94</sup>Simon Johnson, Jonathan Ruane. China soon to be world champion of innovation [N]. Le Monde,01/11/2018: SCQ7 (In French)

The negative reports on science & technology field are mainly established on the viewpoint that the wide application of China’s artificial intelligence technology threatens the personal information security of the Chinese citizens. Le Monde has connected science & technology with politics, establishing the news framework that the Chinese government is monitoring the Chinese citizens more strictly by using artificial intelligence technology. A long communication reporting on the application of China’s facial recognition technology is entitled “In China, facial recognition invades everyday life”<sup>96</sup>. The emotional coloring of the word “invade” (envahir) in the title is very derogatory, with the meaning of unauthorized or violent entry. The readers, especially those cultivated under the western social culture which lays emphasis on personal boundaries, may feel very uncomfortable when reading this word. Combined with the authoritative image of China which has been agitated by the western media, it has further deepened the rigid political impression on China.

### 3.2.3 Sustainable development field

During the period of being analyzed, there were 11 reports from Le Monde on China’s sustainable development, in which the topics involved include environment protection, energy and urban planning.

The environment is the most important topic of Le Monde on China’s sustainable development. Because the environmental issue is always mixed with the nation’s politics and benefits and is becoming more and more globalized which results in “environment diplomacy” (Chai Ling,2005). China’s environment has always been one of the issues that the French media focus on, which is “one of the factors that concern the desire of foreign enterprises to invest in China” (Hong Hui,2018). Among the analyzed reports of Le Monde, the main topics of the reports on the sustainable development occupy half of the number of its reports on the topics of China’s environment protection. LI Yuan pointed out that “in the analysis on the reports of Le Monde on China’s environment from the year of 2009 to 2011, the reports of Le Monde on the efforts and progress made by the Chinese government to improve environmental conditions are in the minority of its reports”(Li Yuan,2014). This reporting characteristic in the reports of Le Monde on China’s environment has changed obviously since May of 2017. No matter the governmental measures that aim to improve the quality of air, or the residents’ volunteer activities that assist with garbage classification, Le Monde has reported the efforts made by China to protect the environment.

In fact, the reports of Le Monde on China’s environmental issue show its contradiction and entanglement. France is seeking assistance from China on climate change issues. On the one hand, Le Monde is reporting the positive efforts made by China on environmental protection; on the other hand, it uses the environment issue as a breakthrough to criticize China’s social and political issues. In the reports, the environmental incidents are always used as entry points and then transferred quietly to the establishment of the governmental image of the Chinese government when facing the environmental crisis.

### 3.2.4 Society field

Compared to the reports on other fields, the portion of reports on the negative topics on society field is quite high, which is the most outstanding characteristic of these reports. The topics involved in the reports on society are all population issue, mostly reporting about youth, women and urban migrant

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<sup>95</sup>Charles-Edouard Bouee. China is also a power of innovation[N]. Le Monde, 20/10/2017: SCQ7 (In French)

<sup>96</sup>Simon Leplatre. In China, facial recognition invades everyday life[N]. Le Monde, 11/12/2017:SCQ2 (In French)

The reports of Le Monde on China's society especially focus on the difficulties of the vulnerable groups. A nation with the tradition of liberty, equality and fraternity, which is treated as political correctness in the country, will naturally focus more on the vulnerable groups. This indicates the value orientation of the French media. However, Le Monde only reports on some specific social phenomena of China to represent the overall social condition in China. The news reporting based on ideological choices has lost its objectivity and replaces its objectivity with opinion orientation. In addition, the reports of Le Monde are immediate with great timeliness, stating the latest news and phenomena that happen in China. But the news reporting frame established via news incidents is full of platitudes. During 2009 to 2011, the reports of Le Monde on the society "shaped a social image that China is full of unsafe factors with various social contradictions being relatively activated"(Li Yuan,2014). Nine years later, the news reporting frame firmly grasped by Le Monde is still the denounce on China's human rights issues, which actually arises out of France (Western)'s attack from ideology on China that has a different political structure from it.

#### **4 Conclusion**

Through the methods of content analysis and news frame analysis, this article has conducted quantitative and qualitative analysis on the reports of people-to-people exchanges between China and France since the administration of the Macron government. We found that: Le Monde's reports focus on four fields: culture, science & technology, sustainable development and society. On the whole, Le Monde's coverage of the people-to-people exchanges between China and France has been relatively friendly since Macron, the new president, took office. After further analysis, we found that news reports on different fields have different characteristics. In general, however, the critical framework in Le Monde's reports is related to politics and has a tendency of pan-politicization. In the international exchanges, the principle of seeking common ground while reserving differences is of great importance. Except for the news reporting framework caused by ideological differences, the French media has also highlighted a progressive, open-minded, and humanistic image of contemporary China, by not only reporting the great progress that China has made in scientific research, but also describing Chinese new-generation designers with an international vision and artists reflecting on the society and caring for the vulnerable, etc.

There is still a long way to go to enhance mutual understanding between the two countries, especially for France to understand China. The China-France High-Level People-to-People Exchange Mechanism, proposed and created by the top leaders of China and France, marks a milestone on this way. At the same time, various underway exchange events under way are also an important opportunity to enhance France's understanding of China's real society. Now that we have realized the huge influence of the media, we should immediately enhance the communication and cooperation between the Sino-French media. For example, we can conduct cooperative interviews and joint drafting for major news events related to both China and France. Such deep communication and cooperation is bound to achieve a better understanding, for the Chinese and French media, of each other's perspectives and views on the other's culture and society. And there are also various potential forms of exchanges and cooperation to be achieved by our creativity.

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# Research on User's Requirement of Game Handle Products Based on KANO Model

Li Qiong, Xu Wei

Department of Economic Management, Wuhan Huaxia University of Technology,

Wuhan, P.R. China, 430223,

(E-mail: liqiong913@163.com, 53589077@qq.com)

**Abstract:** Based on the KANO model, this paper analyzes and studies regarding the most important user requirements in the design of game handle products. Started with the problem of user demand response, combined with the first-hand questionnaire information, and from the perspective of user acceptance and demand weight, by using the KANO model to find the main concerns of the current game handle product users, the paper finds the Bluetooth compatibility is the most important factor affecting users' needs, followed by platform support, keys of game handles, operation of game handles, upgrade of handles and evaluation of game handles.

**Key words:** Game handle products; Users' needs; KANO model; Product demand point.

## 1 Introduction

With the popularity of the Internet and the rapid development of computer technology, the game handle from the traditional handheld start with the computer, smart phones, tablet and smart TV products began to converge, the users in a variety of smart devices play game led to the game product demand becomes diversified.

The research on KANO model and user demand at home and abroad mainly shows two angles. First, the Kano model and QFD are combined to modify the weight of the customer demand information in the QFD, by looking for the focus in the product design process, such as determining the strong and weak correlation between customer demand and product quality characteristics (Duan Liming and Huang Huan, 2008), establishing quality houses including customer needs and quality characteristics (Tang Xiaoling and He Yan, 2013), and adding the indicators of customer satisfaction (Chen Chen and Liang Gongqian, 2013), etc., to find key elements to promote new product development. Second, the Kano model and QFD are combined to find the key factors most affecting customer satisfaction (Huei-Jiun Lai, Hsin-Hung Wu, Carmen Llinares, Alvaro F. Page, 2011). However, using the KANO model to study the user needs of gamepad products is almost blank.



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## 2 Based on KANO Model Handle Product Users' Needs Confirmation and Questionnaire Generation

### 2.1 Confirm the current user's use of the game handle in the process of fuzzy needs

This stage through the brainstorming method enumeration of the game handle users in the use of the game handle the process may encounter problems, after collecting discussion, combined with practical work experience, including supporting software, game update convenience and 42 users fuzzy demand point ( Zhong Xia, Liu Wei, Xu Jialiang,2015,LiFangyu, Zhang Ruifo,2018 ) .

### 2.2 Classification and screening of users' requirements

According to the importance of the project to remove, the same meaning of the same expression of the merger, for the users to improve the class needs to join the survey and the importance of the questionnaire survey of four aspects of the fuzzy demand point of users' needs point classification and screening.

**Table 1 The Classification Filter List of Users' Demand Point**

Demand classification	demand point
	Using 2.4G wireless technology
Poor Bluetooth compatibility	Using double Bluetooth 3.0 and 4.0 optimize Using full-speed USB data cable connection
	Collaborate more partners
Support the small number of games	Open handle connection agreement to game maker Develop technology adaptation game to support handle Increase the connection agreement of handle support
The poorest support of platform	The support of independent game development platform With more partners Increase the handle reset hole to prevent recovery after the crash
Game handle key fault	Button with anti-skid design for button buffer Fixed with nonmetallic material
Game handle operation is too complicated	Unofficial game out of the handle key bitmap Key operation instructions
The handle of the shock motor does not feel strong	Using double motor design Vibration motor with adjustable motor

Support for mobile device upgrades on the basis of support for PC-side upgrades

Handle upgrade is not convenient

Support for more system upgrades such as smart TV terminal handles

Lack of game handle evaluation

Increase the game player evaluation

Media evaluation

### 2.3 Form a questionnaire model, the production KANO questionnaire

Clearly need to investigate the demand point, according to the requirements of the KANO model to generate the corresponding questionnaire to start the investigation. A total of 300 questionnaires were issued and 206 valid questionnaires were collected.

## 3 Data Processing and Results Analysis

### 3.1 Questionnaire based on the KANO model of the user needs of the initial analysis

KANO model analysis through the users to answer the positive and negative questions, analysis of the user's comments. For example, for a user's demand, the users' answers for positive questions to called "I like", and the answer to the reverse question is "I do not like", the user thinks the requirement is "expectation". The possible results for each users' requirements are summarized as follows:

**Table 2 The Possible Distribution Results of KANO Model Users Recommend**

Positive question	Reverse question				
	I like	should be so	does not matte	I can tolerate"	I do not like
I like	Suspicious result	Excitatory demand	Excitatory demand	Excitatory demand	Expected demand
should be so	Reverse result	Do not care	Do not care	Do not care	The basic needs
does not matte	Reverse result	Do not care	Do not care	Do not care	The basic needs
I can tolerate"	Reverse result	Do not care	Do not care	Do not care	The basic needs
I do not like	Reverse result	Reverse result	Reverse result	Reverse result	Suspicious result

Note: Expected demand refers to the respondents are very much looking forward to the realization of the function; excitement is the respondents in the positive question of the survey selected "I like" and reverse the problem chosen "should be so", "does not matter" "I can tolerate" the demand; the basic needs of the respondents are not sensitive to the positive problem, but the reverse problem showed great discontent; suspicious results that the user's answers contradictory; reverse results refer to the user that the answer is the opposite of the opinion of the survey designer. Do not care that the user is not concerned about the questions raised by the questionnaire, not particularly interested.

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 After this statistic, the KANO model requirements classification table can be obtained by  
 classifying the columns with the largest number of vertical and horizontal users.

**Table 3 Summary of KANO Model Requirement Classification**

Question	Demand	KANO Model Requirement Classification
Poor Bluetooth compatibility	Using 2.4G wireless technology	Excitatory demand
	Using double Bluetooth 3.0 and 4.0 optimize	The basic demand
	Using full-speed USB data cable connection	Expected demand
Support the small number of games	Collaborate more partners	Do not care
	Open handle connection agreement to game maker	Do not care
	Develop technology adaptation game to support handle	Expected demand
	Increase the connection agreement of handle support	Expected demand
The poorest support of platform	The support of independent game development platform	Excitatory demand
	With more partners	Expected demand
	Increase the handle reset hole to prevent recovery after the crash	The basic demand
Game handle key fault	Button with anti-skid design for button buffer	The basic demand
	Fixed with nonmetallic material	Expected demand
Game handle operation is too complicated	Unofficial game out of the handle key bitmap	Expected demand
	Key operation instructions	Excitatory demand
The handle of the shock motor does not feel strong	Using double motor design	Expected demand
	Vibration motor with adjustable motor	Expected demand
Handle upgrade is not convenient	Support for mobile device upgrades on the basis of support for PC-side upgrades	Expected demand
	Support for more system upgrades such as smart TV terminal handles	Do not care
Lack of game handle evaluation	Increase the game player evaluation	The basic demand
	Media evaluation	The basic demand

### 3.2 Weight analysis of the Product of game handle demand point based on KANO model

To visually reflect the problem, we quantify all user requirements and insert weight. It can better reflect the intensity of demand because of the weight.

**Table 4 KANO Model User Demand Weight Distribution**

Sector	I like	Reasonable	Whatever	I am fine	I don't like it
Forward problem	1	0.5	0	-0.5	-1
Inverse problem	-1	-0.5	0	0.5	1

By adding weights, the actual survey data are taken into account to obtain the weight of each user's demand. please read the below :

**Table 5 User Requirements Weight Summary**

Problem	Demand	Demand value
Poor Bluetooth compatibility	Using 2.4G wireless technology	282.5
	Use dual Bluetooth 3 and 4 and optimize	201
	Use a full speed USB data line connection	198.5
	Cooperate more partners	117
Fewer games supported	Open handle connection protocol to game maker	228.5
	Development technology adaptation game support handle	161.5
Platform support error	Connection agreement with added handle support	160
	Independent development of game platform support	254.5
	And more partners	225.5
Game handle button fault	Increase the handle reset hole to prevent recovery after the crash	228
	The key adopts anti-skid design to buffer the key	221.5
	The material is fixed with metal material	24.5
The handle is too complex	Unofficial Game out handle key bitmap	232.5
	Button operation prompt	257.5
The vibration motor of the	Dual motor design	229.5

handle does not feel strong	The vibration motor adopts adjustable motor	218
Handle upgrade is not convenient	Support mobile device side upgrade on the basis of supporting PC side upgrade	229
	Support more system upgrades such as smart TV terminal handles	178.5
Lack of joystick evaluation	Add game player evaluation	227.5
	Media evaluation	231

### 3.3 Ranking analysis of user acceptance based on KANO model

Table 6 Based on KANO Model, User Acceptance and Other Analysis Summary

Problem	Demand	User acceptance	Reverse subscriber rate	Total demand value	Per capita demand weight
Poor Bluetooth compatibility	Using 2.4G wireless technology	78.64%	0.49%	282.5	1.378
	Use dual Bluetooth 3 and 4 and optimize	72.82%	0.97%	201	1.581
	Use a full speed USB data line connection	74.27%	4.37%	198.5	1.0076
	Cooperate more partners	38.35%	0.97%	117	1
Fewer games supported	Open handle connection protocol to game maker	66.02%	1.94%	228.5	1.1312
	Development technology adaptation game support handle	67.48%	0.49%	161.5	0.7878
	Connection agreement with added handle support	62.63%	1.64%	160	0.7882
Platform support error	Independent development of game platform support	74.76%	1.46%	254.5	1.2537
	And more partners	75.24%	1.46%	225.5	1.1108
	Increase the handle reset hole to prevent recovery after the crash	76.21%	1.94%	228	1.1287
Game handle button fault	The key adopts anti-skid design to buffer the key	73.30%	1.94%	221.5	1.0965
	The material is fixed with metal material	78.64%	1.46%	24.5	1.1847
The handle is too complex	Unofficial Game out handle key bitmap	77.18%	1.46%	232.5	1.1453
	Button operation prompt	72.33%	0.97%	257.5	1.2623

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The vibration motor of the handle does not feel strong	Dual motor design	75.73%	0.49%	229.5	1.1195
	The vibration motor adopts adjustable motor	73.30%	2.43%	218	1.0846
Handle upgrade is not convenient	Support mobile device side upgrade on the basis of supporting PC side upgrade	77.67%	1.46%	229	1.1305
	Support more system upgrades such as smart TV terminal handles	53.40%	2.43%	178.5	0.8881
Lack of joystick evaluation	Add game player evaluation	75.24%	3.40%	227.5	1.1432
	Media evaluation	73.30%	1.46%	231	1.1379

From table 6, we can see that according to user acceptance and demand level of weights of the top 10 key points in descending order, you can see there is overlap height of the following aspects, first of all users on whether to use the 2.4G wireless technology acceptance and demand weights are the highest, followed by the handle material for metal materials, if it is convenient for use in the mobile terminal, whether a key bitmap guidance, reset function, whether there is a dual motor design, if there is more support for cooperation, whether for user evaluation, if there is an independent game development platform, whether to use the full USB data cable.

## 4 Conclusion

From the perspective of user acceptance and demand weight, both are mainly concentrated in Bluetooth compatibility, platform support, keys of game handles, operation of game handles, upgrade of handles and evaluation of game handles. Judging from the specific needs of these six aspects, these indicators directly affect the direct experience and player communication in the game world when using the game handle products, but the direct stimulating impact on the game handle products such as the vibration motor feeling of the game handle is not strong. The final service product of the game handle product is still the game itself, and the factors of direct contributing to the experience of the game has become the main aspect affecting users' needs.

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## Research on the Advantages of University Online Courses Based on "Super Star Learning platform"

Zhan Wei

School of Arts and Communications, Wuhan Polytechnic University, Wuhan, P.R.China, 430023

(E-mail:45671053@qq.com)

**Abstract:** With the continuous advancement of educational informatization reform, a number of network teaching platforms have emerged. How to select high-quality teaching resources and carry out online + offline hybrid teaching has been the focus of attention in the educational circles. Through more than one year's teaching practice and taking the course "Entering the Music World" as an example, the author uses comparative method, survey method and questionnaire method to analyze it. The author believes that "Super Star Learning Platform" should be applied in seven aspects: teaching environment, teaching idea, teaching content, teaching interaction, participation in learning, teaching evaluation and feedback reflection. It is better than the traditional way of teaching.

**Key words:** Music online course; Traditional curriculum; Advantage; Comparison

### 1 Introduction

Universities general education, as an innovative educational concept and modern talent training mode, is an indispensable supplement to professional education. Its purpose is to expand the breadth and depth of students' knowledge, so that students can develop in an all-round way (Jia Shurong, 2016). College music course has always been a popular elective course for college students. For a long time, limited by the conditions and hours of music courses in Colleges and universities, the traditional teaching methods cannot meet the needs of today's students for knowledge. In view of this situation, teachers and scholars have made some useful attempts, some of them have done some research on music courses in Polytechnic schools. Considering that students' music foundation is relatively weak, they advocate that appreciation courses should be the main course (Li Jing, 2018). Others, from the perspective of aesthetic education, have done some research on the curriculum system of general music education in Colleges and universities, and put forward that the music curriculum should be built into a comprehensive platform of aesthetic education in Colleges and universities (Ma Hua, 2019). Others study the music general education curriculum offered by three top universities abroad, especially in the United States, in order to help and draw lessons from domestic teaching (Zhang Yanli, 2017). The above contents have discussed the general music course in Colleges and universities from different aspects, but little has been mentioned about the research of network education platform. It is in this context that the online course "Entering the Music World" is carefully designed by the lecturer, specially designed and combined with online (superstar learning platform) offline hybrid teaching. Through nearly a year's operation, many problems in traditional teaching have been successfully solved. With the new teaching form, students' learning enthusiasm and initiative have been greatly stimulated, and the learning effect has been improved obviously.



## 2 Analysis

### 2.1 The openness of the teaching environment

As far as the traditional music courses are concerned, the classroom area is limited and there are considerable requirements for the quality of teaching, so there are certain restrictions on the number of students. A large number of students are not qualified to study this kind of course because the number of elective courses exceeds the limit. On-line course "Entering the Music World" completely breaks this restriction, changing "boundedness" into "unbounded", enabling students to have free time and space to learn, to truly "want to learn", and to learn the course repeatedly, so as to help students grasp the course knowledge more comprehensively.

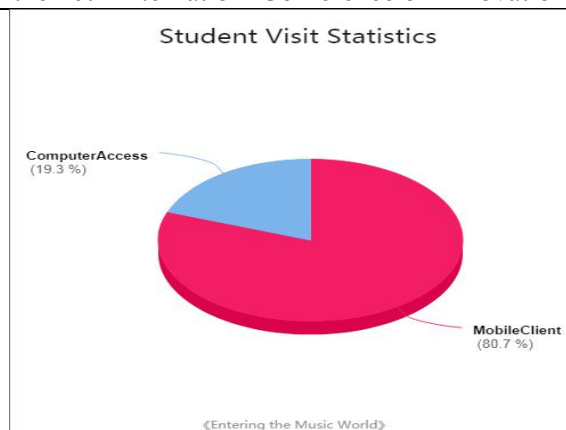
The course was launched in 2018 on the Super Star Chu Course Alliance Learning Platform, which serves as a shared credit course for students in Universities of Hubei Province. In the past year, the rate of visits has reached nearly 200,000. At present, a total of 1,209 students have completed the course in three schools (Table 1), which can only be achieved in the traditional classroom for five years.

**Table 1 Course Selection Number of "Entering the Music World" in the Past Year**

	Jiangnan University	Spring of 2019	Wuhan Polytechnic University	Xueyin Online	Wuhan Institute of Technology
Numbers	228	355	395	123	108

### 2.2 The innovation of teaching ideas

Traditional teaching hours are limited. Generally speaking, teachers, students and after-class practice are used in the classroom. This kind of passive learning cannot really stimulate students' interest and enthusiasm in learning, the learning effect is discounted, and the teaching goal is difficult to achieve. The online course "Entering the Music World" breaks through the shortcomings of traditional teaching mode and limited teaching content. With the help of "superstar" platform, a new teaching concept of "students' initiative learning, teachers' guidance and practical experience learning" is established, which makes students' learning more interesting, convenient and efficient. From September 30, 2018 to December 20, 2018, this course was launched in Chu Class Alliance. 80.7% of the students used mobile clients to access their learning. (Figure 1)



**Figure 1 Student Visit Statistics**

Microvideos are also introduced in teaching (Nie Lei, 2018). The length of the micro-video, the emphasis and the difficulty are prominent. It can help students to "make up" for the lack of knowledge and solve the puzzles in learning in time. At the same time, it also cultivates their autonomous and spontaneous learning habits. Compared with traditional teaching mode, micro-video focuses more on students' own understanding and analysis. Pre-class preview and data collection have become an indispensable part of micro-video education mode.

In teaching, SPOC + flip classroom is effectively combined through Superstar Learning Platform, that is, students preview teaching micro-videos in advance through learning platform, while teachers have more time to analyze heavy and difficult knowledge online, or carry out flip classroom, or conduct art practice guidance exercises, etc. This kind of classroom returns to students, really. Student-centered teaching enables teachers to have more time to guide students, and students can grow up smoothly under the guidance of teachers.

### **2.3 The whole process of teaching evaluation**

In order to make college students achieve effective learning effect in the process of learning, college teachers adopt a series of evaluation methods in the process of implementing teaching activities for students. The purpose is to make students fully aware of the shortcomings and inadequacies of their own in the process of learning, so that they can correct them in time to make progress (Zhang Nuo, 2017). The traditional teaching evaluation has always paid attention to one-off, paper quality examination, while this course pays more attention to the whole process evaluation. In a letter before class, the students are clearly informed of the opening time of the course as a whole and each unit and the weight ratio of each learning content and link. The platform records every learning step of the student, whether it is attendance, participation in classroom learning, interactive mutual evaluation, group discussion, personal report, homework, class quiz, etc., each step of the score has a detailed time, time length, score record, etc. Students can also be clearly queried in the "statistics" module of the platform. In addition, the teacher has no right to change the background information settings of the students, and also eliminates the "love" at the end of the period. The occurrence of the whole process is open and transparent, which ensures the objectivity, comprehensiveness, fairness and fairness of learning evaluation.

## **2.4 The timeliness of feedback and reflection**

Teaching feedback is a process in which teachers transmit the information to students through the teaching process, and after students process and process the information, the effect will be transmitted back, which will have an impact on the future teaching. A good teaching feedback is clear, timely, two-way, real, targeted, motivating, guiding and diverse. Through teaching feedback, students' learning information can be collected, analyzed and utilized. Teachers can understand their own teaching effect and judge students' learning situation, so that they can timely and targeted control the teaching process, improve teaching and promote students' more effective learning. Only through continuous teaching feedback, can we make teaching more perfect, more conducive to promoting students' learning development, and then make teachers and students form a good teaching and learning atmosphere (Li JunXiang, 2017). The platform of "Super Star Learning Communication" understands students' learning behavior through the statistical function of background data, and can make individualized learning programs separately. Through the platform big data, we can conveniently master the universal problems existing in the learning of all students, as well as students' learning tendency, learning track and so on, which is convenient for timely teaching reflection, timely adjustment of teaching strategies and effective teaching improvement. In view of the above requirements, we try to solve them from the following aspects.

## **3 Method**

### **3.1 Customization of curriculum content**

With the national education policy gradually shifting the focus of students' education to the individualized development of students, the teaching of music courses in Colleges and universities in China began to reform in the direction of cultivating students' individuality. In teaching, teachers should adopt the teaching method of teaching students in accordance with their aptitude, adopt different educational methods according to the characteristics of different students, and formulate corresponding learning plans and contents for students to help students gradually improve their music professional level (Zhou Yaqing, 2016). General education is different from professional courses. There are no designated or fixed textbooks. Students come from different grades and majors, and their pre-knowledge level is uneven. At present, there are few general editions of textbooks in the market. The teachers of this course tailor-made the teaching content for the students according to the characteristics of students and the level of music knowledge. Music has the characteristics of the times, which requires that the curriculum content should be updated while maintaining the classicality. At the end of each semester, teachers can select music works which are both students' favorite and teaching value from the discussion and questionnaire results of students in the "Superstar" database, combined with the general courses of advanced universities abroad. The current edition of "Entering the Music World" is the content of the course, which is formulated by the teachers according to their own teaching experience of 20 years in ordinary colleges and universities through many surveys, to help students enter the music world smoothly in limited time.

### **3.2 The diversification of teaching interaction**

Interactive teaching mode is the basis of teaching students in accordance with their aptitude. Compared with traditional teaching mode, the main body of this mode changes into students, pays attention to students' feelings and thoughts, and realizes spiritual communication between teachers and students. Especially in the teaching of the abstract art of music, relying on traditional teaching methods is no longer suitable for the development of modern education, which has become a key factor affecting

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the improvement of the quality of music teaching in Colleges and universities. In addition, the improvement of students' cognitive ability and the maturity of their thinking at the university stage require the reform of teaching methods. The interactive teaching mode can close the relationship between teachers and students. The multiple and effective teaching interaction also directly determines the teaching effect and the achievement of teaching objectives, so as to make teaching activities more successful.

### 3.2.1 Quick check-in

We use two-dimensional code, gesture, positioning, photography and other check-in methods and can synchronously project the results on the big screen, which can be completed efficiently and interestingly in 3 minutes. We can also eliminate the phenomenon of substitution, record every check-in, and ensure the fairness and openness of check-in.

### 3.2.2 "Shake a shake" function

The head of the whole class is constantly changing and updated, and then stops at random. The students displayed on the screen participate in the interaction. This interaction starts with the teacher's questions, which can make the students highly focused, and the students reflect "like and stimulate" after class.

### 3.2.3 "Compensated rush answer"

When the teacher publishes the questions and initiates the rush answer, the students share their learning results through the rush answer, and at the same time get a certain score to refuel the usual results.

### 3.2.4 "Voting, Questionnaire"

Through these two interactions, each student can be given timely feedback, so that they know their own right and wrong, so as to guide them to find problems, and then stimulate their interest in solving problems. Teachers can also get accurate information synchronously to adjust the follow-up teaching content.

## 3.3 The initiative of participating in learning

We use the functions of "grouping tasks" and "scoring" (Table 2) to strengthen participatory learning.

**Table 2 Different Grouping and Evaluation Methods**

Grouping	Evaluation methods
Student Selective Grouping	Teacher Evaluation
Random grouping	Inter-group member review
Optional grouping	Other Group reviews

### 3.3.1 Group tasks of unity and cooperation

Teachers can set three modes: fixed grouping, random grouping and students' optional grouping

according to the course content before class. It breaks the traditional "no group" mode of choosing to study with specialty, classmates or acquaintances in dormitories, and is more conducive to students' thinking sparks when completing group tasks due to different disciplines and different ways of thinking. At the same time, it can also cultivate students' social ability, self-presentation ability and the ability of solidarity and cooperation. In group tasks, teachers can assign different roles to each student in each group, and they can also provide task menus for students to choose freely. This sub-tool and goal-oriented approach has successfully avoided the traditional classroom phenomenon of "most students are indifferent and the activists are always the ones".

### 3.3.2 Mutual learning and mutual evaluation between students and students

In traditional teaching, homework is checked by teachers, which is too heavy and inefficient to give timely feedback to students, and there is no communication channel between students. In addition to setting up "scoring function", we also have two "student assessment" modes, namely "student group members' mutual evaluation" and "inter-group members' mutual evaluation". Its advantage is that students' evaluation of others' homework is also a process of re-learning, followed by the process of students' mutual evaluation is also a process of mutual learning. Different majors, grades and individuals have different understanding, thinking and mastery abilities of the same knowledge point. When reviewing other people's homework, the advantages of their results can be used for reference to help self-learning, while the shortcomings can cause reflection and self-improvement. Through the above methods, students' active participation in learning has played a very good role in promoting.

## 4 Conclusion

Through nearly a year's operation, the online course "Entering the Music World" successfully combines online and offline teaching, and solves some problems in traditional teaching. The proposed method has certain practicality and generalization. It can improve the quality of teaching and teaching effect, expand the scope of teaching and the number of audiences. We know that students are the ultimate users of online courses. In the future work, we should make use of the functions and technologies of the Internet to give students more opportunities to participate in the optimization of curriculum design, curriculum feedback and other curriculum construction links, so that students can have a deeper understanding of the whole process of online courses, so that students can see the results of their own thinking in the course and feel the effect of their own learning. Only in this way can we more effectively stimulate students' enthusiasm for learning, enhance their awareness of curriculum participation, and become true supporters of online courses.

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## **Investigation and Research on Community Property Management: Take a Certain District in Wuhan as an Example**

Wei Minghua

Wuhan University of Technology, Wuhan, P.R.China, 430070

(E-mail: weiminghua@whut.edu.cn)

**Abstract:** By investigating the property management situation in a district of Wuhan, this paper evaluates the three aspects of community condition, residents' awareness and residents' behavior feedback. It finds that there are some problems in the community property management, such as infrastructure, fund utilization, government participation, etc. Finally, it analyses and summarizes the above problems and summarizes the construction of the property company's internal management system, property fund management, and so on. In terms of government responsibilities, it puts forward countermeasures and suggestions

**Key words:** Property; Estate Management; Community; Community Management;

### **1 Introduction**

Property management has always been an important issue in urban management. Overseas property management is relatively mature and has a long history of development. There are mainly ways of combining government as the main body, market as the main body and government market. There are many models that can be used for reference. For example, in Germany, property management companies with government holding are fully market-oriented in Britain. With the development of urbanization in China, the modernization of urban management and governance capacity has become an important symbol of the level of urban development (Liu Zhenping,2018). Property management, as a new form of urban management, has become an important part of the modernization of urban management and governance capacity. As a new type of service industry, property management has experienced the development from disorder to orderly and standardized form, and the degree of standardization of property management has been increasing. At present, China has promulgated many laws with property content, such as the Enterprise Law of the People's Republic of China and the Land Management Law of the People's Republic of China. These laws and regulations have laid a "three-subject" structure for property management owners, property service enterprises and administrative departments. The existence of these legal provisions has helped to maintain the management order of the property industry and construct a good industry environment. However, it is unavoidable that because these laws and regulations stipulate the responsibility subject and scope of authority of property management more dispersedly, and do not form a complete policy system, the urban property management lacks standards and institutional constraints, and the property management is out of order and unbalanced development. Many urban property management will become disordered, which will further give the social environment and self-reliance. However, the environment, population flow, transportation, public security, fire prevention, disaster prevention and other aspects bring hidden dangers(Zhang Hui,2019). At the same time, property management involves owners, property service enterprises and administrative departments. The status of these subjects leads to the heterogeneity of

Therefore, the purpose of this study is to find out the current situation and existing problems of property management in a district of Wuhan through a field survey of property management in a district of Wuhan, and explore effective countermeasures to further standardize and improve property management, to create an orderly and just environment for the growth of the entire property management industry and promote the sustainable and healthy development of the property management industry.

## 2 Research and Design

In view of the current situation of property management in a district of Wuhan, the investigation team investigates the property management situation in a district of Wuhan by sending 300 questionnaires to various communities, there were 227 valid questionnaires, and the validity rate was 75.67%. We collect the data from the questionnaire, use SPSS20.0 analysis software, and use descriptive analysis method to analyze the recovered data, evaluate the basic situation of property management in a district from three aspects: community condition, residents' consciousness and residents' behavior feedback. put forward relevant countermeasures and suggestions of strengthening and Improving the construction of property management in a district of Wuhan to the existing problems found in the questionnaire survey, and combined with the opinions of residents gathered through interviews.

## 3 Research findings

### 3.1 Basic information

#### 3.1.1 Identity of the respondents

In terms of the identity of the respondents in the sample, In this survey, 208 samples of owners and family members were selected, accounting for 91.63% of the total sample; 15 samples of tenants, accounting for 6.61% of the total sample; 4 samples of owners' committee members, accounting for 1.76% of the total sample; and 3 others, accounting for 1.32% of the total sample.

**Table 1 Identity of the Respondents**

Identity	Frequency	Percentage
Owners and family members	208	91.63%
Tenant	15	6.61%
Members of the owners' committee	4	1.76%
Others	3	1.32%
Total	227	100.00%



3.1.2 On-the-job status of respondents

From the on-the-job status of the respondents in the sample, 148 respondents were in the on-the-job status, accounting for 65.2% of the total sample; 23 respondents were out of work, accounting for 10.13% of the total sample; 56 respondents were retired, accounting for 24.67% of the total sample.

**Table 2 On-the-job Status of Respondents**

Status	Frequency	Percentage
On the job	148	65.20%
Out of work	23	10.13%
Retired	56	24.67%
Total	227	100.00%

3.1.3 Types of residential housing

According to the type of residential housing in the sample, there are 180 ordinary commercial housing, accounting for 79.3% of the total sample; 21 public houses, accounting for 9.25% of the total sample; 4 affordable houses, accounting for 1.76% of the total sample; 22 private houses, accounting for 9.69% of the total sample.

**Table 3 Types of Residential Housing**

Type	Frequency	Percentage
Commodity housing	180	79.30%
Public house	21	9.25%
Affordable housing	4	1.76%
Private house	22	9.69%
Total	227	100.00%

3.1.4 Residential property management model

According to the residential property management model in the sample, 11 respondents believed that their residential districts belonged to the owner's autonomous management model, accounting for 4.85% of the total sample; 165 respondents believed that their residential districts belonged to the Professional property company entanglement, accounting for 72.69% of the total sample; 28 respondents believed that their residential districts belonged to the community management mode, accounting for 12.33% of the total sample; and 2 surveys. Those who believe that the subordinate community belongs to the management mode of unit self-management, accounting for 0.88% of the total sample; the remaining 21 people think that the subordinate community belongs to the management mode of owner and community co-management, accounting for 9.25% of the total sample; no investigators choose that the subordinate community belongs to the management of commonweal property enterprise management.

**Table 4 Residential Property Management Model**

Model	Frequency	Percentage
Owner's autonomous management	11	4.85%
Professional property company management	165	72.69%
Community management	28	12.33%
Unit management	2	0.88%
Commonweal property enterprise management	0	0%
Co-management of Owners and Communities	21	9.25%
Total	227	100.00%

### 3.2 Internal management and facilities configuration in residential areas

#### 3.2.1 Problems in property management

From the perspective of the problems existing in the property management of residential areas in the sample, 89 respondents believed that their residential areas had the problem of illegal construction, accounting for 39.21% of the total sample; 94 respondents believed that their residential areas had the problem of noise, lampblack disturbing the people, accounting for 41.41% of the total sample; 59 respondents believed that their residential areas had the problem of vegetable and chicken raising, accounting for 25.99% of the total sample; Investigators believed that there were problems of "drilling holes through walls" and "digging three feet" in the community, accounting for 23.35% of the total sample; 53 respondents believed that there were problems of capsule houses in the community, accounting for 32.16% of the total sample; 128 respondents believed that there were problems of hidden dangers of dogs in the community, accounting for 56.39% of the total sample; 150 respondents believed that the community had problems of stacking debris in the corridor. Questions accounted for 66.08% of the total sample; 123 respondents believed that their community had the problem of running training courses, accounting for 54.19% of the total sample; 71 respondents believed that their community had the problem of cutting down trees and occupying green space without authorization, accounting for 31.28% of the total sample.

**Table 5 Problems in Property Management**

Problem	Frequency	Percentage
Illegal construction	89	39.21%
Noise and lampblack disturb the people	94	41.41%
Vegetable and chicken raising	59	25.99%
"Drilling holes through walls" and "digging three feet"	53	23.35%

Capsule room	73	32.16%
Hidden dangers of dogs	128	56.39%
Stack debris in the corridor	150	66.08%
Running training courses	123	54.19%
Cutting down trees and occupying green space without authorization	71	31.28%
Total	840	370.06%

### 3.2.2 Garbage disposal condition

When investigating the condition of garbage disposal situation in residential areas, 57 people (25.11%) chose to dispose garbage not timely, 58 people (25.55%) chose to dispose garbage not always timely, 91 people (40.09%) chose to dispose garbage more timely, and only 21 people (9.25%) chose to dispose garbage very timely.

**Table 6 Garbage Disposal Situation**

Condition	Frequency	Percentage
Dispose garbage not timely	57	25.11%
Dispose garbage not always timely	58	25.55%
Dispose garbage more timely,	91	40.09%
Dispose garbage very timely	21	9.25%
Total	227	100.00%

### 3.2.3 Intact condition of camera in residential area

In the survey of the Intact condition of camera in residential area, 51 people were found that all cameras were in good condition, accounting for 22.47% of the total number; 95 people were found that some cameras can be used normally, accounting for 41.85% of the total number; 81 people were found that all cameras cannot be used properly, accounting for 35.68% of the total number.

**Table 7 Intact Condition of Camera in Residential Area**

Condition	Frequency	Percentage
All cameras were in good condition	51	22.47%
Some cameras can be used normally	95	41.85%
All cameras cannot be used	81	35.68%

Total	227	100.00%
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### 3.2.4 Treatment condition of security incidents

According to the data statistics of community security incidents, 22 people in the survey sample think that the security incidents are handled very timely, accounting for 9.69% of the total sample; 84 people think that security incidents are handled more timely, accounting for 37.00% of the total sample; 61 people think that security incidents are handled not always timely, accounting for 26.87% of the total sample; the remaining 60 people think that security incidents are handled not in time, accounting for 26.43%.

**Table 8 Treatment Condition of Security Incidents**

Condition	Frequency	Percentage
Very timely	22	9.69%
More timely	84	37.00%
Not always timely	61	26.87%
Not in time	60	26.43%
Total	227	100.00%

### 3.2.5 Elevator equipment condition

When investigating the elevator equipment of the unit building where the respondents live, 23 people chose the elevator to be able to use normally, accounting for 10.13% of the total sample number; 48 people chose the elevator to have occasional faults, accounting for 21.15% of the total sample number; 86 people chose the elevator to have frequent faults, accounting for 37.89% of the total sample number; two people chose the elevator to be damaged and unable to use. It accounted for 0.88% of the total sample number, and the remaining 68 people chose no elevator, accounting for 29.96% of the total sample number.

**Table 9 Elevator Equipment Condition**

Condition	Frequency	Percentage
Be able to use normally	23	10.13%
Have occasional faults	48	21.15%
Have frequent faults	86	37.89%
Elevator to be damaged and unable to use	2	0.88%
No elevator	68	29.96%

Total	227	100.00%
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### 3.2.6 Firefighting equipment condition

According to the investigation of firefighting equipment in residential area, 136 firefighting equipment can be used normally, accounting for 59.91%; 91 damaged equipment cannot be used normally, accounting for 40.09%.

**Table 10 Firefighting Equipment Condition**

Condition	Frequency	Percentage
Can be used normally	136	59.91%
Cannot be used normally	91	40.09%
Total	227	100.00%

### 3.2.7 Parking environment in residential area

When investigating the parking environment in residential areas, 6 respondents reported that parking spaces were adequate, accounting for 2.64%; 46 respondents reported that parking spaces were basically adequate, accounting for 20.26%; 175 respondents reported that parking spaces were too few, accounting for 77.09%.

**Table 11 Parking Environment**

Condition	Frequency	Percentage
Adequate	6	2.64%
Basically adequate	46	20.26%
Too few parking spaces	175	77.09%
Total	227	100.00%

### 3.2.8 Are there any illegal charges for property management fees?

In order to know whether the respondents think that there are illegal charges for community property management fees, 67 people think that this situation exists, accounting for 29.52%; 160 people think that there is no such situation, accounting for 70.48%.

**Table 12 Are There Any Illegal Charges for Property Management Fees?**

Condition	Frequency	Percentage
Yes	67	29.52%
No	160	70.48%
Total	227	100.00%

### 3.2.9 Are residents clear about community maintenance funds

By investigating whether residents are clear about the community maintenance fund, we can see that 15 people are very clear about the community maintenance fund, accounting for 6.61%; 82 people are not very clear about the community maintenance fund, accounting for 36.12%; 130 people are completely unaware of the community maintenance fund, accounting for 57.27%.

**Table 13 Are Residents Clear About Community Maintenance Funds?**

Condition	Frequency	Percentage
Very clear	15	6.61%
Not very clear	82	36.12%
Completely unaware	130	57.27%
Total	227	100.00%

### 3.2.10 Equipment condition of public leisure and entertainment facilities in residential areas

According to the survey on the allocation of public leisure and entertainment facilities in residential districts, 182 respondents reported that their residential districts had public leisure and entertainment facilities, accounting for 80.18%; 45 respondents reported that their residential districts did not have public leisure and entertainment facilities, accounting for 19.82%.

**Table 14 Equipment Condition of Public Leisure and Entertainment Facilities**

Condition	Frequency	Percentage
Yes	182	80.18%
No	45	19.82%
Total	227	100.00%

### 3.2.11 Maintenance condition of public leisure and entertainment facilities in residential areas after damage

According to the survey, 95 respondents reported that public leisure and entertainment facilities were not repaired after being damaged, accounting for 41.85%. The remaining 132 respondents reported that public leisure and entertainment facilities could be repaired after being damaged, accounting for 58.15%.

**Table 15 Maintenance Condition of Public Leisure and Entertainment Facilities After Damage**

Condition	Frequency	Percentage
Yes	95	41.85%
No	132	58.15%
Total	227	100.00%

A total of 149 respondents, 65.64% of them, reported that the owners' committee had been set up in their residential districts. A total of 78 respondents, 34.36%, reported that the owners' committee had not been set up in their residential districts.

**Table 16 Establishment of Community Owners' Committee**

Condition	Frequency	Percentage
Yes	149	65.64%
No	78	34.36%
Total	227	100.00%

### 3.2.13 Disposal condition of violations in residential areas after reported

According to the survey data, after the report, whether the illegal behavior of the community has been dealt with, 54 investigators think that the illegal behavior of the community has been solved, accounting for 23.79% of the total sample data; 23 investigators think that the illegal behavior of the community has only been investigated, but not dealt with, accounting for 10.13% of the total sample data; 61 investigators think that the illegal behavior of the community has been solved but the results were not good, accounting for 26.87% of the total sample data; 89 investigators believed that although the illegal and irregular acts in the community reflected, they were completely unmanaged, accounting for 39.21% of the total sample data.

**Table 17 Disposal Condition of Violations in Residential Areas After Reported**

Condition	Frequency	Percentage
Solved	54	23.79%
Only investigate, but not disposal	23	10.13%
Disposal ineffectual	61	26.87%
Reflected but unmanaged	89	39.21%
Total	227	100.00%

## 3.3 Survey of Residents' Consciousness

### 3.3.1 Residents' understanding of residential property management

When investigating residents' understanding of community property management, there are 60 people who choose property management as a matter of property company, accounting for 26.43% of the total sample; 145 people who choose property management involves the comprehensive management of multiple government departments, accounting for 63.88% of the total sample; 128 people who choose Owners should consciously fulfill their obligations in community management, accounting for 59.39% of the total sample; The number of people that choose establishment of Owner's Committee for

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 coordination and management is 150, accounting for 66.08% of the total sample.

**Table 18 Residents' Understanding of Residential Property Management**

Condition	Frequency	Percentage
Property management is the business of property companies	60	26.43%
Property management involves the comprehensive management of multiple government departments	145	63.88%
Owners should consciously fulfill their obligations in community management	128	59.39%
Establishment of Owner's Committee for coordination and management	150	66.08%
Total	483	215.78%

### 3.3.2 Residents' understanding degrees of the responsibilities and division of labor of relevant administrative departments in community management

When investigating the residents' understanding of the responsibilities and division of labor of the relevant administrative departments in community management, 9 people who choose very familiar with it, accounting for 3.96% of the total sample, 24 people who choose more familiar with it, accounting for 10.57% of the total sample, 66 people who choose have some understanding for it, accounting for 29.07% of the total sample, and 91 people, who did not know something, it accounted for 40.09% of the total sample, and 37 people, or 16.30% of the total sample, chose to know nothing about it.

**Table 19 Residents' Understanding of the Responsibilities and Division of Labor of Relevant Administrative Departments in Community Management**

Degree	Frequency	Percentage
Very familiar with	9	3.96%
More familiar with	24	10.57%
Have some understanding	66	29.07%
Don't know something	91	40.09%
Know nothing	37	16.30%
Total	227	100.00%

### 3.3.3 The content need to be strengthened by the government management in property management

When investigating the content need to be strengthened by the government management in property management, there are 104 people who choose the comprehensive management of residential districts by government departments, accounting for 45.81% of the total sample; 133 people who choose the timely handling of complaints in residential districts, accounting for 58.59% of the total sample; 80



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 people who choose the supervision of property service enterprises, accounting for 35.24% of the total sample; 43 people who choose to solve public service problems such as water, electricity and gas in residential districts, accounting for 18.94% of the total sample; 53 people choose the supervision by the owner's committee, accounting for 23.35% of the total sample.

**Table 20 The Content Need to Be Strengthened by the Government Management in Property Management**

Degree	Frequency	Percentage
Comprehensive management of residential districts by government departments	104	45.81%
Timely handling of complaints in residential districts	133	58.59%
Supervision of property service enterprises	80	35.24%
Solve public service problems such as water, electricity and gas in residential districts	43	18.94%
Supervision by the owner's committee	53	23.35%
Total	413	181.93%

### 3.3.4 Attitudes towards the establishment of owners' committees in residential areas

From the survey sample, 171 survey samples showed that it was necessary to set up the owner committee, accounting for 75.33% of the total sample; 42 samples showed that the owner committee was none essential, accounting for 18.50% of the total sample; 14 samples showed that the establishment of the owner committee was unnecessary, accounting for 6.17% of the total sample.

**Table 21 Attitudes Towards the Establishment of Owners' Committees in Residential Areas**

Attitude	Frequency	Percentage
Necessary	171	75.33%
None essential	42	18.5%
Unnecessary	14	6.17%
Total	227	100.00%

### 3.3.5 Whether the owners' reasonable opinions can be rectified by reflecting them to the owners' committee?

According to the survey sample, we know whether the owners think their reasonable opinions can be rectified by reflecting them to the owner's committee. Only 7 sample data show that all opinions can be rectified, accounting for 3.08% of the total sample; 30 sample data show that most opinions can be rectified, accounting for 13.22% of the total sample; 63 sample data show that partial opinions can be

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 rectified, accounting for 27.75% of the total sample; but 127 sample numbers show that rare opinions  
 can be rectified, accounting for 55.95% of the total sample.

**Table 22 Whether the Owners' Reasonable Opinions can be Rectified**

Attitude	Frequency	Percentage
All can	7	3.08%
Most can	30	13.22%
Partial can	63	27.75%
Rare can	127	55.95%
Total	227	100.00%

### 3.3.6 The enthusiasm of participating in property management affairs of residential districts and performing the duties of owners

In terms of personal participation in community property management affairs and the enthusiasm of the owners to perform their duties, 83 respondents chose high enthusiasm, accounting for 36.56% of the total sample data; 74 respondents chose general enthusiasm, accounting for 32.60% of the total sample data; 70 respondents chose low enthusiasm, accounting for 30.84% of the total sample data.

**Table 23 The Enthusiasm of Participating in Property Management Affairs of Residential Districts and Performing The Duties of Owners**

Condition	Frequency	Percentage
High enthusiasm	83	36.56%
General enthusiasm	74	32.60%
Low enthusiasm	70	30.84%
Total	227	100.00%

### 3.3.7 The ways residents take when problems occur in the community

According to the survey data, 103 respondents chose to consult with the parties when problems occurred, accounting for 45.37% of the total sample data; 150 respondents chose to report to property companies, accounting for 66.08% of the total sample data; 46 respondents chose to report to the owners' committee, accounting for 20.26% of the total sample data; 70 respondents chose to report to the street communities, accounting for 30.84% of the total sample data; 55 respondents chose to report to the relevant government authorities, accounting for 24.23% of the total sample data; 101 respondents chose to make complaints call, accounting for 44.49% of the total sample data; 18 respondents chose to ignore, accounting for 7.93% of the total sample data.

**Table 24 The Ways Residents Take When Problems Occur in the Community**

Behavior mode	Frequency	Percentage
Consult with the parties	103	45.37%
Report to property companies	150	66.08%
Report to the owners' committee	46	20.26%
Report to the street communities	70	30.84%
Report to the relevant government authorities	55	24.23%
Make complaints call	101	44.49%
Ignore	18	7.93%
Total	543	293.20%

#### 4 Problem Analysis

Through the above investigation, we can find that there are many problems in community management of a district in Wuhan, and there are urgent improvements in infrastructure and environmental management, capital operation, government participation and so on.

Firstly, there are some problems in facility and environmental management of residential quarters. Installation of facilities and equipment is imperfect, the environmental situation of residential quarters is more complex and serious, and the related management is disordered. The incompleteness of community facilities brings great security risks to residents' lives, which is not conducive to providing residents with a good living environment. Failure to repair the equipment in time also greatly reduces the convenience of residents' lives. Property management in the installation and maintenance of various facilities is absent, and does not perform its responsibilities well. In addition, there are not in a minority phenomenon such as illegal building, piling up debris and running remedial classes in the residential environment. The property responsible party has not effectively supervised and managed this phenomenon, which makes the residential environment chaotic frequently.

Secondly, the related fund management is disorderly. The use of property-related funds in residential areas has not been open and transparent. Residents have no channels to supervise the flow and use of property funds and cannot guarantee the fairness and fairness of the use of funds. As a result, many community problems cannot be really solved, it also reduces the initiative of residents to participate in community affairs to a certain extent, and it causes the community to fall into a vicious circle of stagnation.

Finally, the responsibility of community property management is relatively single. The government's participation in community property management is too low. Property is fully responsible by professional property companies. The owners who have problems can only negotiate with property companies. The process of property management lacks the effective supervision and regulation of the government, which cannot guarantee the effective solution of the problem. Residents' demands to

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property companies are often neglected, and the problem has not been solved for a long time. In the long run, there have been serious problems in community management, environment and other aspects. Property companies cannot fulfill their corresponding responsibilities, and there may be a phenomenon of freepading.

## 5 Conclusion

In view of the existing problems of property management in a district, we put forward the following suggestions:

Firstly, in view of the management problems such as incomplete infrastructure and absence of environmental management in residential districts, On the one hand, we should rectify the internal management system of property companies, urge the responsible companies to rectify the chaos in the community, establish a long-term return visit supervision organization, and form an effective management mechanism. On the other hand, we should strengthen publicity and education among the residents of the community, establish the residents' awareness of rules, consciously restrain their own behavior, and build a civilized and harmonious community.

Secondly, the government, property companies and owners should jointly establish a fund management supervision mechanism to solve the problem of non-public and non-transparent property fund management. The government should fulfil its duty of supervision and examination and protect the rights and interests of owners as consumers, Property companies should consciously and regularly disclose the use of funds, self-check and self-clean, and eliminate the possibility of embezzlement of management funds from the root. Owners should also actively safeguard their own rights and interests, actively participate in the supervision mechanism, timely raise doubts about the use of property funds in residential areas, and effectively improve the efficiency of the use of property management funds.

Finally, aiming at the absence of government in property management, the government should strengthen supervision, conduct periodic return visits and inspections of community property management, urge property companies to perform their duties, safeguard the legitimate rights and interests of both owners and property companies, implement diversification of property management subjects, break the original single pattern, promote information flow and problem solving, and effectively guarantee the effectiveness of property management and the improvement of property management level.

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## **Research on the Entrepreneurship Intentions for Undergraduates in the background of “Mass Entrepreneurship and Innovation”**

Liu Jia<sup>1</sup>, Li Kai<sup>2</sup>

1 School of Business, Wuhan Huaxia University of Technology, Wuhan, P.R. China, 430070

2 School of Innovation, Wuhan Huaxia University of Technology, Wuhan, P.R. China, 430070

(E-mail: 14110689@qq.com, likaikai28@163.com)

**Abstract:** As the undergraduates increasing, employment is a problem which the government and universities have to face to. This article adopts the questionnaire survey, with TPB theoretical basis, constructing entrepreneurship intentions influence factor mode, data analysis by SPSS, to discuss on the influence relationship between Entrepreneurship Policy, Entrepreneurship Education and TPB variable. The results of the study showed that entrepreneurship education through the perceived behavior control has a positive impact on the entrepreneurial intention of college students, entrepreneurship policy has a positive impact on the entrepreneurial intention of college students through entrepreneurial attitude, subjective norm effect on entrepreneurial intention is not significant. Entrepreneurial attitude and perceived behavioral control play an intermediary role in this process. As a conclusion, it can promote the entrepreneurship intentions with perfect policies and optimize entrepreneurship education.

**Keywords:** Entrepreneurship intention; Entrepreneurship policy; Entrepreneurship education; TPB variable

### **1 Introduction**

The employment problem is always a hot concern by the government and society. As the data from the National Statistical Bureau show, the undergraduates is up to 8.6 million in the year of 2019, plus with the unemployed all previous undergraduate, the pressure for jobs is really great. With the big number of undergraduate and limited market demand, the government needs to provide more positions in many ways. Especially for “Mass Entrepreneurship and Innovation” was issued by the Prime Minister Li Keqiang from “Government Work Report in 2015”, governments at all levels and universities are trying to implement related entrepreneurship education and services, to guide the undergraduates do a good job on innovation and entrepreneurship. However, the entrepreneurship rate is around 2.5%, the low rate and big amount of undergraduates are really out of proportion. Therefore, it is necessary to analysis on the reason for low rate and research on the influence factors for the undergraduates’ entrepreneurship intentions, which is the hot issue concerned by the society, universities and undergraduates.

After reviewing the relationship between entrepreneurship education and entrepreneurial will, Zhang Xiue found: Entrepreneurship education plays an important role in promoting the promotion of entrepreneurial willingness: Firstly, the learning of the basic knowledge of entrepreneurship education can enhance the entrepreneurial awareness of entrepreneurs and awaken entrepreneurial awareness; Secondly, practical teaching with more operational can enhance entrepreneurial skills and capabilities (Ajzen I. Attitudes, 2017). Also, Shi Qiaojun did research with the sample data of the Hunan’s university,

found that: Improving the establishment of an entrepreneurial education system has a significant positive impact on improving the entrepreneurial will. Xiao Xiao found that: A comprehensive entrepreneurial policy system plays an important role in satisfying the policy needs of college entrepreneurs and improving their entrepreneurial attitudes and entrepreneurial willingness. Drucker thought entrepreneurship could be learned by Entrepreneurship Education, such as positive entrepreneurial attitude, control and subjective norms. And these characteristic advantages are crucial for entrepreneurs to engage in entrepreneurial activities (Wang Kai,2018). Stevenson thought entrepreneurial policies are often designed from the perspectives of entrepreneurial motivation, entrepreneurial skills, and entrepreneurial opportunities. The main purpose of the entrepreneurial policy is to stimulate entrepreneurs' entrepreneurial enthusiasm, help entrepreneurs master the skills and knowledge necessary for entrepreneurship, and provide a stable entrepreneurial environment for potential entrepreneurs.

## 2 Research Content and Method

It researches on the influence on the undergraduates' entrepreneurship intentions by entrepreneurship education and policies with the background of "Mass Entrepreneurship and Innovation". It analysis on the most direct influence variable factor for the undergraduates' entrepreneurship intentions, on the basis of theory carding and "Mass Entrepreneurship and Innovation", with subjective norm, entrepreneurship attitude and perceived behavioral control. It builds a perfect and advanced influence factors mode on undergraduates' entrepreneurship intentions, which chooses the planned behavior theory as the prototype pattern, and introduces entrepreneurship policies and education as the external factors. It takes the questionnaires to choose the undergraduates from 5 universities in Hubei province as respondents. 467 backed questionnaires from 500, while 18 valid ones, and the effective questionnaires rate is 89.8%. The questionnaires center on the three measurements of entrepreneurship policies, education and attitude, and also the TPB variable (entrepreneurship attitude, perceived behavioral control, subjective norm), verified by SPSS19.0 data processing tool, and finally to provide proper suggestions for promoting the undergraduates' entrepreneurship intentions and amounts. (As the Table 1-6)

**Table 1 Entrepreneurship Policies Measurement**

Variable	No.	Item
Entrepreneurship Policy	A1	Entrepreneurship education
	A2	Soft loan
	A3	Industrial and commercial breaks
	A4	Tax reduction and exemption
	A5	Site expenses reduction and exemption
	A6	Venture capital funding project

**Table 2 Entrepreneurship Education Measurement**

Variable	No.	Item
Entrepreneurship Education	B1	Enough courses and projects in the university.
	B2	The University invites outstanding entrepreneurs for lecturing frequently.
	B3	The University holds entrepreneurial design competitions frequently.
	B4	The University organizes the students to take part in entrepreneurship training.
	B5	There are perfect entrepreneurship facilities and bases in the university.

**Table 3 Entrepreneurship Attitude Measurement**

Variable	No.	Item
Entrepreneurship Attitude	C1	To prove our own thoughts
	C2	For self-challenge
	C3	For personal success
	C4	For personal independence
	C5	For reputation
	C6	For public recognition
	C7	For money and treasure
	C8	Make contribution to society
	C9	Make contribution to the national's development

**Table 4 Perceived Behavioral Control Measurement**

Variable	No.	Item
Perceived Behavioral Control	D1	I am innovative.
	D2	I can solve problems calmly.
	D3	I think the chances exist everywhere.
	D4	I can make use of many resources.
	D5	I can solve all the problems if I try my best.



**Table 5 Subjective Norm Measurement**

Variable	No.	Item
Subjective Norm	E1	My relatives have successful business.
	E2	My parents support me to start a business if conditions obtained.
	E3	My friends support me to start a business if conditions obtained.
	E4	The local culture encourages people to gain business success very much.

**Table 6 Entrepreneurship Intentions Measurement**

Variable	No.	Item
Entrepreneurship Intentions	Y1	I think I will be self-employed in the future.
	Y2	I will choose to self-employment if I meet practical difficulties.
	Y3	I think I will be self-employed within 5 years in all probability.
	Y4	I was thinking to run a business by myself.

The questionnaires adopts Lickrt five-point scale. (1=Totally Not,2=Not,3=Uncertainty ,4=Yes,5=Totally Yes)

### 3 Results

#### 3.1 Analysis on the control factor influence on the variable factors with the single factor analysis method.

Choosing and grouping the individual variable factor, analysis on if the respondents ideas of entrepreneurship education, policies, TPB variable and intentions are changed with the influence by different control variable. The conclusion is as following:

- (1) Sex differences have no prominent influence on the entrepreneurship intentions.
- (2) Major differences have no prominent influence on the entrepreneurship intentions.

#### 3.2 To verify the variable correlation, and the inclusion is as following:

(1) Between the independent variable and dependent variable, the entrepreneurship education and policies have prominent influence on entrepreneurship intentions.

(2) Between the independent variable and agent variable, the entrepreneurship education, policies and TPB have prominent influence with each other.

(3) Between the agent variable and dependent variable, the TPB and entrepreneurship intentions have prominent influence with each other.

### 3.3 Analysis of regression by SPSS19.0

Analysis on the relationship between entrepreneurship education, policies and intentions; the relationship between entrepreneurship education, policies and attitude; the relationship between entrepreneurship education, policies and subjective norm; the relationship between entrepreneurship education, policies and perceived behavioral control; the relationship between TPB variable, entrepreneurship intentions and the agent function of TPB variable. (The Analysis Results As the Table 7-10)

**Table 7 The Regression Analysis of Entrepreneurship Policy and Education for Entrepreneurship Intentions**

Dependent variable: Entrepreneurship Intentions		
	Model 1	Model 2
Control variable		
Sex	0.391***	0.378**
Age	0.080	0.120
Major	0.012	0.024
Independent variable		
Entrepreneurship Policy		0.139**
Entrepreneurship Education		0.276**
R-square	0.193	0.255
Adjusted R-square	0.172	0.222
F-Measure	9.099***	17.668***

Note: \*\*\*/\*\*/\* Distinguish Represents Significant Level at 0.05/0.01/0.001

**Table 8 The Regression Analysis of Entrepreneurship Policy and Education for Entrepreneurship Attitude**

Dependent variable: Entrepreneurship Attitude		
	Model 1	Model 2
Control variable		
Sex	0.354***	0.178

Age	-0.017	-0.123
Major	0.176	-0.059
Independent variable		
Entrepreneurship Policy		0.374*
Entrepreneurship Education		0.216**
R-square	0.214	0.280
Adjusted R-square	0.194	0.248
F-Measure	10.357***	18.726***

Note: \*/\*\*/\*\* Distinguish Represents Significant Level at 0.05/0.01/0.001

**Table 9 The Regression Analysis of Entrepreneurship Policy and Education for Subjective Norm**

Dependent variable: Subjective Norm		
	Model 1	Model 2
Control variable		
Sex	0.379***	0.296*
Age	0.003	-0.001
Major	0.002	-0.081
Independent variable		
Entrepreneurship Policy		0.219*
Entrepreneurship Education		0.348***
R-square	0.146	0.251
Adjusted R-square	0.123	0.217
F-Measure	6.481***	17.494***

Note: \*/\*\*/\*\* Distinguish Represents Significant Level at 0.05/0.01/0.001

**Table 10 The Regression Analysis of Entrepreneurship Policy and Education**

**For Perceived Behavioral Control**

Dependent variable: Perceived Behavioral Control		
	Model 1	Model 2

Control variable		
Sex	0.379***	0.296*
Age	0.003	-0.001
Major	0.002	-0.081
Independent variable		
Entrepreneurship Policy		0.219*
Entrepreneurship Education		0.348***
R-square	0.146	0.251
Adjusted R-square	0.123	0.217
F-Measure	6.481***	17.494***

Note: \*/\*\*/\*\* Distinguish Represents Significant Level at 0.05/0.01/0.001

With the Results above, the inclusion is as following:

- (1) Entrepreneurship education and policies have positive influence on entrepreneurship intentions.
- (2) Entrepreneurship education and policies have positive influence on entrepreneurship attitude.
- (3) Entrepreneurship education and policies have positive influence on entrepreneurship subjective norm.
- (4) Entrepreneurship education and policies have positive influence on entrepreneurship perceived behavioral control.

## 4 Conclusion

### 4.1 Make a conclusion for the questionnaires and verifying

4.1.1 Entrepreneurship policies have prominent influence on the undergraduates' intentions. The better of the policies, and the stronger of the intentions.

The data analysis shows, the perfect policies are helpful for the intentions' strengthening. Now many university carry out the national policies to support the undergraduates to self-employed, such as temporally leaving, special funding project, provide business start-up spaces in campus. Etc., which can encourage them for entrepreneurship. (Guo Xin,2018).

4.1.2 Entrepreneurship education has prominent influence on the undergraduates' intentions.

*Entrepreneurship Education* becomes a required course in most universities, and more and more students' entrepreneurship intentions are promoting. The university is trying to improve the course, while the government invites outstanding entrepreneurs to communicate with the undergraduates.

The research shows that the entrepreneurship education cannot influence the intentions directly, but in the agent variable way. Therefore, we need help the undergraduates to set up positive attitude, better subjective norm and strengthen perceived behavioral control and finally to promote their entrepreneurship intentions.

4.1.4 TPB variable plays the agent function between entrepreneurship policies and intentions.

The government and universities issue many support policies can relieve the pressure of fund and site. The key is that the undergraduates can feel the good atmosphere for entrepreneurship, and then help them to confirm their intentions (Armitage CJ,2016). Through the entrepreneurship competitions, it helps them to get better attitude and strong abilities of perceived behavioral control, and stimulate their passion and initiative for entrepreneurship (Xu Jialun,2017).

## **4.2 Suggestions**

4.2.1 Entrepreneurship policies system needs constant innovation.

It shows the big problem that the undergraduate facing to is funds shortage, which is very important for the entrepreneurship beginning period. However, the fund support from the university is always very limited. It is an urgent problem to be solved. The government needs to cooperate with the universities to issue convenient policies to help undergraduates (Li Chao,2017). For examples, the government can work with banks to simplify the loan procedures, introduce the risk evaluation mechanism, maximum the loan line of limit or lower the lending rates for projects with better rate of return. The universities can hold more competitions to attract social capitals, and select good project to be invested and incubated before it goes to the society. Government, university and society work together to solve the big problem at the beginning of entrepreneurship, and help the undergraduates increase the entrepreneurship rate (Evans.Lee,2017).

4.2.2 The contents and forms of *Entrepreneurship Education* need constant innovation.

The course of *Entrepreneurship Education* is always short and theoretic, which is difficult to attract the interests of the undergraduates (Ai D F,2017). It's necessary to introduce Internet platform, set up micro class and Massive Open Online Courses to enrich the course contents; invite experts for lecturing; bring the undergraduates to innovate companies for visiting and learning; make a reformation of innovation evaluation system and encourage them work together to finish the business report(Wang Benxian,2017). Through the evaluation on process and result of entrepreneurship education, it can strengthen the intentions.

4.2.3 Entrepreneurship education advertising needs to be concerned.

It needs to create a good atmosphere in the society and university for entrepreneurship education. The undergraduates are young, who are acceptable for all kinds of new knowledge and have lots of new ideas with entrepreneurship. Otherwise, the economy pressure and influence from surroundings will be obstructive factors for their entrepreneurship intentions (Mao Yu,2019). The subjective norm can be increased and the intentions can be strengthened only if there is an entrepreneurship trend of thought in the whole society with entrepreneurship education advertising.

## **4.3 Research outlook**

4.3.1 Expand the number of samples and region

At the beginning of the questionnaire, only five high schools in Hubei Province were selected, it's existed a lack of persuasiveness reflected in the results of the questionnaire. So, we will increase the number of institutions and questionnaires issued, with improving the reliability and validity of the questionnaire, we will also improve quality of the questionnaire for Ensure that the results of the later investigations could be more accurately reflect the actual situation.

#### 4.3.2 Correct and rebuild a more scientific theoretical model

This study only considers the impact of entrepreneurship education and entrepreneurship policies on entrepreneurial willingness. In the future we will consider introducing more variables for exploring the effect of new variables on college students' entrepreneurial will, the theoretical model also needs to be further combined with the situation in Hubei Province, especially Wuhan City. And enhancing the applicability of the model. In order to ensure the results can be more effective in guiding practice.

#### 4.3.3 Dynamic attention to the follow-up development of entrepreneurial college students

At present, the research on college students' entrepreneurial behavior focuses more on a certain time node of their entrepreneurship, but there are not many longitudinal studies on entrepreneurial behaviors of entrepreneurial college students. This study will also focus more on the research of entrepreneurial college students in future. Through the future tracking research, it's could be better understand the actual development of the entrepreneurial process, especially the later development direction. Through the results of the continuous research, the university has improved the entrepreneurial education, and the social related departments have obvious practical significance.

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# **Inheritance and Innovation, Adjustment and Accumulation: On the Modernization Thinking of Chinese Traditional Culture from the Development of the Cultural and Creative Industry of the Forbidden City**

Zhu Meifan, Ai Wenjing

School of Marxism, Wuhan University of Technology, Wuhan, P.R. China, 430070

(E-mail: 975212912@qq.com, 1043737405@qq.com)

**Abstract:** General Secretary Xi Jinping put forward in the report of the Nineteenth National Congress a new era topic of creative transformation and innovative development of Chinese traditional culture, which put forward higher requirements for the modernization of Chinese traditional culture. The modernization of traditional culture has always been an important part of building a socialist modernization country in an all-round way, but in the process of modernization, cultural modernization, especially the modernization of traditional Chinese culture, has been shackled. Cultural industry, especially cultural creative industry, is an important model for the development of cultural modernization. Its development course provides an important experience for the modernization of Chinese traditional culture. Starting from the symbol cultural creative industry of the Palace Museum, this paper analyses the process of innovative development and creative transformation of Chinese traditional culture, focusing on the realistic dilemma of Chinese traditional culture. What is it, how to develop the modernization of Chinese traditional culture and how to guarantee the modernization of Chinese traditional culture are discussed in order to promote the modernization of Chinese traditional culture.

**Key words:** Inherit; Innovate; Chinese traditional culture; Modernization; Cultural Creation of the Palace Museum

## **1 Introduction**

The report of the 19th National Congress clearly pointed out: "The overall task of the socialist ideology with Chinese characteristics in the new era is to realize socialist modernization and the great rejuvenation of the Chinese nation." (Xi Jinping, 2017) China's excellent traditional culture is an uninterrupted cultural heritage, which shines with the wisdom of the Chinese people of all nationalities, also highlights the great innovation and creativity of the Chinese nation. The modernization of China's excellent traditional culture is also an important means of inheriting innovation and promoting Chinese traditional culture and enhancing the overall strength of culture. It is an important part of the great rejuvenation of the Chinese nation. As the largest museum of ancient culture and art in the world, the Palace Museum is the main carrier of the development of Chinese excellent traditional culture and an important window for Chinese traditional culture to go global. In recent years, the cultural and creative industries led by the Forbidden City have developed rapidly, breaking through one billion turnover in a very short period of time, and making the "Forbidden City Cultural Creation" a well-known brand. Its rapid development not only represents the vigour and vitality of Chinese traditional culture, but also provides a creative development path for the modern Chinese traditional culture to modernize.

This paper takes the Chinese Journal Full-text Database (CNKI) as a sample, and searches for 917



Proceedings of the 16th International Conference on Innovation & Management - 1697 - documents with the theme of “Chinese Traditional Culture Modernization”. A total of 6457 documents (as shown in Figure 1) are searched for “Cultural Creative Products”. It is from the field of modernization of Chinese traditional culture or cultural and creative products as research objects. The academic research has been very thorough, but the number of documents searched for common themes by “Chinese traditional culture” and “cultural creative products” is only 117. The result of this comparison is very unexpected. Through the analysis of these 117 documents, it can be seen from the research level (Figure 2) that the proportion of basic research (social science) and industry guidance (social science) is higher among the two subjects, but Less in policy research and basic applications. For example, Zhang Jing's "Sinicization of Marxism and Cultural Modernization of China" in Nankai University, through reviewing and comparing the development process of Chinese cultural modernization, deeply shows the relationship between Marxism and Chinese excellent culture and foreign culture in the process of Chinese cultural modernization. It holds that the modernization of Chinese culture can not be separated from the critical inheritance and innovation of Chinese traditional culture and foreign culture, which requires both national characteristics and world vision(Zhang Jing,2012).Fu Yan of Tianjin Normal University, in her book *The Application of Chinese Traditional Culture in the Process of Socialist Modernization*, believes that from the contemporary perspective, Chinese traditional culture can not directly lead to modernization, but China's modernization can not be separated from the modernization of traditional culture. The evolution of Chinese traditional culture since modern times tells us that the present of culture Modernization must be based on the modernization of economy. The relationship between them is dialectical unity (Fu Yan,2012).

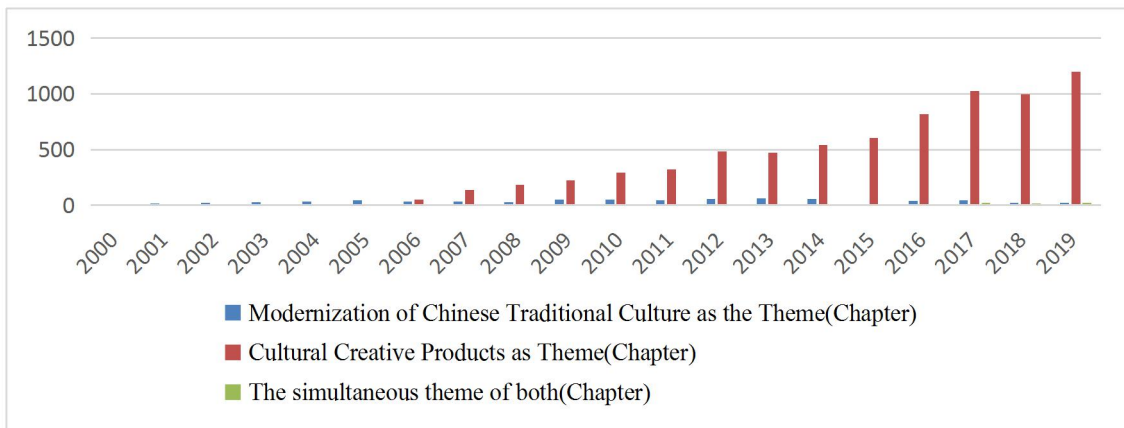


Figure 1 Overall Trend Analysis Chart of CNKI Key Words Publication Quantity

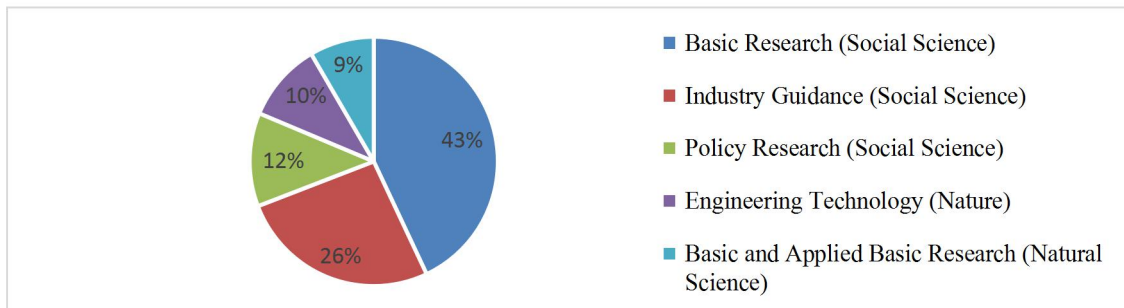


Figure 2 Research Level Distribution Map of CNKI Related Documents

Searching for “cultural creative products” as a key word, a total of 1051 documents were retrieved, and 200 articles were selected through subjective sorting (see Figure 3). It was found that the proportion of philosophy and humanities and social sciences was very high. but through specific analysis, it will be found that the current research on cultural and creative products in the academic circles mostly stays in the art and other majors, focusing on the microscopic aspects of the research and development of cultural and creative products and product development, and the social impact on cultural and creative products. There is still very little research on the forces and the construction of socialist culture with Chinese characteristics. The role of cultural and creative industries in economic construction has become more and more prominent, just as Zhang Qiang, from the Institute of Geographic Science and Resources, Chinese Academy of Sciences, put forward in his article "The Present Situation, Layout and Development Strategy of Cultural and Creative Industries in Chinese Cities", that the cultural and creative industries in Chinese cities are developing rapidly and continuously, and have become the branches of the economy of big cities. The new impetus of pillar industry and transformation development has initially formed six cultural and creative industry clusters, as well as four spatial layout modes of central city, periphery of central city, adjacent high-tech parks and suburban counties (districts). (Zhang Qiang,2013)

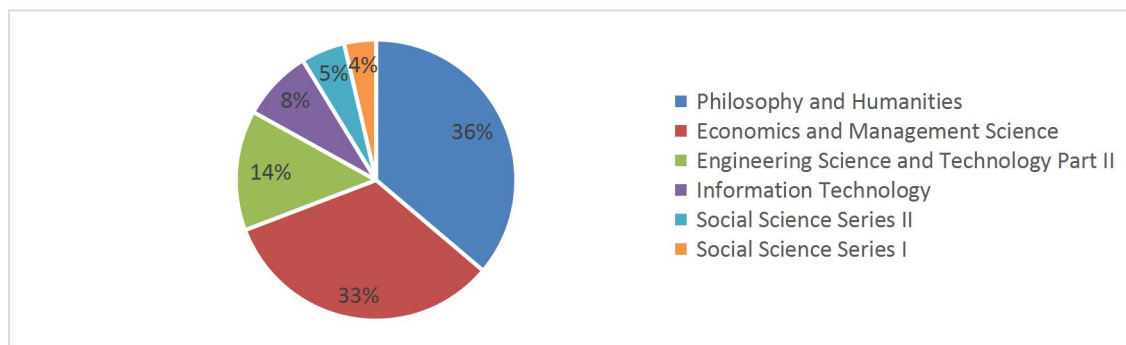


Figure 3 Subject Distribution Map of CNKI Related Documents

In summary, the level of research and the distribution of disciplines, it is not difficult to conclude that on the basis of the existing literature, there are still many studies on Chinese traditional culture and cultural modernization, and the depth and breadth of research are also very Appreciable; the research on cultural and creative products has also shown a sharp increase in the past decade, and the research on cultural and creative products is also constantly deepening. On the one hand, with the advent of the new era, the construction of socialist culture with Chinese characteristics has entered a new historical orientation, and new research has emerged on the modernization of Chinese traditional culture. On the other hand, although research on cultural and creative products has been made. The depth and breadth of the culture are still deepening. with the continuous development of the cultural industry, its position in economic development is deepening, and the development of cultural and creative industries needs to be deepened, and it is mentioned at the height of promoting a strong socialist culture. To further address the importance of the cultural and creative industries, thus providing a new development path for the development of China's special socialism.

## 2 The Dilemma of the Modernization of Chinese Traditional Culture

Chinese traditional culture is deeply rooted in the practice of China's five thousand years, and

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china's vast land. It contains the strong emotional sustenance and spiritual pursuit of the Chinese nation and is the unique emotional bond and spirit of the Chinese nation. In the face of the ever-changing technological development, the process of modernization is getting faster and faster, the pace of China's transition to a modernized country is getting bigger and bigger, and the process of cultural modernization is constantly improving and developing, but it is still trapped and existing problems.

### **2.1 The contradiction between traditional culture and modern culture**

The contradiction between traditional culture and modern culture is an inevitable contradiction in the process of modernization. Some scholars believe that Chinese traditional culture is impossible to modernize, but most scholars hold a positive view. From the definition of culture, culture is the historical imprint of self-development and self-improvement formed by human beings in adapting to nature and transforming nature. Different cultures represent different people's ideas, customs and life in different backgrounds in different historical periods. Chinese traditional culture is the sum of the outstanding cultural achievements of the formation and development of the Chinese nation in all historical periods of China. This represents the existence of the Chinese tradition due to the inevitable existence of differences in different periods and the modernization. The contradiction between tradition and modernity unfolds. Judging from the historical process of China's modernization, China's modernization is not a process of active development, but a passive start. The slogans such as "Beat someone by playing his games only better", "Chinese learning as the fundamental structure, Western learning for practical use" are not only self-examination of their own systems, but also a reflection of the lack of self-confidence and even inferiority for their feudal culture in the early stage of China's modernization. Forming the pattern that the east is subordinate to the west as Marx said. In the process of modernization, the opening door of China is greater and greater. People are receiving more and more new ideas and concepts, more and more forms, more and more high-end means, under the guidance of pluralistic thoughts and values people's way of thinking and behavior practice have changed the transmission of Chinese traditional culture has been impacted and even overthrown. In the modernization process, it is especially important to deal with the relationship between tradition and modernity. In the process of building a socialist culture with Chinese characteristics, based on the reality of modern development, we must handle the relationship between Chinese traditional culture and the relationship between foreign culture and especially Western culture.

### **2.2 The problem of how to treat Chinese traditional culture correctly**

The answer to the question is not to return to the basic consensus that is considered in the macro sense - "take its essence, go to its dross", but to return to the microscopic problem of what to "take" what to "go". That is how to deal with the boundary between "essence" and "dross". This issue has also been controversial in Chinese academic circles. Some scholars believe that the generation and disappearance of culture all have their own natural evolution laws. People's understanding and change of culture should be based on the law of respecting the evolution of culture. Correspondingly, some scholars believe that culture is determined by people. Decisions, its evolution and development should be based on human subjective needs and development.

Regarding the issue of the traditional cultural modernization approach, the academic circles have given three views of "basic affirmation" and "complete reconstruction" and "compromise". Most scholars believe that it is necessary to "take the essence and go to its dross." This has created a new problem: in traditional culture, there are both "essence" and "dross". Does "essence" necessarily apply, and "dross" does not necessarily apply? Is the "essence" always the "essence", and is the "dross" always "dross"? Can the positive factors and the "essence" of traditional culture and the modernization process be equated, and can the negative factors that are not compatible with the modernization process be equal? Even positive factors that are compatible with the modernization process can maintain their enthusiasm

### **3 The Avenue of the Modernization of Chinese Traditional Culture**

The modernization of Chinese traditional culture is a process of continuous progress. The development process of The Imperial Palace's cultural and creative industries has provided reference for the development of traditional culture modernization. The success of the Palace Culture Creation reflects that the traditional culture modernization must be based on the roots of Chinese excellent traditional culture; Give play to the role of economy, science and technology and the masses of the people; the limitations of The Forbidden City Cultural Creation enlighten the modernization of traditional culture: we must persist in comprehensively deepening the reform of the cultural system, innovating various aspects of the traditional cultural modernization, and injecting vitality into cultural creation.

#### **3.1 Based on the root of the modernization of traditional culture**

Traditional culture is an important bridge connecting traditional culture and modern society and plays an important role in the process of socialist modernization. General Secretary Xi Jinping mentioned on many occasions that he should fully explore and carry forward the fine traditional Chinese culture. China's excellent traditional culture has a strong vitality, and this vitality will be a powerful driving force for the Chinese nation to prosper and rejuvenate. The modernization of traditional culture must be based on the "root" of excellent traditional culture itself, fully tap its value, strengthen cultural self-confidence, condense the cultural community, and finally drive the process of cultural modernization.

Deeply explore the value connection of Chinese excellent traditional culture. Take the Beijing Palace Museum as an example. The Forbidden City is a unit of ancient Chinese cultural art based on the old Tibetan cultural relics of the Ming and Qing Dynasties. It has collection, research and display functions. The total collection of the museum is more than 1.8 million pieces, mainly involving cultural relics, ancient buildings books and other 25 categories, it is a treasures house of art that cannot be neglected in china and even in the world. The Palace Culture is the most representative of Chinese traditional culture. For the cultural relics of the Palace Museum, it is the icy "objects" displayed in the Forbidden City, all of which are lifeless "empty shells" on the exhibition shelf. In 2013, the creative Design Competition with the theme of "Bringing the Forbidden City Culture Home" brought the Forbidden City culture to the market. So far, the number of products in the Forbidden City has been sung more than 10,000. In 2016, The Forbidden City Cultural Creation earned 1 billion yuan, and in 2017 it reached 1.5 billion. This figure exceeds 1,500 A-share listed companies. The 600-year-old Forbidden City began to become young, and the Forbidden City culture was "lived". The Forbidden City Cultural Creation products from the shelves no one cares to countless powder, this is the success of The Forbidden City Cultural Creation, but also the National Palace for the full excavation of the traditional culture of the Forbidden City, from the tall and the Great Hall of the Temple to the grass in the back garden, The Forbidden City Cultural Creation is known for its unique design philosophy and communication methods. The continuous exploration of the traditional cultural value of the Forbidden City is the source of strength and the foundation of the Forbidden City. It is the foundation of each story. It is the key to the modernization of traditional culture to express the story behind each cultural relic and express the past and present life of cultural relics.

Strengthen cultural confidence in traditional culture. Churchill once had a famous saying: I would rather lose an Indian than lose a Shakespeare. This should be an important expression of the importance

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of traditional culture. General Secretary Xi Jinping pointed out: "Chinese outstanding traditional culture is the spiritual lifeline of the Chinese nation and a solid foundation for us to gain a firm foothold in the world cultural agitation. We must inherit and promote the Chinese traditional culture in light of the new era conditions." (Xi Jinping,2014) Based on a deep understanding of Chinese traditional culture, the slogan of CCTV's National Treasures is "This is a young program, how young is it? Up and down five thousand years!" This is a great confidence in Chinese traditional culture. The extremely confident performance, the program created by the Provincial Museum of the United Nations in the Palace Museum of Beijing allows people to more intuitively understand the "previous life" and "this life" of our cultural relics, which is also a perfect presentation of the modernization of traditional culture. The strengthening of culture and going out are based on the deep treasure house of traditional culture. Chinese civilization is the only continuous civilization in the world. This is the result of cultural self-confidence. The inheritance and promotion of traditional culture is the fundamental reason for its continuation. Since the industrialization, Chinese traditional culture has been strongly impacted by Western advanced culture. However, in the long history of history, this setback is only a small wave. The Chinese civilization of 5,000 years is still luminescence, giving the Chinese nation a steady stream of self-confidence.

Correctly handle the relationship between traditional culture and modern culture. The contradiction between traditional culture and modern culture is not irreconcilable. The principle of "creative transformation and innovative development" proposed by General Secretary Xi Jinping is the correct methodology for solving the contradiction. Transforming and innovating on the basis of the positive inheritance of Chinese traditional culture. The creative transformation emphasizes breaking free from the traditional culture, based on the actual needs, guiding the positive elements in the traditional culture, and transforming with the requirements of the new era development; Innovative development refers to the improvement and transcendence of excellent traditional culture. Innovation and development on the basis of solving problems based on reality. In this principle, traditional culture is the foundation, development is the pursuit, innovation is fundamental (Wan Guangxi,2017). The Palace Museum profoundly excavated the cultural value of the Forbidden City collection, and implanted the traditional cultural elements of the Forbidden City into the fashionable and trendy modern handicrafts, so that the excellent cultural traditions and fashions can be perfectly combined, express the service concept of Bring the Palace Museum Home through the carrier of cultural products. Let more people understand and love the Forbidden City culture through cultural products, as well as the traditional Chinese culture represented by the Forbidden City culture. On the basis of creative design, The Forbidden City Cultural Creation actively participates in cultural and creative learning exchange forums and exhibitions at home and abroad, and sends the Forbidden City culture out of the country in rich cultural exchange activities, breaking the boundaries of national culture and making the Forbidden City culture a "public property".

### **3.2 Highlighting the power of traditional cultural modernization**

As a kind of soft power, culture has become more and more important in international competition. The "Cultural Policy for Development" conference held in 1998 clearly stated that "the world economic development is ultimately defined by cultural concepts, and cultural prosperity is the highest goal of development (Shen Zhuanghai,2008) . The cultural industry presents its indispensable influence with a new economic growth. The two sources of power that cannot be ignored in the process of cultural modernization are the power of economy, science and technology, and the people.

Show the "economic power" of cultural modernization. Compared with the rapid and efficient characteristics of modern culture, traditional culture is long and soft, and there is a sense of "powerlessness" in today's market economy. In the process of modernization of traditional culture, we must pay attention to the development of cultural productivity. The core part of cultural productivity is

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the cultural industry. The most important contribution to the cultural industry is the cultural and creative industry. As a pillar industry of the tertiary industry, the value-added of national culture and related industries in 2017 was 3.5462 trillion yuan, accounting for 4.29% of GDP, of which Beijing accounted for 14.3%. In the 13th Beijing Expo, 20% of the 39 cultural and creative industries that signed the 6.8 billion yuan project were mixed cultural projects. The Palace Museum is a representative of traditional culture and modern culture. According to a survey of purchasers of The Forbidden City Cultural Creation products, 70% are women, 70% are after 80s, 90s, and 80% of purchasing power is below 200. In view of this feature, Forbidden City can be described as shoot the arrow at the target, The Forbidden City Cultural Creation has developed Silk, pottery, porcelain, bronze, wooden, and other materials, paintings, key chains, pens, T-shirts, jewelry, ties, bags, umbrellas, houses, dolls, make-up, and other different products, more than 10,000 kinds It involves all aspects of life, not only for consumers to be willing to consume but also for consumption. A good cultural and creative product should be to facilitate the daily life of the people, reflect the traditional values of Chinese culture, and spread the story of China. It's not surprising that billions of sales legends. At the same time, on the basis of the full realization of economic benefits, the National Palace Museum has also placed social benefits in the first place. Yuxiang Shan, former director of the Beijing Museum, said in an interview: "The mission of the Forbidden City is not just to make money. In 2018, the National Palace Museum held more than 60,000 educational activities, and went to many countries around the world without collecting a penny. A large part of the money for public welfare and education comes from the income of The Forbidden City Cultural Creation" As a public cultural service unit, the Palace Museum is at the forefront of the modernization of traditional culture.

Perform the "scientific and technological power" of culture modernization. The most striking feature of modernization is the rapid development of science and technology. As the primary productive force, science and technology have greatly improved production efficiency and promoted rapid economic development. Its role has greatly exceeded the role of capital and labor in economic transformation. The Forbidden City Cultural and Cultural Achievements will be fully demonstrated. In product research and development, Forbidden City has independently developed and launched three ipad applications: "The Beauty of the Man", "The Forbidden City Auspicious omen" and "The Emperor's Day". In the collection display, six films were shot using virtual reality technology. It will also rely on the Duanmen Digital Museum, the "Firmament Tower" Digital Cinema, the Great High Hall Digital Museum and the National Museum of the Imperial Palace. Through the real reproduction of the film, let the audience feel the glamour of the Forbidden City culture, and taste the depth of the Forbidden City culture in the details. At the time of the 5G discussion, the Forbidden City decisively signed a strategic cooperation agreement with Huawei to allow 5G to enter the museum to provide technical support for the "Digital Palace" and further promote the digitalization, informatization and intellectualization of the Palace Museum.

Manifest the "people's power" of cultural modernization. General Secretary Xi Jinping emphasized that "literary and artistic creation, philosophical and social science research must first understand the question of who to create and who to speak for. This is a fundamental problem." (Xi Jinping, 2019) The people are the source of creation for cultural workers, only rooted in the people, entering Practice, express the voice of the people, serve the people is the vocation of the literary and art workers. The Forbidden City Cultural Creation always adheres to the people-centered and demand-oriented. From the history of the Forbidden City, it is not difficult to see that the real fire of the Forbidden City is the Cultural Creative Design Competition held in 2013. Before this, The Forbidden City Cultural Creation mainly carried out activities under the symbol of "Forbidden City", only considering the cultural, historical and aesthetic functions of the product have resulted in a series of cultural products that are uninteresting and non-practical, and naturally will be left out. After 2013, The Forbidden City Cultural Creation began to collect cultural product ideas from the public, so that the products are really close to

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life, close to the people, like the "Forbidden City Calendar", "Chaozhu-style headphones" and "Queen's Tea Cup" in the Forbidden City Cultural Creation. It indicates that the needs of the people are the orientation of culture. The Forbidden City Cultural Creation bears the dual responsibility of inheriting culture and spreading culture. For product research and development, it must be designed and created from the perspective of the people. The most common objects in people's lives, such as headphones, calendars, teacups, wall clocks, etc., serve as carriers and then break into the basic elements of traditional culture in the Forbidden City. It not only gets rid of the rigid image of the old "souvenir" that used to talk about cultural attributes, but also adds the interesting, innovative and functional needs of the people, which makes the traditional culture more "existent" in people's daily life. "Only when they are needed by the people, the cultural relics have dignity and this is also the ultimate goal of cultural relics protection."

#### **4 The Institution of the Modernization of Chinese Traditional Culture**

The report of the 19th National Congress pointed out that "culture revitalizes the country and prospers cultural strengthens the nation and strengthens" (Xi Jinping, 2017), and the cultural construction of socialist modernization requires the establishment of a world-class c-korea. Traditional culture is the source of Chinese culture that has lasted forever and youthful vitality. To build a strong cultural strong country and accelerate the pace of modernization of traditional culture, we must accelerate the reform of the cultural system.

Since the reform and opening up, especially since the 16th National Party Congress, China's cultural system reform has achieved initial results. However, some deep-seated contradictions that restrict cultural development still exist. At the Third Plenary Session of the 18th CPC Central Committee, Comrade Xi Jinping put forward the "age strategy of comprehensively deepening reforms", stressing "adhering to the people-centered work orientation, insisting on putting social benefits first, and integrating social and economic benefits. Inspire the whole culture to create vitality as the central link, and further deepen the reform of the cultural system."<sup>97</sup>

The most important thing in the reform of the cultural system is to establish and improve the modern cultural market system. The cultural market is the sum of various cultural production relations in the process of cultural resources exchange between producers, operators and consumers. It has four functions: one is the resource configuration function. Strengthen the socialist culture's great development and prosperity by giving play to the decisive role of the market in resource allocation; the second is to balance supply and demand. The cultural market can objectively reflect and coordinate the relationship between market supply and demand; the third is creative transformation. The creativity and wisdom that will be condensed in cultural products are expressed in the form of materialization; the fourth is the function of value communication, that is, the transmission and transformation of cultural creativity through the exchange and consumption of cultural products, which is a process of creating, transferring and realizing value. The cultural market combines the commodity economic attributes of the general commodity with the unique ideological attributes of the culture itself.

The development of the current cultural market has achieved gratifying results. In 2016, the Ministry of Culture issued a series of policies and regulations on cultural development, such as the

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<sup>97</sup>Decision of the Central Committee of the Communist Party of China on comprehensively deepening reforms on several major issues  
[EB/OL].[http://www.moe.gov.cn/jyb\\_xxgk/moe\\_1777/moe\\_1778/201311/t20131115\\_159502.html](http://www.moe.gov.cn/jyb_xxgk/moe_1777/moe_1778/201311/t20131115_159502.html),  
2013-11-12 (In Chinese)

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"Notice on Promoting the Development of Cultural and Creative Products in Cultural and Cultural Relics Units" and "Publicities of the People's Republic of China" Cultural Service Guarantee Law, the Public Library Law of the People's Republic of China, etc. Taking the Forbidden City Cultural Creation as an example, the document "Notice on Promoting the Development of Cultural and Creative Products for Cultural Relics Units" is of great significance in exploring the cultural resources of museum collections, developing cultural and creative industries, exploiting cultural and creative products, and promoting excellent traditional culture, and inheriting Chinese Civilization. The document expands cultural and cultural relics units, promotes the combination of cultural resources and cultural production and life, and encourages cultural relics units to cooperate with social forces. Under the guidance of the policy, the prosperity and development of The Forbidden City Cultural Creation has made great contributions to enhancing the vitality of the market. However, there are still many shortcomings in the development of the cultural market, such as insufficient exploration of cultural consumption potential, insufficient supply of high-quality culture, numerous and chaotic market players, fierce homogenization competition, and insufficient protection of cultural intellectual property rights. For example, the development path of The Forbidden City Cultural Creation is not smooth sailing. When the "Changxin Pajamas" designed with the elements of the Changyue Pavilion, the bat pattern and the Qing Dynasty's old Tibetan costumes are still in the crowd funding, Plagiarism and imitation goods are already on the line and crowd funding; The flooding of the Forbidden City lipstick in the online sales platform; the public's confusion on the flagship store of the Forbidden City and the misfortune of the Forbidden City Taobao all showed the problems of the imperfect protection system of cultural property rights and the ineffective supervision of the network market.

## 5 Conclusion

If Chinese traditional culture wants to accomplish modernization, it must inherit and carry forward the excellent traditional culture of China. It is not only to refine and innovate the unique spiritual signs in traditional culture, but also to innovate on the basis of inheritance and inherit in innovation, so that Chinese traditional culture can promote the construction of a powerful socialist modernization country. Only in this way can we serve the great rejuvenation of the Chinese nation. The creation of Palace Museum prose epitomizes the process of modernization of Chinese traditional culture. Its success and misunderstanding provide experience and lessons for the road of modernization of Chinese traditional culture in the new era. They all add value to the building of a powerful socialist cultural country in an all-round way and a powerful socialist modernization country in an all-round way.

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Proceedings of the 16th International Conference on Innovation & Management - 1706 -  
**Exploration of the Constructing Mode of Talents in Colleges and Universities Based on  
Information Technology**

Yin Yang

Personnel Department, Wuhan University of Technology, Wuhan, P.R.China, 430070

(E-mail: 825941511@qq.com)

**Abstract:** Information technology exerts a profound influence on people's lifestyle in modern society, all walks of life are transforming from traditional mode to information technology mode. Information technology promotes the efficiency and level of work. Based on summarizing the characteristics of the era of information technology, the article takes the present situation of talents construction in domestic and international colleges and universities as the background, analyzes the important role of information technology in the introduction of talent, services for talent and talent evaluation in colleges and universities of both at home and abroad, and puts forward the path of talent construction in colleges and universities based on information technology, improves the quality of talents construction and the level of services for talent.

**Key Words:** Information technology; The introduction of talent; Services for talent; Talent evaluation

## 1 Introduction

Information technology is based on modern communication, network, and database technology, and it collects and store all elements of the objects it studies in the database for specific groups to live, work, study, and assist in decision-making. With the continuous development of internet information technology, new technologies represented by the internet of things, cloud computing, big data and artificial intelligence have been applied more and more widely, information technology also profoundly affects social production and lifestyle in various aspects (Li Zhibo,2010). With the rapid increase of data in colleges and universities, data processing methods should constantly change to adapt to the new situation. Facing the rapid development of information technology and big data, how to integrate the construction of university talents with information technology is an urgent problem.

There are problems such as lag in concept and unreasonable structure in the construction of talents in domestic colleges and universities (Gao Fuan, Wang Hui, Ge Na,2009),scholars put forward improving the comprehensive ability of managers (Liu Chunlai,2005), establishing a standardized management system (Gao Jing, Tu Qinghua,2013). The use of selection, training, evaluation and incentive system in the management of teachers in foreign universities is instructive to domestic colleges and universities (Zhang Dichen,2014).

## **2 The Characteristics and Research Meaning of Information Technology Era**

### **2.1 Main characteristics of information technology**

Based on modern intelligent tools, information technology has the characteristics of scientific, efficient and accurate by information acquisition, transmission, and processing. It has two distinct characteristics (Gao Jing, Tu Qinghua,2013). On the one hand, digitization is reflected on the huge amount of data, various types of data and extremely fast speed of data. Secondly, digitization can transform many complexes and changeable information into measurable figures and data, and then use the coupling relationship between these numbers and data to establish appropriate digitization model and introduce computer for unification. On the other hand, intellectualism is embodied in the carrier of information processing. Intellectualism intellectualizes data processing through modern computer technology, which reduces the link with manual complex analysis and provides a technical guarantee of the realization of information technology.

### **2.2 The importance of information technology in talent-related work**

Talents are the first resource for the sustainable development of our society, and the construction of talents team is also an important support for the development of colleges and universities. Because information technology has a strong database system as the basis, modern computer technology as the guarantee, from the introduction of talent, services for talents, and talent evaluation, information technology plays a very important role in the development of talent work in Colleges and universities (Liu Chunlai,2005). Firstly, information technology can play a screening role in the introduction of talent to Colleges and universities. By expanding the scope of talent selection of information platform, comparing the achievements and honors of talent, analyzing the potential and prospects of talent, scientific and accurate identification and screening of talent is conducive to achieving high efficiency and normalization of the introduction of talent. Secondly, using information technology to establish a perfect database system and embedding an algorithm to improve the service level of talents, we can timely understand the needs of talents for Colleges and universities. Through the analysis of historical data, we can predict the direction of talent development, so that colleges and universities can foresee the structural changes of talents ahead of time, and provide convenient conditions for building a strong talent, so as to realize the three-dimensional service of talent for Colleges and universities. Finally, information technology can make an all-around and multi-dimensional analysis and evaluation of University talents, not just take the number of papers as a single criterion. Through scientific and quantitative data, we can widen the scope of the evaluation and accurately evaluate the results, alleviate people's subjective will, and weaken conventional thinking. From the technical level, it is possible to solve the problem of the single talent evaluation index.

## **3 Current Situation of Talents Construction in Colleges and Universities**

### **3.1 Current situation of talents construction in colleges and universities at home and abroad**

With the implementation of the strategy of rejuvenating the country through science and education, the construction of talents in colleges and universities has achieved remarkable results. In teams of the management system of construction, the introduction of talent, training, using various colleges and universities improve, especially among many colleges and universities in the new round of reform of personnel system, to create positions work personnel allocation and post-appointment as an opportunity to build up the “on-demand positioned, the open recruitment, equal competition” the system of choose and employ persons and “according to post salary, optimal reward for distribution system, effectively

Proceedings of the 16th International Conference on Innovation & Management - 1708 - mobilize the enthusiasm of teachers, enhance the vitality and dynamism of the talents (Li Pu,2004). Wu Qingwen et al. studied the characteristics of talents in research-oriented universities and put forward constructive Suggestions on the introduction of high-level talents, performance evaluation and incentive mechanism deepening of the distribution system and other issues in the construction of talents. Wang Yejunetc put forward some thoughts on the reform of personnel distribution system and the establishment of teacher management mode in colleges and universities (Wang Zheng,2008). In terms of talents building, foreign universities pay attention to the development of talent resources, attract top talents and provide humanized and high-quality services for talents American colleges and universities attach great importance to the construction of the teaching staff, the development of human resources and the recruitment of top talents Many colleges and universities have established talent committees to attract outstanding experts and scholars from all over the world The establishment of education reform center in Japan has made a great contribution to the reform of university teacher development system.

### **3.2 The main problems in the construction of the talents in colleges and universities**

#### **3.2.1 Inconsistent thoughts and lack of initiative in the introduction of talent**

In the specific work of the introduction of talent in some colleges and universities, there are common problems such as inconsistent ideas and lack of initiative in work(Gao Fuan, Wang Hui, Ge Na,2009). For example, the school has attached great importance to the introduction of talents, but it is perfunctory to the college, which has caused the school to be very urgent, and the college is not in a hurry, failing to achieve the situation of linker between the upper and lower levels (Zheng Xiaobo,2004); the work of the introduction of talent mainly relies on "waiting for" rather than "looking for", fails to give full play to the role of subject leaders, team leaders, and existing teachers, and the way of the introduction of talent needs to be broadened.

#### **3.2.2 The lack of services for talent is obvious and the efficiency is low**

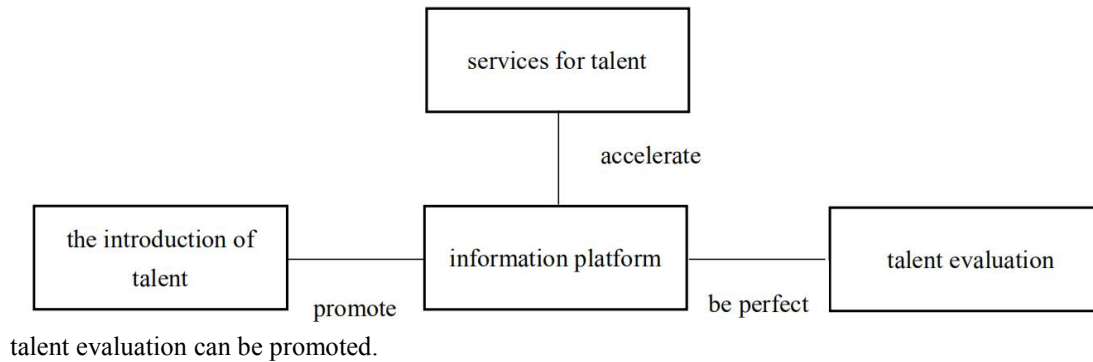
In the construction of talents, the service is very important and is the key to retain talents. For example, teachers' wing rooms, family resettlement, children's enrollment and so on, the relevant personnel services are all paid special attention to by high-level talents in today. The existence of "humanistic care" is needed more in the construction of the talents in colleges and universities. However, at present, due to the lack of timely updating of data and information, the work of services for talent is lagging behind, and it is not able to serve talents in time.

#### **3.2.3 Talent evaluation is too one-sided**

At present, it is not perfect for colleges and universities to publish articles and research funds as the main evaluation indicators. The problem is that the evaluation index of talents used at this stage is one-sided, and the real data needed is not complete enough. It only uses simple scientific research data to measure but lacks data to measure other aspects such as teachers' morality, teachers' style, and students' evaluation. The only scientific and effective evaluation criterion is to have both talents and virtues. In particular, the current talent management mechanism in many colleges and universities is in a relatively closed cycle. The one-sidedness of talent evaluation results in the poor mobility of personnel to a large extent, and meanwhile restricts the establishment of a reasonable talent diversion and elimination management mechanism. In addition, in the process of college the introduction of talent, personnel departments tend to overlook the appraisal of the most important standard of professional master degree of knowledge, lack of necessary for its comprehensive quality assessment, makes the candidate's study and understanding of the degree is limited

## 4 The Consideration and Exploration of the Construction of Talents in the Information Era

Based on information technology, the construction of an information platform for university talents will include three core functions: services for talent, the introduction of talent, and talent evaluation (Zhang Dichen ,2014). Through information platform, the introduction of talent, services for talent, and



**Figure 1 Information Platform for A Talent**

### 4.1 Improving the structure efficiency by using and information system

In the view of the existing problems in the introduction of talent, the information system can play its role in optimizing talent structure (Xue Dexiang,2017). To find out the shortage of subject talents quickly by data statistics can realize the targeted introduction of talents. In terms of the efficient introduction of talents, personal information, scientific research experience, academic ability, and other data can be captured and analyzed accurately on the Internet in the form of information data. Information technology realizes the real-time update of the talent situation. On the one hand, it can prompt universities to know the general situation of job seekers in time to avoid brain drain or placement dislocation. On the other hand, it can find out in time after it has made significant academic breakthroughs, remind personnel departments to pay attention to, and prevent the occurrence of "one size fits all" situation. The operation is simple and easy to tap talents contrapuntally.

In the actual operation process, establish a the introduction of talent and screening information system, import the basic key data of the candidates into the database through data mining technology, and set a demand standard according to the basic requirements of the University for teachers, the system will automatically screen out candidates who meet the introduction of talent benchmark of the university. Set up the classification mechanism according to the disciplines, the information system will pass the personal letter of the initial examination and the information is directly sent to the leading disciplines experts of the corresponding colleges to organize interviews and appraisals, which not only improves efficiency and saves manpower costs, but also avoids the influence of the low enthusiasm of the colleges on the introduction of talents(Zhou Shu, Fang Zhongjin,2011). In addition, the system can update the papers and project information of talents in the reserve database through data mining technology. When it achieves a major breakthrough and qualifies, the information system will promptly remind and form timely and effective communication. In addition, when some other indicators failed to meet the requirements in the process of the introduction of talent and were unfortunately eliminated in the specific assessment process, they can also be informed through the information system. When the

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corresponding indicators meet the requirements, they can be introduced again, which can save a lot of manpower and material resources. At the same time, it can also reduce the probability of high-end talent loss.

#### **4.2 Using information technology to enhance service capacity, and serve them in every dimension**

In view of the "services for talent lag obviously, efficiency is not high" phenomenon, when high-level talent enters the school day, can enter the property status, including family placement, children's education, medical interconnection, office conditions, and other stereoscopic information into the system. And instant entry into the information platform. Do not only understand the talent situation, as a record but also know their warm and cold, timely support. (Yue Bin, Liu Chunxia, 2016) The system sets up the time reminder function, before the occurrence of talents' need, pushes the information to the University relevant department responsible personnel, and record in the Personnel Department system, causes each department to cooperate with the personnel to complete the related matters, makes them feel the warmth of home.

For example, know the status of people in advance, housing subsidies for those without housing or assistance in the settlement of resettlement procedures. In the terms of children's education, the information system will send children's message to the affiliated schools after understanding the age of their children, before the first half year of kindergarten, primary school, secondary school. After the school procedures have been completed, the system will feedback to the corresponding personnel, avoiding their trouble of going back and forth and reduce their worries. The application of talents service under information technology will not only greatly simplify the originally complicated and redundant procedures and links, but also reflect the humanistic care of colleges and universities for higher talents and their eager for talents. It is also an excellent way to establish the reputation and image of the university.

#### **4.3 Using information system to make the evaluation standard quantifiable and establishing the evaluation mechanism**

Aiming to the phenomenon that "talent evaluation is too one-sided", the information system can quantify the evaluation standard, establish the evaluation mechanism, and realize the scientific introduction of talent and evaluation mechanism. Through the construction of information, a platform to change the past rigid only the number of papers and scientific research funds as a talent assessment and evaluation of the status, the establishment of regional Talent competitiveness Evaluation Index system and evaluation model, the massive index data into it. The evaluation of colleagues, the evaluation of subject leadership, the evaluation of students and the number of papers and the proportional weighting of scientific research funds were evaluated. The quantitative and accurate generation of talent positioning can play a huge role in improving the scientific and reasonable performance appraisal system and improving the talent management mechanism. The adoption of big data analysis and processing method will promote talent assessment, job title renewal, dismissal, post adjustment and the implementation of rewards and punishments to be more scientific, reasonable and accurate.

## **5 Conclusion**

The 21st Century is a century of the talent competition. If higher education aims to train qualified and competitive creative talents, it is necessary to reserve a strong strength of human resources highland. At present, there are still some problems in the construction of talents in colleges and universities in China. By strengthening the construction of information platform, changing database's function that

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simply store data, realizing the application function of information platform based on cloud computing and big data, expanding the scope of data collection in all directions, making qualitative evaluation into quantitative analysis, at the same time opening up information barriers, integrating multiple information technology modules into resources. From the technical level to further improve the aspects of "the introduction of talent", "services for talent", "talent evaluation", free the work from the traditional way, accurate and efficient introduction of talent, humanistic care service personnel, fair and reasonable evaluation of talent. Innovation in the system and mode, formatted to positive feedback mechanism, can better build talents in colleges and universities, so that high-level talent to attract, stay and use well. At the same time, we should select and train a group of professionals who are skilled in the application of talent building information platform in colleges and universities, strengthen the application research work of information platform, especially big data and cloud computing technology, and constantly put forward new solutions under the new trend, so that the processing and application of information and data become the general direction, so as to promote the transformation of talents construction in colleges and universities. In the future, the way of introducing and activating talents can be further elaborated.

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# Effectiveness of Social Work Intervention in Classroom Management of Moral Education

Zhang Xiaoxiao

School of Law and Humanities and Society, Wuhan University of Technology,

Wuhan, P.R. China, 430070

(E-mail: zhangxx9@outlook.com)

**Abstract:** Based on the theoretical foundations and value concepts of social work such as "Self-help", this study puts forward innovating traditional management methods in moral education classroom by using various professional methods and techniques in social work. The main achievements are as follows: Firstly, the application of social work methods in moral education classroom of secondary vocational students has a significant effect, which can enrich classroom content, improve classroom atmosphere and improve classroom quality. Secondly, class-based social work intervention model is an effective and practical method, which is suitable for school social work related practice.

**Key words:** Social work; Classroom management; Moral education; Students

## 1 Introduction

The intervention of social work method in the study of moral education classroom for secondary technical vocational students belongs to the intersection and integration of social work and classroom teaching. Few innovative studies have been done on school moral education classroom in China, which is a weak area in the study of technical vocational schools. There are some problems in the teaching situation of moral education classroom, such as students' disgust with learning, lack of interaction between teachers and students, empty and outdated contents, simplification of educational methods and so on (Shen, 2013; Cheng, 2011). The classroom of secondary technical vocational students also show the following characteristics: it pays less attention to habit formation, but to form preaching; it pays less attention to practice, but to theory teaching; it pays less attention to personality guidance, but to common education; it pays less attention to ability training, but to culture inculcation (Wu&Wu, 2007). All of these provide a wide range of space for the application of social work to intervene.

Most researchers agree that social work in moral education in vocational schools is short of focus. At present, the school education field of social work practice in China is mainly divided into colleges, including the discussion of the application of adaptive education growth group in college freshmen, and the study of college student's adaptation problem. Group Activities are carried out among freshmen to tap the potential of freshmen and enhance class cohesion (Xu, 2010; Sun&Wei, 2011; Hu, Song, &He, 2012). These studies explored the practice and application of social work in the process of localization in China and reflected the positive role of social work methods in some problems and fields of students.

It has been observed that researchers always emphasize the current situation of moral education classroom and analyses the reasons for the existing problems among schools in China (Wang, Xu,

Proceedings of the 16th International Conference on Innovation & Management - 1714 - &Ding, 2017). Current moral education mostly adopts the traditional monotonous mode, which cannot meet the needs of students. Traditional moral education always tries to restrain students or reprimand them with its authority, and even takes administrative measures to punish students, rather than actively guide. The result is often counter-productive, making students hostile to teachers and losing interest in moral education. In addition, traditional moral education lacks scientific conceptual basis, which is basically based on experience and easy to become superficial in classes (Englund, 2016).

It is generally recognized that the research on classroom dilemma countermeasures mainly focuses on the proposition of innovative methods, but there are few practical applications. At the same time, there is a lack of practical experience in applying social work to the classroom, field investigation and quantitative research (Xiong, Liu, & Song, 2016). Social work absorbed the knowledge of system theory and ecology, and formed a comprehensive knowledge system of helping people. It is an educational process aimed at promoting growth through personal interaction and collaboration among members in order to achieve the common goal of class (Taylor, Oberle, & Durlak, 2017; Smith, Egizio, & Bennett, 2018). The skills of observing, communicating, establishing relationships and utilizing social resources in social work can also be applied to moral education classrooms (Mcdavitt, Tarrant, Boxall, 2018). Based on the feasibility and superiority of social work intervention in secondary technical vocational schools, combined with the field service of moral education classes, this study carries out a series of group services such as class cohesion and career planning, tries to integrate social work methods into class teaching, makes up for the shortcomings of traditional moral education classrooms, and finally achieves good service effect and is unanimously recognized by students and teachers.

## **2 Analysis of the Current Situation**

S Vocational Senior High School is a national key secondary technical vocational school in Wuhan. It has 150 teaching and administrative staffs, 48 classes and more than 2700 students. The average age of vocational students in this school is between 14 and 19 years old. They have common problems among vocational students in our country and are labeled as "poor students who can't pass the high school entrance examination". By observing, investigating and talking with the teachers and students of the school, the author finds that there are three main problems in moral education in S School.

First, the content of moral education courses is hollow. Although moral education is the main position of moral education in S School, it is still the classroom-based didactic education in moral education classroom, which mainly focuses on imparting knowledge. Teachers teach according to the series of textbooks of vocational literacy in Wuhan. However, the content of textbooks is mostly theoretical knowledge and rules, which are abstract and empty and cannot meet the requirements of the times and the needs of students. Moreover, the book content is not close to the reality of social life, and most of its cases are well-known celebrity deeds or great man's success records, which do not conform to the reality of modern secondary technical vocational school students' learning and life. It can be seen that the content of moral education classroom is divorced from reality. The author even finds that there are some wrong words in these two textbooks. It may affect the effect of moral education.

Secondly, the way of management is monotonous. In order to pursue good discipline, teachers often carry out rigid control and command over the behavior of students, criticizing or even punishing students with problems directly in class. The way of criticism and punishment can easily leave a deep negative impression in students' minds, arouse students' disgust, make students feel pressure or boredom, and even more affect the quality of teaching. Teachers still focusing on maintaining classroom order which according to the traditional way of classroom management. According to the results of

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 investigation and analysis, we can find that teachers mainly play the role of inculcating knowledge. They pay attention to the theoretical learning(63.6%) while pay less attention to the growth and psychological state of students(only 9.0%). Moreover, teachers use punitive management which makes some students feel their self-esteem is hurt, and it may even cause students' disgust and rebellion. One-way management also makes students and teachers lack the necessary communication, teachers cannot get students' feedback and opinions in time. Table 1 presents the Evaluation of Students.

**Table 1 A Table of Students' Evaluation of Moral Education Classroom(N=44)**

	n	%	n	%	n	%	n	%
What do you think the teacher is?	The providers of knowledge		The leaders of class students		The models of imitation		The spokespersons of parents	
	22	50.0	14	31.8	3	6.8	5	11.4
Can you appreciate the teacher's concern for you in class?	Often		Sometimes		Seldom		Not at all	
	6	13.6	24	53.3	12	27.5	2	4.5
Does the teacher teach by punishment in class?	Often		Sometimes		Seldom		Not at all	
	8	19.8	15	33.4	11	24.5	10	22.3
What do you dislike most about the teacher's punishment in class?	Penalty copy		Penalty station		To criticize loudly		Not allowed to attend class	
	3	6.8	2	4.5	33	77.3	6	9.8
How do you or your classmates feel after being punished in class?	Feel educated		Damage self-esteem		Lose face		Indifferent	
	12	27.3	20	45.5	6	13.6	6	13.6
What do you do when you have an opinion about what teachers do?	Speak directly to the teacher		Tell the teacher anonymously		Never say it		Discuss with classmates	
	12	27.3	8	18.2	10	22.7	14	31.8

Thirdly, the atmosphere is dull. In class, the teacher talks on the platform and the students play or sleep below. They are not interested in the classroom and are doing things unrelated to the classroom. Some students are still alive after class, but once they have a moral education class, they fall asleep or played telephone games. Moreover, students are lack of motivation to learn. A teacher in the school thought that secondary technical vocational students were not well managed and disciplined. Students also reflect that moral education course is not the main course anyway. It has also left some teachers lack of ideological communication with students.

### 3 The Application Effect of Social Work in Moral Education Classroom

#### 3.1 Enriching the content of moral education classroom

According to the activities carried out, the students scored the interesting, enlightening and knowledgeable of the content of the activities (the highest score was 10, the lowest score was 0). A total of 44 students received questionnaires, out of which 36 students responded, yielding a response rate of 81.82%. The result of students' scoring on activity content shows that interesting of the activity content has the highest score, with an average score of 7.49; followed by enlightenment, with an average score of 7.39; knowledge is the lowest, with an average score of 7.21 and the lowest score of 4.0. It shows that the activities we carry out are more interesting and attractive to students, and students feel the deepest is whether the activities are interesting or not. On the other hand, the general scores of interesting, enlightening and knowledgeable are relatively high. The average score of the three items is 7.36, which shows that the design of our classroom activity content is relatively average in these three aspects, and the activity content has been recognized by the students in the class. The survey of students' satisfaction with the form of overall activities shows that 69.5% of them are "very satisfied" and "satisfied". Table 2 presents the activity satisfaction of students.

**Table 2 Students' Satisfaction with the Content of the Activity(N=36)**

	Very satisfied		Satisfied		Ordinary		Dissatisfied		Very dissatisfied	
	n	%	n	%	n	%	n	%	n	%
Are you satisfied with the content of the group activities?	5	13.9	20	55.6	11	30.6	0	0.0	0	0.0

According to the feedback, students have a quite good evaluation of the activity content. Many contents of group activities have left a deep impression on the students, such as "scenario play", "career auction", "interview simulation" and other games. These varied and colorful activities not only make up for the shortcoming that students only pay attention to books in traditional classroom, but also enrich the content by games such as "interview simulation", which enables students to learn knowledge beyond books in class, and enables students to better grasp the content of moral education in practice. It is conducive to enriching the content of moral education classroom of S Vocational Senior High School.

In addition, according to the results of the students' impression on the content of the activities, the average score of all 12 group activities was 7.29. The highest score was 8.38 for the "My Show" activity in the class, followed by 7.63 for the "guest symposium" activity in the vocational planning training group. "My Show" is an outdoor activity which students have a high degree of enthusiasm and participation, the group members in this game cooperate with each other and complete the task of activities in full of laughter and fun. The lowest score in group activities is 6.59, which is the "This is me" activity in the "New Journey" growth group. We analyze the reasons for this activity, which requires students to draw their own self-portraits on white paper. It requires students to sit in their seats regularly to complete. Because teachers usually let them finish their homework and topics in class, these students are more disgusted with the task of starting to write, the activity failed to attract students' interest in participating. The richer the activity content, the higher the score, which also shows that the students are more interested in the new form of activity content and methods, and the completion of classroom learning in a harmonious and happy atmosphere can enable them to better grasp the content, so as to achieve the goal of class activities.

Communications and contacts with students also reflect the effect of group activities to enrich classroom content. For example, A student mentioned in an interview, "in the past, the teacher basically talked according to the book in class, which was boring, but now there are many interesting activities, and also talked about some knowledge we did not know, which was not mentioned in the books above." The design of some group activities comes from their moral education textbooks and is not separated from the content of moral education that they should master. More importantly, social workers tend to extend the knowledge and talk about a lot of things they need to know but outside of books.

### 3.2 Improving the atmosphere of moral education classroom

Through the summary and record table of these activities, it can be found that most students gradually participate in the activities from the initial state of constraints to activeness. In the middle and late stages of the activities, students show high enthusiasm and participation, and gradually become the leader of the activities. Because the classroom atmosphere is harmonious and full of laughter and happiness, students are also willing to participate in discussions and express their opinions, and even some students take the initiative to express their feelings and experience of activities in the class. Moreover, when students scored according to their participation in the activities, the outdoor activities were as high as 8.3, and the other activities was about 7.1, if the activities are outdoors, students will have more enthusiasm. It is obvious students are more interested in new forms of activities.

The results of the evaluation show that 66.7% of the students think the number of activities is just appropriate, indicating that the number of two group activities is suitable for most students. When answering the reasons, the students who choose "Fit" think that the number of activities is "neither more nor less; just right". Some students also answer that "the activities are held just right, which not only keeps us away from the boredom of knowledge, but also learns knowledge". It shows that compared with the previous moral education classes, students are more fond of the current classroom and have a certain grasp of the content. In addition, those students who think that group activities are "Less" mentioned that "feel relaxed and open in class". This variety of open group activities enrich the classes and attract students to participate in the classroom. 61.1% thought that the time for each group activity was appropriate, the reasons were that "the activities were completed in class" and "we were able to complete the tasks and objectives of each group in class on time". Some students who thought that the time for the activity was "Less" mentioned "We should communicate more", indicating that some students were eager to have a meeting with workers and reminding workers that there is a slight lack of communication with students in class. Table 3 presents the satisfaction of students.

**Table 3 Students' Satisfaction with the Number and Time of Activities(N=36)**

	Much		More		Fit		Less		Very few	
	n	%	n	%	n	%	n	%	n	%
Do you think the number of activities?	1	2.8	7	19.4	24	66.7	3	8.3	1	2.8
Do you think the time of the activities?	1	2.8	4	11.1	22	61.1	7	19.4	2	5.6

The workers pay attention to observe the performance of each member during the whole group

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activities, pay special attention to the students who have special problems, find and deal with contradictions and conflicts among students within the class in time, and coordinate relations, all of which ensure that the group activities can proceed smoothly in a warm and pleasant classroom atmosphere. The patience and love of workers in the process of activities also infected some students. Students also realized that it was hard and difficult for workers to design and develop activities. They believed that workers who never lose their temper also made them feel the warmth of the classroom and more willing to participate in activities.

The methods and attitudes adopted by the workers are different from the traditional teaching methods and attitudes. Social workers are good at guiding each student to actively engage in group activities, fully inspiring each student to participate in group activities in class, and triggering students to talk about their inner feelings, give praise or encouragement in time; When they find that there is a phenomenon of deviation from the theme in the activities, they intervene appropriately in the members who deviate from the theme in the discussion; When necessary, they reasonably use the skills of support or prevention to interrupt the speeches of the dominant students or encourage the silent members to express themselves, in order to ensure everyone can participate in activities and role playing according to their abilities. Workers timely guide members to extend or proceed to the next issue in discussion and sharing, avoid staying too long on the same issue, let everyone experience activities and classroom in sharing and interaction, complete activities in a harmonious and pleasant classroom atmosphere, and achieve the goal of the class. It is beneficial to improve the atmosphere of moral education classroom.

### **3.3 Improving the quality of moral education classroom**

With the development of different stages of social work, the cohesion of students have been emphasized and promoted in growth group. The communication between students has obviously become more close and harmonious than before, and their ability to communicate and cooperate with each other has improved. And most of the students have made positive and optimistic comments on their own growth. The goals of social work have been implemented and basically achieved, and the results of the activities have been achieved.

Through social work in class, students have subjective evaluation of their new understanding of themselves and career planning. Most of the students think that "as long as there is hope, it is possible to succeed", "as long as we strive hard for it, everything is possible", "cultural courses and professional courses need to have a good foundation", "make great efforts, have a firm belief", "vocational school students can also have a bright future, which let me have hope", "have new understanding about working hard", "have a new understanding that compared with senior high school students, it is easier for us to find a job in secondary technical vocational school. " "as long as we work hard and earnestly, everything is possible." These show that students have more or less a clearer understanding of their future in group activities, and their attitudes have gradually changed to positive. Most of the students in the class have a significant change in their understanding of themselves and their careers. And 72.1% of the students can plan for themselves in the future after the activities. Although only 50% of the students choose to change their ideas about entering a higher school, we can find that 50% of the changes are positive according to their subjective answers, such as "more hard work", "longer-term goals", "more firm-minded, more visionary", "we had no plans for their work before, but now we have plans", "we have goals, we used to just spend time, but now we know how to work hard to achieve goals", "the importance of knowledge", "because of the communication between teachers and classmates, I know that the more places you know, the better for yourself". The application of career planning group makes the career planning ability of students in this class develop and improve effectively. They can set goals and work hard for them, and basically achieve the effect of group activities. Table 4 presents the evaluation of students.

**Table 4 A Table of Students' Evaluation for Activity Effect (N=36)**

	n	%	n	%	n	%	n	%
What do you think you know about yourself through activities?	A big change		Partial changes		The change is small		No change	
	14	38.9	10	27.8	10	27.8	2	5.6
Do you feel that your previous career ideas have changed through activities?	A big change		Partial changes		The change is small		No change	
	8	22.2	10	27.8	13	36.1	5	13.9
Do you have any changes in your career knowledge through career planning group activities?	A big change, and the understanding has increased a lot		Partial changes and basically understand		The change is small, and knows a little bit about it		No change, still doesn't understand	
	14	38.9	17	47.2	5	13.9	0	0.0
Do you think these activities will help your career planning in the future?	Very helpful		Sometimes helpful		A little helpful		No helpful	
	5	13.9	23	63.9	6	16.7	2	5.6
Do you have a plan for future career goals, including long-term, medium-term, short-term?	Yes, I know exactly what I will do after graduation.		Yes, it's clearer, but only have a short term plant.		Yes, it's just a little. I didn't think about it very carefully.		I never thought about it.	
	5	19.3	19	52.8	11	30.6	1	2.8

All activities basically achieve the goals of classroom and social work. Students have a clearer understanding of themselves as well as of themselves in the eyes of others. Most students think that they have grown up by participating in these classes, and basically adapt to the life of secondary technical vocational school in a relatively short time. Especially, they have greatly improved their interpersonal communication, peer-to-peer relationship and attitude towards learning and life. Social work makes the students in this class familiar with each other in a short period of time, stimulates their enthusiasm and initiative to participate in the classroom, and makes students feel that moral education classroom is not necessarily a way of inculcation, but also a way of enjoying teaching. From theory to practice, students can grow up happily in practice.

In addition, the students' evaluation of the two social workers showed that the average score of the two social workers was 8.8 and 8.5, which were relatively high. Workers mainly guide group members in group activities. This shows that the working methods and attitudes of the workers have been recognized by the students, which also provides support for the smooth development of group activities in the classroom. When the last group activity of the semester was held, the students felt reluctant and expressed their hope that they would be able to participate in such activities in the future. It is conducive to improving the quality of moral education classroom.

## 4 Results

Social work and classroom management are belong to different disciplines and have many differences. However, we found there are some advantages of social work intervention in classroom management through this study.

First, the value concept of social work is conducive to the innovation of moral education ideas and thoughts. There are many similarities between the theory of social work and moral education. Therefore, applying the value concept of social work to the moral education has a deep theoretical basis. The values of "people-oriented", "respect and equality" and "service" are worth learning from social work.

Traditional moral education classrooms in China focus on imparting and inculcating knowledge, neglecting students' subjective status and self-motivation in moral education, and students passively accept the views taught by teachers in the classroom. Therefore, the application of the "people-oriented" concept of social work in classes can give full play to its ideological advantages. In traditional moral education classrooms, teachers generally use preaching, warning, advice and other means to force knowledge into students, and some criticism and punishment of teachers in the classroom can easily cause students' conflicting emotions, which not only affect the classroom teaching effect, but also cause psychological impact and harm to students. Introducing the value concept of "respect and equality" in moral education class can enable the teachers to treat students equally, understand students, accept their shortcomings and believe that they have the ability to change. Introducing the concept of "service" makes classes have the advantages of wide coverage and flexibility. Emphasis on students' needs and pay attention to students. Only by providing services for students' urgent difficulties and problems can we truly solve students' various problems with the right remedy.

Secondly, the universality and individuality of social work is conducive to improving the moral education classroom model. Introducing the method of social work into classroom is conducive to solving the problem of single moral education method in secondary technical vocational schools. Under the circumstances of diversification, complexity and thorny problems, the introduction of social work has provided new ideas and methods for moral education teaching and injected new vitality into school moral education. The methods of sharing, supporting, influencing and educating in the interaction of group members in social work can be applied to the moral education classroom, bringing about changes in the attitude and behavior of students. Teachers can use these skills to diversify the teaching methods. The secondary technical vocational school students are in the adolescent period. They are active in thinking, impulsive and irritable, and are prone to encounter various problems, such as interpersonal relationship problems, learning pressure problems, self-perception bias problems and so on. During this period, they are also faced with the task of growing up, the accumulation of knowledge, the improvement of interpersonal relationships, the improvement of their own abilities and so on. Teachers can develop different groups in the moral education classes. These groups are composed of students with common characteristics. When students find that other members of the group have similar problems with themselves, they will increase their sense of identity with the group, eliminate disturbances, alleviate psychological burden, and reduce loneliness and inferiority.

The individuation of social work makes it possible for classes to set up new groups for students who have common needs in some aspects according to the needs of moral education classrooms, For example, different types of moral education teaching groups can be set up different needs, including interest groups, task groups, growth groups, education groups and service groups to carry out targeted work, as well as therapeutic groups, preventive groups and developmental groups. Different group objectives and contents can be set up according to different moral education tasks. Team activities are used differently to serve group members better according to their individual evaluation.



Third, the flexibility of social work is conducive to increasing the attraction of moral education classroom. The working methods and service skills of social work are flexible and diverse. Different from the ways of preaching, warning and persuasion used in traditional moral education classrooms, social work can set up different groups according to different educational tasks and the demands of service objects in moral education classrooms. It pays attention to enrich the content of classroom activities, which not only meets the characteristics and needs of the ages of secondary technical vocational students, but also stimulates their enthusiasm and initiative in learning, so that students can constantly improve their moral education level in the process of playing games.

At present, the main dilemma of moral education for students in our country is the lack of practical links in the process of moral education. Introducing social work to change the original isolated and static classroom teaching mode into dynamic teaching activities, providing students with plentiful group activities in the classroom, and students can interact and help each other in the group, which can stimulate students' enthusiasm and creativity, make up for the lack of practice in traditional moral education classroom, and meet the needs of moral education curriculum.

## 5 Conclusion

Through the evaluation of classroom content, process and effect in the course of service, it is found that flexible and diverse forms of social work can activate classroom atmosphere, attract students to participate in activities, stimulate students' enthusiasm, and improve their level of moral education in activities. Therefore, social work methods can make up for the shortcomings of the traditional moral education classroom for secondary technical vocational students, enrich the content of the classroom, improve the atmosphere of the classroom, and improve the quality of the classroom, and its application in the field of moral education for secondary technical vocational students is feasible and effective.

Social work respects students. Its student-centered values make the relationship between students and workers more like friends and spiritual communicators than the traditional relationship between authority and managed persons. For example, some students wrote in their evaluation of the activities, "It's OK, at least the teacher is very attentive, the students are also looking at it, we all like the teacher's lessons very much." It shows that social work respects students and pays attention to students' needs, so that students really feel the concern of workers in their hearts, and has a positive impact on students' psychology. It makes the concrete content of moral education change the students' thoughts gradually in a subtle way. The content of moral education classroom is referred and followed by every member. Social work promotes the realization of moral education goal more comprehensively. Therefore, social work service is more humanized, which promotes the full realization of moral education goals.

In addition, social work classes can more effectively solve the common problems in a class, such as classroom atmosphere, learning methods and so on. In moral education classroom, social workers can be social workers, psychological counseling teachers, class teachers and friends. The unique service concept, flexible working methods and various working forms of social work can make up for and improve the moral education classroom from various aspects. Class-based social work is an effective and practical method in the field of moral education, which is suitable for the practice of social work in the field of learning.

This research result not only helps to improve the teaching concept of moral education classroom in secondary technical vocational schools, and enriches and improves the methods of moral education teaching, but also has certain reference significance for the professional study of social work and the study of moral education classroom in secondary schools.

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## **Research on the Cultivation of Chinese College Students' Global Competence from the Perspective of Internationalization**

Lu Yan

Shaanxi Normal University, Shaanxi, P.R.China, 710062

(E-mail: luyan@snnu.edu.cn)

**Abstract:** In a context where the trends of economic globalization and IT application are surging forward, the global competence of college students has become an important evaluation index for ranking talents' quality in colleges and universities at home and abroad. Cultivating global competence is not only a critical element for national development strategies and education internationalization, but also a requisite way for colleges' double first-class construction and Chinese youth's growth. Therefore, on the basis of its time value, this paper concludes the key elements of global competence so as to explore various ways for Chinese colleges to develop global competence and further promote our youth's participation in international competition.

**Key words:** The perspective of internationalization; Chinese college students; Global competence; Promotional measures

### **1 Introduction**

The trends of global multi-polarity, economic globalization, IT application, and cultural diversity are surging forward; changes in the global governance system and the international order are speeding up; countries are becoming increasingly interconnected and interdependent, especially in social, political, ideological, cultural, educational and other fields. Against this backdrop, the competition among countries' composite national strength is mainly a competition among talented professionals. Thus, global competence is getting more and more attention from all countries in the world.

"Global competence" was initially put forward by Council on International Educational Exchange during its report *Educating for Global Competence* published in 1988, which elaborates on the necessity and feasibility of overseas studying for global competence. Afterwards, some scholars also offer their understanding of global competence concerning its core components, index system and so on. Originally intended for higher education, global competence is aimed at helping students better interconnected with the world, truly understand universal changes and effectively compete in the labor market. Then on December 12, 2017, the Directorate of Education and Skills at the OECD and the Project Zero at the Harvard Graduate School of Education co-hosted the public launch of the new *OECD PISA Global Competence Framework*, which gives global competence an official account. Global competence is the capacity to examine local, global and intercultural issues, to understand and appreciate the perspectives and world views of others, to engage in open, appropriate and effective interactions with people from different cultures, and to act for collective well-being and sustainable development.<sup>98</sup>

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<sup>98</sup> *The Public Launch of the New OECD "PISA Global Competence Framework" | Educational Counseling,*

As western researchers work on global competence, not to be behind, Chinese scholars also study this topic from various perspectives, firstly bringing in the concept and then talking about its cultivation methods, curriculum systems, assessment strategies, and other aspects. Owing to an intensified international competition, how to improve students' global competence becomes an important issue for colleges and universities to think and explore.

## 2 Time Value of Cultivating Global Competence

### 2.1 The urgent need of national development strategies

The Belt and Road Initiative and the calling for building a community with a shared future for mankind both reflect China's traditional idea "Inclusiveness", especially in the education sector. In 2018, there are 662,100 Chinese students studying abroad, in comparison with 492,100 international students in China. Hence, whether willing or not, Chinese youth have no choice but to engage in the fierce international competition.

In May 2010, *The Guidelines of the National Program for Medium- and Long-Term Educational Reform and Development (2010-2020)* clearly states that "We should strive to nurture a large number of international talents, who are equipped with international vision, familiar with international rules and also able to participate in international affairs and competition."<sup>99</sup>, which suggests that global competence is formally integrated into the national talent training system. So in the future, if China wants to play its part as a more important and responsible major country in global governance, the kind of youth with global competence must be largely trained. At the same time, China also takes an increasingly active part in international organizations. In July 2015, the Ministry of Education and other four governmental departments jointly issued *The Action Plan for Studying Abroad (2015-2017)*; in April 2016, the General Office of CCCPC and the State Council released *The Several Opinions on Opening-up Education in the New Era*; and in June 2017, the Ministry of Education promulgated *The Notice on Promoting the Internship of General College Graduates in International Organizations*. All of these documents require colleges and universities to proactively adapt to national external development strategies, to accelerate the cultivation of all-round talents competent to participate in global governance, and to improve the curriculum system and talents training plan.

September 2016 witnessed the official release of *The Key Competence of Chinese Students' Development*, a major achievement of the project "Overall Framework Research on the Key Competence of Students during the Stage of Basic and Higher Education", which is led by Beijing Normal University and jointly undertaken by many other colleges. Aimed at training all-round personnel, the achievement builds a key competence framework and proposes the characters and abilities essential for students to meet the needs of lifelong development and social development. The framework consists of three parts including cultural basis, independent development and social involvement, which can be further manifested as six major competences like humanistic knowledge, scientific spirit, learning to learn, living healthily, responsibilities and duties, and practice and innovation, and 18 minor details such as national identity and so forth. What's more, one of the major competences, responsibilities and duties has intentionally mentioned the capacity of international understanding, which is composed of the following three requirements: firstly, have a global awareness and an open mind to see human civilization history and world developments; secondly, embrace the diversity of multi-culture and

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[http://www.sohu.com/a/216655430\\_287574](http://www.sohu.com/a/216655430_287574)

<sup>99</sup> [http://old.moe.gov.cn/publicfiles/business/htmlfiles/moe/info\\_list/201407/xxgk\\_171904.html](http://old.moe.gov.cn/publicfiles/business/htmlfiles/moe/info_list/201407/xxgk_171904.html), the Ministry of Education of the People's Republic of China.

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 respect the differences, thus actively participating in intercultural communication; lastly, pay attention to the global challenges facing human and understand the concept and value of community with a shared future for mankind. As a result, it looks even more important for college students to understand international culture and engage in international affairs.<sup>100</sup>

In September 2016, during the G20 Hangzhou Summit, President Xi emphasizes that participating in global governance requires a large quantity of professionals who are familiar with the principles and policies of the Party and the country, understand the country's realistic conditions, possess a global vision, have a good command of foreign languages and international rules, and are skillful at international negotiations. Therefore, it is necessary to strengthen the building of a talent pool for global governance, breaking through the talent bottleneck, so as to provide strong support for China's participation in global governance. Besides, in his congratulatory letter to the first Schwarzman Scholars College of Tsinghua University, General Secretary Xi pointed out that nowadays, the people of all countries have seen their destinies woven together closer than ever, so the youth of all countries should set up a global vision through education, enhance the sense of cooperation, and create a bright tomorrow for all of us. Thus, improving the global competence of college students is of great strategic significance for China to participate in international affairs and competition.

**Table 1 The Sum of Chinese Students Studying Abroad from 2014 to 2018<sup>101</sup>**

Year	Government-sponsored	Company-sponsored	Self-sponsored	In total
2014	21,300	15,500	423,000	459,800
2015	25,900	16,000	481,800	523,700
2016	30,000	16,300	498,200	544,500
2017	31,200	35,900	541,300	608,400
2018	30,200	35,600	596,300	662,100

## 2. 2 The inexorable trend of education internationalization

The traditional education mode is facing impact and challenge in such a society with highly IT application. For instance, the pure intellectual content can be easily acquired through online search. The International Curriculum Conference held in Melbourne in May 2000 comes up with the concept of "International Curriculum". The experts at the conference also deeply discuss how to construct the national curriculum system under the background of globalization, and transfer the curriculum emphasis from teaching the closed and divided content to generating the value of students as an individual, which gives an important enlightenment to education internationalization development. During the two reports *Rethinking Education: Towards a Global Common Good* and *Education 2030 Framework for Action* published in November 2015, UNESCO points out that human society is experiencing the most grave global challenges, and the social responsibility of higher education is gradually more shouldered by the whole world than by one country. Additionally, the Institute of International Education mentions that

<sup>100</sup>The Official Release of "the Key Competence of Chinese Students' Development", [http://www.sohu.com/a/114389183\\_100928](http://www.sohu.com/a/114389183_100928).

<sup>101</sup> Data source: Ministry of Education of the People's Republic of China.

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global competence in the 21st century is no longer a luxury, but a necessity on its release *Global Competence, the Key to the 21st Century*. And as early as 1996, the report *Learning: the Treasure Within* submitted to UNESCO by the International Education Committee for the 21st Century clearly states that education plays a special role in building a more united world.

Considering the university evaluation index, plenty of international ranking systems such as Academic Ranking of World Universities (for short, ARWU) undertaken by the Center for World-Class University at Shanghai Jiao Tong University, Quacquarelli Symonds (for short, QS), Research Center for Chinese Science Evaluation (for short, RCCSE), the Times Higher Education Supplement (for short, THE), and U.S News & World Report (for short, USNWR) all regard the ratio of international teachers and students and the amount of international publications and citations as an important indicator of a university's strength. Moreover, with the development of economic globalization and information integration, young people are in possession of a broader horizon and a greater academic, among which more and more wants to go abroad to appreciate the charms of multi-culture, therefore becoming an all-round international professional. The annual report *Education at a Glance 2018: OECD Indicators* announced by OECD indicates at the higher education level, the number of Chinese students studying abroad and international students in China keeps on a rapid growth, from 2013 to 2016 increased by 22% and 43% respectively. Therefore, with a view to underpin a sustainable economy development, China's education must be oriented to the world and the future, thus making a forward-looking plan for present and future.

### 2.3 The major mission of college development

In accordance with *The Notice of the State Council on the Overall Plan of Making Coordinated Efforts to Develop World-class Universities and World-class Disciplines*, one of the reform tasks of "double first-class" construction is to promote international exchange and cooperation. Specifically speaking, it involves the four aspects followed: first, enhance the pragmatic cooperation among world-class universities and academic institutions, effectively integrate foreign high-quality resources into our teaching and research process, and make joint efforts to cultivate high-level personnel and solve scientific problems; second, increase international collaborative innovation and actively engage in or organize major international and regional scientific programs and projects.; third, create a sound international teaching and research environment to attract more excellent foreign teachers and high-level foreign students; at last, take an active part in the formulation of international education principles and the evaluation and accreditation of international education and teaching, practically improve the international competitiveness and discourse power of China's higher education, and establish a good brand and image of Chinese universities.<sup>102</sup> Undoubtedly, all of these mentioned above can be viewed as the specification of global competence.

For one thing, at the global level, the rapid development of network technology deepens the international integration and division; the rising number of college graduates leads to a severe domestic employment situation. So competing in the global employment market becomes one of the methods for college graduates to get a job. The United Nation launches Global Education First Initiative in September 2012, one of whose priority is to nurture international citizens. For another, at the regional level, to begin with, on the occasion of the 160th anniversary of the founding of Adams College in South Africa in 2013, Ms. Zuma, the chairman of the African Union, comes up with the idea that "To train talents for AU, who are familiar with the global political and economic structure, procedures and laws." In addition, Tsinghua University proposes its global strategy in July 2016, setting the goal of "cultivating innovative talents with global competence" and establishing a guidance center for

<sup>102</sup> [http://www.gov.cn/xinwen/2017-01/27/content\\_5163903.htm#1](http://www.gov.cn/xinwen/2017-01/27/content_5163903.htm#1), the Central People's Government of the People's Republic of China.

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developing students' global competence. Furthermore, Shanghai International Studies University pioneers an integrated-subject teaching model and opens many "multilingual plus" talent training platforms. To sum up, the whole world is taking action for cultivating global competence.

### 3 Key Elements of Cultivating Global Competence

By interoperating the domestic and foreign research results and training program of famous schools and considering national development progress and the demand of global talents, the researcher holds the view that the key elements of Chinese college students' global competence include the following three aspects:

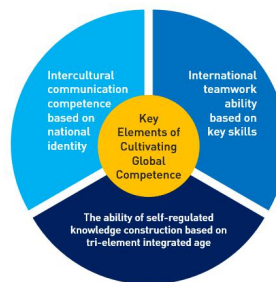


Figure 1 Key Elements of Cultivating Global Competence

#### 3.1 Intercultural communication competence based on national identity

Culture is the soul of a country and a nation. The fate of a nation will be good with prosperous culture. A nation will be strong with prosperous culture. High sense of cultural confidence promotes the prosperity and revival of a nation. Different scholars have different understandings of the intercultural communication competence, but the core elements of it are similar. That is to say, intercultural communication competence is a kind of comprehensive ability which includes knowledge, skills, attitude and cultural awareness. Cultural communication is embodied in language and behavior. However, it does not exist only as an instrument, but also as kind of perception of the cultural connotation hiding in language. On the basis of language skills, intercultural communication competence means a conscious and profound identity to the indigenous cultural property in the first place and comprehension and application of cultural difference in the second place. In cross-cultural communication, communicators should maintain a right attitude and should not be extremely arrogant and slavish. At the same time, communicators should also pay attention to cultural tradition and the context. All of these require that college students, especially students majoring in foreign language and diplomacy studies, should lay a solid multilingual foundation and look into the political, economic and cultural background of corresponding countries. They should also realize that foreign language proficiency is not equal to intercultural communication competence for the latter tends to be the comprehensive ability of multi-culture and communicative ability.

#### 3.2 The ability of self-regulated knowledge construction based on tri-element integrated age

Nowadays, although china is in the age of school education, the stage of lifelong learning has been quietly approaching. The headmaster of Northeastern University put forward three literacies in *Robot-Proof: Higher Education in the Age of Artificial Intelligence*, which includes data literacy, technological literacy and humanics. In this book, he educated students to face the information technology wave

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bravely. In the future, illiteracy is not those who cannot read and write, but refer to the people who does not master the way to learn and unwilling to reflect and relearn. Premier Li Keqiang once described the development of science and technology as a development of collective intelligence, which means that various subjects blend with each other, forming a kind of phenomenon of Tri-element Integration, which includes human society, information space and physical world. Especially, the integration of science and technology, society and culture and the rapid development of high education informatization reform the process that college students gain knowledge. Global competence requires learner to have more meaningful learning objectives, learn out of joy rather than out of material gains and make learning become their individual endogenous needs. Besides work skills, learners should attach great importance to strategic knowledge and discard the ineffective knowledge. Furthermore, learners should also supplement useful knowledge by the ability of knowledge transfer and develop high-level cognitive and non-cognitive skills, which are helpful to develop problem solving skills, critical thinking skills, creativity, communication skills and problem solving skills to combine cognition and imagination and realize autonomous knowledge construction.

### **3.3 International teamwork ability based on key skills**

Dating back to 2005, Thomas L. Friedman pointed out clearly in *The World is Flat: A Brief History of the Twenty-first century* that “the human society has already entered a whole new era: Globalization 3.0. Following countries and transnational corporations, individuals, relying on modern science and technology, become an importance force to accelerate the process of globalization.”<sup>103</sup> Facing international competition and multicultural work environment in the future, individuals should obtain the ability of work in teams. Learning centered on 21<sup>st</sup> century skills and key competences has become the consensus of educational reform all over the world. From the 1990s, many countries and areas, including Canada, Singapore, America, have begun to integrate 21<sup>st</sup> century skills in the curriculum, teaching progress and evaluation. PISA testing is improved constantly and has added measurement of cooperative problem solving skills. In 2015, Education 2030 Framework for Action, a global education agenda published by UNESCO, has made the strategy of educational reform stands in the center in every country’s planning. It pointed out that key skills could play an important role with the reform of technology and education. Chinese scholar Zang Lingling conducted a case study on 10 world-class universities, including Harvard University, Yale University, Oxford University, Cambridge University, Toronto University, Nanyang Polytechnic University of Singapore, Sydney University of Australia and Hong Kong University of China. In the paper *A Study on University Students’ Key Competence in International View*, she points out the world-class universities tend to converge on the core skills indicators of college students by the analysis of word frequency of three first-level indicators, including cultural accomplishment, social participation and self-development, and ten second-level indicators of core literacy, and their emphasis on teamwork also reflects the direction and trend of personnel training of higher education around the world.

## **4 Various Ways to Cultivate Global Competence**

### **4.1 Developing global awareness in strengthening national cultural identity**

Global awareness is a kind of world view which refers to how people perceive their relationship with the world and their sense of responsibility as citizens of the world. Cultivating global awareness has the important guiding significance for the promotion of global competence, and culture is one of the

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<sup>103</sup> *The World is Flat: A Brief History of the Twenty-first century*. Hubei: Human science and technology press, 2006.



important factors which affect young people directly in global awareness. One of the prerequisites for cultivating global awareness is making learners fully understand and identify the cultural characteristics of our nation. First of all, learners should be guided to understand the relationship between Chinese culture and global culture. They are not in the opposite. However, they would interact with and influence each other. Different cultural backgrounds and diverse cultural development could foster the genealogy of global culture, and these would integrate and develop together in the future. Only by maintaining its uniqueness, developing constantly and being open to communicate with others, can national culture gain long-term vitality in the cultural world. Furthermore, learners should be cultivated the awareness to participate in the global competence actively and grow up to the "Global Talents". Although students' internationalization degree in the school and after school is closely related to their family background, major, career planning, schools' internationalization degree, campus culture, etc., the cultivation of their global awareness is indispensable. Most of the world-class universities at home and abroad focus on developing students' global awareness systematically by integrating with international needs in many aspects, such as enrollment education, campus culture developing, professional curriculum setting, foreign exchange projects, summer schools, career planning and so on. At the same time, they avoid students' participation in Culture Shock of international affairs by daily education. This kind of idea of cultivating global talents worth of thinking and drawing lessons from for research universities.

#### **4.2 To build an international curriculum system under the concept of ideological and political education**

Chinese president Xi Jinping gave a speech at the 100<sup>th</sup> anniversary celebration of the establishment of the Western Returned Scholars Association. "Overseas-educated talents are encouraged to use their advantages to promote exchange between China and other countries so that China can gain more understanding and support from the world", he said<sup>104</sup>. At present, most of international courses in domestic universities mainly include the knowledge of region, country, literature and language and they are insufficient in high-level degree program. What's more, these courses only scatter in Colleges of International Studies and the Colleges of International Sinology. These courses are not systematic and significant enough and they performed not well in guiding learners in solving the international problems. Considering that, universities should avoid two kinds of misunderstandings in strengthening the construction of international curriculum system. First of all, promoting students' global competence does not mean open a course named "Global Competence" in colleges. From the perspective of inter-subjectivity, educators and educatees, as equal subjects, should give fully play their role of subjectivity and carry out communication to realize self-promotion. It requires teachers to explain the meaning of global competence in class teaching, after-class activities and environment setting in a vivid way, embedding this teaching goal in various goal, by which the course can be international and students' ability in solving practical problems and research history can be improved. Secondly, the process of internationalization cannot be realized at the cost of reducing the inheritance of the traditional culture of our nation. Teaching in English should be encouraged, but for the courses of Chinese, Chinese history and Chinese philosophy, teachers should use Chinese and the certain amount of class hours should be guaranteed. In scientific research, researchers are encouraged to study Chinese condition and problem in foreign language. At the same time, researchers should use the evaluation standards to promote themselves, drawing conclusions and reflecting themselves in international competence, so as to participate in establishing rules and standards in the future.

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<sup>104</sup> Xi Jinping's speech at the 100th anniversary celebration of the establishment of the Western Returned Scholars Association. [http://www.china.com.cn/legal/2013-10/22/content\\_30367173.htm](http://www.china.com.cn/legal/2013-10/22/content_30367173.htm)

#### **4.3 Applying the mode of deep experience to the practice platform in colleges**

One of the necessary ways to develop global competence is college students' global academic experience and global communication experience. On the one hand, on the basis of increasing the frequency and number of international exchanges, universities should change the mode of international activities in campus and design more activities with more cultural connotations, global elements and inspirations. Universities should also increase the number of exchange activities between Chinese students and foreign students in China, which is benefit to cultivate students' global awareness and ability in the process of experience it personally. The activities should cover the first and second classed. Consideration should be given to the training levels and objectives in different grades. At the same time, attention should be paid to factors, such as participants' interest and ability, knowledge base, cultural differences and regional characteristics. On the other hand, the government and universities should also consider how to make favorable policies in training and application for studying abroad and employment opportunities, and promote international appeal and absorptive capacity of Chinese higher education to attract more foreign students to study in China and establish campuses with more international atmosphere.

#### **4.4 Improving international development mechanism in management measures**

At present, there are still some improper phenomena in domestic universities, such as the inadequate publicity of international exchange programs, the imperfect mechanism of international visits, the imperfect policy of foreign teachers' teaching management, and complicated management of intramural international exchanges, which have brought obstacles to the cultivation of college students' global competence. Therefore, one of the important tasks of Chinese universities' internationalization is to straighten out various supporting measures and management mechanisms, which requires the leading body's overall consideration and reasonable layout. Meanwhile, full consideration should be given to the developmental gap between the east and the west and the development of geo-economy when evaluating the cultivation of global competence and international work. In cultivating global competence, the process rather than results should be emphasized for individuals. It's should be noted that promoting global competence is a lifelong process. No individuals can master the perfect global competence. What's more, the evaluation of it is also a way to promote students' ability.

### **5 Conclusion**

In a word, the cultivation of Chinese college students' global competence is not only an urgent need of national development strategies and international talent competition, but also a requisite way for future college students' growth during the course of economic globalization. It is also a call for the responsibility and mission of "slash youth" in the developmental trend of a community with a shared future for mankind. Therefore, Chinese colleges and universities must closely follow this historical trend and strengthen the cultivation of international talents with global awareness, thus promoting the realization of Chinese national rejuvenation.

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## **Study on the Double-helix Coupling Interactive Mode and Realization Path of University Culture, Ideological and Political Education**

Ma Jiaming<sup>1</sup>, Li Qian<sup>2</sup>, Zhang Sijie<sup>2</sup>, Liu Xu<sup>2</sup>

1 College of Resources and Environment Engineering, Wuhan University of Technology,  
Wuhan, P.R. China, 430070

2 Hubei Collaborative Innovation Center for Early Warning and Emergency Response Technology,  
Wuhan, P.R. China, 430070,

(Email: 605520413@qq.com, 850556798@qq.com, 1019775713@qq.com, liuxu0116@qq.com)

**Abstract:** University culture, ideological and political education has a high degree of consistency. They have the same goals and similar functions. But there are still differences. How to clarify the relationship between the two scientifically, and make them integrate, penetrate and influence each other in practice, so as to play a greater role in combining forces, and then improve the effectiveness of education, is an important issue that we need to seriously and thoroughly study. This paper analyses the difference and homogeneity between university culture and ideological and political education, expounds the interaction between university culture and ideological and political education, put forward the double helix coupling interactive mode of university culture and ideological and political education and finally the realization path of the double helix interaction mode is discussed.

**Key words:** University culture; Ideological and political education; Double-helix coupling; Interactive mode

### **1 Introduction**

With the deepening of academic research on culture, experts have different views on the definition of university culture. Some experts believe that the carrier of university culture is the university, through the inheritance and development of each teacher and student, the synthesis of material and spiritual achievements accumulated by the university (Gao Minghui, 2016). Some experts believe that university culture can generally refer to all activities and modes of activities within the university (Wei Bin, 2018). Also some experts pointed out that there are theorists believe that the university culture is in the long-term process of running through the judgment, the choice of all teachers and students staff and pursue, innovation, and gradually formed the education thoughts of school-running idea, rules and regulations, management style, ethics and code of conduct and group consciousness, work style and spirit school image (Zhang Fan, Gao Tianqin, 2018). From the perspective of cult urology, some experts believe that university culture is a kind of subculture, which is a collection of a whole set of values, behavior patterns, language habits, institutional systems, knowledge symbols and architectural styles established around university education and teaching activities (Fan Shengwu, 2015). In terms of the basic attributes or functions of the university, some experts believe that the university culture is developed from the history of the university. People have different group consciousness and spiritual

The university cultural education function has become a hot topic in the current academic research. Scholars at home and abroad attach great importance to the study of university culture, not only have achieved more results in theoretical research, but also actively applied these results to the practice of university education. The research results of domestic scholars mainly focus on the connotation of university culture, the function of university culture education, and the way of university culture education function. The reason why the western developed countries have a higher level of higher education development and talent training has its own characteristics. One of the main reasons is the emphasis on the research of university cultural education and the importance attached to the construction of its own university culture. According to the available data, foreign scholars mainly study the following aspects of university cultural education function: research on university culture construction, university culture education function research, university culture education model research.

Because experts define the concept of university culture differently, they have different views on the connotation and structure of university culture. Some experts put forward the "Iceberg Mode" of cultural stratification, which divides university culture into two layers: explicit and implicit. Others believe that "university culture mainly includes three layers: spiritual culture, institutional culture and environmental culture". Hofstadter put forward the "onion model" of cultural stratification, and compared culture to an onion: the outer layer is called a symbol, the second layer is Heroes, the third layer is rituals, and the inner layer is Values. This theory gives a comprehensive static description of the connotation of culture from different dimensions, and also makes a dynamic analysis of the internal relations among various elements, which gradually wins consensus in the academic circle. According to the "onion" theory of cultural stratification, this paper holds that the connotation of university culture consists of spiritual culture, institutional culture, behavioral culture and material culture.

## **2 Study on the Difference and Homogeneity of University Culture, Ideological and Political Education**

### **2.1 Differences between University Culture, Ideological and Political Education**

As two different concepts, university culture and ideological and political education belong to different categories and have different theoretical bases of nature. The construction of university culture includes both spiritual and material construction, which belongs to both engineering and cultural disciplines. While the work of ideological and political education is to persuade, educate and change people's behavior with Marxist Theoretical System, which belongs to the category of political science. They also work in different ways. Ideological and political education belongs to educational activities, and the process of education must be relatively standardized and systematic. The construction of university culture guides university students to study, live and work in a subtle and silent way. If you keep good men company, you will be of the number.

### **2.2 The homogeneity of university culture and ideological, political education**

Although there are some differences between university culture and ideological and political education in concept, in essence, they both belong to social ideology and there still exists homogeneity. They have the same guiding ideology. Both of them adhere to the leadership of the Communist Party of China and are guided by the Marxist theoretical system and the socialist core values. From the perspective of content, both of them are based on the correct guidance of world outlook, outlook on life and values. From the point of view of the working objects, both of them work for "people", and the main

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purpose of the work is "public feeling". From the perspective of goal orientation, the goal of both is to cultivate a healthy and perfect personality and promote the all-round development of people. In addition, the content of university culture and ideological and political education are similar, and the two are not static, and they are interfered and influenced by the international and domestic economic and political situations and social thoughts to varying degrees.

### **3 The Interaction between University Culture, Ideological and Political Education**

#### **3.1 The Promoting Role of University Culture in Ideological and Political Education**

The functions of university culture have been analyzed above, including indoctrination, standardization, cohesion, motivation and edification. The promotion of university culture to ideological and political education is mainly realized through these aspects. The spiritual culture of university can guide teachers and students to set up correct values, help teachers to cultivate noble moral sentiment and shape perfect personality quality. On the one hand, university institutional culture provides daily norms and codes of conduct for teachers and students; on the other hand, it also enhances their sense of awe and trust in system rules, which can provide institutional guarantee for the advancement of ideological and political education. University behavioral culture infiltrates the content of ideological and political education into a rich and colorful cultural activities, which not only enhances the appeal and appeal of ideological and political education, but also enhances the combat effectiveness and cohesiveness of teachers and students. The material culture of the university provides the material basis for ideological and political education, and continuously expands the resources and carriers of ideological and political education.

#### **3.2 Promotion of ideological and political education to university culture**

The fundamental purpose of ideological and political education in colleges and universities is to guide teachers and students to form a correct value orientation. Therefore, ideological and political education is not only an important part of university cultural construction, but also a guarantee for the direction of university cultural construction, so as to maintain its advanced nature. Ideological and political education work is also an important means of university culture construction, ideological and political education work can effectively guide teachers and students to actively play the scientific attitude of Marxism to examine and analyze university culture, so as to consciously identify and practice the noble university culture.

### **4 Construction of the Double-helix Coupling Interactive Mode between University Culture, Ideological and Political Education**

#### **4.1 Spiral Theory and Coupling Theory**

Spiral propulsion systems method logy, abbreviated as helical methodology and helical system methodology. The author of this theory holds that the solution to the problem does not necessarily have to be a one-time direct attack on the key point. It can take a spiral and circuitous way to repeatedly use a certain method, constantly win the push force, so as to promote the solution of the problem and ultimately achieve the goal. The application of spiral theory fully considers the whole and part of the problem, long-term and short-term, theory and practice, making the solution of the problem more flexible and efficient. The basic spirit of spiral propulsion systems method logy has five main points: (1)

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determining the direction and principal axis according to the initial state of the system and its changing objectives, (2) setting the deviation range relative to the main axis; (3) flexible selection of appropriate methodologies and methods to regulate and control; (4) pushing forward; (5) pursuing relatively limited optimization in the process. The double helix model is a theoretical model based on the spiral theory. It is mainly used to describe the interaction and influence between the two acting factors, as well as the combined effect of the two on the target object, such as the double helix structure of DNA, which can only play the role of instructions under the joint action of the two chains and produce effects on the cell (Chun Dong, 2012) .

In physics, coupling refers to the phenomenon that two or more systems or modes of motion interact with each other through various interactions, or even unite together or form an integration through the interaction of internal mechanisms. It is a dynamic relationship of interdependence, coordination and mutual promotion under the benign interaction among subsystems (Huang Jianjian, Wang Baoqian, 2012) . Systematic coupling theory is a hot issue in the field of system engineering, and related theories are widely used in basic agricultural science, resource utilization and environmental science, economic management and other fields.

#### **4.2 Theoretical model of double-helix coupling interaction between university culture, ideological and political education**

Through the analysis of the relationship between university culture, ideological and political education, we can easily find that there is a coupling relationship between them, which is inseparable, mutual penetration, mutual promotion and two-way interaction. Based on this analysis, this paper establishes a theoretical model of the interaction between university culture and ideological and political education, as shown in Figure 1.



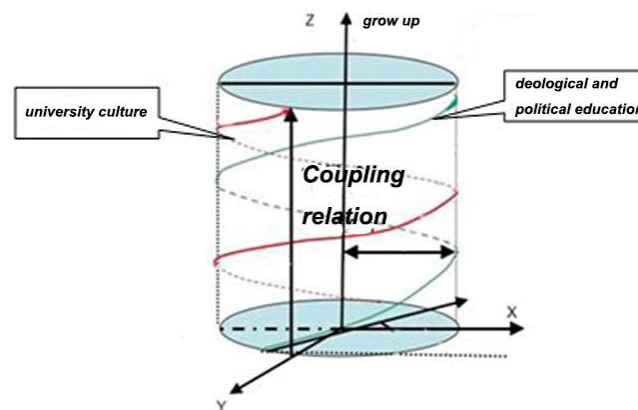
**Figure 1 Theoretical Model of Interaction between University Culture , Ideological and Political Education**

In the above model, university culture and ideological and political education, as two independent educational activities, their own structure makes them appear spiral development trend, respectively on two independent spiral curves, moving forward toward their respective goals. Because the two are intermingled in terms of resources, systems, behaviors, etc., they promote each other in the effect of the effect, and the ultimate goal is the same. Therefore, the two independent spiral curves appear parallel coupling, and finally the double-coiled coupling relationship is presented. It can be concluded that there is a double-helical coupling relationship between university culture and ideological and political education.

#### **4.3 Operation mode of double-helix coupling interaction between university culture, ideological and political education**

The theoretical model of double helix coupling mainly analyzes the static correlation between university culture and ideological and political education from the aspects of objective and content, but

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does not reveal the coupling mechanism and dynamic processional process of the two. Therefore, based on the above research, this paper proposes the operation mode of the double-helix coupling interaction between university culture and ideological and political education (as shown in figure 2).



**Figure 2 Operation Mode of Double-helix Coupling Interaction between University Culture, Ideological and Political Education**

In this model, the construction of university culture and ideological and political education work, as a double chain of moral cultivation, spirals around individual development. The dynamic precession includes breadth precession, content precession and depth precession.

The interactive system of university culture and ideological and political education can be regarded as a whole composed of several relatively divisible parts. First of all, according to the priority of these parts and their interrelation, human, financial and other educational resources, we can make it work orderly from the breadth of rotation. Secondly, we can make a systematic plan for the construction of university culture and ideological and political education, set priorities and do first thing first and promote it spirally in content. Thirdly, the precession triangle cycle theory of system engineering is applied to precession from depth (Chang Shaoshun, 2016). That is, analysis - planning - implementation - reanalysis - reanalysis - reanalysis... The small ring can also be wrapped with big rings, spirally advancing upward until the completion of the transaction and entering the next spiral cycle.

#### **4.4 The realization path of the double-helix coupling interaction between university culture and ideological and political education**

The double-helix coupling model of university culture and ideological and political education is proposed mainly on the basis of their homogeneity and mutual promotion, without considering other interference factors, with a certain degree of idealism (Liu Wei, 2012). Whether they can be scientifically coupled and efficiently promoted in accordance with the expected goals still needs to explore specific practice paths. The author believes that the realization of the double-helix interaction between university culture and ideological and political education mainly includes the following aspects:

4.4.1 Attach importance to the coupling and interaction between university cultural construction and ideological and political education.



University leaders and teachers must deeply understand that the coupling between university culture construction and ideological and political education is an inherent requirement for achieving the goal of talent cultivation, as well as it is also an objective need for college students to grow up and become an effective way to achieve timeliness. The coordination and promotion between the two should be constantly strengthened, and the campus culture and ideological and political education should never be regarded as two juxtaposed subjects to be separated, so that the coupling interaction between the university culture and ideological and political education can be promoted from the behavioral level of unconscious to the ideological level of conscious.

4.4.2 Strengthen the team building of coupling interaction between university culture construction and ideological and political education.

The coupling interaction between university culture construction and ideological and political education is based on the benign interaction between educators and educates. The main body of interaction includes all teachers and students. The realization of the interactive goal does not depend on one department or several departments. It requires the active participation of all teachers and students, and gradually builds up a full-staff interactive main body team.

4.4.3 Improve the working mechanism of coupling and interaction between university cultural construction and ideological and political education.

The positive interaction between university culture construction and ideological and political education is a systematic project, which needs to be guaranteed by a perfect working mechanism. For example, the driving force mechanism to promote operation, the unified and coordinated operation mechanism, and the safeguard mechanism that attaches equal importance to both material and spiritual aspects.

4.4.4 Expanding the activity carrier of coupling interaction between university culture construction and ideological and political education.

Carrier is the bridge and link of the coupling interaction between university culture and ideological and political education. It plays a vital role in the establishment of interactive relationship and the impact of interaction effect (Xu Taobao, 2017). Therefore, actively expanding the carrier of activities from management, media, practice and curriculum teaching is the key path to realize the coupling interaction between university culture and ideological and political education.

## 5 Conclusion

The connotation of university culture consists of spiritual culture, institutional culture, behavioral culture and material culture. University culture, as a kind of subculture, is an important part of social culture. In the process of school development, it naturally embodies many social functions, such as indoctrination, standardization, cohesion, motivation and edification. University culture and ideological and political education have a high degree of consistency.

In the above model, university culture and ideological and political education, as two independent educational activities, have a tendency of spiral development due to their own structure. They are respectively on two independent spiral curves, advancing towards their respective expected goals. Because of their cross-integration in resources, systems and behaviors, mutual promotion in effect and the same ultimate goal, the two independent spiral curves appear parallel coupling, and eventually show

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a double-helix-helix coupling relationship. From this, we can conclude that there is a double-helix  
coupling relationship between university culture and ideological and political education.

At present, the scientific and feasibility are analyzed from the theoretical level. The next step will  
continue to make useful explorations in practice, and find problems and deficiencies in practice in order  
to better guide practice.

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# The Differences of Chinese Vocabulary between Mainland China and Taiwan: A Case Study of Picture Book Title Translation

Jiang Fan

School of Foreign Language, Wuhan University of Technology, Wuhan, P.R. China, 430070

(E-mail: 264045642@qq.com)

**Abstract:** Mainland China and Taiwan are of the same language root, but there are actually many differences in their respective Chinese. This paper tries to take the picture book title as the research object. Through practical examples, this paper compares the vocabulary differences between translators from both sides of the strait when translating the same picture book. Attempt will be made to explore the factors and reasons behind this difference. Based on the comparison of a large number of translated language materials, this paper qualitatively analyzes and summarizes the research results.

**Key words:** Picture book; Title translation; Mainland China; Taiwan Mandarin; Putonghua

## 1 Introduction

The main content of children's picture books is pictures with relatively simple stories and a small amount of text narration. Readers are generally between the ages of 2 and 12. These books “combine the two kinds of arts, language and painting, together by means of re-creation without losing their characteristics, vividly showing the unique material state of book.” (Tadashi Mstui, 1997)

At the beginning of the 21st century, as a large number of children's picture books were translated into China from various countries, the translation of children's picture books gradually entered the field of translation theory researchers. Foreign translators and scholars mainly study the relationship between pictures and sounds in children's picture books, the translator's position, translation practice and power in translation. The mainland has also published related research works, such as Mei Zihan's "Children's Book - Children's Literature of Picture Books", Kang Changyun's "Study on the Reading Process of Children's Picture Storybooks", and Yu Yao's "Reading by Picture Books". In Taiwan there are Hao Guangcai's "How Good is a Picture Book", Lin Meiqin's "What's So Great about Picture Books", etc. Most of these works start with analyzing the characteristics of children's picture books, and explore the standards of excellent picture books and how to read picture books. But the question about the translation of the picture book is not involved.

In contrast, the papers on the journal online are more involved in the translation of the picture book. These papers explain the translation of children's picture books from different angles and provide reference for the research and development in this field. Many translation theories have also been applied in the study of children's picture book translation, such as functional translation theory, skopos theory, feminist theory and other theories.

According to the statistics of periodical network, 208 papers related to the translation of picture books have been published so far. There were 20 master's theses and 7 doctoral theses. Most of them

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discuss some problems in picture book translation from the language level. Research on the translation of picture books still focuses on language, aesthetics and translation strategies. Moreover, only one paper on the comparative study of picture book translation between Taiwan and China has been found.

It can be found that, from a horizontal perspective, the application research of picture book translation is gradually deepened. For example, it is not uncommon to study some Chinese translation of picture book, such as Cheng Xiufang (Cheng Xiufang, 2014). From a vertical perspective, the theoretical study of picture book translation has gradually deepened and began to develop from the perspective of ecological translation theory. Guo Ping said, "From the perspective of ecological translation, this paper aims to explore how to adapt the picture language of picture books to linguistic, communicative and cultural dimensions, so as to do a good job in the translation and introduction of foreign picture books." (Guo Ping, 2013)

The people of both the mainland China and Taiwan are the sons and daughters of the Chinese nation, and the language used is originally Chinese or Mandarin. For more than half a century, the superposition of political, economic, historical and other factors has caused long-term cultural and geographical isolation between the two sides. In this state of complete isolation, the two places have developed their own distinctive language and cultural environment. The lingua franca on both sides of the strait have also experienced some differences in their respective developments. It is called Putonghua in mainland while Mandarin in Taiwan. The difference between words that reflect the most rapid changes in society is particularly evident.

The author of this paper tries to start from the study of the title of children's picture book, which is an important carrier of language, comparing the strategies of the translation of children's picture books on the both sides, revealing the differences in the translation of picture book titles, and analyzing the causes behind the differences.

## **2 Source of Materials and Methods of Analysis**

The object of this paper study is the title of the children's picture book. The main content of the children's picture book is a picture, accompanied by a corresponding simple story and a small amount of textual narrative. Readers are generally between 2 and 12 years old.

The source of mainland books collected is mainly from the current mainstream book websites on the market--- "Dangdang.com" and "JD. com". The other source includes the official websites of Hubei Provincial Library and the National Library. The titles of the picture books in Taiwan are obtained by browsing the "National" Taiwan Library website, the "National" Public Information Library official website and some online bookstores in Taiwan.

Based on a large number of translated materials, this paper sorts, summarizes and analyzes existing title translations by contrast and induction, the research results being qualitative and summarized.

## **3 The Expressions and Causes of Chinese Vocabulary Difference between Mainland and Taiwan**

The differences in title translation collected in this paper are mainly reflected in the following aspects:

### 3.1 Name Translation

A great feature of the drafting children's picture book titles is that they are often named after the hero of the picture book story. There is always a naughty, lovely or naive little hero in most of the picture book stories. The title directly shows the name of this little protagonist to help immediately capture the interest of the little readers, fully mobilizing the children's curiosity, and make them eager to know what kind of adventure or experience the little protagonist will encounter, attracting them to open the book and continue reading.

Therefore, the translation difference of picture book title between mainland and Taiwan is primarily and most reflected in that of picture book titles with names. See the following table 1:

**Table 1 Comparison of Names Translation**

Original English Texts	Mainland's Translation	Taiwan's Translation
①“David Gets in Trouble” by David Shannon	“da wei re ma fan” by Yu Zhiying	“xiao mao re ma fan” by Huang Yuhui
②“Brave Irene” by William Steig	“yong gan de ai lin” by Ren Rongrong	“Yong gan de xiao lin” by Song Pei
③“Max and the Superheroes” by Rocio Bonilla	“mai ke si de chao ji Ying xiong” by Xiao Lujun	“Xiao mai he chao ji ying xiong” by Wang Xinyu
④“Templeton Gets His Wish” by Greg Pizzoli	“xu yuan yao xiao xin” by Xu Yaocen	“xiao dun de yuan wang shi xian le” by Sha Yongling
⑤“Ralph Tells A Story” by Abby Hanlon	“la er fu hui jiang gu shi le” by Li Yiman	“xiao fei de zuo wen ke” by Sun Qingfeng
⑥“Alexander and the Wind-up Mouse” by Leo Lionni	“ya li shan da he fa tiao lao shu” by A Jia	“a li he fa tiao lao shu” by Sun Qingfeng
⑦“Matthew's Dream” by Leo Lionni	“ma xiu de meng” by A Jia	“lao shu a xiu de meng” by Sun Qingfeng
⑧“Gruffalo” by Julia Donaldson	“gu lu niu” by Ren Rongrong	“gu fei le” by Hao Guangcai
⑨“Stuart Little” by E. B. White	“jing ling shu xiao dl” by Ren Rongrong	“xiao bu dian xiao si te” by Wen Tingshu
⑩“Spinky Sulks” by William Steig	“si bin qi fa pi qi” by Ren Rongrong	“shi bin qi sheng men qi” by Liu Qingyan

In terms of translating people's names, the mainland translations are generally faithful to source language, but they are purely transliterated and simple in style. In contrast, Taiwanese translators tend to use the Chinese surname to apply the first syllable of the source language, as in the cases of ⑧⑨⑩.

This practice of letting foreigners' names be Chinese ones is not the creation of Taiwan, but the new cultural movement from the May Fourth Movement. At that time, Lu Xun, Yan Fu and others, the main character of the New Culture Movement, will name them with Chinese surnames when translating

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 foreign people's names. For example: Gao Erji (Gorky)、Xiao Bona (Bernard Shaw)、Zhuo Bielin( Charles Chaplin)、Luo Sifu (Franklin D. Roosevelt) etc. After the founding of the People's Republic of China, the mainland translation field began to emphasize the transliteration of foreign names, the chinesization of foreigners' names being gradually reduced. But Taiwan has followed the practice of domestication translation strategy.

Adding the Chinese character A or Xiao in the front of translated names is a common practice among Taiwan translators. The character Ah or Xiao was commonly seen in Taiwanese nicknames, creating a sense of intimacy, such as examples ① to ⑦. In comparison, the preserving of the original pronunciation in mainland translated names appears to be relatively neutral.

### 3.2 Heteromorphic Synonyms

Here heteromorphic synonyms refer to words with the same meaning but in different forms. See the following table 2:

**Table 2 Comparison of Heteromorphic Synonyms Translation**

Original English Texts	Mainland's Translation	Taiwan's Translation
① "Charlotte's Piggy Bank" by David McKee	"xia lu te de xiao zhu qian guan" by Liu Yang	"xia lv di de pu man" by Ke Qianhua
② "Gangsta Granny" by David Walliams	"liao bu qi de da dao nai nai" by Xu Kuang	"shen tou a ma" by Xie Yawen
③ "Willy The Wimp" by Anthony Browne	"dan xiao gui wei li" by Tang Lin "wo te bie liao jie tun shu" by Xiao Pi	"xun ka wei li" by Liu Qingyan "wo fei chang fei chang liao jie tian zhu shu" by Lai Ciyun "da ye lang" by Ke Qianhua
④ "I Completely Know about Guinea Pigs" by Lauren Child	"da hui lang" by Yang Lingling and Peng Yi	"di song ping zhong xing de ren" by Song Pei
⑤ "Wolves" by Emily Gravett	"piao liun ping song xing ren" by Ye Huli	
⑥ "The Uncorker of Ocean Bottles" by Stead, Erin E		

The above table can be divided into the following former two situations.

#### 3.2.1 Minnan dialect source

Studies show that Taiwan is a bilingual region of the "Taiwanese Mandarin + Dialect" type. Mandarin and many dialects, Minnan, Hakka, Cantonese, Wu and so on, are intermingled and influence each other.

Among the many dialects in Taiwan, Minnan dialect is the largest one. In terms of geographical location, this dialect is widely distributed. The coverage and usage rate in Taiwan is also higher than other dialects. It is undoubtedly a strong dialect. Naturally, it has the greatest influence on the Taiwanese Mandarin, and the dialect vocabulary that enters the national language is also the most. As shown in Table 2, example②and③, "a ma" means grandmother in Minnan dialect. In Minnan dialect, the pronunciation of the foot is also "ka", which is extended to the meaning of people or role. More examples:

Alter John "a gong hui jia"

Tento and the Chain “xiao gou dou dou tao shang la feng de lian zi”

Zloty “ xiao ji che pao de kuai”

The "a gong", "cai niao", "la feng" and "ji che" in these translated names are all derived from Minnan dialect. They are referring to grandfather or grandfather, a rookie, stylish or fashionable and motorcycle in mainland respectively.

### 3.2.2 Old vocabulary

After the founding of New China, the mainland vigorously promoted Mandarin. The simplified Chinese character standardization movement also makes the traditional characters used before liberation gradually replaced by simplified characters. Some of the original ancient Chinese vocabulary and usage gradually disappeared.

After 1949, there was no qualitative change in Taiwan's political system, social life or even people's ideology compared with before 1949. Many words reflecting the old things are still active in the real context. Taiwan still partially retains the language and habits previously used on the mainland, and to some extent retains or partially retains the usage of ancient Chinese, such as “shu si”(bookstore), “bu si”(cloth shop), “pao jie” (salesman), “jiao xi” (teachers) and so on. This makes the Taiwanese language bear more ancient color. See the Table 2 example ①. “pu man” is a crockery of various shapes and sizes in ancient China. The ancients advocated saving, not breaking pu man until it is full. So the ancients called the piggy bank “pu man”. The "Piggy Bank" in this title is translated into the old Chinese word "pu man" by the Taiwanese translator, while the mainland translation is the modern language "xiao zhu qian guan".

### 3.2.3 Japanese loanwords

Taiwan had experienced the period of Japanese occupation as long as 50 years in modern times. During this period, Japan "colonized" Taiwan by imposing the Japanese education and finally made the Japanese language widely used in Taiwan. After the restoration of Taiwan in 1945, the authorities promoted the Mandarin with great success. A large number of Japanese words disappeared from the historical stage as a result of colonial rule, but some Japanese usages still survived and gradually penetrated into the Taiwanese Mandarin. In the mid to late 1990s, Japan began to export its culture to Taiwan, which is geographically close to it. As a strong language Japanese with their comics, animations, TV series and other cultural products once again flooded into Taiwan. The "Hari" phenomenon appeared in large numbers.

It is for these reasons that the Japanese foreign words in Taiwan Mandarin are wide-ranging and large in number. It can be said that Japanese is the most influential foreign language to Taiwanese Mandarin. This influence is reflected in the vocabulary and its content involves all aspects of social life. Many Japanese vocabulary not only integrated into various dialects, but also stabilized as the basic vocabulary for Taiwanese Mandarin, such as: kan hu fu (nurse), ci zhang (deputy minister), chu zhang (business trip), ying hua (movie), qian qin(absence), tie ban shao(Teppanyaki), ect. The

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following examples are also found in the translation of picture book titles.

All My Feelings at Preschool “zai you zhi yuan de gan shou”

The Tiffin “bian dang xun ren qi shi”

How the Subway is Constructed “di xia tie kai gong le”

“you zhi yuan” “bian dang” and “di xia tie” in these Taiwan title translations are all from Japanese foreign words. The corresponding mainland translations are “you er yuan”, “he fan”, and “di tie”.

### 3.2.4 The difference between transliteration and free translation

When translating loanwords, relatively speaking, there are more free translation words in mainland China and more transliteration words in Taiwan. For example:

Nara de film “dian ying kai mai la /she ying ji”

Carnival at the Candlelight “feng kuang jia nian hua /kuang huan jie”

We Won the Lottery “wo jia zhong le tou /cai piao”

Lasers “lei she /ji guang”

Unidentified Flying Objects “you fu/bu ming fei xing wu”

(Note: the former slash is Taiwan translation and the latter the mainland translation)

### 3.3 The Reverse Words

Reverse words here refer to words with the same morpheme and the same meaning but opposite order. The following are some Taiwan translations:

Pandamonia “bie chao xing mao xiong”

Dirty Bertie “zang xiao di feng kuang yuan you hui”

Encyclopedia of plant “tan xun di qiu de quan yuan”

The above underlined translations of Taiwan are opposite to that of mainland. The mainland’s corresponding translations are “xiong mao”, “you yuan hui” and “yuan quan”.

## 4 Conclusions

It is true that there are many differences between mainland Putonghua and Taiwanese Mandarin due to many factors. But after all, the two sides share the same root. Both have a common cultural "gene" - ancient Chinese, which determines that there is a limit to the difference between the two.

In fact, with the close relationship between the two places, their development is inevitably influenced by each other. The differences between mainland Putonghua and Taiwanese Mandarin can be regarded as the manifestation of the development of different personalities of the same language. In addition, with the continuous expansion of cross-strait exchanges and the influence of the world



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informatization trend, the language characteristics of both sides are constantly influencing and promoting each other. The healthy development of Chinese towards a more diversified and rich direction is undoubtedly of great benefit to the improvement of Chinese's international status and the value of communication.

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## **A Study on the Path and Method of the Improvement of University Counselor's Professional Ability**

Yu Qinfang, Wang Meixia

School of Marxism, Wuhan University of Technology, Wuhan, P.R. China, 430070

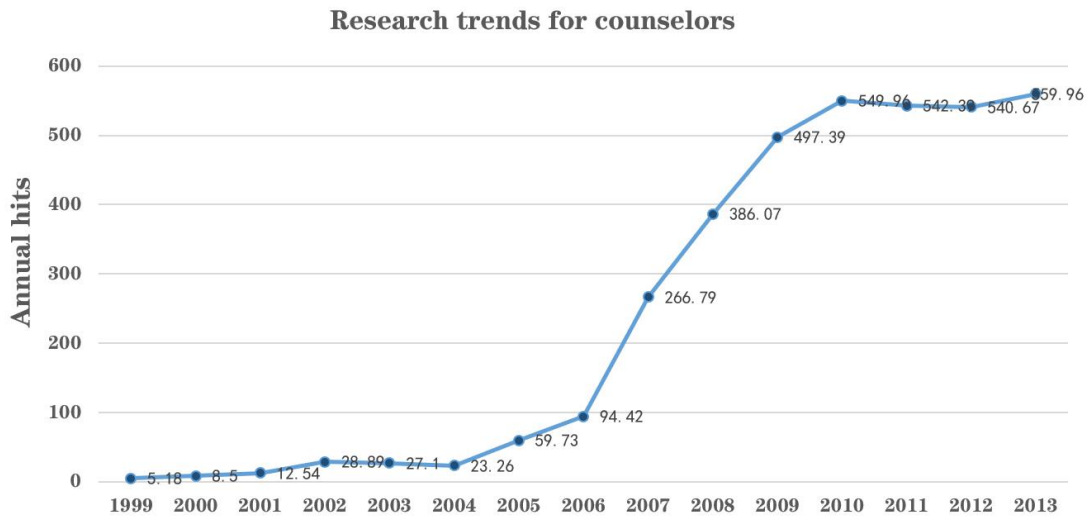
(E-mail: 303228597@qq.com,787659891@qq.com)

**Abstract:** In the university education work, counselors are the implementers of the education work and also play an indispensable part of university teachers. They take on the important responsibility of ideological and political educational work. Along with the rapid popularization of higher education and increasingly changing international situation, there are also new requirements for the work of university counselors. Thus it can be seen that building more professional university counselor team is an urgent task to improve university counselors' work quality. Based on the related policies and theories, this paper studies the connotation and improvement path to university counselors' professional ability. It focuses on the work nature, positioning, requirements and other aspects and puts forward the effective way to promote counselors' professional quality combined with the present situation of research.

**Key Words:** Professional ability; University counselor; Connotation; Improvement path

### **1 Introduction**

Since Tsinghua University established the position of student counselor in 1953, the college counselor system has a history of more than 60 years. In China's higher education system, counselors have always played an important and special role as an indispensable part of college education. In 2004, the CPC Central Committee and the State Council issued the opinions on further strengthening and improving the ideological and political Education of College students. Since then, the work significance of counselors has been affirmed, the work requirements have been continuously improved, the team is growing day by day, and the social attention to college counselors is also unprecedented. (Jiao Jia, 2016) online search for counselors in China under the title of "counselors". From the trend of "Research trend Map of counselors", since the promulgation of "opinions on strengthening and improving counselors in Colleges and Universities and the Construction of Class Teachers" in 2005, the research on counselors has entered a rapid development and has been in a continuous stage (See figure 1). (Lou Hangfang and Bai Binggui, 2017) The research of the scholars mainly plays the role of university instructors (Zhang Anhu, 2019). The current construction status and research path of university instructors (Jingshuang, 2019), the professional development of the college instructors (Zheng Yongting, 2010), the professional development of the university instructors, and the cultivation of the professional ability of the university instructors (Li Lin, 2015), but there are insufficient exploration for the practical improvement of the professional ability of the university instructors.



**Figure 1 Research Trends of Counselors**

As the main undertakers and executors of ideological and political work in colleges and universities, university counselors play an irreplaceable role in promoting university students' healthy growth, maintaining campus stability and prospering the construction of campus culture. Therefore, the improvement of counselors' professional ability is an essential way to the development of moral education in university and the inevitable result of the development of higher education reform in China. However, great mobility, lack of professionalism and ambiguous responsibility assignment of university counselor team still exist, which has affected the counselor's professional ability improvement. At present, economic and cultural situations have changed and the society has made higher requirements of counselors. Under the new situation and based on the current reality and practice, how to actively promote the improvement of the counselor's professional ability is of important significance.

## **2 Connotation of University Counselor's Professional Ability**

Professional ability refers to the capability that a person should have to be engaged in a profession and a series of stable and comprehensive characteristics that a person should possess to work successfully in the specific occupation. It is also an important factor for a person to obtain a sense of personal achievement in this position. The professional ability of college counselors means that counselors are guided by Marxism, based on the reality of contemporary society and college students' growth, taking the national culture of our country as the background, taking the relevant knowledge of developed countries as reference, promoting the all-round development of college students as the goal, relying on the subject of ideological and political education, and applying the theories and methods of relevant disciplines (or related professional knowledge). The state and ability of carrying out ideological and political education effectively. (Zheng Yongting, 2010)

### **3 Connotation of University Counselor's Professional Ability**

#### **3.1 The work nature of the counselor lacks professional identity**

There is no doubt that university counselors are an important part of university teachers. They actually bear the burden of students' ideological and political education. However, as far as the current situation of colleges and universities is concerned, counselors have higher academic qualifications, but many colleges and universities only attach importance to academic research and teaching reform and innovation, attributing the work of counselors to teaching assistance, and there are many differences between counselors and professional teachers in terms of treatment, resulting in the lack of sense of achievement and honor in the work of counselors. Counselors have a low sense of professional identity, lack of enthusiasm and autonomy, resulting in burnout psychological impact in the work and the improvement of professional ability. (Liu Yangyang and Yang Liu, 2019) Although some universities have taken the position competition system for counselors and improved the problem to a certain extent, it is still not objective on the whole. Compared with other university teachers, there are still some differences in the salary, treatment and cultivation, making most of the university counselors fail to really feel that they are members of the university teachers and cannot really dedicate themselves into the promotion of their professional working abilities.

#### **3.2 Weak professional knowledge structure and relatively insufficient educating ability**

Multiplicity and complexity of counselors' responsibility determine that they must have rich professional knowledge which is one of the important basic conditions to do a good job of a counselor. From political theories to the national policies and from the pedagogy, management, psychology, sociology, philosophy and other subjects to students' specific affairs, the national education department has made unified requirements of the knowledge that a counselor should have. The ability is based on certain knowledge, so weak professional knowledge can lead to insufficient educating ability to a certain extent, because carrying on the effective education on students must be based on rich reserves of knowledge. According to the survey, students think that counselors should improve their abilities in psychological counseling, interpersonal communication, analysis and judgment, which requires that counselors should strengthen their professional knowledge learning and constantly improve their educating abilities in various aspects.

#### **3.3 Lack perfect system for the counselor's profession assessment**

To promote the university counselor's professional ability needs to have the perfect professional evaluation standards. Through the inspection standards, universities can regulate counselors' professional ethics and working methods and put forward specific requirements of the counselors' professional abilities so as to achieve comprehensive and objective evaluation of the university counselors' work. However, for the present situation of the counselor team construction, there are seriously short of perfect professional evaluation standards and the evaluation standards between universities are not identical. There is also the lack of specific and feasible evaluation standards for the counselor's selection, training and promotion, leading to unclear direction of the counselor's professional ability improvement, indefinite work of counselors and inactive work attitude. Therefore, it is difficult for them to take the initiative to improve their professional abilities.

#### **3.4 Instability of university counselor team and lagging construction**

Along with the continuous improvement and development of the university education system, university counselors have gradually evolved into a powerful group which exists independently. They, together with full-time counselors, guarantee the students' ideological and political education. But in the

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 current team construction of university teachers, limited importance has been attached to the status of counselors who cannot be evaluated and promoted reasonably. Hence, it is difficult to retain talents. Most people do not think highly of counselors and they even feel they are unable to get the respect from people. In the meantime, the counselor's professional belonging is indistinct and there is also the lack of corresponding system of professional training. Counselors are also short of skills and basic experience related to education management.

The current popularity of university education has brought many problems to campus management and made the school leaders focus on funds, relationships, appraisal, employment rate and other factors. There is no related overall planning or strong economic guarantee for the construction of the counselor team. In addition, the lack of competent leadership's awareness of management and development also leads to lagging construction of the university counselor team. Under the influence of traditional ideological and political education thoughts, counselors mainly give priority to practical work and ignore the learning of relevant theoretical knowledge. Therefore, they cannot really improve their rational knowledge or the teaching ability, making the counselor team construction gradually cannot adapt to the objective law of efficient development or meet the internal logic of counselor team development.

#### 4 Effective Path to the Improvement of University Counselor's Professional Ability

There are many difficulties in the improvement of the professional ability of college counselors, and the effective promotion path is proposed in a targeted way. Through the various methods of improving the professional ability of college counselors, the author summarizes the three aspects of constructing training mechanism, perfecting relevant systems and stimulating self-cultivation, see figure 2.

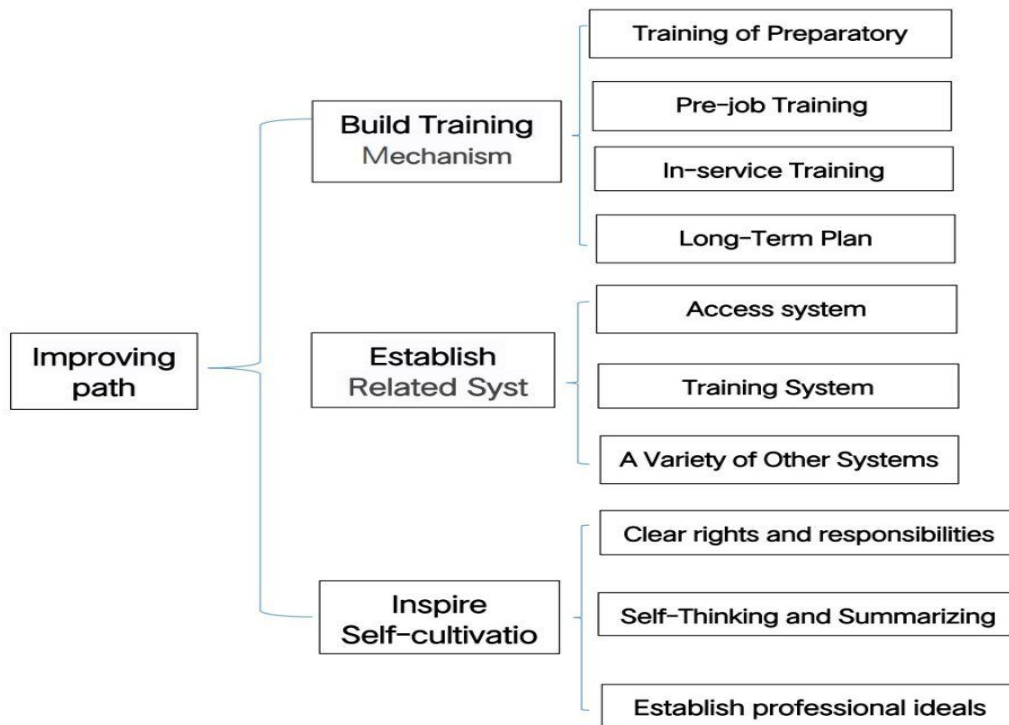


Figure 2 Effective Path to the Improvement of University Counselor's Professional Ability

#### **4.1 Strengthening quality training and constructing mature training mechanism**

For the educational training of university counselors, universities should not only guide them in theoretical learning, but also pay attention to the cultivation and exercise of the ability to practice. This is a systematic and coherent task. Therefore, a university must be based on its actual construction situation and consider how to build its counselor team and ensure the permanent vitality of the counselor team from a long-term perspective. The training of counselors in colleges and universities should reflect the characteristics of multi-level and wide fields:

The first level, the establishment of preparatory personnel training system. At present, many colleges and universities are equipped with part-time counselors for full-time counselors, mainly by excellent student cadres. On the one hand, they provide a practical opportunity for students, on the other hand, they can also be regarded as pre-service training for college counselors. These part-time counselors often have the idea of engaged in the counselor industry, colleges and universities should seize this opportunity to bring part-time counselors into the training mechanism to improve their professional and professional abilities (Sun Yu, 2017).

The second level, the establishment of pre-service training system. After the counselors sign the appointment contract with the school, they should accept the pre-service training held by the school, train first and then take up the post, and those who do not pass the assessment will not be accepted. The contents of the training include ideological and political theory, sociology, psychology, pedagogy, management, responsibility of counselors, management system and so on. At the same time, the present situation of ideological education of the students in our school is introduced, so that counselors can have a preliminary understanding of their work and present situation, and carry out their work more pertinently. The Standard stipulates that counselors need to receive 40 hours of induction training. The effect of induction training is related to the ability of counselors to get started quickly. Therefore, colleges and universities should make scientific training plans, strive to make counselors have a clear grasp of the basic knowledge and professional skills needed for their work in an effective time, and deepen the counselors' understanding of the work. Colleges and universities should provide corresponding food and accommodation arrangements for the induction and training of counselors, so that new counselors can feel the care of colleges and universities and avoid other worries about their lives outside of work.

The third level, the establishment of on-the-job training system. A variety of training methods to increase their on-the-job training opportunities, or through hanging up training, or social training, or special training, or post rotation or inter-school communication, to promote their continuous study of students' work theory and related knowledge, timely knowledge reserve and update, at the same time improve the practical ability of counselors, accumulate work experience to gradually improve the professional ability of this team. In-service training should mainly focus on the new problems or policies that arise at present to train counsellors. This kind of training has strong professionalism and practicability, and can quickly improve the vocational skills of counselors and promote the improvement of their work effectiveness. In-service the training should pay attention to the selection of time and address. It is better to carry out the time period where the instructors work in hand are relatively loose. After the training, a set of scientific theoretical papers or practical operation shall be set up to assess the instructors to inspect the effect of the training. Of course, the establishment of a perfect training mechanism is dependent on the feedback and suggestions of the group of instructors. After each training, the training effect should be investigated in order to provide the basis for the improvement of the next training.

The fourth level, the construction of sustainable development model. The development and promotion of the overall professional ability of counselors is a relatively long-term process. It is necessary to further emancipate the mind, focus on the reform of mechanism system and system innovation, formulate a long-term development plan and system management model for the construction of counselors, deepen the reform of counselors' job evaluation and employment system, the de-administrative reform of academic resources, the reform of salary system, and improve the academic governance system. With the system design to promote the construction of the team to improve quality and efficiency. So that the ability of counselors can be followed, degree can be followed, clear direction of promotion, so that the team to move forward healthily.

#### **4.2 Consummate the regulations and systems and promote steadily specialization cultivation**

The counselor team construction should be on the premise of system reform, the key of system specification, the core of professional training and the soul of shaping of professional spirit. The premise of counselor professionalization is the earnest professional training work. Strict selection and training system and professional development are the effective guarantee to improve the professional knowledge and skills of counselors, promote their working ability, management ability and psychological quality. It is necessary to thoroughly change the original mode of thinking, actively create conditions on the basis of emancipating the mind and seeking truth from facts, unswervingly follow the development road of professional training and professionalization, encourage and support counselors to design themselves according to different educational experiences, knowledge background and personal characteristics, and perfect and improve themselves according to certain professional directions.

On the one hand, colleges and universities should strictly restrict the admission system of counselors and improve the qualifications and conditions of selection and employment. Strict selection and employment access mechanism is the premise to ensure that the counselors have strong politics, good business, strict discipline and positive style of work, and is the basic condition to improve the professional ability of counselors. It is necessary to strictly choose academic qualifications and professional background. Counselors must have a master's degree or above, and their professional requirements must be based on ideological and political education, taking into account psychology, management background and other similar to the nature of their posts, from the source to improve the professional knowledge and skills of counselors, to promote their comprehensive quality and ability. As far as possible, counselors choose people who have had part-time counselors, student unions and other related experiences in colleges and universities, and assess their language expression ability, interpersonal communication ability, teamwork ability, organization and management ability, active learning ability, crisis response ability and psychological quality through interview and examination.

On the other hand, colleges and universities should pay attention to and perfect the training mechanism of counselors, establish training bases, optimize the training content, carry out the coordinated training contents of pedagogy, management, psychology, sociology and other disciplines at various levels, pay attention to the cultivation of counselors' organizational leadership ability, social practice ability, psychological consultation and employment guidance ability, improve the level of counselors' knowledge and skills in an all-round way, and expand the form of training. Pay attention to the actual effect of training, with high foresight, development, innovative thinking to promote the professional and professional development of counselors. (Lin Weiyi, 2017)

Universities must designedly build the counselor echelon, care for and support the cultivation and utilization of counselors as attaching great importance to the teaching and scientific research backbones, practically improve their statuses and treatment, make the counselor post a new profession with distinctive professional characteristics and prominent industry features and make student management work one of the important posts which allow universities to attract and absorb high-competence talents.

Universities which have conditions can gradually set up the master's and doctoral degree courses for counselors to cultivate academic and professional master and doctoral counselors. There are many factors affecting the development of university counselor specialization. The most direct restraining factor is the system construction. Without a sound, objective, standardized and scientific regulatory framework as the support, the counselor professional development and professional cultivation will be meaningless. Universities should strengthen the construction of system to guarantee, regulate and promote the counselor's professional cultivation, and constantly perfect the counselor's work responsibility system, cultivation and training system, post appointment system, assessment and evaluation system, qualification certification system, position and title promotion system, salary system of rewards and punishments, etc.

#### **4.3 Improve counselor's active growth awareness and motivate counselor's self-cultivation and improvement**

The work of counselors must get rid of the past situation of "much, disorder and miscellaneous work". The competent department should make the counselor duty manual to help counselors be clear about their own responsibilities, specific work content and the specific working methods with the combination massed learning and self-learning. They are encouraged to follow the objective law and play their own subjective initiative to consciously and independently make innovations of thoughts and methods, actively learn the latest professional theoretical knowledge, such as pedagogy, psychology, sociology, ideological and political education theories and methods, employment and entrepreneurship guidance. The counselor training system should be perfected with the combination of theory and practice to pay attention counselors' understanding of improving theoretical knowledge in practice and the counselors' self-thinking and self-summary and periodically evaluate the gains and losses of their own work so as to reach the purpose of learning lessons and summing up experience. Through teaching appraisal activities, counselors can consciously take the initiative to improve their teaching skills, apply theories they have learned to teaching in time and further enhance their professional abilities and skills. The most crucial thing is that counselors should change ideas and establish professional ideals. The lack of counselors' professional ethics will bring great losses to their own development and students' educational management. Therefore, counselors must promptly change from the ideological awareness and put the personal professional ethics in a high status to realize that the counselor's work is not only a career for living, but also a great cause of education so that they can arouse the inner love for the education work, recall the commitment of deciding to dedicate themselves into the education when choosing the work, shoulder their glorious mission and establish their own professional ideals again.

## **5 Conclusion**

Colleges and universities are the cradles of talent cultivation and stability and development of the colleges and universities are closely related to successful and effective university students' ideological and political education work. University counselors play an important role in the university ideological and political education. Therefore, to establishing a team of counselors with high professional abilities is an irresistible and imperative trend. To improve university counselors' professional abilities not only needs their own unremitting efforts, more depends on the constant deepening of the university's reform of cadre and personnel system, establishment and perfection of the corresponding social evaluation system. Only building a team of high-quality counselors based on professions and supported by the practice can practically ensure the pertinence and effectiveness of ideological and political education work and then provide a powerful guarantee for the cultivation of university talents.



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# The Predicament of the Current Home-based Elderly Care Service in China and the Countermeasures for the Rule of Law

Xu Zhihua<sup>1</sup>, Zhao Jing<sup>2</sup>

1 School of Law, Zhongnan University of Economics and Law, Wuhan, P.R.China, 430070

2 School of Law, Zhongnan University of Economics and Law, Wuhan, P.R.China, 430070

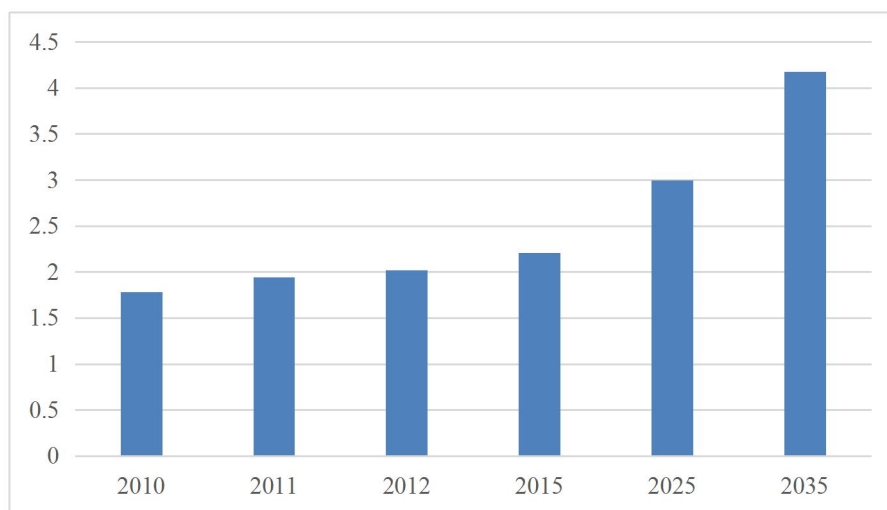
(E-mail:superxzh@aliyun.com, 277864911@qq.com)

**Abstract:** Based on the current situation of home-based elderly care services in China, this paper objectively evaluates the research status of home-based elderly care services, and points out that there are many problems in the practice of home-based care services. On the basis of analyzing the causes of the problems, it puts forward some suggestions on the construction of the legal system for home-based care services: it is believed that the home-based care service must be specifically enacted, the legal system for fund protection should be constructed, and the regulatory legal system should be improved, thus drawing the conclusion that government must vigorously promote the rule of law for the home-based elderly care service in China.

**Key words:** Home-based elderly care service, Financial security system, Regulatory system, Legalization

## 1 Introduction

The aging of the population is a major social issue in the 21st century and a major feature of human development in the new century. From 2015 to 2035, China will enter a period of rapid aging, and the elderly population will increase from 212 million to 418 million, accounting for 29% of the total population. At present, with the changes in China's demographic structure and the normalization of population movements, "family elderly care" have become extremely difficult, and "home-based care for the elderly" has become the best



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choice for reforming aged care services in the new era. Chinese government has required the establishment of an institutionalized residential care service system since 2011, and now various local regulations have been issued successively. The legalization, systematization and institutionalization of home-based elderly care services need to be determined urgently. Therefore, it is a pressing matter in the field of theory and practice to construct a legal system of home-based care services with Chinese characteristics to meet the new requirements of China's market economy for old-age services.

**Figure 1 Number of Elderly People (Unit: 100 million people)**

Home-based elderly care has been developed from the proposal to the institutionalization for many years, and rich achievements have been made in theoretical research, scholars mainly show different opinions on the main body and content of home-based elderly care services.

On the main body of home care services, Lester Parrott (2003) believes that the elderly, the government, and social groups, including the community, are the mainstays of services, forming a social service network between them, and providing social services through the integration of social resources (Lester Parrott, 2003). Sherry Anne Chapman (2002) and Hillel Schmid (2004) mainly discuss the government's dominant position in the system in the main research. In the construction of the community care service system, the government not only provides financial security services, but also plays a role in ensuring the quality of care services.

On the contents of home-based elderly care services, A. Pavey & D. Pstios (1999) argues that the main body of care service can be divided into two modes: formal care and informal care. He believes that formal care is provided by a government or specialized agency with certain authority and formality. Old-age care services, rather than formal care, are more based on the provision of old-age care services provided by families, relatives and friends based on natural ethics. Wang Zhen (2018) and Yao Hong (2018) regard the contents of services rely on the community and family, and leading by the government (Wang Zhen, 2018; Yao Hong, 2018). Pan Liping (2019) believes the services contents including the basic public elder care services provided by the government, and the professional services provided by enterprises and social organizations, at the same time autonomous mass organizations at the grass-roots level and volunteers to provide public welfare support services (Pan Liping, 2019).

Western countries pay more attention to empirical and applicable research because of their traditional thinking mode. domestic scholars focus more on the orientation of home-based elderly care services, and less on how to effectively promote the operation of home-based elderly care services and achieve good social effects. In the research process, there are too many theoretical analyses, and the case analysis and reference are few.

## **2 The Analysis of Legal Relationship in China's Home-based Elderly Care Service**

Legal relationship is the relationship between rights and obligations formed by social relations through legal adjustment. The subjects of legal relations are generally two-party. When studying the legal relationship of home-based elderly care services, because they contain multiple legal relationships, they need to be discussed separately.

The first is the legal relationship between the government and the elderly, which is mainly based on the constitutional and legal provisions of civil rights and obligations, and these rights and obligations also apply to the government and the elderly in the home care service. In the legal relationship between the government and the elderly, the government has the obligation to carry out home-based elderly care services, and the elderly have the right to demand that the government to achieve good elderly care services.

Second is the legal relationship between the government and the service provider. The government can provide services in specific communities in the form of purchasing home-based care services, and the social institutions that have won the bid directly provide elderly care services to the elderly. In this way, the government and the service provider form a legal relationship according to the provisions of the "Government Procurement Law" and other laws and regulations, including the government's obligation to publish the bidding information and guarantee the fairness of the procedure, while the social organization is responsible for submitting the bidding documents, and to ensure they compliance with the conditions of the bidding conditions. After winning the bid, the government signs a service agreement with the service provider. The specific rights and obligations are mainly stipulated in the agreement, but are also subject to the adjustment of the "Contract Law" and other laws. After signing the agreement, the government and the service provider form a new legal relationship. The government has the obligation to pay the fees according to the regulations, and the service providers are required to carry out the construction of home-based elderly care services according to the agreement. According to the agreement, the service provider has the right to request the government to pay the fee on time, and has the obligation to provide high-quality home-based care services.

Finally, the legal relationship between the elderly and the service provider based on the signed home-based elderly care service contract. The contract mainly stipulates the obligation of the elderly to pay the expenses on time, the obligation to accept the management arrangement of the service provider and the right to enjoy the good care service in a timely. According to the contract, the service provider has the obligation to provide care services to the elderly, the obligation to protect the security, the obligation to inform in a timely manner, etc. Meanwhile, it also has the right to ask the elderly to pay the service fee on time, and to modify the management method after soliciting opinions, etc.

### **3 Existing Legal Problems of Home-based Elderly Care Services in China**

At present, many regions in China have started to build home-based elderly care services, and they have begun to take shape. For example, Shanghai Government vigorously promotes the construction of “house for the care of the elderly”, promotes the integration and development of “institutional, community, and home” aged care services, integrates various types of elderly service resources, and builds a “15-minute home care service circle” in the urban area. Haishu District Government of Ningbo actively carried out socialized home-based elderly care work. After more than ten years of development, it took the lead in constructing a new community-based socialized home-based care service platform, and embarked on a “social elderly care home-based, home-based elderly care socialization”, the basic way out for the problem of social elderly care. Wuhan Government provides services for the elderly, such as food, cleaning, medical assistance and remote care, through the “three-in-one” development model of “community embedding, central radiation, and unity”, promote the development of “Internet + home care for the elderly”, and so on. However, due to the lack of a good legal system to guarantee them, many problems inevitably arise.

#### **3.1 Lack of legislation makes it difficult to establish a unified legal system for home-based elderly care**

The legislative style of the home-based elderly care law in our country belongs to the decentralized legislative system. At present, the comprehensive “Home-based Elderly Care Law” has not been formulated and promulgated. Its provisions are scattered in laws, such as the Law on the Protection of the Rights and Interests of the Elderly and various separate regulations, rules and policies. The contents cover a wide range of areas and have different levels of effectiveness, which has brought some difficulties in the implementation of the current practice of elderly work in China. In recent years, although the state has advocated the development of a model of home-based care for the elderly at the policy level, various local governments have also promulgated a number of special local policies for home-based elderly care services. From the perspective of legal texts, it is rich in content, but it is not ideal in practical applications. The reasons are as follows: the above-mentioned normative legal documents are mainly based on the principles of advocacy, lack of provisions on the rights and obligations of each subject, and lack of detailed provisions on the rules directly applicable to specific problems, which lead to numerous difficulties in the implementation process. Especially for the specific system of home-based elderly care law, such as long-term care medical insurance system, home-based pension institution investment and financing system, etc. are still based on the provisions scattered in other laws. The current legal system of home-based elderly care established by the above-mentioned legal documents does not have strong substantive normative function, nor does it conform to the codification style of comprehensive legislation in the sense of text. Due to the lack of the upper-level law of the home-based elderly care system, the legislation for the home-based care service in China lacks systematicness.

### **3.2 The legal system for home-based elderly care service funds is not sound enough**

At present, most countries encourage social forces to participate in the development of public service projects. However, in China, home-based elderly care services are still more biased towards national government responsibilities. Many regulations stipulate that the government should ensure that the home-based care service funds are adequate, with the expenditure of the financial budget and the revenue of public welfare lottery as its largest source of funds. As far as the current national policies and local regulations are concerned, the funds for home-based elderly care services are mainly based on the government financial support, while ignoring the functions of the family and society. Social capital has only made a simple "encouragement" provision in the regulations, which is not clear about its legal positioning and cannot give trust to social capital. As a result, the fund guarantee system is not sound, which is manifested in the following aspects: first, the home-based elderly care service market is relatively chaotic. Without a stable market environment, it directly leads to a small proportion of investment in social capital, and it is impossible to form a diversified source of funds for home-based elderly care services. Second, governments at all levels have not yet formed a long-term stable home-based elderly care capital investment planning system, but decided short-term investments based on the fiscal revenue and expenditure budget. Third, China's pension fund investment tax incentives, pension institutions tax incentives and other policies have stimulated the enthusiasm social capital for participating in the housing service, but in general, most of the urban home care services in China are still insufficient.

### **3.3 Weak legal supervision and evaluation mechanism for home-based elderly care services**

In the process of developing home care services, China has paid too much attention to how to build and promote, while ignoring relevant regulatory issues. The evaluation and supervision system plays the role of testing the results of service operations and is the institutional guarantee for its long-term operation. At present, there is no supervision and evaluation system for home-based elderly care services in China, and there is no special supervision department for home-based elderly care services. The corresponding communities rarely make self-assessments on a regular basis. The lack of supervision is the reason for the low level and low quality of residential services. However, if the quality of services is not improved, the elderly or their families will not trust the service, which is not conducive to the development of the service industry. It is also an important reason for the large amount of home-based elderly care demand and low actual utilization in China.

## **4 Improve the Rule of Law in China's Home-based Elderly Care Services**

### **4.1 Establishing a new concept of legislation for home-based elderly care services**

In the process of institutionalization of home-based elderly care services, legislation should be the first step, and some adjustments should be made in the legislative concept. From the perspective of multiple subjects, each role should be configured to establish a multi-linkage, harmonious and unified legal system for home-based elderly care services.

First of all, clarify the legal relationship of multiple subjects. The concept of home-based

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elderly care is a broad understanding of multi-party subjects. Governments, society, families, and communities all have the obligation to implement the care responsibility. The rights and obligations of multiple subjects constitute the legal relationships; home care service legislation should be included in these subjects. In the legal system of home-based elderly care service, multiple subjects have their own positions and are related to each other. It is of great significance to clarify the relationship between them in order to achieve effective cooperation among the subjects.

Second, clarify the results-oriented concept in regulation. The implementation of home-based care services should adhere to results-oriented, and the government, as the leader, should systematically investigate the operation and results of home-based elderly care services, timely grasp the advantages and disadvantages existing in the system operation, and make appropriate adjustments, so as to enable the whole service to achieve predetermined social benefits. Therefore, the results-oriented evaluation method should be clarified in the legislation of home-based care services. As the manager of public service, the government should accept more supervision from the society. It has the obligation to guarantee the quality of public service and fulfill the initial goal of public service in the most effective way. The fulfillment of these obligations requires social supervision and evaluation. Insist on result-oriented thinking is actually to better sum up experience and improve home care services.

#### **4.2 Build and improve the legal system for supervision of home-based elderly care services**

Establish a performance evaluation system for home-based elderly care services and give legislative confirmation. In terms of performance evaluation, China has affirmed and supported it in the form of law. The performance appraisal system should be constructed from the following aspects:

- a) Clarify service standards, including standards for service providers' standards and service methods. Standardization of service providers means that institutions are effectively regulated before they engage in the industry. For example, the capital of an institution, the professionalism of its employees, the completeness of supporting facilities and the social satisfaction with relevant responsibilities should be taken as the criteria for participation;
- b) Strengthening the government's supervisory responsibilities for public services. The important reference for regional government performance appraisal includes the implementation of service projects;
- c) Provisions on evaluation subjects in the performance evaluation system. Because the government has the responsibility to supervise the public service projects, it can evaluate the home-based care services. The government's evaluation of public services should mainly reflect the supervision role of service providers, and it should not be divorced from the reality by attaching too much importance to the results.

#### **4.3 Constructing a legal system for the protection of home-based elderly care funds**

First, the legal status of social capital is clarified. According to the 13th Five-Year Plan for National Economic and Social Development, there are two ways for social capital to participate in public services and achieve diversified supply: one is social capital and government cooperation; the other is when social capital can directly provide services, the government purchases services from them. Social capital should also be widely understood in the home-based care service system. Through the government and social capital cooperation, jointly set up the service centers for the aged in the community to provide the elderly with residential care services. Social capital will invest in the establishment of elderly care service institutions, and get the qualification to provide home-based elderly care services by participating in the government purchase method when meeting the needs. The social capital in home-based care service mainly refers to social organization. The social capital discussed in this paper not only refers to social organizations, but also includes social donation and social charity.

The second is to establish a legal system for social nursing insurance. Social nursing insurance and endowment insurance are different: social nursing insurance objects are more extensive and not limited to workers, freelance workers and farmers must also become the main insured. The conditions for enjoying rights, in addition to reaching a certain age, there are cases of illness and other self-care disability. Payment to the caring service as the principle, money payment as a supplement. Social nursing insurance is also similar to endowment insurance, both of them are stipulated by national compulsory legislation, and they assume the responsibility of achieving a more comfortable aged care in the future. Compared with social medical insurance, social nursing insurance is not responsible for the illness and the cost of illness treatment, but is responsible for the people who were illness and cannot take care themselves, and is responsible for the payment of caring services. Social nursing insurance can also be used as a source of funding for home-based care services. After insuring social nursing insurance, it is not necessary for the elderly to take out the pension and buy the aged care service. Instead, they can enjoy the aged care service directly under the social care insurance system.

## **5 Conclusion**

China's home-based care service system has initially formed a relatively complete theoretical system and institutional system, and played a greater role in relieving the survival pressure of the elderly. However, we cannot ignore the existing legal problems of home-based care services, for example, China has not yet formed a unified legal system for home-based care for the elderly, the legal system for financial security for home-based care services is not sound enough, and the legal supervision and evaluation mechanism for home-based care services is weak. Therefore with the maturity of home-based elderly care service in our country, we need to standardize the construction of the rule of law, establish the principles of home-based elderly care service by legislation, and improve the corresponding diversified



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supervision system and fund-raising guarantee system in the statute law, and to ensure the long-term sustainable development of the system. Under the premise, we can further expand the content of the system and deepen the development. The legal system of home-based elderly care services can play the biggest role in China and provide a strong guarantee for the construction of a socialist harmonious society.

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## **The Discussion on the Curriculum Management of Undergraduate Voluntary Service in University**

Chen Yinghua

Youth League Committee, Wuhan University of Technology, Wuhan, P.R. China, 430070

(E-mail: 87066728@qq.com)

**Abstract:** Focusing on the curriculum management of undergraduate voluntary service, this paper makes a theoretical study on the basic connotation of undergraduate voluntary service education, and reveals the necessity and feasibility of constructing a voluntary service curriculum system in universities. The curriculum structure was put forward that courses of theory study, service practice, environmental education and feedback sharing can be combined. It is believed that the effective way to promote the curriculum management of undergraduate volunteer service should focus on the system construction of the volunteer service curriculum including the syllabus, course materials, teachers' troop, practice platform and evaluation system. This paper drew a conclusion that curriculum management of undergraduate voluntary service has difficulties in ideological understanding, resource support, system management, etc. Only by correctly understanding the curriculum, promoting the coordinated development with teaching and establishing a network management platform for voluntary service curriculum, can we effectively promote the normalization, specialization and standardization of undergraduate volunteer service.

**Key words:** Universities; Undergraduates; Voluntary service; Curriculum; Management

### **1 Introduction**

The appearance of voluntary service has distinct characteristics of the times, it is the product of social development at a certain stage. Some foreign countries carried out voluntary service education earlier. By setting up special voluntary courses and designing servicelearning segment, many countries with a high level of volunteer service development have incorporated volunteer service into the education system to guide students to establish a sense of social responsibility and civic awareness.

The introduction of voluntary service into school education in the United States originated from the "service learning" concept in the 1980s. American voluntary service course is an experiential teaching method that takes students' learning, school education and social needs as three orientations, takes professional course and non-professional course as the main content, takes community service organization as the medium and takes activity record, credit certification, reward and punishment incentive as the evaluation method (Chen & Luo, 2016).

After the 1980, voluntary service was incorporated into the school education system in Japan. In Japan, voluntary education is mainly carried out in two ways: voluntary service

included in formal school curriculum and voluntary service outside formal curriculum. By 1999, more than 100 universities were actively conducting educational experiments to incorporate volunteering into their formal curricula. Apart from the United States and Japan, the United Kingdom, Germany and other western developed countries have all attached great importance to the voluntary service education for teenagers. The contents, methods, means, approaches and management of foreign voluntary service curriculum system are relatively systematic and standardized, which are worth learning by Chinese scholars.

Due to the differences in national conditions, the voluntary service curriculum system adopted by each country is based on respective national conditions and school conditions with its own characteristics and emphasis. Before 2008, there were no voluntary service courses in Chinese education system. After the Beijing Olympic Games, under the promotion of large-scale activities such as the Shanghai World Expo 2010 and the Guangzhou Asian Games, voluntary service was unanimously recognized by education administrative departments, schools and students. In 2009, the ministry of education issued *The Opinions on Deepening Student Voluntary Service Activities*, whose policy spirit and relevant deployment set up a platform for developing voluntary service education. At present, the voluntary service courses for university students are only in the pilot stage and have not been popularized comprehensively.

The general research idea in this paper is from theory to practice. Following the logic of asking questions, analyzing and solving problems, we will study how to construct the university voluntary service curriculum model from following four aspects: theoretical teaching courses, service practice courses, environmental education courses and feedback sharing courses. And we will further promote the normalization development of voluntary service education in universities. From the aspects of syllabus, course materials, teacher team, evaluation system, and practice platform, we will study the construction of a scientific and perfect management system of voluntary service course to improve the effectiveness of voluntary service education.

## **2 The Connotation and Significance of Voluntary Service Curriculum for Undergraduates**

### **2.1 The connotation of voluntary service curriculum**

Voluntary service generally refers to the service provided by anyone who voluntarily contributes his or her own time and energy to the promotion of human development, social progress and social welfare undertakings on the premise of not obtaining material rewards (Zhang, 2011). For universities, voluntary service is not only an important cultural carrier for moral cultivation, but also the intrinsic motivation for undergraduates to grow into talents and an effective form of practical education. The curriculum of university students' voluntary service is to bring the voluntary service education into the course of ideological education theory. The curriculum of voluntary service not only emphasizes the volunteerism of university students, but also emphasizes that college students should internalize the spirit of voluntary service in this process, turn it into knowledge reserve, and contribute to serve the society. Therefore, it is necessary for colleges and universities to construct the curriculum

structure of undergraduates' voluntary service and establish the generalized curriculum concept, that is, "all the efforts made by schools to promote students' knowledge growth, ability improvement and quality cultivation in a purposeful and planned way can be called curriculum" (Jin, 1996). The curriculum structure of undergraduates' voluntary service will be composed of four modules: theoretical learning, service practice, environmental education and feedback sharing. Under the guidance of curriculum, undergraduates will gradually learn voluntary service knowledge through "curriculum content", and cultivate correct service awareness and responsibility.

## **2.2 The significance of voluntary service curriculum**

In terms of theory, research for undergraduate volunteer service course is helpful for promoting the development of voluntary services education in colleges and universities. It helps to explore the standardization operation of voluntary service course, the new thoughts and new methods of process management. It also enriches theory knowledge in the field of voluntary service and provides theoretical basis for research on volunteer service curriculum in university. The course in the curriculum structure module is not a simple split, but it takes theory study as the foundation, service practice as the core, environmental education as the supplement, feedback sharing as the promotion. The four major course modules complement and relate to each other for completing the mission of undergraduate' voluntary service course collectively.

In terms of practical application, firstly, normalized development of voluntary services should be stimulated. Undergraduate voluntary service needs to be organized, managed and assessed in a planned, organized and standard way, so as to make university volunteer service professional, standardized and long-term. Secondly, the effectiveness of voluntary service practice and education should be promoted. The theory and practice of voluntary service should be incorporated into the ideological and political teaching to give full play to the educational function of voluntary service, cultivate the comprehensive quality and social responsibility of contemporary college students, and make them become the practical carrier to practice the core socialist values. Thirdly, the innovation of the voluntary service curriculum system should be propelled. It promotes the development of teaching syllabus, curriculum materials, teachers' team, practice platform and evaluation system to cultivate students' ability of practice and innovation, and provide a new beneficial model for the innovation of education reform. The fourth is to achieve mutual development of students, universities and society. Combining the teaching objectives of voluntary service with social needs, establishing voluntary service courses to promote the cultivation and integrated development of students' comprehensive quality, and integrating social service experience into the process of education can make universities play the real role. The combination of the voluntary service's teaching objectives with social needs can create great social and economic wealth (Prentice & Garcia, 2000).

## **3 The Main Difficulties and Reasons in the Curricular Management of Undergraduate Voluntary Service in Universities**

The curriculum of undergraduate voluntary service is a meaningful attempt in colleges

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and universities, and there is a process for people to understand it. With the gradual deepening of the voluntary service curriculum, some aspects that are not mature and perfect become increasingly prominent, and it is easier to encounter various difficulties and obstacles in the process of trying. Therefore, the curriculum of voluntary service in universities is a process of constantly discovering problems, seeking countermeasures and improving innovation.

### **3.1 Lack of systematic management in curriculum leading by deficient ideological understanding**

As a feasible system design, the curriculum of undergraduate voluntary service is short of management experience and ideological understanding. Problems of thinking and cognition among university leaders, teachers, administrators, students and the society will be firstly met in the curriculum. At present, undergraduates are enthusiastic about voluntary service, but their rational participation is not enough and the sustainability is not strong. Although there are some measures for the curriculum management of undergraduate voluntary service, there are problems such as disorder and formalization.

### **3.2 Lack of internal motivation in curriculum management leading by shortage of supporting resources**

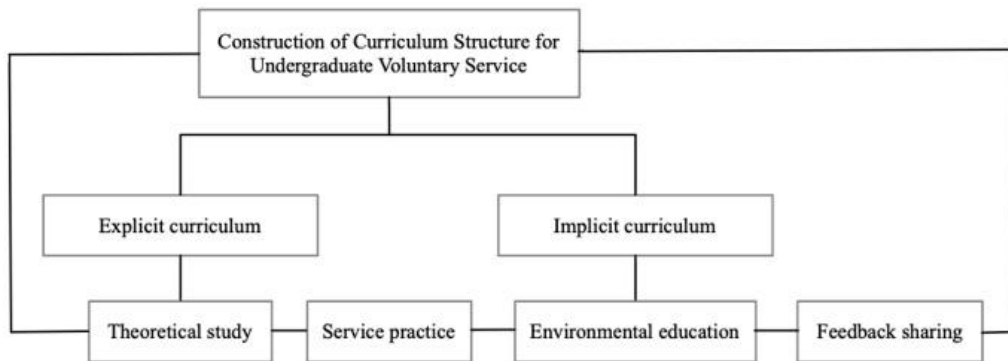
The curriculum management of undergraduate voluntary service has not yet taken shape in colleges and universities. The implementation scope of compulsory courses and elective courses is generally small, so the support of curriculum resources should be strengthened. The curriculum management of undergraduate voluntary service should follow the law of practical education, which requires the cooperation of all departments of colleges and universities. However, at present, there is a lack of unity between various departments of colleges and universities, which makes it difficult to form resultant force and scientifically design each link, resulting in serious shortage of course resources. Therefore, the current situation of university curriculum is not conducive to the implementation of curriculum management, lack of voluntary service curriculum management to promote the growth of internal power.

### **3.3 The insufficient effect of curriculum management leading by unsound system**

The curriculum of undergraduate voluntary service is conducive to improve the initiative of students to participate in voluntary service. However, there is still no reasonable scheme for how to plan and formulate the relationship between curriculum structure and management mode and how to build a reasonable curriculum management system based on the respective characteristics of colleges and universities. The education dimension of voluntary service courses is single, lacking systematic management and foundation for moving from theory to practice. It is difficult to use scientific management plan to solve the problem of voluntary service curriculum, and it's unable to bring powerful theory to the development of voluntary service curriculum management.

## 4 The Curriculum Structure of Undergraduate Voluntary Service in Universities

It is an important way to promote the curriculum management of undergraduate voluntary service for constructing the curriculum structure. According to the generalized concept of curriculum, there should be two categories: explicit curriculum and implicit curriculum. "Explicit courses mainly refer to the courses of various subjects formally included in the school's professional teaching plan, while implicit courses involve the contents that exert a subtle influence on students' personality, emotion, belief, will, value orientation and behavior choice, etc (Zhang, 2007)." Specifically, the design of undergraduate voluntary service course is constituted by four major parts: theoretical study, service practice, environmental education, and feedback sharing. It combines explicit curriculum with implicit



curriculum, gives full play to the volunteer service as effective activities of undergraduate ideological and political education carrier, digs deeper into the ideological and political education contained in the curriculum elements, and forms education experience with the characteristic of voluntary service.

Figure 1 Construction of Curriculum Structure for Undergraduate Voluntary Service

### 4.1 Theoretical course

Theoretical courses are the foundation. According to the characteristics of voluntary service activities in university, the contents of theoretical courses are designed as *The Development and Current Situation of Domestic and Overseas Volunteer Service*, *The Basic Concept and Related Theories of Voluntary Service*, *The Social Function of Volunteer Service*, *Undergraduate Development with Volunteer Service*, and *The Practice of Volunteer Service*. By learning the theoretical knowledge of voluntary service, colleges and universities can help students understand and master the phylogeny, content, characteristics, functions and professional skills of voluntary service at home and abroad, help them consolidate the theoretical foundation, and guide students to participate in voluntary service in a prepared way, so as to improve the actual effect of voluntary service education.

#### 4.2 Service practice course

Service practice course is the core. It involves the implementation of the overall process of undergraduate voluntary service and determines the educational effect and influence of voluntary service. It should include three parts: organization and training, activity implement and management, as well as assessment and evaluation. Universities should combine respective actuality and characteristics with launching volunteer service activities and building volunteer service brand projects. Through the construction of undergraduate voluntary service base and community practice platform, the long-term mechanism of volunteer service can be established to enhance the effect of practical education, guide students to actively participate in volunteer service activities, apply the theoretical knowledge learned to practical activities, and promote the all-round development of students.

#### 4.3 Environment education course

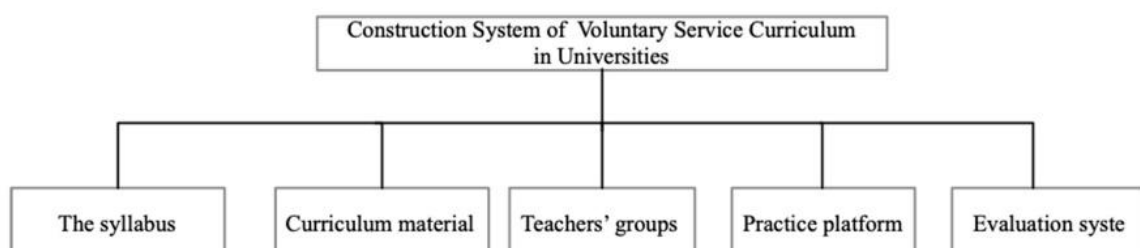
Environmental education courses are the supplement. As the implicit course, it has the characteristics of concealment, pluralism and openness (Tan, 2004). Invisibly, students are edified and influenced to develop the spirit and emotion of voluntary service. It emphasizes the environmental construction of colleges and universities, that is, the external appearance of the university and the internal influence of campus culture and spiritual tradition. This influence is carried out in an indirect and implicit way, which makes students invisibly influenced by the spirit and culture of voluntary service to generate a high sense of identity (Wei & Dai, 2012).

#### 4.4 Feedback sharing courses

Feedback sharing is the promotion. The sharing module mainly requires students to sort out their gains and feelings after each theory learning and practice, which is also interspersed in the learning process of theory learning and service practice module. In this part, students can explain their feelings, perception, shortcomings, areas for improvement and expectations for themselves. Teachers ask questions, comment and give feedback on students' sharing, then students answer relevant questions.

### 5 The Curriculum Management System of Undergraduate Voluntary Service in Universities

The voluntary service education should be included in the school training program to realize the curriculum of undergraduate voluntary service by constructing the curriculum system. Attention need to be paid to the construction of the curriculum system, including the syllabus, curriculum materials, teachers' groups, practice platform and evaluation system. Only after the volunteer service has a clear status and identity in university education can it



be standardized, organized and managed in a planned, orderly and standardized way, and undergraduate voluntary service can enter the track of the normal development, which is also conducive to promoting the reform and innovation of education and teaching.

**Figure 2 Construction System of Voluntary Service Curriculum in Universities**

### **5.1 Formulating the course outline of undergraduate voluntary service**

Syllabus is the legal document of teachers' teaching in classroom and the specific manifestation of teaching plan. The course of university students' voluntary service should consider following parts: firstly, the nature, purpose and task of the course; secondly, the basic requirements of teaching, the teaching content with key points and difficult points; thirdly, the requirements of each teaching link and the distribution of class hours. The connection with other courses, as well as teaching materials and reference books should also be taken into consideration. Since voluntary service education is not a national compulsory course and there is no national unified teaching program standard, in principle, it should be formulated by colleges and universities according to the compilation standard of the curriculum teaching program and in combination with the professional training objectives and regulations (David, 2000).

### **5.2 Compiling teaching materials for college students' voluntary service courses**

Curriculum materials are the basis of transmitting volunteer service knowledge and the important symbol of volunteer service curriculum. The theme, branch and emphasis of the teaching material are the blueprint of developing the voluntary service course, which is the important carrier of teaching thought, training target and teaching content. Colleges and universities should base on theory of voluntary service, voluntary service operations, quality and ability of volunteers, implement and technique of volunteer service activities, knowledge of voluntary management. With it, university can provide students with volunteer service authority, detailed and vivid and readable education text, as well as play an important role in education and guidance for promoting undergraduate volunteer service theory and practice (Chen et al, 2009).

### **5.3 Improving teachers' team construction of undergraduate voluntary service**

The teachers teach the knowledge and skills of voluntary service, and they are the leaders of the courses. Excellent teachers are the basic guarantee to complete the teaching tasks, and also the supporting point to improve the teaching quality comprehensively. Therefore, the construction of teacher's team is the key to achieve goals of voluntary service education in colleges and universities. First of all, we should strengthen the study of theoretical knowledge of voluntary service and have excellent professional quality. Secondly, we should establish and perfect the organization of volunteer teaching and research, and increase the support for teachers' scientific research. Finally, the number of teachers should be rationally allocated and the structure of the teaching staff should be optimized (Zhang,



#### **5.4 Building the practice platform for undergraduate voluntary service**

Practice platform is a stable place for students to receive education and develop talents. We need to establish a three-level linkage mechanism of “institute + school + community”, which is a large classroom for undergraduates to learn and obtain voluntary service experience. To achieve it, we need to take use of the community to provide a practice platform for the school, and build a voluntary service base for undergraduates. On the basis of this practice base, a series of various voluntary service projects that can not only give full play to the professional qualities of undergraduates, but also meet the practical needs of the community will be created to cultivate the spirit of volunteer service of college students. Based on the personal service experience, the essence of voluntary service will be perceived and the core socialist values will be actively promoted. At the same time, it can effectively promote the development of economy and culture in practice base.

#### **5.5 Establishing an evaluation system for voluntary service courses in universities**

The evaluation system determines the level of teaching efficiency and teaching quality, promotes the standardization and scientization of voluntary service courses, and ensures the practical effect of teaching. It means that making a value judgment on the planning, implementation, results and other related issues of the course and seek ways to improve according to certain evaluation standards. It needs systematic collection of relevant information and adoption of various qualitative and quantitative methods. It has great significance to the voluntary service curriculum. In addition, the evaluation system needs to be adjusted and designed for different evaluation contents and more detailed indicators according to the practical content, so as to ensure that the evaluation results have a positive role in promoting the curriculum of voluntary service (Li, 2012).

## **6 The Main Methods of Curriculum Management of Undergraduates'**

### **Volunteer Service**

#### **6.1 Improving the understanding of curriculum management**

In terms of nature, undergraduate voluntary service is voluntary, public spirited and gratuitous. In terms of activity content and form, it is broad, diverse and practical (Hu & Yang, 2010). Therefore, in order to change the current scattered and changeable state of undergraduate voluntary service by means of curriculum management, we must firstly have a correct understanding of the connotation and extension of undergraduate voluntary service. The management mode should be chosen according to the characteristics of undergraduate voluntary service. The undergraduate voluntary service curriculum system and specific construction need to be correctly understood, so that all parties can realize the importance that undergraduate voluntary service curriculum is existing based on Chinese university

## **6.2 Developing management with teaching of voluntary service curriculum coordinately**

Compared with other courses, undergraduate voluntary service courses are special because learning and practice can be simultaneous. Only by penetrating teaching into the whole process of undergraduate voluntary service can we give full play to the advantages of curriculum. Only by constituting a mutually rewarding circulation between the four major parts including theoretical learning, service practice, environmental education and feedback sharing in the curriculum structure, can we realize the coordination of voluntary service and course teaching. With the guidance of professional teachers and the coordination of student volunteer organizations, undergraduates will be more able to effectively use volunteer service knowledge and skills, cultivate the spirit and quality of volunteer service, and achieve the effect of learning from practice (Chen & Luo, 2015).

## **6.3 Developing an online management platform for voluntary service courses**

The management platform provided by the network is an effective way for undergraduate volunteer service curriculum to be recognized and popularized. We need to develop a set of curriculum network system to provide online course resources, and establish a set of operation system for online management platform to make the platform system run efficiently. Teachers also obtain information from the online platform, arrange course contents and provide students with professional knowledge and abilities. Colleges and universities can summarize the achievements and deficiencies in the development of undergraduate volunteer service through the operation of the network management platform, and put forward new development directions and solutions.

## **7 Conclusion**

Promoting the curriculum management of undergraduate voluntary service is conducive to improving the effectiveness of voluntary service education. It can give full play to the practical education function of volunteer service in the university education of ideology and politics, and it is able to cultivate the comprehensive quality and social responsibility of contemporary undergraduates. Combining with the current situation and typical experience at home and abroad, this paper puts forward the structure of voluntary service curriculum referring to the generalized concept of broad curriculum. By discussing the connotation and significance of the curriculum, a complete curriculum system of undergraduate voluntary service is constructed, and suggestions are put forward to solve the difficulties faced by the curriculum management. So that the development of undergraduate voluntary service curriculum in China can achieve a leap from theory to practice and open up a new world for volunteer service as well as ideological and political education in university.

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Xiao Jianbo, Ma Ke, Cai Wenzeng

School of Computer Science and Technology, Wuhan University of Technology,  
Wuhan, P.R.China, 430070

(E-mail: whutxjb@whut.edu.cn, make.mark@whut.edu.cn, caiwenzeng@whut.edu.cn)

**Abstract:** Informationization can be regarded as a miracle after the development of human society from the stages of industrialization. In modern society, computer and information technology play a vital role in the development of society as well. Delicacy Management is also the main idea for modern management fields. Nowadays, with the increasing number of college students, the informationization management of college students has become the focus of daily work in colleges and universities. However, in this process, some problems have gradually begun to appear in the informationization management of college students. At present, the informationization management of college students has basically covered teaching and scientific research activities, but still cannot reach the level of Delicacy. In the current era of informationization, how to integrate Delicacy Management into student affair management system has gradually become a new topic. This essay is based on the background of informationization, the needs analysis is conducted through the results of the questionnaire. At the same time, the Quantitative Analysis Method is used to derive the weight of each requirement, and then forms an information management system. The purpose of this essay is to construct a precise education system of student affair in colleges and universities, which includes meticulous training, fine classification, precise difficulty demand and accurate period, and to provide a feasible scheme for Delicacy Management of student affair.

**Key words:** Informationization; Student affair; Delicacy; Quantitative analysis method

## 1 Introduction

With the development of society and economy, the management organizations of colleges and universities are becoming larger and larger. However, in the field of management, there are still a small number of managers are influenced by the traditional management concept, they do not have enough understanding of the necessity of student affair informationization and management delicacy, their awareness of information and Delicacy Management are still relatively weak, and their sense of urgency to quickly promote the construction of informationization and Delicacy Management is not strong as well(Zhao Xiaopeng, Liu Xiong,2018);although many colleges and universities have resources invested in the Delicacy Management of informationization, most colleges and universities still lack the talents of informationization management major. The lack of informationization knowledge and talents in the field of college and university management directly leads to the imbalance between the development of information technology and Delicacy Management; at the same time, due to the asymmetry of information, there are difficulties in the process of solving the needs of students, which also causes great obstacles to democratic decision-making and scientific decision-making(Shi Rui,2016). Therefore, it is urgent to accelerate the construction of information technology and fine management.

Under the background of information, it is an inevitable trend to realize the fine management of College Student affair to adapt to the development of the times, and it is also the basic requirement of the law of student work (Judith Warren Little, Maryl Gearhart, Marnie Curry, Judith Kafka, 2003). Fine management of student affair is helpful to improve the efficiency of student affair and achieve standardization and efficiency. At the same time, teachers and staff are required to master information management technology and fine management knowledge, so as to improve the quality of work (Fu Nina, 2015). Careful cultivation, precise hierarchy, precise demand difficulty, precise period of time of fine nurturing system, more conducive to the growth of students (Chen Jin, Xia Xing, 2018).

College counselors, as the most grass-roots managers, play an extremely important role in student affair (Qi Qiran., 2018). They should be able to actively acquire information technology-related skills in order to adapt to information-based life and work, and try to refine management in student management (Ying Xiangtai, 2013). Many magazines and literature at home and abroad have studied and discussed the fine management mode of College student affair. In order to further study and construct an efficient and feasible information refinement management platform, this paper will use quantitative analysis method to evaluate students' information needs comprehensively and determine their development weights. According to the conclusions drawn from the analysis, it will be analyzed by professional programmers. Finally, it will develop a high level suitable for the actual situation. Information platform for fine management of student work in other schools.

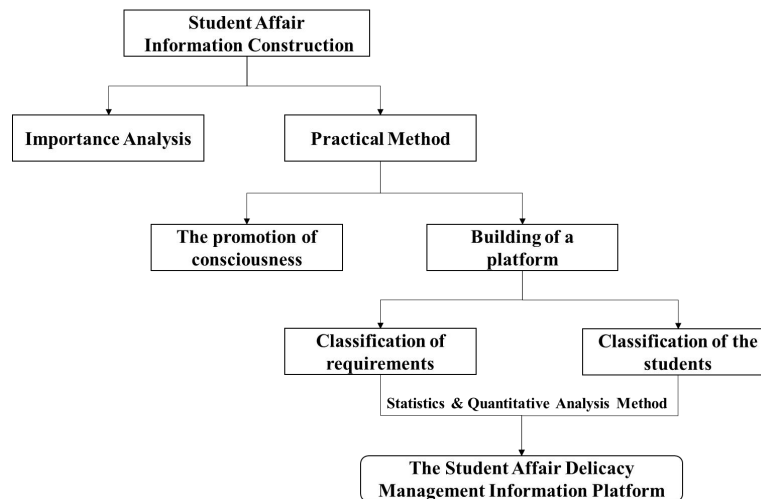


Figure 1 The Research on the Delicacy Management of Student Affair

## 2 The Importance of Student Affair Delicacy Management

Student affair is an important part of serving and managing students in colleges and universities. Therefore, under the background of informationization era, the realization of Student Affair Delicacy Management in colleges and universities is not only the inevitable trend to adapt to the development of the times, but also the basic requirement of the law of student affair.

### 2.1 The improvement of work efficiency

The implementation of Student Affair Delicacy Management is not only the inevitable requirement to improve the efficiency of student affair, but also the way to realize the standardization and efficiency

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of student affair. At present, student affair informationization has made great progress, but at the same time, good technical and environmental conditions make the demand of Student Affair Delicacy Management become more urgent (Cheng Linhong, 2013). With the entry of the students born in the 00s, the traditional informationization management mode has been difficult to adapt to the current development of colleges and universities, so speeding up the promotion of Student Affair Delicacy Management has become the inevitable trend of the development of colleges and universities.

## **2.2 The improvement of the quality of teaching staff**

In order to better implement Student Affair Delicacy Management, student affair personnel should not only have a down-to-earth and meticulous work style, but also master informationization management technology and Delicacy Management related knowledge (Zhao Chunyang, 2017). The realization of student Delicacy Management can not only simplify the routine work and business matters, but also greatly improve the work efficiency. At the same time, it can also enable student affair personnel to carry out more ideological and political research, stimulate innovative work ideas, improve the level of management, better manage students, serve students and promote the development of the school (Zhang Yanzhong, 2017).

## **2.3 Contribute to the growth of students**

For the management of students, most of the contemporary colleges and universities adopt a loose management mode, and the management environment is also very loose. As students do not have a clear guidance for study and life, which also leads to many students on the school's learning and assessment mechanism has a lot of confusion and misunderstanding. At the same time, due to the limited human resources in colleges and universities, it is impossible for the school to answer and help each student's questions (Li Yan, 2011). In the past, in the face of these conditions, colleges and universities often hope for the help of senior students or student associations, but since this year, the weakening of the nature of the work of student associations has also led to the loss of this way. If colleges and universities can realize the Delicacy Management, of student information so that each student's information can be stored in the form of visual data in the background management platform of the school, so that it can be easily viewed by teachers and provide necessary help and guidance in a timely manner. At the same time, students can view the changes of relevant information at anytime and anywhere through the network platform, quickly evaluating their achievements and after-school assignments and making corresponding study plans and arrangements as well. This way can completely improve students' autonomous learning ability, greatly alleviate the pressure of educational institutions, at the same time, it is undoubtedly of great help to the growth of students.

# **3 Practical Method of Constructing Student Affair Informationization Efficiently**

## **3.1 The promotion of consciousness**

In recent years, with the continuous development of informationization management means, the educational administration management system of our school has become the main way for most students to carry out course selection operation and information achievement inquiry. In order to further improve the delicacy of management systems and methods, more student information needs to be entered into the system, which is bound to cause many students to worry about personal privacy security (Ding Shihui, 2016). At this time, it is necessary for grass-roots educators to carry out necessary, comprehensive, and timely education and guidance to students, and to publicize the necessity, importance, new, and convenience of Delicacy Management to students through grade weekly meetings

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 or relevant academic associations and online platforms (Chen Tiannian, 2011). Only with the recognition and approval of the majority of students, can we make the Delicacy Management of our school form a good state praised by everyone, and enhance the students' correct understanding of the importance of Delicacy Management (Li Desen, Zhou Meilan, Chen Nijishi, 2011).

At the same time, as basic education workers, we should timely feedback the students' reflection and the students' urgent need for Delicacy Management to the colleagues in charge of educational administration and the relevant leaders of the school, so as to make a good link and bridge between the students and the school, so as to make the whole school have a deeper understanding of the students' Delicacy Management and speed up the information Delicacy Management process of our school.

### 3.2 Building of a platform

Due to the wide range and deep level of content involved in student affair Delicacy Management for higher education, Therefore, only the Delicacy Management work on the various information about students<sup>105</sup> is analyzed here (Chen Haitao, 2007):

#### 3.2.1 Classification of requirements

After the study of the results of the questionnaire survey on the various measures of the school and a wide range of students, the following table of students' information service needs is drawn up. In this table, each indicator evaluates its importance, which is divided into three levels, which are "unimportant" "Important" and "very important". The proportion of demand is the proportion of people who fill in "important" and "very important". Get the following demand table (Kenneth Green, 2016).

**Table 1 Students' Information Service Demand Table**

Sorting	Classification	Number of subitems	Demand ratio	The top two subitems of demand	
1	Basic information service	17	98.90%	Student status information	Reward And Punishment information
2	Academic service	10	80.20%	Course selection	Query of exam results
3	Library service	7	64.30%	Book search function	Books materials
4	Logistics service	6	45.00%	Provide one-card service	Medical information and outpatient reimbursement
5	Admission / opening service	5	32.10%	Holiday arrangements and school information	Enquiry Admission and Admission Procedure
6	Graduation service	4	25.80%	Provide employment information and related guides online	Online graduation information registration

<sup>105</sup>Kenneth Green. The 2016 National Survey of eLearning and Information Technology in US Higher Education[EB/OL]. <https://www.campuscomputing.net/content/2016/11/21/the-2016-campus-computing-survey>, 2016.10.21

7	Management service	3	13.90%	Application and evaluation of various awards and bursaries	Declaration and notification of club activities
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3.2.2 Demand analysis—Quantitative Analysis Method

Weight calculation of Level 1 Indicator;

Assign "unimportant" to 1; "important" to 2; "very important" to 3; and its weight is 0.17, 0.33, 0.5.

Then, the number of people who choose the importance of each index in the questionnaire multiply the importance weight summation to get the weighted number, from the weighted number of all indicators of the index divide weighted number of all indicators to get the weight of the index.

Weight calculation of Level 2 Indicator;

The proportion of the level 1 index multiplied by the level 2 index in the index.

**Table 2 Indicator Framework and Weight**

Classification of indicators	Level 1 indicator		Level 2 indicator		
	weight	Indicators	weight	Indicators	weight
Query information class	0.551	Basic information service	0.203	Student status information	0.179
				Reward and punishment information	0.020
		Academic service	0.195	Course selection	0.123
				Query of exam results	0.074
		Library service	0.153	Book search function	0.089
				Books and journal materials	0.052
Information notification class	0.238	Logistics service	0.126	Provide one-card service	0.057
				Medical information and outpatient reimbursement	0.068
		Admission / opening service	0.112	Holiday arrangements and school information	0.038
				Enquiry Admission and Admission Procedure	0.028
Application registration class	0.211	Graduation service	0.111	Provide employment information and related guides online	0.047
				Online graduation information registration	0.048



		Application and evaluation of various awards and bursaries	0.045
	Management service	0.100	
		Declaration and notification of club activities	0.024

### 3.2.3 The classification of the students

#### ① Classified according to the level of education

For students with different levels of academic qualifications, stratified management should be carried out according to graduate students and undergraduates, that is, different information management methods and means are implemented for graduate students and undergraduate students. In the information of undergraduate students, it should be more related to course selection and inquiry, achievement inquiry, self-study room inquiry, school news and related cultural and sports activities and so on. In the information of graduate students, it should be more related to scientific and technological innovation, employment and entrepreneurship, further studies and so on. While managing the two hierarchically, it is important to be clear that the two are not individual, but organic, so they need to stay connected and share resources.

#### ② Classify according to the type of difficulty

The types of difficulties can be initially divided into: academic difficulties, psychological difficulties, family financial difficulties, and employment difficulties. The difficulties encountered by students in economy, psychology, study and so on are important factors that affect students' life and learning status, so they should pay more attention to it.

For students who encounter academic difficulties, their curriculum information and subject achievements should be directly connected with their teachers, through the connection of the network platform, so that they can have close and timely contact with the teachers, and the teachers can help them to make relevant learning plans and give advice. At the same time, the Delicacy platform should develop the corresponding supervision and assessment mechanism, so as to urge students with academic difficulties to carry out related tasks (Olivas M, 2006).

For students who encounter psychological difficulties, the platform should provide relevant ways of talking, as well as the way of enlightenment and the help of relevant psychological teachers, so that students can find the object to talk to and get psychological guidance in the first place. At the same time, they can feedback the relevant psychological situation of the student to their counselors, so that their counselors can also carry out guidance and help. At the same time, through the timely detection of students' behavior activities, the platform can make a timely prediction of students' extreme behavior, which can reduce the harm caused by similar behavior.

For students with financial difficulties in their families, they should, in accordance with the principle of fairness, justice and transparency, establish contact with the local civil affairs institutions of the students to verify the true family situation of the student, so as to keep abreast of the real financial situation of their families. In the aspect of selection, the selection mechanism of artificial participation is realized online, and the relevant supervision mechanism is established in order to achieve the corresponding fairness and justice.

#### ③ Classify according to the grade of the student

According to the different grades of students, they can be divided into graduating class, non-graduating class, freshman class and so on. For the graduating class, you should keep abreast of the student's graduation destination, credit check, and household directory migration; For non-graduate classes, students should keep abreast of student academic progress, participation in scientific and technological innovation, etc.; For freshmen classes, we should provide admission help, answer questions, rules and regulations, cultural activities and so on.

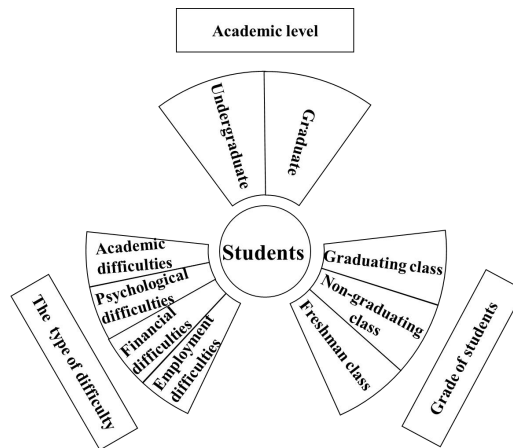


Figure 2 The Classification of the Students

### 3.2.4 The establishment of a platform

The service hierarchy model of student information is as follows:

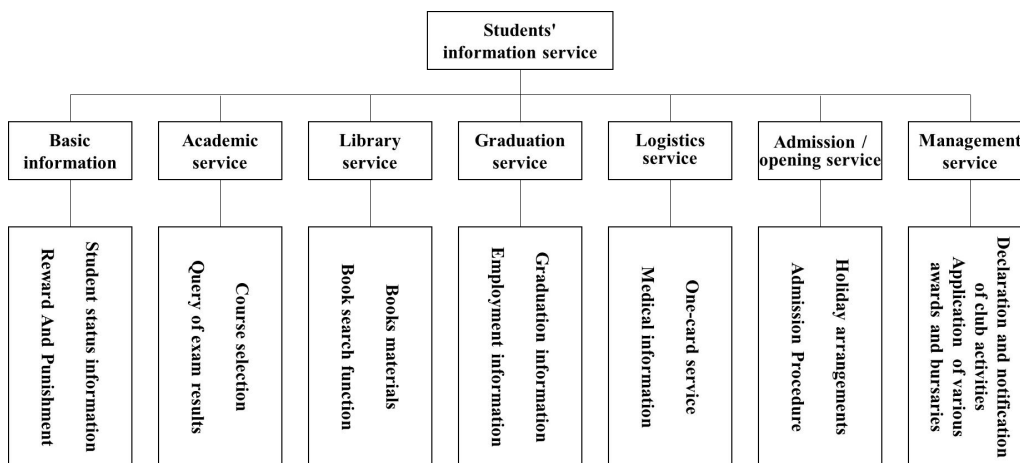


Figure 3 The Service Hierarchy Model of Student Information

According to the above table 2: indicator framework and weight table and figure 5: student information service hierarchy model diagram, at the same time, combined with the functions to be implemented in the student classification in chapter 3.2.3, it is handed over to professional programmers for analysis. Finally, the student affair Delicacy Management information platform for colleges and universities is developed, which is suitable for the actual situation.

## 4 Conclusion

To achieve the refined management of student information, and to establish a meticulously nurturing system with precise training, precise stratification, precise demand and precise time, is the courage to innovate in keeping with the development of the information age, to meet the needs of students and to enhance school work. An important measure of efficiency. Ten years of trees, a hundred years of tree people, the cultivation of talents is the top priority of any university. The refined culture method is the catalyst and propellant of "Tree Man". To achieve refined management, in the most scientific and exciting way, we will build our school into an excellent university that will satisfy the people and admire the world. I like to see the apricots and the beautiful colors.

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## **Inheritance and Development of Craftsman Spirit**

### **from the Perspective of Cultural Confidence**

Han Lu, Chen Mengyun, Han Mingdan\*

School of Marxism, Wuhan University of Technology, Wuhan, P.R. China, 430070

(E-mail: 597584281@qq.com, 404574715@qq.com, 448143757@qq.com)

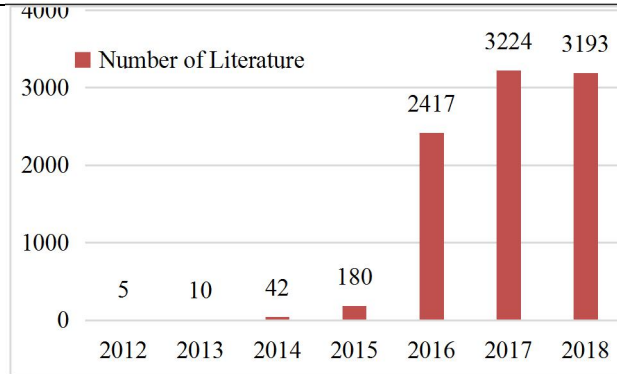
**Abstract:** The spirit of craftsman has been a national temperament of China since ancient times. It is a concrete manifestation of the confidence of the Chinese nation's culture, highlighting the style of a big country and the feelings of the world. The inherent logical relationship between cultural self-confidence and craftsman spirit is manifested in the fact that cultural self-confidence is conducive to the promotion of craftsman spirit and the promotion of craftsman spirit is conducive to consolidating cultural self-confidence. Based on the field of cultural self-confidence, carrying forward craftsman spirit can enhance citizens' ability to serve the cause of socialism, practice socialist core values, enhance national cultural vitality and competitiveness, and provide a strong cultural heritage for the cultivation of craftsman spirit. The inheritance and development of the craftsman spirit not only needs to be based on practice, but also emphasizes the combination of tradition and modernity. It also requires a culture of craftsman culture to support the craftsman spirit and innovative craftsman spirit.

**Key words:** Cultural self-confidence; Craftsman spirit; Excellent traditional culture; Revolutionary culture

## **1 Introduction**

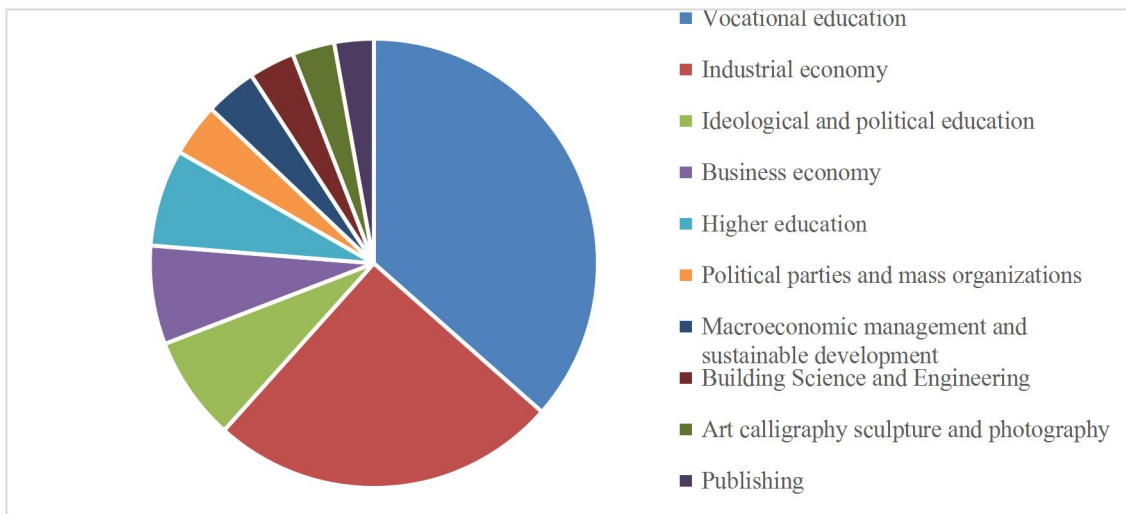
In 2016, YAOWEN JIAOZI magazine published ten popular phrases in 2016. Craftsman spirit ranked among them. In the same year, craftsman spirit was first written into the government work report. The report of the Nineteenth National Congress of the Communist Party pointed out that it is necessary to build a knowledge type, skilled and innovative laborers, carry forward the spirit of labor model and craftsman spirit, and create a glorious social style of work and a dedicated spirit of excellence (Xi Jinping 2017). The spirit of craftsmen has aroused wide resonance in society since it was put forward. In the new era, China's strategic transformation and upgrading from a manufacturing power to a manufacturing power cannot be achieved without the spirit of craftsmen and craftsmen. In addition, General Secretary pointed out that Cultural self-confidence is a more basic, deeper and lasting force in the development of a country and a nation (Xi Jinping 2017). In the pursuit of high-quality development today, craftsman spirit and cultural self-confidence are the important cultural details of China's transition from a big manufacturing country to a powerful manufacturing country. Craftsmanship and cultural self-confidence are social consensus and a key factor for success.

Use the China Academic Journal Network ([www.cnki.net](http://www.cnki.net)) to search the relevant content. The literature search and statistics were carried out with the theme of "craftsman spirit". There were 12,827 items in subject search and 6713 items in title search. It is obvious that the research on craftsman spirit is a hot topic in theoretical circles. Figure 1 shows the number of research literature from 2012 to 2018.



**Figure 1 Number of Research Literature**

In the 2016 "Government Work Report", Premier Li Keqiang first put forward the strategic task of cultivating the spirit of craftsmanship for excellence. The report of the 19th National Congress of the Communist Party of China pointed out that it is necessary to carry forward the spirit of the model workers and craftsman spirit, and create a glorious social style of labor and a spirit of dedication to excellence. Through the academic journal network to sort out the number of articles about craftsman spirit, it is not difficult to find that the number of literatures on the craftsmanship has increased dramatically in 2016 and has been increasing year by year after 2016. In sorting out the literature, it is found that the number of studies on craftsmanship spirit in academic circles is not only increasing year by year, but also the research field is expanding gradually.



**Figure 2 Distribution Map of Research Areas**

On the connotation of craftsman spirit. "The Thinkers: the amateurs, diyers, and inventors who make America great" points out that the inherent essence of American craftsman spirit is the innovative ability of "breaking through the boundaries (AlecFoege,2013), "Craftsman" thinks that craftsman spirit is the desire to do a good job (Richard Sennet,2009); Scholar carries out the connotation of craftsman spirit through professional growth and advocating technology and morality (Xue Dong,2016). A Japanese scholar believes that Japanese professional workers influence customers with their professional

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attitude, emphasizes the spirit of self-contribution, and forbids service professionals to pursue their own convenience at the expense of personal aspects of service for efficiency (Reijiro Aoyamaa,2015).

On the logical relationship between craftsman spirit and cultural self-confidence. In the article "Inheritance and Innovation of Craftsman Spirit under the Background of Cultural Confidence", the author thinks that Chinese excellent traditional culture, revolutionary culture and advanced socialist culture have played an important role in inheriting and innovating craftsman spirit, which is a manifestation of cultural self-confidence (Song Ruinan, , Liu Huanming,2017); in "Three Spirits" leading workers' culture from In the letter, the author takes workers' cultural self-confidence as an important manifestation of cultural self-confidence as the starting point. Craftsman spirit is not only a professional belief, but also the connotation of workers' cultural self-confidence (Qiao Xin,2017).In the article" Promoting craftsman spirit and enhancing cultural self-confidence", the author emphasizes the important role of craftsman spirit in cultural self-confidence (Yang Dongmei,2018).

On the value of promoting the spirit of craftsmen. Sticking to the spirit of craftsmen is the reason why some enterprises create myths, which is also one of the reasons why modern society pays more and more attention to the spirit of craftsmen. Therefore, the study of the spirit of craftsmen must be based on its contemporary value. Professor believes that craftsmanship is the soul of contemporary manufacturing industry (Xiao Qunzhong, 2015); some scholars believe that craftsmanship is conducive to leading people to advocate labor and Practice Socialist Core values (Liu Jianjun, 2016); Professor believes that craftsmanship is a spiritual force and plays an important role in personality building and moral upgrading(Qi Shan hong, 2016).

By sorting out the relevant literature, we can easily find that under the background of cultural self-confidence, the research on craftsmanship spirit is not very rich. Most of the studies are related to the essence of craftsmanship spirit, vocational education and Made in China. In the existing studies, scholars mainly discuss the role of craftsmanship spirit on cultural self-confidence. The internal relationship between the two is neglected.

## **2 Contemporary insight into Cultural Confidence and Craftsmanship**

### **2.1 Rich content of cultural self-confidence**

Cultural self-confidence is the full affirmation of the cultural value of a country, a nation and a political party. It is also a full affirmation of the vitality of the national culture and its development prospects. It is a self-confidence and pride of culture from the heart. In the long-term practice, the Chinese nation has created extensive and profound excellent traditional culture; in the long-term and difficult practice of revolution, construction and reform, the Communist Party of China has led the people of all nationalities to form a revolutionary culture of independence, self-reliance and hard struggle; in the process of reform and construction, through continuous innovation, an advanced socialist culture with unique characteristics has been gradually formed. That is to say, cultural self-confidence refers to the self-confidence of a country, a nation and a political party to the excellent traditional Chinese culture from the bottom of their hearts. It is also the inheritance and development of revolutionary culture and the promotion and affirmation of the advanced socialist culture with Chinese characteristics. General Secretary Xi Jinping pointed out in the report of the Nineteenth National Congress of the CPC that the socialist culture with Chinese characteristics originates from the excellent traditional Chinese culture nurtured by the Chinese nation's more than five thousand years of civilization history. It is melted into the revolutionary culture and the advanced socialist culture created by the Party's leading people in the revolution construction and reform and rooted in the great practice of socialism with Chinese characteristics (Xi Jinping,2017). Excellent traditional culture and revolutionary

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culture are the important contents of the construction of advanced socialist culture. The advanced socialist culture escorts them. They complement each other and constitute the connotation of cultural self-confidence.

## **2.2 Interpretation of the connotation of the craftsman spirit**

### 2.2.1 Respecting the teacher

Respecting the teacher is the traditional virtue of the Chinese nation. Respecting the teacher means that in life, you must respect the teacher and value your own learning. "The teacher, is also the model of the person" "Once a teacher, always a teacher" where, it fully embodies the moral values of the Chinese nation's respect for teachers. Masters and students live together and study together. Respecting the teacher is to respect the elders, and the emphasis is on the profession. The younger generation must not only respect the elders, but also respect for skills. In the daily academic life, the attitude of the apprentice to the master determines to a certain extent whether the apprentice can learn the skills, which is the foundation of a craftsman.

### 2.2.2 Dedication and hard-working

Dedication and hard-working is the source of strength of the craftsman spirit. "Dedication" is to do a job and love the job, namely loves whatever job one takes up. "Hard-working" is to be careful and serious about the work. Dedication is the traditional virtue of the Chinese nation. The Chinese nation has always had the tradition of "loyalty to duty" and "dedication". It is the basic moral norm that every citizen should have and an important part of the core values of socialism. In life, we can't just regard work as a tool for raising a family, but we should treat love and dedication as a work habit, implement love and dedication to social practice, and internalize it in mind and externalization in action.

### 2.2.3 Keep improving

Today, with the rapid development of the economy, people are eager to do everything, and they often have a quick and quick attitude toward things, excessive pursuit of speed, but neglect the quality of products. The public has always believed that craftsmen need "craftsman spirit". In fact, the craftsman spirit is a professional ethic. It is a must for every worker who is based on the post. "Thirty-sixth chapter of the Tao Te Ching" records that "the great things in the world must be done in detail", which means that the big things are all started from the nuances, and the swords are slashed and refined, and the behind them are the craftsman spirit that craftsmen are striving for excellence. The goal of craftsman spirit is to do things to the utmost and to create the highest quality products.

### 2.2.4 Realistic and innovative

Looking back at history, the important force driving social progress has always been the products created by the craftsmen who have devoted themselves to innovative inventions. Innovation has always been carried out, no matter how difficult, we must not forget the original heart, do the combination of theory and practice, and integrate what we want into the product. The reason why Luban and Edison have been passed down to the present day is not because they polish their products day after day, but because they continue to innovate and leave valuable material and spiritual wealth to future generations. Therefore, the modern craftsman spirit is not constantly repeating and persisting, but doing improvement and innovation in the work. For the public, improving their own working methods and continuously improving work efficiency is also an innovation.



### **3 The Inherent Relationship between Cultural Self-confidence and Craftsman Spirit**

#### **3.1 Cultural self-confidence highlights craftsman spirit**

##### 3.1.1 Chinese excellent traditional culture is the cornerstone of the inheritance of craftsman spirit

The Chinese traditional culture is the source of the craftsman spirit. The Chinese traditional culture is more embodied in the real thing that has been passed down to the present. These objects contain the "ingenuity". Many of the artifacts and stories that have been handed down to date record the superb skills of ancient craftsmen, such as Su Shi's "Nuclear Zhou Ji" and Zhang Zeduan's "The River on the Qing Dynasty". The broadcast of "National Treasures" has made people see the profoundness of Chinese culture for thousands of years. One piece of cultural relics is not only the inheritance of culture, but also the inheritance of craftsman spirit.

Looking back at Chinese history, the Chinese architecture and carpenter's originator Lu Ban invented a series of tools in the Spring and Autumn Period. The weight of the plain yarn unearthed from Mawangdui in Changsha is less than 50 grams, which represents the superb craftsman spirit of the Western Han Dynasty. So far, it is difficult to copy with modern technology. The Chinese nation has thousands of years of excellent traditional culture. Nowadays, we are always proud of our profound and excellent traditional culture. The excellent traditional culture is not only the source of spreading the craftsman spirit, but also embodies the craftsman spirit that the times need.

##### 3.1.2 Revolutionary culture extends the inheritance of craftsman spirit

China's revolutionary culture is guided by Marxism and has matured step by step in practice. Marxism was born in Europe in the mid-19th century. The victory of the October Revolution brought Marxism to China. When China clashed and chose various ideologies, it used Marxist theory as its guiding ideology. This kind of thinking method that combines the national conditions of the country and absorbs the external beneficial results also applies to the inheritance of the craftsman spirit. The inheritance of the craftsman spirit should take the essence of the foreign culture to the dross on the basis of respecting the local culture and continuously promote its own development.

From the Jinggangshan spirit to the Zunyi Conference, from Yanan's "reorganization of the Three Winds" to Xibaipo's "Going to Beijing to test", the Communist Party of China led the people of all nationalities in the revolutionary struggle to form a revolutionary culture of hard work. The "Not arrogant", "Endure hardships and be capable of hard work" and "Willing to sacrifice" in the revolutionary culture are the essence of the spiritual connotation of craftsmen.

##### 3.1.3 Socialist advanced culture sublimates craftsman spirit

The advanced socialist culture is the sublimation of the essence of the traditional culture of the Chinese nation. While creating the culture, the people also shoulder the important responsibility of inheriting culture. The transformation of the main contradictions in our society shows that the people's spiritual needs are getting higher and higher. Building an advanced socialist culture is, in the final analysis, to meet the growing spiritual and cultural needs of the people. General Secretary Xi Jinping put forward the goal of "China Dream" and "Two Hundred Years". To achieve these goals, the unremitting struggle of great artisans is needed.

Today's society can be said to be an Internet age. The Internet runs through people's daily lives. Similarly, the popularity of the Internet has injected new vitality into the inheritance and development of the craftsman spirit. More and more cultural relics are displayed in front of the world through the Internet, telling the world about its past legends. For example, the Gou Jian sword which is the representative of hardships, the workers use the scientific means to interpret the password of Goujian sword, lead us into the microscopic world of Goujian sword, and understand more clearly the skill of

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Goujian sword. This is an opportunity that science and technology provide us. The advanced socialist culture of advancing with the times has sublimated craftsman spirit and further inherited innovation and development.

### **3.2 Craftsman spirit enhances cultural confidence**

#### **3.2.1 Craftsman spirit can enhance the cultural pride of the working group**

China is the country where the people are the masters of the country. The working class is the master of the country. The working class plays an irreplaceable role in the construction of socialist culture. Gao Fenglin, a great craftsman, said that "every time I see the engine I produce, I send the satellite to space. There is a sense of pride after success. This kind of pride can't be bought with money." This is not only the voice of Gao Fenglin, but also the voice of the craftsmen used. The sense of honor of the labor group is an important part of the cultural confidence of the new era.

#### **3.2.2 Products with Chinese culture let China go to the world**

Silk and porcelain are of great attraction to the world. The Silk Road brought Chinese fine silk to the Western countries and also became an important channel for political and economic exchanges between China and Western countries. The invention of porcelain is China's great contribution to the development of world culture. In addition, the thoughts, the four inventions, and the farming of the pre-Qin dynasty all reveal the profound cultural heritage of the Chinese nation, which highlights our cultural self-confidence.

In modern society, Chinese drama and Chinese kung fu are constantly going to the world, and they are touring around the world. Foreign friends have begun to learn Chinese in order to learn more about China. The enthusiasm for the establishment of Confucius Institutes is on the rise, and more and more foreign friends are approaching Chinese. All of these prove the affirmation of Chinese culture in all countries of the world and further consolidate cultural self-confidence.

## **4 The Cultural Significance of Inheriting Craftsman Spirit under The Vision of Cultural Self-confidence**

### **4.1 Improving the ability of citizens to serve the cause of socialism**

In terms of the intention, the craftsman spirit is the professional spirit that people should have in the course of their work, and it is a kind of value pursuit of people. Respecting people's labor value and promoting people's all-round development are not only the needs of the growth of the public, but also the need to promote socialist modernization. The report of the 19th National Congress of the Communist Party of China pointed out that China should speed up the construction of an innovative country and build a country with strong science and technology and a country with high quality. Cultivate a large number of strategic and technological talents, leading scientific and technological talents, young scientific and technological talents and high-level innovation teams with international standards (Xi Jinping, 2017).

In the new era of socialism, in order to further promote the process of socialist modernization and realize the transformation and upgrading of China's manufacturing industry, it is inseparable from the creation of the broad masses of workers. In order to achieve the improvement of the quality of workers, it is necessary for the majority of citizens to take up their duties and stand on their own. The craftsman spirit is introduced into the work of the workers. The craftsman spirit can enhance the cultural self-confidence of the public, guide the laborers to learn new knowledge, research new technologies, and promote the excellence and innovation to become the common value pursue and behavioral norms of the

Proceedings of the 16th International Conference on Innovation & Management - 1787 - public. And it can improve the ability of the broad masses of workers to serve the society, and contribute to the socialist modernization in the new era.

#### **4.2 Conducive to the practice of socialist core values**

Values are the deepest cultural core of a nation. Value self-confidence is the most direct manifestation of cultural self-confidence. The core values of socialism are the pursuit of value of a nation and the spiritual pillar and action orientation of the Chinese nation. The craftsman spirit is the concrete practice of practicing the core values of socialism. The professional concept of dedication and professionalism embodied in craftsman spirit. Spirit is highly consistent with the value orientation of “dedication” and “integrity” advocated by the socialist core values at the individual level. Dedication is not only the traditional virtue of the Chinese nation, but also the basic requirement of the socialist core values. It is not only expressed in the fine art of the product, but also a professional concept constructed by people at the social level.

The meticulous work concept in craftsman spirit is the concrete practice of the concept of professionalism advocated by the core values of socialism. The socialist core values need to be implemented in the ordinary work of the broad masses of workers. Good laborers must concentrate on their own work, be responsible for their own work, constantly surpass themselves, and take advantage of small and large, thus enhancing the public professionalism.

#### **4.3 Enhancing the vitality and competitiveness of national culture**

The report of the 19th National Congress of the Communist Party of China pointed out that it is necessary to adhere to the development path of socialist culture with Chinese characteristics, stimulate the cultural innovation vitality of the entire nation, and build a socialist cultural power (Xi Jinping, 2017). The key to building a cultural power is to enhance the vitality and competitiveness of the entire national culture. Cultural vitality and competitiveness are important support for building a strong socialist culture. The world has entered the era of cultural brand competition, and cultural competition has become an important part of global competition. History has proved that the formation of a powerful country in the world today cannot be separated from the respect and attention of a country to craftsman spirit. Craftsman spirit has become a symbol of national cultural competitiveness. We advocate respect for labor and promote the spirit of the model workers. It is the extension and development of the craftsman spirit. It is also the development of the Communist Party's respect for the working people and the concept of labor. In addition, the craftsman spirit reflects not only the spiritual concept of the workers' excellence, but also the charm and cultural self-confidence of the excellent traditional culture. In the new era, promoting the craftsman spirit can not only promote the transformation of the manufacturing industry, but also promote the combination of the traditional Chinese culture and the times revitalizes and rejuvenate the vitality of the times.

## **5 The Path of Cultivating Craftsman Spirit in The Perspective of Cultural Self-confidence**

### **5.1 Based on practice, focusing on the combination of tradition and modernity**

Inheriting and developing the craftsman spirit from the perspective of cultural self-confidence must pay attention to the combination of tradition and the times. The inheritance of the craftsman spirit is not the same as the old-fashioned layer. It should be combined with the times on the basis of traditional culture, innovating, creating new crafts and giving it a new era connotation.

#### **5.1.1 Cultivate craftsman spirit based on excellent traditional culture**

Cultural self-confidence mainly comes from the traditional Chinese culture. It comes from the revolutionary culture which the party leads the people of the whole country to strive for development. It comes from the advanced socialist culture. The premise of cultivating craftsman spirit in the context of cultural self-confidence is to establish a good traditional culture. To develop the craftsman spirit should carry forward the fine traditions and draw useful ingredients from the excellent traditional culture of the Chinese nation for thousands of years. The spirit of ancient craftsmen has been continuously developed through the inheritance of craftsman spirit, and the inheritance of craftsman spirit is the precipitation and integration of excellent traditional culture through history. In particular, products with generations of inheritance and crafts contain the spirit of the Chinese nation's craftsmen. While actively integrating the new standard into the trend of the new era, we should not lose sight of the value inherent in it. The core value of some old products that have been developed for decades or even hundreds of years is a profound cultural heritage. As we know the Zhangqiu iron pot, after 12 procedures, many times of fire, 10,000 hits, can be completed, Zhangqiu iron pot is because of the persistence of generations of artisans, making "Zhangqiu no pot" become a social hot word. The reason why it can compete with the same product is the heavy cultural tradition it carries.

### 5.1.2 Cultivate craftsman spirit to keep pace with the times and combine with modern society

Today, with the rapid development of science and technology, industrialized production has replaced the production of traditional small workshops. Mechanized production has replaced manual labor to a certain extent, but this does not mean that social production no longer requires craftsman spirit. In the new era, society calls for craftsmen. The return of the spirit, the core of the craftsman spirit is innovation. The craftsman Lu Ban is known as the originator of Chinese carpenters, not because he polished many products day after day, but he repeatedly thought during the process of polishing products, constantly providing creativity and leaving valuable spiritual wealth to future generations. The craftsman spirit that modern society needs is no longer simply learning the repetition and persistence of the traditional craftsman spirit, but constantly innovating and developing in practice. For companies, the innovation of craftsman spirit can be combined with traditional techniques and the science and technology and management concepts of modern society. For the general public, rationally arranging working hours, improving working methods, and improving work efficiency are also innovations in craftsman spirit.

## 5.2 Thick planting craftsman culture, using craftsman culture to support the craftsman spirit

Premier Li Keqiang said in the 2017 government work report that the soul of quality is ingenuity. It is necessary to vigorously promote craftsman spirit, plant the artisan culture, fulfill professional ethics, admire excellence, cultivate many Chinese craftsmen, build more world-renowned China Brands and promote China's economic development into the quality era (Li Keqiang, 2017). Cultivating craftsman spirit in the field of cultural self-confidence must foster culture and use craftsman culture to support the development of craftsman spirit.

### 5.2.1 Thick system culture

To cultivate and promote craftsman spirit, we need top-level design. We should establish a "craftsman system" that is consistent with the needs of the times, so that technically talented people can be economically guaranteed, have a status in society, and be respected in their personalities. First, in the work, it should ensure that skilled personnel are fully employed, especially for some highly skilled craftsmen, increase their wages, improve working conditions, and improve welfare, so that workers do not have to worry about material life. Second, companies should fully mobilize the enthusiasm of the craftsmen. Adopt a combination of encouragement and responsibility to improve the professional honor and responsibility of craftsmen. Craftsmen should adopt a life-long responsibility system for their own

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products, and use modern technology to real-name each of the craftsmen's works. This not only protects their own intellectual property rights, but also they are responsible for their products for life.

### 5.2.2 Thick social culture

In the historical tradition of more than two thousand years of the Chinese nation, craftsmen have always been at the end of the social class. In particular, Confucianism emphasizes that "everything is inferior, only reading is high", ignoring the skilled talents, and that the handicraft industry is a bit of a singularity. So that the public is bent on pursuing reading, thus neglecting the craftsmen. When it comes to craftsman spirit, everyone naturally thinks of Swiss watches and German machinery. Although contemporary China is a big country, the whole society still lacks craftsman spirit. It is a necessary condition for cultivating craftsman spirit to build a culture that respects craftsman spirit in the society.

First, in the society, vigorously promote the era value of the craftsman spirit, so that the public can recognize the role of artisans, and abandon the notion of "gentlemen do not work on device", "He who uses his brain will govern; he who uses his strength will be governed.", respect the skilled workers, and strengthen. The sense of honor of the spirit of the national craftsman spirit has formed the mainstream values of respecting skilled talents and vying for skilled talents in the society, making the model spirit become the value pursued by the public. Second, with the help of the Internet and the media, we will vigorously promote the craftsman spirit of the new era. In recent years, the selection of craftsman spirits in various places has enabled the public to further discover that craftsman spirit is in our lives. Especially the popular broadcast of "Greater Craftsman" and "I am repairing cultural relics in the Palace Museum", the audience saw the spiritual qualities of the great craftsmen. General Secretary Xi Jinping pointed out that all valuable and meaningful literary and artistic creations and academic research should reflect reality and care for reality, and should be conducive to solving real problems and answering realistic questions (Xi Jinping, 2017). This requires media workers in the new era to take root. Social life, combined with the development of the times, fully taps the story of "craftsman spirit" in the society, enhances the cultural connotation and value of the works, and publicizes craftsman spirit in the whole society in a way that the public likes to hear, so that craftsman spirit is deeply rooted in the hearts of the people.

### 5.3 Innovative craftsman spirit and spiritual education mode

Li Keqiang pointed out at the Symposium on Higher Education Reform and Innovation held in Beijing: focus on enhancing students' practical ability, cultivating craftsman spirit, practicing the integration of knowledge and practice, providing more mobile phone conferences for students, improving their ability to solve practical problems, and helping to enhance Chinese products quality (Li Keqiang). School is an important position to cultivate craftsman spirit, so it is necessary to innovate the craftsman spirit mode.

On one hand, when the school educates students on the theory of craftsman spirit, it is necessary to integrate the dedication, excellence, meticulousness, and innovation in craftsman spirit into the classroom teaching. Teachers play their role in guiding and demonstrating, so that students can learn. In the process, I feel the charm of the craftsman spirit. At the same time, the school should also help students establish a correct professional outlook and improve professionalism while educating students about craftsman spirit. The school should actively invite some craftsmen to the campus to give students direct contact with the craftsmen in the form of lectures, so that students can directly feel the charm of the great craftsmen. On the other hand, modern apprenticeship should be further promoted. German "dual system" vocational training mode, students also need to study and accept in the enterprise while learning professional theoretical knowledge in vocational colleges professional skill in terms of training, this dual-system cultivation model has become the secret of German manufacturing's longevity. In the

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perspective of cultural self-confidence, we must cultivate craftsman spirit, not only based on China, but also on the world, taking the essence of the world culture and discard its dross. China can learn from the education mode of craftsman spirit in Western countries and reach the goal which we called "Stones from other mountains can attack jade". In the society, a group of craftsmen with the character of the craftsman is selected as the professional teacher of the school. In the actual teaching, the teacher's words and deeds are used to achieve the purpose of the students to cultivate their own craftsman spirit, and finally internalize in mind and externalize in action.

## 6 Conclusion

This paper mainly discusses the inheritance and development of the craftsman spirit from the perspective of cultural self-confidence. The spirit of craftsman has been a national temperament of China since ancient times. It is a concrete manifestation of the confidence of the Chinese nation's culture, highlighting the style of a big country and the feelings of the world. The inherent logical relationship between cultural self-confidence and craftsman spirit is manifested in the fact that cultural self-confidence is conducive to the promotion of craftsman spirit and the promotion of craftsman spirit is conducive to consolidating cultural self-confidence. The inheritance and development of the craftsman spirit not only needs to be based on practice, but also emphasizes the combination of tradition and modernity. It also requires a culture of craftsman culture to support the craftsman spirit and innovative craftsman spirit.

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Wu Qian

School of Foreign Languages, HanKou University, Wuhan, P.R. China, 430200

(Email: 13476864162@sina.cn)

**Abstract:** The Chinese officialdom discourse, different from the Chinese official discourse, typically refers to the red-taped, stereotyped and empty discourse that some officials deliberately use in face of accidents or crises. It is typically characterized by vagueness, ambiguity, obliqueness and indirectness, for the purpose of evading the problem and avoiding the responsibility of the official. Thus, it is extremely essential and practically significant to make a study of the Chinese officialdom discourse in order to help people to recognize its nature and harm so as to reduce or even eliminate its use. Verschueren's Linguistic Adaptation Theory holds the opinion that using language is a dynamic process of making language choices, which can be realized because of the variability and adaptability of the language. Accordingly, the pragmatic vagueness of the Chinese officialdom discourse is a deliberate pragmatic choice of language for the purpose of evading the responsibility. Thus, the thesis, under the framework of the Linguistic Adaptation Theory, expounds systematically on the pragmatic vagueness of the Chinese officialdom discourse in terms of its pragmatic variability. To put it in detail, the variability of the pragmatic language is shown in the use of the lexical and syntactic devices to realize the pragmatic vagueness. All the examples in the thesis are derived from the news reports in the contemporary mainstream media in China.

**Key words:** Chinese officialdom discourse; Pragmatic vagueness; Linguistic adaptation theory; Variability

## 1 Introduction

Chinese officialdom discourse refers to a special discourse field used on official occasions. With its earliest history hardly traceable, it constantly associated with a negative connotation, has been criticized at home and abroad, for it runs against the audience's expectation for official language, which follows the principles of an ideal language communication: accuracy, clarity and economy – the criteria expected by Grice in his Cooperative Principle (Grice, 1975).

The officialdom discourse is different from the officer discourse. While the latter one tends to convey clear information directly, Chinese officialdom discourse, on the contrary, is intended to give indirect, stereotyped, and vague information in order to evade the issue under discussion. As the information contained in the officialdom discourse cannot meet the communication expectation, it inevitably evokes the audience's reversion. Thus, the pragmatic vagueness in the officialdom discourse is worth studying to overcome and guard against such expressions.

It is true that the pragmatic vagueness prevails in the officer discourse, just as it abounds in daily communication. Channel says that the pragmatic vagueness is "part of our taken-for-granted world" and is generally unnoticeable unless it appears inappropriate. (Channel, 2000).

However, the pragmatic vagueness achieved in the officialdom discourse is often regarded as indefensible, for on formal official occasions where language proficiency and accuracy are highly desirable, the purposely-chosen officialdom discourse is condemned for its emptiness, evasiveness and stereotype. To a certain extent, these features are seemingly defensible in order to harmonize the atmosphere, save the officers' face and avoid direct conflicts and frictions between the officers and the general public. On the second thoughts, however, the officialdom discourse should be avoided or even



Therefore, an exploration into the pragmatic vagueness of Chinese officialdom discourse is imperative, for it provides a schematic perspective in terms of pragmatic communication. A profound insight into Chinese officialdom discourse is, hopefully and possibly, an efficient and effective way to avoid and even eliminate it so as to avoid the use.

**1.1 Relevant research on Chinese officialdom discourse**

The Chinese officialdom discourse refers to the red-taped, stereotype language used by public officials or business representatives in news reports. As a special linguistic discourse, it is featured by its evasiveness, emptiness, stereotype, ambiguity, and high-blowing tone. For example, the news reporter in a newspaper is called the relevant staff members, and the real staff is named as a temporary worker.

The Chinese officialdom discourse belongs to the undesirable component of the Chinese official discourse. As put forward by George Orwell in his famous essay "Politics and the English Language" in 1946, the officialdom language used in politics is the "decline of a language", "decay of language" and "debasement of language", used as "the defense of the indefensible." The Australian scholar Don Weston, in his famous paper *Death Sentence: the Decay of Public Language* in 2011, describes the officialdom language in Australian English. He mentions that compared with the time described by George Orwell over 60 years ago, the current business organizations, public departments and newly-emerging media are still responding to the public in stereotyped, lifeless and insensible language use.

In China, some scholars describe the Chinese officialdom discourse as the linguistic corruption. For example, Professor Zhang Weiyong from Beijing University points out in 2012 that the Chinese officialdom discourse is becoming severe with the problem of the social corruption. Professor Ding Lifu also expounds on the corrupted officialdom discourse from its source, essence and prevention in 2012.

However, up to now, there is little literature on the study of the pragmatic use and pragmatic vagueness of the Chinese officialdom discourse. Thus, it is of some significance to conduct such a research in order to understand the Chinese officialdom language better so as to prevent or even eliminate it.

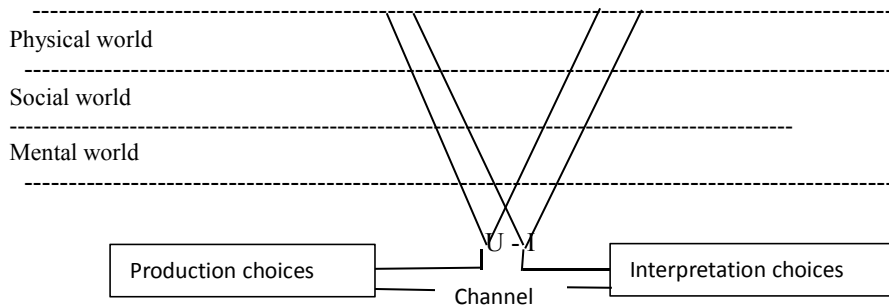
**1.2 Relevant research on pragmatic vagueness**

According to Verschueren, the use of language must comprise a continual procedure of intentional and unintentional language choices out of both linguistic or non-linguistic factors. (Verschueren, 1999) In a communication, both the speaker and the hearer are frequently making adaptive choices in order to reach their communication goals. According to Verschueren, humans make linguistic choices because of the three linguistic properties: variability, negotiability and adaptability, which guarantee the inseparable and dynamic language choice in people's communication. (Verschueren, 1999)

Variability, the spectrum of probabilities of language choices, clarifies the abundance and indeterminacy of the language use. The choice, as regards both linguistic forms and communicative strategies, is always dynamic in constant change.

Negotiability, the flexible communicative principles and strategies rather than the rigid or mechanic language rules, demonstrates the flexibility of speakers' continuous linguistic choices.

Adaptability, people's deliberate language choices among many possibilities for a satisfactory communication need, reveals people's motivation of linguistic choices. In the choice-making process, linguistic variability provides the possibility; negotiability provides the options, while adaptability allows language users to choose flexibly from all possibilities. Thus, the study of language adaptability must take into account social, cultural and cognitive factors. In order to illustrate his point, Verschueren has presented a sketchy summary of contextual correlates in the form of the following figure.



**Figure 1 Contextual Correlates of Adaptability**

Verschueren's three properties, fundamentally inseparable and interrelated, successfully explain the dynamic process of language user's choice making in communication. With the chosen data from news report, a one-way language choice rather than a two-way negotiation among writers and audience, the thesis is to focus on variability of Chinese officialdom discourse.

## 2 Methodology of the Study

A qualitative-descriptive approach is adapted to analyze the pragmatic vagueness in Chinese officialdom discourse. All the examples of the Chinese officialdom discourse in the thesis are selected from the news reports in the mainstream Chinese media from 2010 to 2017. In addition, the data collected for the Chinese officialdom discourse should be discriminated from the desirable Chinese official discourse.

To put it in detail, the news reports are selected based on two criteria. Firstly, the news reports touch various fields and heated issues of the Chinese society, especially the concerns and complaints of the general public and the corresponding response from the officers in the related administration branches or business organizations. Secondly, most news reports are taken from good-reputed portal websites and newspaper to ensure their authentic source in order to ensure the timeliness of the analysis, though the overall data cover almost 10 years. Furthermore, considering the general motivation for officials to use the officialdom discourse, the contents of most selected examples fall naturally to the range that covers the response or feedback of the related parties to an exposed problem or issue.

As to the selected linguistic data, the thesis applies Verschueren's Linguistic Adaptation Theory to conduct qualitative and descriptive analyses. Namely, the pragmatic vagueness of the selected samples of the Chinese officialdom discourse is studied from variability perspectives.

## 3 Variability of Pragmatic Vagueness in Chinese Officialdom Discourse

Enlightened by the Linguistic Adaptation Theory, this chapter will make a detailed analysis of the variability of the pragmatic vagueness in the Chinese officialdom discourse. To be specific, the chapter will explore the realization devices of the pragmatic vagueness at different linguistic levels.

### 3.1 Linguistic realization at lexical level

In Verschueren's view, three linguistic properties, i.e. variability, negotiability, and adaptability, determines speakers' continuous choices in language use. Among the three properties, variability defines the possibilities of language choices. Thus, it is necessary to analyze the variability of the pragmatic vagueness and its realization devices from the two levels: lexical and syntactic.

The wide use of vague words is one of the commonest ways for news spokesmen or officers to express vagueness in their language. In order to avoid touchy topics and direct answers, the officer deliberately uses some semantic vague words, namely vague words in scope to achieve the pragmatic vagueness at the lexical level.

The vague words in scope, namely, the abstract or vague words in the semantic scope, are chosen to satisfy the communicative needs in the Chinese official situations. However, the abstract and vague expressions, with some general but empty comments on the issue in question, can hardly convey any substantial meaning. These vague words in scope can be further categorized as referential vagueness and quantity vagueness.

#### 3.1.1 Referential vagueness

In a news report, the officer who does not want to specify a thing or a person usually employs lexical means, such as plural forms, abstract reference and arbitrary reference, thus giving a vague and abstract utterance without any specific reference.

##### Example 1

Many foreign brands are synonymous with 'high quality' in the minds of many people. In recent years, some big domestic and foreign brands have emerged frequently in the market. From cosmetics, milk powder to leather shoes and clothing, from mobile phones and digital cameras to computers and automobiles, the involved internationally renowned companies are far beyond the imagination of consumers.<sup>106</sup>

Example 1 is a typical example for the use of plural words which are used tactfully to realize the pragmatic vagueness. However, in the above-cited Chinese officialdom discourses, a superordinate in the plural form is deliberately chosen when its hyponyms are available. Hence, a specific mention of the

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<sup>106</sup> Where the URL is <http://mt.sohu.com/20150422/n411705171.shtml>

specific time, companies or brands is avoided. Naturally, these vague expressions cannot satisfy readers' expectation. The readers are expected to know what companies are violating the basic labor laws and the customers' trust in the famous brand. However, Chinese officialdom discourse keeps the readers in darkness and maintains the positive image of those negative companies. In the way, the readers cannot stop their speculations that those specifically identified companies are the corporations without backdoors or powerful pulls or tactful public strategies, while a vague mention is protected. In the long run, the whole news media will lose the trust from the public. Considering the long-term potential harm, the referential vagueness of Chinese officialdom discourse in the news reports should be avoided to the greatest extent.

### 3.1.2 Quantity vagueness

The quantity vagueness, another kind of vagueness in scope, refers to a speaker's intentional use of vague quantifiers to allow certain approximation. The typical approximated reference includes "about", "some", "a little bit", "possible", "certain" etc. Admittedly, non-motivated quantity vagueness is common owing to a speaker's lack of exact or adequate information. However, in Chinese officialdom discourse, the officer will deliberately withhold certain information by using these approximates. While it is a useful strategy to avoid absolute or false statements, the quantity vagueness, in most cases in Chinese officialdom discourse, is a means to conserving or hiding the information concerned.

#### Example 2

Food safety issues has always been concerned by the people and the government departments also have attached great importance. Relevant departments claimed that they have checked the source of chicken and duck meat sold in the market at regular intervals and no unqualified frozen chicken or duck has been found in the market apart from some details. Coincidentally, regarding the report on the safety of the community swimming pool, the relevant departments responded that they would conduct inspections non-scheduled and would require rectification once they find any problems.<sup>107</sup>

The cited report, by using such vague quantifiers as "at regular intervals", "some", "it is not temporary...", "non-scheduled", answers everything but nothing at all. What the readers are really concerned with, such as the food safety examination, the legal operation of the food stands, the dangers of the reported food, is not mentioned at all. Furthermore, no specific measures are taken about how to guarantee or ensure the safety and avoid the danger. These empty words can merely lead to readers' negative impression. Similar approximators include "it is not temporarily found that...", "it is being investigated that...", "it will be handled as soon as possible", etc. The frequent use of these words can hardly be defended.

The use of the pragmatic vagueness in Chinese officialdom discourse is different from the other use of quantifier vagueness. For example, some expressions such as "within the capacity", "some", and "certain" are used to allow flexibility and scope. However, concerning the problems of the food safety or the life security in the swimming pools, the use of such vagueness can merely leave the impression that the officers are avoiding their duty. Such a use of vague expressions about quantity reflects that the officers concerned are not treating the events seriously, but are perfunctory in performing their duty. Obviously, the vagueness in concerned Chinese officialdom discourse will ruin the image of public servants in the long run.

## 3.2 Linguistic realization at syntactic level

Besides the lexical vagueness, the pragmatic vagueness of Chinese officialdom discourse can also be obtained at the syntactical level.

### 3.2.1 Pragmatic vagueness realized by moderating tone

The pragmatic vagueness can be realized by directly or indirectly moderating the officers' tones. This is most commonly used when the officers intend to mitigate the severity of the events.

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<sup>107</sup> Where the URL is <http://news.hexun.com/2016-07-22/185099254.html>

Example 3

The Zhongmu County Committee issued an official statement saying: "A preliminary investigation revealed that this was an accident that occurred during the construction of Henan Hongyi Agricultural Technology Co., Ltd.<sup>108</sup>

The above example is a typical direct moderation of the event. In the coercing process of pulling down the residential buildings, the real estate developer, driving bulldozers directly into the peasants' land, assumed two deaths. While the police arrested the suspects for murder and slaughter, the news report declared the event as an accident. This deliberate tone-easing are hiding the truth by the tactful use of directly moderate vagueness. On the one hand, it seems that the remarks mitigate the events and avoid further tension; on the other hand, however, the typical Chinese officialdom vagueness is harmful to the social fairness by giving a prejudiced, moderated description and declaration of the events.

### 3.2.2 Pragmatic vagueness realized by shifting focus

The pragmatic vagueness can be realized by shifting the focus. Namely, the officer will deliberate shift the focus to others in order to avoid tough and sensitive questions and shuffle the responsibility.

Example 4

Director Xie said: We must focus on positive publicity. The people's difficulties will not be solved even if you come over with cameras. Not only the Zhenjiang City Housing Authority, but the whole country may do wrong things and commit mistakes.<sup>109</sup>

In Example 4, the official, unaware of the presence of the journalist' hidden camera, insisted repeatedly in his declaration that the negative report should be avoided while the positive report should be persisted. His utterances are typical of the focus shift. Namely, instead of admitting the mistakes in his own work, the officer simply attempted to shuffle the responsibilities by shifting the focus from his department to the others, from the problems to the so-called positive side. The journalist of this report further revealed that this official continuously kept warning the journalist that if the negative report were given, she should shoulder the responsibility of causing social instability. This stereotype vagueness in the Chinese officialdom discourse, common but inexcusable, should be further revealed.

In sum, the linguistic realization of the pragmatic vagueness in the Chinese officialdom discourse is explored at the two levels: the lexical level and the syntactic level. At the lexical level, the vague words in scope are illustrated in terms of referential vagueness. Furthermore, the vagueness at the syntactic level is mainly demonstrated with the Chinese officialdom discourse in news reports, during the process of which the vagueness is realized by moderating the tone, shifting the focus.

## 4 Conclusion

The pragmatic vagueness refers to the phenomenon that a speaker, in the specific context, may deliberately use the indeterminate, implicit or indirect utterances to express multiple illocutionary acts or forces. (Yu Dongming, 1993) As an inherent trait of language, vagueness has always been a heated topic that attracts the attention of scholars in the various fields. Much progress has been made. However, relatively limited work has been done in the interrelationship between the pragmatic vagueness and Chinese officialdom discourse, especially from the view of Verschueren's Linguistic Adaptation Theory.

Therefore, based on the framework of the Linguistic Adaptation Theory, this thesis is an attempt to analyze the pragmatic vagueness in the officialdom language.

The thesis studies the variability of the pragmatic vagueness in the Chinese officialdom discourse

<sup>108</sup> Where the URL is <http://news.sina.com.cn/c/2013-03-28/185426671604.shtml>

<sup>109</sup> Where the URL is [http://zzwb.zynews.cn/html/2010-01/21/content\\_154197.htm](http://zzwb.zynews.cn/html/2010-01/21/content_154197.htm)

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from the lexical and syntactic levels. The basic approaches include referential vagueness and quantity vagueness. Furthermore, the declarative sentences are used to achieve the pragmatic vagueness at the syntactic level. The officers usually intentionally declare vague statements by moderating the tone, by shifting the focus.

The systematic study of the pragmatic vagueness of the Chinese officialdom language provides a brand-new perspective, and helps people have a clear understanding of it, recognize its harm to the society and reduce or eliminate the Chinese officialdom discourse.

In addition, such a tentative analysis would shed some light on the development of the communicative skills and the language learning and teaching. Since the study is only an initial attempt of the author, there must be some problems to be solved and much room for improvement. Firstly, the present thesis mainly focuses on the pragmatic vagueness of the Chinese officialdom discourse chosen from the mainstream Chinese news media. Thus, a quantitative study of the raw data is desired. Besides, this thesis makes a pragmatic analysis of the pragmatic vagueness in the Chinese officialdom discourse under the framework of Verschueren's Adaptation Theory. Other famous pragmatic theories, such as the Cooperative Principle, the Politeness Principle and the Relevance Theory, are not taken into consideration. So, the author will try to continue this study and make it more complete in the future.

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## **Study on the Influencing Factors and Mechanism of Residents Satisfaction in the Public Space of Urban Community**

### **Based on the Grounded Theory Analysis**

Tan Liman<sup>1</sup>, Zhou Ling<sup>2</sup>

1 The United Front Work Department of Wuhan University of Technology. Wuhan, P.R. China, 430070

2 Hubei University of Education. Wuhan, P.R. China, 430205

(E-mail: 26879451@qq.com, lingda\_zi@126.com)

**Abstract:** This article collects a large amount of datum through field interviews with J community and Z community in H district of W city. Technical methods of grounded theory are applied to processing the data by opening coding, axial coding, and selective coding with the result of 76 initial concepts, 22 subcategories and 7 main categories of the urban community residents satisfaction of public space, by refining the influence factors of residents satisfaction including community public space, community and residents behavior, and constructing the "space-community-behavior" model of Influencing factors of residents satisfaction on the urban community public space. Meanwhile, on the basis of the "space-community-behavior" story line way, we analyze the paths of different factors on the residents' satisfaction in urban community public space, and put forward suggestions on promoting residents' satisfaction from framework system, community relations and the basic rules of the community public space.

**Key words:** Community; Public space; Residents satisfaction; "Space-Community-Behavior" model

### **1 Introduction**

To strengthen and innovate social governance, it is proposed in the report of the 19<sup>th</sup> National Congress of the People's Republic of China that social governance patterns shall be created for common construction, governing and sharing. Besides, it is pointed out in the report that communities are focuses of social governance. However, with the rapid development of market economy and fast advancement of urbanization, fundamental changes have occurred to urban community life, and disintegration of unit systems brings about value deconstruction of communities in original units (Zhao Xin, Fan Bin, 2014). Thus, "place-based communities based on acquaintance societies turn into communities of strangers" (Xin Fangkun, 2018). Communities have become increasingly more mobile and heterogeneous. Common community governance dilemmas (Shu Xiaohu, 2017) highlight problems and difficulties of community governance.

Community public spaces, as the most important subjects for undertaking functions of public spaces in original units and actual fields for social mobilization (Zhao Xin, Fan Bin, 2014), are important for enhancing interactions between community residents to reduce mobility and relieve heterogeneity, in order to promote community governance. Community public spaces, as "containers for community residents' lives" (Gao Wanhui, 2016), have different people assembled in some interactions, and

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“create infinite possibilities for people to develop social relationships and reshape personal identities beyond original individual identities developed based on common intimate relationships” (Xu Kai, Klaus KlausSemsroth, 2013). These spaces can be used as media for reciprocal interactions among diverse subjects such as grassroots governments, social organizations, community elites and community residents; they reconstruct governance relationships in optimizing public services, resolving community conflicts and cultivating public spirit (Xin Fangkun, 2018). They are favorable for promoting formation of social governance patterns for common construction, governing and sharing. It is helpful for optimizing construction of community public spaces and promoting the formation of new governance patterns by studying residents’ satisfaction with the spaces.

## 2 Literature Review

Public space emerged in 1950s as a specific noun (Chen Zhu, Ye Min, 2009), and people like Arendt are representatives studying public spaces. Hannah Arendt (Hannah Arendt,1958) demonstrated that actions were basic material conditions for people to enter public spheres by classifying people’s fundamental activities into labor, work and action. Besides, she analyzed publicity of public spheres, namely extensive publicity and equality. Habermas reckoned public spheres as tools for him to criticize the society (Chen Qinfen, 2009). The core thoughts include openness, publicity and rationality of public powers as well as bourgeois’ ideals and goals in public spheres (Chen Qinfen, 2009). Jan Gehl (Jan Gehl,2002) categorized human activities into necessary, spontaneous and social activities based on the relationships between outdoor activities and physical environment of public spaces, thus clarifying the impacts of the physical environment upon intensity of social interactions. Jacobs (Jacobs,1961) profoundly criticized harms of functional regionalism, considered that the essence for facilitating public intercourses was to build mutual trust and a social monitoring mechanism, and put forward ways for promoting public intercourses in urban public spaces. Dai Yifeng (Dai Yifeng,2011) deemed that “public spheres, which corresponded to private spheres, were physical spaces owned by the public and equally made open to all people of the society”; Bai Jing et(Bai Jing et,2007) all considered that public spaces were crucial carriers of urban ecology and urban life. They exhibited distinct social and spatial patterns and features (Yang Zhen, Xu Miao, 2008). Qin Hongling (Qin Hongling,2008) thought that the value of public spaces was reflected from how to realize the objective of promoting human development, while their humanistic features were mainly manifested from individuality, diversity, humanistic care, sense of place, pleasantness of space scale and easiness for intercourse. In addition, they regarded sense of security, sense of sphere, sense of belonging, sense of identity, and sense of participation as people-oriented value pursuits (Yu Qing, 2006).

Community public spaces refer to internal public spaces of communities. Social cultures and relationships included in these spaces are important aspects for studying these spaces. Yuan Ye (Yuan Ye,2012) paid attention to roles of community public spaces in enhancing residents’ communications and sense of belonging, investigating how to serve residents with the spaces and create favorable community atmosphere. Liu Zhongqi (Liu Zhongqi,2012) considered that community public spaces, to certain extent, played positive roles in facilitating residents’ communications and participating in community affairs, and was of positive significance for fostering residents’ sense of belonging. Shu Xiaohu (Shu Xiaohu,2017) reported that connotations of community public spaces could be analyzed based on three ideas as follows: firstly, community public spaces were physical public spaces which worked as functional vectors; secondly, they were public social and political spaces which functioned

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as civil societies; thirdly, they were public spaces which functioned as public spheres, where material and interpersonal interactions exist. Zhang Yong (Zhang Yong, 2017) thought that functional “publicity” and spatial “openness” were major attributes of community public spaces, among which “openness” implied that the spaces were open to all people within certain range, while “publicity” meant that the spaces were critical for residents’ cultivation and development of publicity.

Satisfaction is a measure for weighing degree of satisfaction. In current studies about community public spaces, little attention has been paid to the degree of community residents’ satisfaction with measures of services and spirit of the spaces. Besides, satisfaction surveys on public spaces have mostly focused on urban public spaces as well as their planning, design and construction. Nevertheless, few studies have been conducted to explore community public spaces and pay attention to residents’ satisfaction perceived by “users”. Therefore, this paper based on the “users” perception impacting the satisfaction, studies residents’ satisfaction in community public space by field interviews and ground theory analysis so as to find out what and how impact the satisfaction and bring forth suggestions.

### **3 Coding Process and Research Findings**

#### **3.1 Research Methods and Data Sources**

Grounded theory is a qualitative analysis method frequently used in social sciences. In essence, it looks for useful information among numerous first-hand materials or raw materials and then codes them. Coding has three stages, namely open coding, axial coding and core coding. In this paper, field surveys were performed on communities J and Z in District H, City W, Hubei Province. Field interviews were conducted in the sampled communities from 1<sup>st</sup> July to 1<sup>st</sup> September 2017 and 2018 respectively to solicit community residents’ opinions on factors impacting satisfaction with community public spaces. 39 respondents were sampled from the field surveys for in-depth interview. They included 16 males and 23 females, among whom there were over 4 respondents above 60 and 9 respondents who weren’t younger than 40; their average age was 45.3; about 30% interviewees held junior college diplomas and higher degrees. After the interviews, all interview materials were promptly sorted out and saved as data subsources of this paper.

#### **3.2 Coding Process**

##### **3.2.1 Open Coding**

During open coding, main research tasks are defining, summarizing and naming phenomena. Definition refers to that primary records of interviews are scrambled and then extract the statement related to the study surmising refers to that analyzing extracted original statements and generalizing with phrases or short sentences as succinctly as possible. At last, their categories are extracted and named. In this paper, 39 interviewees’ raw interview materials were scrambled, sorted out and analyzed. Finally, 76 initial concepts and 22 categories were extracted, including management services, complaints, design, supporting facilities, road smoothness, passive participation, individual expectations, convenient accesses, entrance/exit setting, reduced use, situation about complaints, community impressions, emergency broadcast, building quality, fire fighting facilities, opinions/suggestions, spatial expectations, symbolic meanings, recommendations, visual aesthetics, trust and active participation. For information about extraction of initial concepts, refer to Table 1



**Table 1 Regarding Creation of Open Coding**

Category	Initial concept
Management service	Opinions on community management; (Public space) Poor design, no improvement in management; Later management services are not up to date; Hominization.
Complaint	Increasing property fees neither proceeds according to established procedures nor improves service quality accordingly; The quality of elevator is not good. It's useless to reflect with the estate management; Property management fees are the only consideration of estate management, but damaged walls are not repaired..
Design	The design of public space lays particular stress on aesthetics and less consideration on safety and practicality; (Public space) too scattered, making each place too small; Cars occupy the space, impeding the residents going out; Central Plaza is too small to move conveniently..
Supporting facilities	(Public space) Facilities should be complete, otherwise what does children play with? (Public space) More fitness facilities, less recreational facilities.
Road patency	(Public space) fire fighting facilities and passages make a sense of security; Neighbors hang clothes by rope in fire stairs, affecting fire drills; There's no sunrise in the corridor; Road design is unreasonable so that it can't get through to traffic in an emergency.
Passive participation	Lack of space suitable for young people, go less; The venue is too small to hold an event. I don't want to go; (Estate management) do not deal with the problems we reflect, so we are not in the mood to participate in the activities; The service level of the estate management.
Individual expectation	Not used to the small broadcasting in the community; I hope there will be a special space for our young people; I hope (public space) can push wheelchairs without steps, which is satisfactory; It's ok to have convenient and good hygiene conditions.
Convenient arrival	Location design should be convenient for old people's arrival; It's quite convenient for it to locate in the center of the community; The gates of the community are locked and not accessible.
Entrance and exit settings	The square in the district is flat and easy to get in and out; There's a water pool at the intersection of several roads, which is dangerous; The volume ratio is too high; There is only one entrance and exit for 300 families in our community, which is a hidden danger.
Reduced use	There are too many cars on the road, so there is less going out for a walk; The nearby square is too small for dancing.
Complaint status	It's no use complaining about these old and damaged facilities; Property complaints by residents are unresponsive or delayed.
Community impressions	Property management is not good, so people's impression of the community is not as good as before; The poor quality of elevators affects the overall impression of the community; There exists a gap between the ideal and the reality.
Emergency	I hope there can be some sound reinforcement equipment in the corridor, which will be

broadcast	more useful in emergencies; It is more convenient to broadcast emergency notification in residential area.
Building quality	The elevator shaft was soaked in the rainstorm and the quality is not good; The poor quality of supporting facilities affects the overall quality.
Fire protection facilities	Community (public space) should have fire fighting facilities and access, so it has a sense of security; There must be fire hydrant in the high-rise elevator building; Emergency exits are often locked, causing hidden dangers in fire fighting.
Suggestions	The hidden safety hazard was solved after the reflection; This problem has been reflected many times to the estate management but the property said they were not good at it; Most of the suggestions for property reflection are not responded.
Space expectation	Lack of rest facilities causes disappointment; Don't be too demanding; There is a gap between the advisement before buying a house and the reality after buying a house.
Symbolic meaning	The center plaza is good for us to assemble and it has become the landmark building here.
Recommend	Free clinic, repairing small household appliances, enjoy the cool party and other activities are very good; I feel good about the whole community. I'd like to recommend it; I was recommended to buy a house here.
Visual beauty	Hope the community will be more beautiful; The trees are growing up now, and they look better.
Trust	Property is now being improved; Reflected problems are solved preliminarily and trust is limited; we are confident of the re-election of the industry committee organized by the community.
Active participation	Love to participate in activities organized by the community, because of the lively atmosphere; Buildings housekeeper's service attitude is OK. I will participate in community activities when time is available.

### 3.2.2 Axial Coding

Axial coding is a coding process for core categories. It distinguishes intrinsic connections among categories forming at the preceding coding stage, and has all categories associated and summarizes core categories after raw materials are analyzed. At this stage, this paper discriminates internal connections among 22 subcategories during open coding. At last, seven core categories are identified, including spatial quality, safety, accessibility, residents' expectations, residents' complaints, community trust and community image, as shown in Table 2.

**Table 2 Axial Coding Processes**

<i>Principal category</i>	Subcategory	The Specific Meaning of Category
Spatial quality	Design	Planning of the Geographical Location, Size and Function of space
	Supporting facilities	Equipment required for corresponding functions in space

	Building quality	Quality of buildings and related facilities
	Management and Service	Management and maintenance of community public space and its facilities
Safety	Road patency	Reasonable Road Design and Barrier-free
	Entrance and exit settings	Enough number of entrances and exits will not cause congestion and other phenomena
	Fire protection facilities	Free roads, fire hydrants, etc.
	Emergency broadcast	Amplifiers in the community
Accessibility	Entity reachability	Distance and difficulty of reaching community public space
	Visual accessibility	Whether to give visual beauty enjoyment
	Symbolic accessibility	Is it symbolic and attractive with a sense of space
Residents' expectation	Personalized expectation	Residents' individualized demand expectations for the use of community public space
	Overall expectation	Residents' overall expectations for the use of community public space
Residents complaint	Complaint	Express discontent by complaining to others or communities
	Passive participation	Expressing discontent by refusing to participate in community public space activities
	Reduce use	Expressing discontent by reducing the frequency of use of public space
Community trust	Trust	The trust degree of community to realize public space service
	Active participation	Degree of initiative to participate in community public activities
	Recommend	Recommend the community and its public services to others
Community image	Overall impression	Impression on the community public space management and services
	Complaint status	Openness of complaint channels for community public space
	Suggestions	Whether the community responds to the residents' suggestions and opinions, and whether it is timely

### 3.2.3 Selective Coding

Selective coding clarifies connections among core categories. In the process of selective coding, core categories are analyzed in details in order to elaborate their relationships clearly. Specifically, the contributing factors are “space dimension”, “community dimension” and “dimension of residents’ behaviors”. Table 3 shows the typical relationships.

**Table 3 Relational Structure of Main Categories**

Influencing factors dimension	Typical Relational Structure	The Connotation of Relational Structure
Dimension of Public Space	Spatial Quality Affects Resident Satisfaction	Resident satisfaction will be affected by spatial quality
	Spatial Safety Affects Resident Satisfaction	Resident satisfaction will be affected by the security of public space
	Spatial Accessibility Affects Resident Satisfaction	Resident satisfaction will be affected by accessibility of public space
Dimension of Community	Community Trust Affects Resident Satisfaction	The degree of trust in community will affect residents' satisfaction
	Community Image Affects Resident Satisfaction	Cognition of Community Image Affects Resident Satisfaction
Dimension of	Residents' expectations affect residents' satisfaction	Residents' satisfaction will be affected by their expectations
	Residents' Complaints Affect Residents' Satisfaction	Residents' Satisfaction Degree Affected by Their Complaints to the Community

### 3.2.4 Modelling

According to the grounded theory based on typical relationships, residents' satisfaction with urban community public spaces is impacted as follows: Space dimension, as an objective factor, which affects residents' satisfaction directly; community dimension, impacted by space dimension owing to subjective cognitions like residents' trust, influences residents' behaviors as external objective environment of a community, thus impacting residents' satisfaction; residents' behaviors, affected by space and community dimensions, impact residents' satisfaction. Therefore, spaces, communities and behaviors are connected to build a related model for studying residents' satisfaction with community public spaces (Fig 3-1).

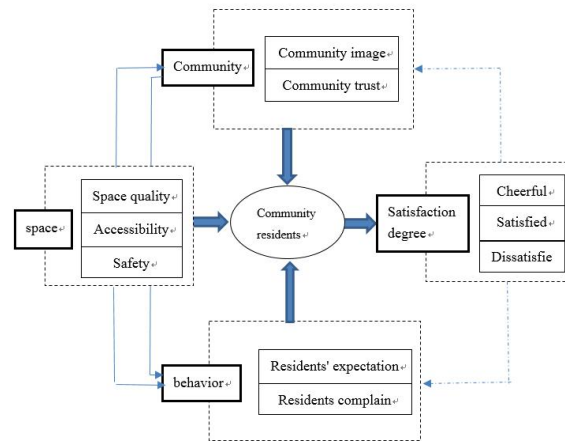


Figure 1 Factor Model on “Spaces-Communities-Behaviors”

### 3.3 Results

#### 3.3.1 Factors Impacting Residents’ Satisfaction with Urban Community Public Spaces and Impact Mechanisms

From the model on “spaces-communities-behaviors”, it is found that residents’ satisfaction with urban community public spaces is impacted by factors in three dimensions: the first is about space, including spatial quality, accessibility and safety, which as basic criteria for the state of community public space are the fundamental factor. the second is related to community, including community image and trust, which impact residents’ satisfaction with urban community public spaces by affecting their perception about communities as exogenous factors outside the spaces; the third is about residents’ behaviors, including residents’ expectations and complaints. These factors impose varying impacts upon residents’ satisfaction under different environment, and their impact mechanisms can be adjusted by changing related conditions, so they are also called regulatory factors.

From the perspective of space, three factors have direct and indirect impacts upon residents’ satisfaction. Concerning direct impacts, residents’ satisfaction is impacted by whether status quo of public spaces satisfies residents’ demands. As to indirect impacts, residents’ satisfaction is affected by spatial status from the perspective of communities and residents’ behaviors. Two factors about community also impact residents’ satisfaction directly and indirectly. In terms of direct impacts, residents’ perception about community image and their degree of trust impact their satisfaction with public spaces. As regards indirect impacts, those two factors affect residents’ behaviors, thereby impacting residents’ satisfaction. The two factors about residents’ behaviors directly impact residents’ satisfaction. Residents’ satisfaction with community public spaces is affected by their expectations and responsiveness to community complaints.

#### 3.3.2 Suggestions for Improving Residents’ Satisfaction with Community Public Spaces

Factors impacting residents’ satisfaction with community public spaces are systematically summarized based on the factor model on “spaces-communities-behaviors”. In this paper, suggestions are put forward with respect to how to improve residents’ satisfaction with community public spaces.

(1) Build a basic architecture of community public space for satisfying residents’ demands from the perspective of space. The key for building a complete basic architecture of community public space

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is to satisfy residents' demands. First of all, it is necessary to make planning/designs for community public spaces more scientific, attach importance to generally know about spatial layout, intensively study/understand space scale and corresponding systems, improve spatial functions, manifest spatial cultures, make the spaces convenient in terms of scale, endow the spaces with unique features and foster a sense of occasion, in order to increase accessibility of community public spaces from the perspective of their physical, visual and symbolic meanings. Secondly, efforts shall be made to improve intactness of facilities inside community public spaces and solve problems about current public facilities (including incomplete variety, shortage of quantities, oldness, worn-out, slow updates and incomplete functions). Thirdly, construction quality of public spaces shall be improved. The construction shall be performed in strict compliance with related national laws, rules and regulations as well as particular operating procedures. Meanwhile, rigorous requirements shall be identified for people, materials, construction standards and methods from the perspective of safety consciousness and quality consciousness.

(2) Formulate basic rules on community public spaces as behavioral restraints from the perspective of communities. Formulate basic community rules on the premise of improving community image to guarantee the enhancing community trust: Firstly, people should strive to develop community residents-oriented serving concept to improve service attitudes, optimize service performances and community image; Secondly, it is necessary to foster basic values of fairness and equality in communities to maintain good community trust among residents; Thirdly, Given that it rules on utilization of community public spaces shall be formulated through negotiation based on existing supply capacity of the spaces and in line with general community demands to further standardize community residents' behaviors in order to prevent accumulation and aggravation of internal community conflicts and guide individuals and enable them to reach a consensus on the use of community public spaces, for the final purpose of improving residents' overall satisfaction.

(3) Develop community relations in community public spaces from the perspective of residents' behaviors mainly by communication and consultation. Build favorable community relationships, which mainly cover following aspects: Firstly, residents' suggestions, opinions and complaints should be responded correctly. It is critical for the community to build sound community relationships whether a community appropriately treats its residents' suggestions, opinions and even complaints. Secondly, communication mechanisms and negotiation platform, such as residents' councils and consultative conferences, should be built so as to create necessary conditions and likelihoods for building sound community relations. Meanwhile, actively regulating community residents' psychological expectations about public spaces is one of effective ways for facilitating sound community relations and improving community residents' satisfaction, because of "meanings of appropriateness, comfort, satisfaction and efficiency will change with expectations" (Kevin Lynch,1960). People's expectations and environment jointly impact cognitive objects.

#### **4 Conclusion**

Kevin Lynch, an urban designer, reports that cognition about environment is people's common experience under environment; instead, it is not merely fostered based on researchers' and professionals' subjective aesthetics. Satisfaction is a measure for comparing performances of and expectations about used or experienced products or services based on the cognition, on the premise that differences exist between cognized actual and expected service management. In this paper, field interviews were performed on community residents based on such commonness and specific differences to know about what community residents are really thinking. In addition, the author pondered upon factors impacting residents' satisfaction with urban community public spaces and impact mechanisms in accordance with grounded theory. Thus, this paper built a factor model on

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"spaces-communities-behaviors" and clarified the factors influencing residents' satisfaction with urban  
community public spaces. It also explored basic architectures, community relations and basic rules of  
urban community public spaces, thereby bringing forth pertinent countermeasures and suggestions.

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## **On the Innovative Application of Micro-Media in Ideological and Political Education in Colleges and Universities in the New Era**

Lin Kai

School of Law, Humanities and Sociology,

Wuhan University of Technology, Wuhan, P.R. China, 430070

(E-mail: 601428805@qq.com)

**Abstract:** By using the methods of literature research, qualitative analysis and interdisciplinary research, this paper puts forward that with the rapid development of information technology, micro-era has come, and various kinds of micro-media have emerged. It is believed that the prominent characteristics of micro-media have brought great changes to information dissemination, as well as opportunities and challenges to ideological and political education in the new era. This paper constructs innovative ideas of Ideological and political education in Colleges and universities in the new era based on micro-media. It is concluded that we should focus on the fundamental task of cultivating people by virtue, combine the characteristics and law of the micro-era, strengthen the innovation of Ideological and political education in Colleges and universities, and constantly explore new ways of Ideological and political education in Colleges and universities in the new era.

**Key words:** Micro-media; Colleges and universities; Ideological and political education; Innovation

### **1 Introduction**

General Secretary Xi Jinping emphasized at the National Conference on Ideological and Political Work in Colleges and Universities: "We should make use of new media and new technology to make the work alive, promote high degree of integration of traditional advantages of Ideological and political work with information technology, and enhance its sense of the times and attractiveness." (Xi Jinping, 2016). This provides basic guidance for ideological and political education in colleges and universities to grasp the characteristics of the development of the times and constantly innovate ways. In the whole social field, the "micro-era" based on micro-media has come. The earliest proposal of "Micro Age" is Luan Yimei's article "Value Discovery of New Media in Micro Age 2009". Luan Yimei believes that the new media in 2009 has opened three important times, one of which is the "micro" era, in addition to the 3G era, the new era of popularization and so on. The development of new media presents the characteristics of "micro-era". Both content production and consumption show the characteristics of "micro-era" (Luan Yimei, 2009). On how to correctly understand the opportunities that micro-media faces in the ideological and political education of college students in the micro-era, An Shuyi analysis is as follows: the ideological and political education of college students expands in time and space, improves in timeliness, updates in form and enriches in content; At the same time, "micro-era" also poses challenges to the implementation platform, management threshold, traditional education mode, education environment and the quality of educators of ideological and political education for college students (An Shuyi, 2015). Wang Qian research on the carrier of Ideological and political education in Colleges and universities in the micro-era, i.e. micro media, holds that for the emergence of the use of

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the network carrier, WeChat and Microblog, we should further strengthen the position of network education and improve the rapid intervention mechanism of network public opinion. Fully grasp the characteristics of the "micro-era" and occupy the main position of online education. As for the rise of Micro-public welfare, we should constantly enrich the forms of activities and pay attention to practical teaching, so as to improve the overall understanding of Ideological and political education (Wang Qian, 2012). There are no disciplines consistent with the "Ideological and Political Education" of China in foreign countries, and there is no special research on the micro-era, so there is no special research on Ideological and political education for College Students in micro-era. Research on the application of micro-media in foreign disciplines is mainly embodied in policy publicity, distance education, ideological education and other fields. We need to pay attention to the application of micro-media in government work and ideological propaganda abroad. Manuel Caster pointed out that the new media has become an effective means for individuals to participate in politics and promote democratic politics, and an important carrier for the government to accept public opinion supervision (Manuel Castells, 2000).

## **2 Main Characteristics of Micro-Media**

### **2.1 The dissemination of information is more efficient**

Characterized by "micro", mass media like Micro-blog, WeChat, Microfilm and so on, has gained a rapid development. (Chen Ting, 2016). Nowadays, there are more and more kinds of micro-media, such as WeChat, QQ, Microblog, micro-government, micro-film, micro-fiction and short video APP represented by Douyin, etc. At present, a remarkable feature of micro-media is that the mobile terminal is more popular than the PC terminal. Only a small number of words, pictures, videos, voice, etc. can be used to transmit information efficiently. People receiving information only need mobile or PC terminals connected to the Internet, which can effectively and timely obtain information.

### **2.2 Information content is more attractive**

The content of information disseminated by micro-media is short and abundant. In a very short time, people can learn as much information as they are interested in. For example, short videos usually only last for 15 seconds, but they deliver much more information than traditional news reports can deliver. Every frame of video can attract people's attention. More and more people are willing to receive information in this way.

### **2.3 Information dissemination is more interactive**

Micro-media breaks through the limitation of traditional media which is difficult to interact. People can transmit information and express their opinions through the platform of WeChat Moments, Microblog, Qzone and their own recording of short videos. When people accept the information transmitted by others, they can express their opinions by message, reply and compliment. People's sense of participation and interaction is stronger.

## **3 The New Situation of Ideological and Political Education in Colleges and Universities in the Micro-era**

Ideological and political education refers to social or social groups that exert purposeful, planned and organized influence on their members with certain ideological concepts, political views and moral norms, and urge them to accept such influence independently, thus forming social practice activities that conform to the ideological and moral qualities required by certain social classes (Chen Wanbai, Zhang

Proceedings of the 16th International Conference on Innovation & Management - 1811 - Yaochan, 2015). In the micro-era, it is more difficult for educators to control this process, which brings both opportunities and challenges. In order to have a more intuitive understanding about the new situation of Ideological and political education in Colleges and Universities in the micro-era, we took undergraduates in Wuhan University of Technology as respondents, conducted random surveys and interviews towards the influence micro media had on them.

### 3.1 Field investigation

500 students were randomly selected for surveys and interviews, among which there were 492 valid questionnaires accounted for 98.4%. Among the respondents, 72.39% were freshmen, who took the first place of the survey. 23.81% were sophomores, 2.83% were juniors and 0.97% were senior students. In terms of the sex ratio, boys accounted for 43.75% of the total, while girls accounted for 56.25%. The proportion of the two was relatively balanced. From the age point of view, all the students surveyed and interviewed were “post-95” college students. From the perspective of discipline attributes, the respondents were distributed in law, economics, management, engineering, art and other disciplines. Generally speaking, the sample of this survey was typical. The data of the survey is as follows:

**Table 1 The Impact of Micro-media on College Students**

Items	Strongly Agree (%)	Relatively Agree (%)	Agree (%)	Inconsistent (%)	Quite Inconsistent (%)
Have habits of constantly playing micro-media like WeChat, DouYin, etc.	232 (47.15)	116 (23.58)	103 (20.93)	29 (5.89)	12 (2.44)
Normal use in class, meeting and other collective activities	147 (29.88)	101 (20.53)	128 (26.02)	62 (12.60)	54 (10.98)
Using time often exceeds your expectations	114 (23.17)	128 (26.01)	85 (17.28)	105 (21.34)	60 (12.20)
Use micro-media as a way to relieve stress	137 (27.85)	109 (22.15)	102 (20.73)	89 (18.09)	55 (11.18)
Believing in that the amount of information in micro-media is greater than that in books.	92 (18.70)	103 (20.93)	107 (21.75)	114 (23.17)	76 (15.45)
Sometimes it's difficult for you to identify the accuracy and correctness of information	102 (20.73)	106 (21.54)	114 (23.17)	97 (19.72)	73 (14.84)

According to the investigation, we find out that college students have a high degree of attention to micro media, a high frequency of use, and diversified use categories. But they are easy to lose rational control of the use of time, resulting in a strong dependence, habits to obtain information from micro

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media, and the lack of ability identifying information. There is a deficiency of positive direction in the use and attention towards micro media.

### **3.2 New situation of ideological and political education method in Micro-era**

Traditional ideological and political education generally concentrates on the same time and place, and carries out the same content of education. The educators are in an authoritative position among them. Traditional ideological and political education is the same model, that is, inculcation-style classroom education mode. It lacks pertinence, such as classroom teaching, seminars, reading newspapers, learning documents and other forms of education. Teachers spend a lot of energy and time preparing lessons. Students accept it passively (Wang Xiaoxue, 2016). The disadvantages of this way are more obvious in the micro-era. College students lack enthusiasm, participation and interaction in the process of education. Micro-media can provide a more equal, open, rich and interactive educational environment for ideological and political education. We can regard the educational environment with micro-era elements as the ideological and political education ecosystem in the micro-era. The innovation basis of the ideological and political education ecosystem in the micro-era is the educational platform, that is, micro-media. When ideological and political education in Colleges and universities correctly follows the operation law of the ideological and political education ecosystem in the micro-era, it will bring opportunities for ideological and political education, and more in line with the needs of the times.

### **3.3 New situation of ideological and political education content in Micro-era**

The traditional textbooks and learning contents of Ideological and political education in Colleges and universities are carefully screened by educational authorities, universities and educators. Their orientation and orientation can reassure educators and educates. However, the characteristics of the micro-era determine that the content of Ideological and political education of college students has a wider coverage and a larger amount of information, and that it is more difficult for the competent educational authorities, universities and educators to supervise the correctness of the content. Moreover, due to the increase of channels for college students to obtain information, there is no doubt that the supervision of information channels also poses difficulties for the educators. These also pose challenges to educators. In the process of contacting information, whether college students can distinguish the correctness of information, judge the accuracy of information, find wrong information and resist the induction of errors is also a common concern of teachers. While providing abundant resources and timely updating information, the openness of the network will also disseminate bad information, which will lead to the loss of value of College students. The virtual nature of the network affects the real interpersonal communication of College students, and leads to the lack of sincerity to others and themselves in the real communication, thus affecting the establishment and development of good interpersonal relationship between themselves and others (Rui Xianhong, 2016).

## **4 Innovative Application of Micro-media in Ideological and Political Education in Colleges and Universities**

### **4.1 Enhance the ability of the ideological and political education team in colleges and universities to use micro-media**

In the micro-era, the ideological and political education team in Colleges and universities must improve their abilities in order to meet the requirements of the new era and not be eliminated by the times. First of all, educators should strengthen their own education of ideals and beliefs, strengthen systematic theoretical learning, have correct outlook of world, life and values, be good at identifying wrong views in micro-media, and have a sense of responsibility to consciously maintain correct views. Educators should constantly improve their professional knowledge reserve and information quality,

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possess more skilled information processing ability, actively participate in relevant learning and training, actively interact with students through micro-media, explore the "private customized" teaching mode in micro-media, accurately teach, and carry out ideological and political education with pertinence and creativity. It should be pointed out that young people are the main audiences in the micro-era, so we should constantly supplement the young blood of the ideological and political education team, let more aspiring and potential young people join the ideological and political education team. At the same time, we should give full play to the role of long-term struggle in the ideological and political education front workers, with management experience, teaching experience, coping with public opinion experience and so on. Promote the level of Ideological and political education.

#### **4.2 Strengthen the innovation of ideological and political education in colleges and universities based on Micro-media platform**

In the micro-era, the traditional ideological and political education methods such as inculcation can no longer be used solely, but should be innovated constantly. Educators should be guided by innovative ideas, keep pace with the development of the times, and view the positive role of micro-media in Ideological and political education with Internet thinking. We should attach importance to the construction of innovative platform for ideological and political education. In addition to using QQ and microblog as ideological and political education platform, we should further explore new ideological and political education platforms such as WeChat Moments and short video APP in the process of education. For example, we can combine the operation mode of MOOC to optimize online courses on a large scale. In order to transfer knowledge, broaden students' horizons and stimulate students' learning motivation, we mainly adopt "Mu class" and "micro class" together with "micro topic", "micro investigation", "micro teaching research" and "micro investigation" (Gao Di, 2015). Educators should make full use of the interactive characteristics of micro-media, strengthen interaction with college students, and let college students truly participate in the whole process of Ideological and political education. Through the equal relationship between educators and college students in the process of micro-media education, the effect of Ideological and political education can be fundamentally improved and the foundation consolidated.

#### **4.3 Improving the content of Ideological and political education in Colleges and Universities Based on micro-media platform**

The content of Ideological and political education in micro-era must be accurate. It should "enable students to understand the practical value of Sinicized Marxism, the wisdom power of Chinese excellent traditional culture and the significance of the times for the development of socialism with Chinese characteristics" (Gu Hailiang, 2017). First of all, educators should strengthen the selection of educational content to help students read the original works and learn the principles, so that ideological and political education can really return to the theoretical origin. Secondly, educators should ensure the attractiveness of the content of Ideological and political education. The important reason why micro-media can be quickly accepted by college students is the novelty of the content and the impact of the sense. Educators should really make the content of Ideological and political education resonate with college students through editing, beautifying and post-production. Finally, educators should ensure the minimality of educational content, take micro-media as a platform, educators should abide by the principle of "micro", strive to make the content brief and interesting, and truly make the ideological and political education work based on micro-media platform achieve remarkable results.

### **5 Conclusion**

The world has entered a micro era. Micro media brings us massive and timely information, broad and convenient platform. The world has become smaller, people's horizons have become wider, and the

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micro era has brought people great changes in all aspects. At the same time, it also brings a lot of unknown and confusion to people. As the frontier group of receiving micro-media, college students are greatly influenced by micro-media. How to do ideological and political education in Colleges and universities well in the micro-era has become a realistic problem to be studied and solved urgently in front of every ideological and political educator. Further research needs to further increase case studies and integrate other innovative ways in the new era to deepen research on improving the effectiveness of ideological, formulating micro-media management system and comparing research at home and abroad.

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# Research on the Status Quo and Influencing Factors of Art Education in Science and Engineering Universities in China

Li Fang

Committee of Communist Youth League, Wuhan University of Technology, Wuhan, P.R. China,  
430070

(E-mail: 258382815@qq.com)

**Abstract:** This paper collected and analyzed university students' evaluations on the status quo and effects of art education in science and engineering universities in China. The result shows that, in general, university students spoke highly of art education in universities while male students were less satisfied than their female peers. Students were less content with the form of art competitions; students did not think highly of the quantity of art activities, which indicates that improvements should be made in the concerning aspects. By using the regression analysis, this paper analyzed the factors influencing the effects of art education in science and engineering universities in China. Further analysis offered specific solutions by analyzing factors influencing the effects of art education. Based on analysis results, this paper proposed specific measures to improve the effects of art education in science and engineering universities in China.

**Key words:** Science and engineering universities; Art education; Art competition; Art activity

## 1 Introduction

Art is a unique way for humanity to understand and reflect the world through emotion and imagination. It is also an epitome of both real and spiritual world of human. Artistic quality is an indispensable and basic merit for modern generations, especially for innovative talents. With its enlightening and appealing characteristic, art education not only help students foster sound views on life, world and value, but also cultivate the ability of imaginal and logical thinking, which is conducive to reinforcing art education and comprehensive quality education at the same time. Carrying out art education activities is beneficial to students, and helps them develop in a balanced and healthy way. However, it is not rare to see that science and engineering universities in China lack clear understandings of artistic culture, the importance of art education and correct idea of education. As a result, science and engineering universities in China often meet with difficulties in various aspects, such as carrying out art activities and competitions, creating original artworks, placing sufficient attention on artistic activities, boasting established brands of art activities and promoting art competitions at different levels at the same time. Therefore, objectively evaluating and analyzing the status quo and influencing factors of art education in science and engineering universities in China can practically improve its effects in targeted universities.

## 2 Literature Review

### 2.1 Art education and social development

Foreign researchers enjoy a head start in studying art education. Richard (Richard,2007) considers talents as one of the 3T (technology, talent and tolerance) factors in innovation-driven economic development. Robert (Robert,2008) thinks that art can promote the advancement of science and provide scientists with a new way to explore the world, which compensated the traditional pure logical and analytical models among scientists. In China, JinYuanfu (Jin Yuanfu,2010) started relatively early carrying out researches on interaction between cultural creative industry and talents. He stressed that culture and arts not only advance the concerning industry, but strengthen the integration of artistic talents and cultural industry. Liu Juan (Liu Juan,2011) pointed out the key of creative talents education of artistic design based on creative industry: we must put emphasis on integrating the innovative quality education of students with trend of the times.

### 2.2 Art education and training of talents

American scholar Daniel (Daniel,2013) and other scholars argue that artists and scientist are alike, and they stress that due to the importance of art in understanding modern science, undergraduate education should be encouraged to combine art with science in education. In recent years, more and more Chinese scholars start to focus on the relations between art education and talents training. Ma Fengqin (Ma Fengqin,2013) argues that there is a gap between university talents supply and the demand of developing cultural industry in China, which calls for the integration of the resources of universities in China so as to build a multi-level training network that tailors to different talent demands of cultural industry. Zhang Yabin (Zhang Yabin,2014) finds out that art education plays a significant role in training scientific talents. Jia Tao (Jia Tao,2015) concludes that art education has three main functions--- liberal arts education, talent training and cultural inheritance, which makes it important in promoting the quality of students. Zheng Qinyan (Zheng Qinyan,2016) deems that by integrating art education with science education, students can effectively cultivate the imagery and abstract ability as well as the innovative thinking. Most studies concerning the status quo and effects of art education in Chinese universities are based on theoretical analysis. Few studies are built on empirical researches and even fewer cater for art education in science and engineering universities in China. Through the survey on university students, this paper analyzed the status quo and problems of art education in science and engineering universities in China and proposed suggestions so as to give the full play of the art education, hence the artistic accomplishment of students in Chinese universities are improved.

### 3 Research Design

#### 3.1 Questionnaire design

This paper adopted the method of questionnaire to collect and analyze the data, presenting the overall evaluation on university students of the status quo and effects of art education in universities; difference analysis was conducted on the evaluation of art education based on genders, majors and schools; the status quo of university art education in China was concluded and influencing factors were analyzed. The questionnaire consists of three parts: 1) evaluation of university art competitions in terms of the content, instructor team, publicity and form; 2) evaluation of university art activities in terms of the theme, form, publicity, content and quantity; 3) evaluation of the effects of university art education from two perspectives, including its role in promoting artistic quality of students and building artistic atmosphere on campus. All single-choice questions were rated by 5-point Likert scale and each indicator was divided into 5 scales (Gurnon,2013). Non-art majored students of one science and engineering university in Hubei province have been chosen to be the objects for the study. 330 questionnaires were distributed with the valid callback rate of 87.27%. 288 students participated the survey, in which 47.92% were males and 52.08% were females; freshmen accounted for 15.63%, sophomores 44.79%, juniors 22.92%, seniors 8.33%, and postgraduates 8.33%. Sample distribution is as shown in the Figure 1.

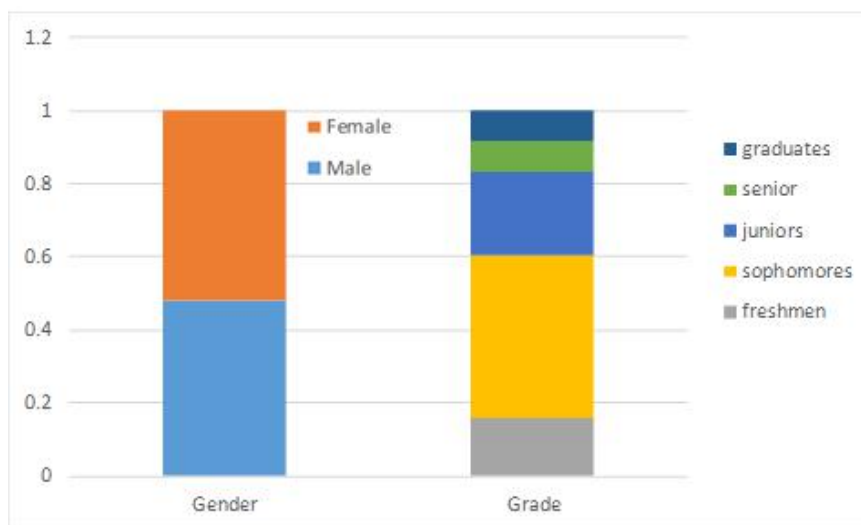


Figure 1 Sample Distribution



Sampling students from multiple levels ensured the representativeness of the results, showcasing a relatively comprehensive picture of the status quo and effects of art education of science and engineering universities in China.

### 3.2 Reliability and validity test

In order to ensure the credibility of the conclusion, the reliability and validity of the returned questionnaires need to be tested. Reliability indicates the consistency of the questionnaire (Meredith, 2014). The most used internal reliability coefficient is Cronbach  $\alpha$ , the indicator of the internal reliability of the questionnaire. The higher the coefficient is, the more consistent the measures in the questionnaire are. The formula is:

$$\alpha = \frac{K}{K - 1} \left( 1 - \frac{\sum_{i=1}^K \sigma_{Y_i}^2}{\sigma_X^2} \right)$$

Validity, namely the effectiveness, refers to how well an instrument as measures what it is intended to measure. This paper used KMO test to measure the questionnaire. Through factor analysis, it measured how suitable the questionnaire was for the hypothesis model came up by the researcher when designing it. The formula is:

$$KMO = \frac{\sum_{i=j} r_{ij}^2}{\sum_{i=j} r_{ij}^2 + \sum_{i=j} p_{ij}^2}$$

The Cronbach  $\alpha$  of the questionnaire was 0.732, indicating a high reliability. KMO was 0.873, suggesting that the validity is valid.

## 4 Empirical Analysis

### 4.1 Difference analysis

This survey designed a questionnaire with 14 questions to collect data and then analyzed the overall evaluation of all participants and evaluations of male university students and their female counterparts of art education. Then, the evaluations of male and female students were tested by T-test to show if any significant differences existed. The results are as follows:

**Table 1 Analysis of Questionnaire Results**

Objects	Assumed	Overall	Male	Female	T-test	
			university	university		
Measures	Average	Average	Average	Average	Significance	
		score	score	score		
Overall evaluation	39	41.704	40.421	42.767	0.077	
Art	Content	3	3.128	2.984	3.291	0.040
competitions	Instructor team	3	3.111	2.891	3.327	0.008

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	Publicity	3	3.908	3.800	3.990	0.175
	Form	3	2.947	2.854	2.958	0.070
Art	Theme	3	3.125	3.021	3.229	0.039
Activities	Form	3	3.156	3.083	3.229	0.572
	Publicity	3	3.021	2.854	3.188	0.637
	Students participation	3	3.021	2.917	3.125	0.199
	Quantity	3	2.969	2.833	3.104	0.214
Effect of art education	Art knowledge	3	3.063	3.063	3.063	0.067
	Art performance	3	3.198	3.063	3.333	0.867
	Artistic atmosphere	3	2.969	2.813	3.125	0.137
	Interest in art	3	3.833	3.896	3.771	0.077

Compared with the assumed average score, the overall average score is higher, which suggests that university students speak highly of art education in general and the overall evaluation is above the average. To be more specific, the average scores of the form of art competitions, the quantity of art activities and the artistic atmosphere are lower than the assumed average scores (3 points), indicating that students are less satisfied with the three aspects.

From the perspective of gender differences, the results of T-test show that, under the confident level of 10%, the evaluation of art education between male and female students varies significantly, in which female students are generally more content with art education than male students. Specifically, the results of the T-test ( $p < 0.1$ ) of the content, instructor team, and form of art competitions and the theme of art activities show that female students are more satisfied than their male counterparts while male students are more content than female ones in terms of the interest in art.

#### 4.2 Regression analysis

In order to analyze the correlation among art competitions, art activities and the effects of art education, this survey adopted multiple linear regression method. The regression relationship was established by setting the total score of the effect of university art education as the dependent variable and the scores of art activities and art education as the independent variables. The respective regression models were built as follows:

$$\text{Effect of Art Education} = \alpha_0 + \alpha \sum \text{ArtCourse} + \varepsilon(1)$$

$$\text{Effect of Art Education} = \alpha_0 + \alpha \sum \text{ArtActivities} + \varepsilon \quad (2)$$

The regression models reflect the correlation between dependent variable and independent variables as shows in the Table 2:

**Table 2 Results of Regression Analysis**

	Model (1)	Model (2)
Content of art competitions	0.626	
Instructor team	0.922**	
Publicity of art competitions	1.395***	
Form of art competitions	1.547***	
Theme of art activities		0.452
Form of art activities		0.656**
Publicity of art activities		0.701**
Students' participation		0.391
Quantity of art activities		1.226***
R <sup>2</sup>	0.536	0.672
F	56.62	114.75

Model (1) shows the relation between art competitions and the effects of art education. The results indicate significant positive correlation among the instructor team, publicity and form of art competitions and the effects of art education. In terms of the regression coefficient, form of art competitions is the highest, which reflects that it has the largest impact on the effects of art education in universities.

Model (2) reflects the relation between art activities and the effects of art education. The results show significant positive correlation among the form, publicity, quantity of art activities and the effects of art education. Quantity of art activities is the highest regression in terms of the coefficient and significance, meaning that it has the largest impact on the effects of art education.

### 4.3 Further analysis

To further analyze the influence of different art competitions as well as art activities on art education, this paper conducted regression analysis with art knowledge, art performance, artistic atmosphere and art interests as the dependent variables. The results are shown in Table 3.

**Table 3 Results of Further Analysis**

	Art knowledge	Art performance	Artistic atmosphere	Art interests
Content of art competitions	0.271**	0.145**	0.134**	-0.01
Instructor team	0.044	0.036	0.250**	0.191**
Publicity of art competitions	0.253***	0.341***	0.316***	0.535***
Form of art	0.374***	0.489***	0.314***	0.068

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competitions

Theme of art activities	-0.13**		0.511***		0.215**		-0.13	
Form of art activities	0.531***		-0.10		0.008		0.221**	
Publicity of art activities	-0.06		0.241**		0.354***		0.173**	
Students' participation	0.219**		-0.08**		0.050		0.289**	
Quantity of art activities	0.327***		0.396***		0.364***		0.137**	
R <sup>2</sup>	0.681	0.766	0.594	0.792	0.560	0.797	0.339	0.293
F	51.73	63.33	35.72	73.44	31.17	75.76	13.17	8.87

The results of further analysis indicate that among different factors influencing art knowledge, the form of art competitions and art activities are the most important, and the two factors both showcase positive influence towards art knowledge.

Among factors influencing art performance, form of art competitions and theme of art activities influence the art performance most, and the two factors both showcase positive influence towards art performance.

Among factors influencing artistic atmosphere, publicity of art competitions and quantity of art activities exert the greatest influence on the artistic atmosphere, and the two factors both showcase positive influence towards artistic atmosphere.

Among factors influencing art interests, publicity of art competitions and student's participation influence the art interests most, and the two factors both showcase positive influence towards artistic atmosphere.

Based on the results of regression coefficient, this paper concluded that the effects of art education in science and engineering universities in China can be improved in the following aspects.

#### 4.3.1 About the art competitions.

In accordance with analysis results, universities are able to improve the effects of art education through improving the professional quality of competition instructors (Malina,2018), strengthening the publicity of competition and enriching the contents of art competition.

In terms of improving the professional quality of competition instructors, since instructors determine the level of participants, universities should encourage instructors to attend concerning trainings and academic meetings. Also, universities should regularly convene seminars for the building of faculty team, spotting problems existing in the team and putting forward with solutions. Then, responsible, professional and experienced teachers can be sorted out to form the instructor team for art competitions.

In terms of strengthening publicity of art competitions, universities are suggested to host experience sharing conferences where winners of art competitions can share their thoughts and experience to others (Yang Liu,2019). Meanwhile, universities should build atmosphere for art competitions. The publicity and atmosphere building can be achieved through means such as posters on campus, publicity on official website, WeChat group, QQ group, etc.

In terms of enriching the content of art competitions, insufficiency of contents relatively reflects the lack of enthusiasm and concentration of students on the art competitions. Universities should take these factors into consideration, and enrich the contents of art competitions so that students are motivated to participate.

#### 4.3.2 About the art activities.

Universities are able to improve the effects of art education through enriching forms of art activities, strengthening the publicity of art activities, increasing the quantity of art activities.

In terms of enriching forms of art activities, universities should upgrade all forms of current art associations to attract more students to participate. At the same time, universities should plan to host annual large-scale art activities or art festivals that all faculties and students can join. Such measures will not only mobilize students to participate, but are also beneficial to professors in terms of art quality and interests, which will build a favorable artistic atmosphere around the campus (James,2019).

Similar to strengthening the publicity of art competitions, strengthening of art activities can be achieved through hosting seminars and using multiple social media tools. As for increasing the quantity of art activities, universities can combine it with enriching contents of art competitions. The two sides are interconnected and can be promoted at the same time.

## 5 Conclusion

This paper took science and engineering universities as examples and analyzed the status quo and influencing factors of art education in science and engineering universities in China. This paper studied various aspects of art competitions and art activities to conclude their influence on the effects of art education. However, this paper still bears some problems. For example, the empirical investigation of this paper was not carried out on a large scale; the sample of this paper is only one science and engineering university, which bears some deviations; the method for empirical research is regression analysis, thus, the results may bear some deviation. In the following researches, the author will continue focusing on the development of art education in China's science and engineering universities, and will constantly improve the theories and empirical knowledge so as to offer new researches for improvement of the status quo of art education in science and engineering universities in China.

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# **How to Develop Cultural Resources to Promote Sustainable Development of Cultural Industry a Case Study of Yellow Crane Tower, Wuhan Cultural Resources**

Qiao Juying

Library, Central China Normal University, Wuhan, P.R. China, 430079

(Email: 492922363@qq.com)

**Abstract:** This Paper analyses The Current domestic and foreign research on cultural resources to promote the sustainable development of cultural industry, cultural resources to effectively develop Wuhan yellow crane tower, for the purpose of strengthening the Wuhan cultural resource effective development of a variety of forms, finally it is concluded that only draw lessons from foreign government as the leading factor, by using the technology of support to promote the sustainable development of cultural industry in Wuhan, only in this way can help promote the national culture of confidence and achieve the goal of cultural power.

**Key words:** Cultural resources; Cultural industries; Yellow crane tower; Sustainable development

## **1 Introduction**

Singapore has accepted the new media art form as an important part of the national culture and vigorously practiced it. Under the background of globalization, the development of Singapore's creative industry not only highlights the important role of the government in promoting the development of the creative industry, but also puts new media technology at an important position in the continuous development of cultural products (Chung, 2008). In Europe, the French government has formulated a series of preferential policies to promote the development of cultural industry, most of which are directly funded. The creative industries export promotion advisory group (CIEPAG) was set up in the UK. America has been slower than Europe to embrace cultural policy. In Asia, South Korea makes rational planning and overall management of the development of cultural industry from the perspective of national strategy, and puts forward the strategy of "cultural establishment" and "creative South Korea" (Zhou Rongguo, 2009). At the end of the 20th century, Japan put forward the "national strategy of culture" and "development strategy of cultural industry", and formed its own characteristics. In the financing of cultural industry, a collaborative system of "industry-university-research" was formed (Luo Li, 2009). According to statistics, 610 adults were employed in the cultural industry in Japan in 1995, and the proportion of the employment in the cultural industry in Japan accounts for a large proportion of the national employment (Ying Andy c. Pratt, 2004). The university of Brisbane creative industries research center was established in Australia. In Canada, a special fund, CIDE, has been established to provide working capital for the development of cultural industry.

In China, we attach importance to the effective development and utilization of historical and cultural resources from the national level. The fifth plenary session of the 18th CPC central committee

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deliberated and approved the proposal of the central committee on the formulation of the 13th five-year plan. It is clear that by 2020, the cultural industry should become a pillar industry of the national economy, thus becoming an important part of China's construction of a strong socialist culture and rejuvenation of the great "Chinese dream". At the local level, all regions have reached a consensus to actively support the development of cultural industries and accelerate the development and utilization of cultural resources. In 2017, Wuhan formulated the 13th five-year plan for the development of Wuhan's cultural industry, which clearly proposed to actively cultivate the cultural industry to become the pillar industry of the city's economic growth. In recent years, policies on Wuhan's public cultural services, cultural resources and cultural inheritance have also been issued.

Realizing the sustainable development of cultural industry is the navigation and target of the development strategy of cultural industry in various countries. From the point of the research of scholars, to explore cultural strategic planning and development of cultural industry, some scholars mentioned cultural industry sustainable development strategy, strategic planning in discussing the culture and the cultural industry development puts forward the strategy for the sustainable development of cultural industry, this paper discusses the development of cultural industries and cultural resources sustainable capacity and the relation between the (Tom, 2002).

What are cultural resources? On the one hand, the academic circle considers it as a legacy of the historical process. On the other hand, cultural resources are the development of social history, which is a process of continuous human culture. General secretary Xi Jinping has fully developed and absorbed the precious resources in traditional culture, so as to form many important discussions on civilization exchanges with Chinese style and style and Oriental wisdom, which have far-reaching significance of pointing out the new path of human civilization development (Ren Siqi, 2019). Under the background of the Internet of things, big data, in the form of the traditional historical and cultural resources protection and inheritance has had the change, the development of cultural industry become to the protection and use of the carrier of cultural resources, not only promoted the development of cultural industry, but also conforms to the national strategy to promote the development of cultural industry fast also protect and inherits the local culture resources.

Take the yellow crane tower of Wuhan cultural resources as an example to study how to develop cultural resources to promote the sustainable development of cultural industry. The purpose of the study is to "make the accumulated cultural resources of Wuhan really alive" so that the yellow crane tower of Wuhan cultural resources can be effectively developed and utilized. It is helpful to give full play to the contemporary value of Wuhan's cultural resources, greatly improve the development level of Wuhan's cultural industry, and achieve the practical significance of promoting the sustainable development of Wuhan's cultural industry. It will also play an exemplary role in some areas, especially for the development of cultural industry in central and western cities.

## **2The Status of Cultural Resources and Cultural Industries in Wuhan**

### **2.1 Cultural Resources in Wuhan**

Wuhan's cultural resources belong to the Central Plains cultural resources and Jingchu cultural resources according to different regions or provinces. Wuhan's cultural resources include: natural ecological cultural resources and historical relics cultural resources. Natural ecological and cultural resources include: Donghu Scenic Area, Hankou Jiangtan, Nanhu Scenic Area, etc.; Yellow Crane Tower and Yangtze River Bridge have become business cards in Wuhan; There are also revolutionary historical and cultural resources, national key cultural relics protection units and so on. Wuhan National



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Historical Relics Cultural Resources include: Wuchang Uprising Military Government Site, August 7th Site, Wuhan National Government Site, Wuhan Peasant Movement Workshop, Jianghuan Building, Hankou China Federation of Trade Unions Site, etc.; Another example: Hanyang Iron Works, Hanzheng Street, and Hankou Port Terminal founded by Zhang Zhidong have become symbols of Wuhan's early industrial and commercial culture; In addition, Wuhan's intangible cultural heritage resources are also very rich: folk literature, folk music, folk dance, Yellow Crane Tower Legends, Han embroidery and so on. These valuable cultural resources have become the advantages of Wuhan's development of cultural industry.

## **2.2 Characteristics of Wuhan Cultural Resources**

One of the characteristics: From its environmental point of view, Wuhan has its unique natural geographical environment. The Yangtze River and Hanshui meet here. "Water" has an important influence on Wuhan's history and culture. Sima Qian recorded in the "Historical Records of the Historical Records" that the geographical environment was associated with the temperament and behavior of the people (Hubei Academy of Social Sciences Research Group, 2007). Therefore, Wuhan's geographical environment also plays an important role in shaping Wuhan's local culture. In the long river of history, the Yangtze River culture and the Central Plains culture blend with each other. Wuhan has many tributaries such as the Fuhe River, the Tongjing River, and the Jinshui River. It is known as the "City of Baihu" and has developed water transportation. The ancient book has a cloud: "South of the Dajiang River, Jingchu is upstream, and the benefits of the millet are spread all over the world, and the clay clay is more than the" Gonggong ". Its land spans the rivers, Han, and Wuchang as the metropolis. Its people and widowhood. Gathering, Jiasifang, The Jiayi of the Quartet gathered. " (Hubei Academy of Social Sciences Research Group, 2007)

The second characteristic: From its content, Wuhan's cultural elements are rooted in its own history and have distinctive features; Features 3: From the perspective of its time, Wuhan's historical and cultural resources have continued for a long time, and most of them have been better protected.

## **2.3 Legend of Yellow Crane Tower**

The earliest seen in the "Nanqi Book of the 15th State Jun County" around 502 AD, this book has a record of "the world passed fairy son to take the Yellow Crane". The story of the Republic of China in Wuhan collected the "Xin Shi Xiu Lou Xie" and so on (Yu Riji, TangCunchen, Hu Shushan, 2014).

The literati of the past left many popular poems here. For example, Cuihao's "Yellow Crane is gone forever, and this place is free of Yellow Crane Tower". The legend of Yellow Crane Tower has fairy Legends, historical stories, celebrity anecdotes, and so on. For example, "ZiAn Drive Crane", "Fairy Piper", "FeiFei ascended to heaven", "Tangpi Painting Crane" and other Wuhan Untill Protection Center: and "Xin Shi Xiu Lou XieEn", "Lu Ban Shen Gong Jian Lou", "LibaidenglouCuihao", "Victory Tower Kong light. " Most of these legends promote punishment, promote good, reduce greed, and unite heaven and earth. They contain folk wisdom, fairy culture, and concepts of good and evil. The legends of the Yellow Crane Tower were accompanied by the Yellow Crane Tower. Over the thousands of years, they have spawned various poems, songs, paintings, folk arts, architecture, and music. They have great historical and cultural values, literary values, and artistic values. They are valuable folk cultural wealth in Wuhan. It is also a precious cultural resource in Wuhan.

## **2.4 How to develop Wuhan's cultural resources effectively.**

With the increasing attention of the country to cultural construction, "let the precipitated historical and cultural resources really live up" has stopped at shouting slogans but put into actual action. So how

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to develop Wuhan's cultural resources effectively? According to the distribution and category of cultural resources in Wuhan, Wuhan cultural resources can be collected by investigating the detailed statistics of Hubei Provincial Bureau of Statistics and Hubei Provincial Statistical Yearbook. Wuhan's cultural resources are rich in content, and more representative ones such as: 3500 years of Shiwei left a rich and splendid cultural heritage. The reputation of "Hometown of Yellow Crane" is known throughout the country. This paper only chooses Yellow Crane Tower as the representative of Wuhan cultural resources, based on this research how to develop Wuhan cultural resources.

## **2.5 Taking Yellow Crane Tower as an Example to Analyze the Forms of Developing Wuhan Cultural Resources**

### **2.5.1 Collection and collection of postcards, medals, etc. related to Yellow Crane Tower**

Make full use of major newspapers in Wuhan, government work websites, Wuhan Radio and TV stations and other news media to publish postcards and medals related to the Yellow Crane Tower. The postcards and medals collected in connection with the Yellow Crane Tower will use the holidays to make large-scale theme exhibitions at the Yellow Crane Tower Tour Point to allow the public to understand the Yellow Crane Tower, know the Yellow Crane Tower, and increase the cultural resources of the Yellow Crane Tower in Wuhan. Publicity and wide dissemination.

### **2.5.2 Collection of poems, stories, folklore, etc. with the theme of Yellow Crane Tower**

Widely collect and collate poems, stories, folklore, etc. with the theme of Yellow Crane Tower, and make full use of major newspapers in Wuhan, government work websites, Wuhan Radio and TV stations and other news media to publish poems, stories, and folklore on the theme of collecting Yellow Crane Tower. The earliest record of the legend of the Yellow Crane Tower was the "Nanqi Book Book of the Fifteen Counties" contained: "Xiakouchengjuhuanghaoji, the world passed the fairy son An Yi took advantage of this also." (Liang XiaoZixian, 1972) He also conducted a poetry contest with the theme of Yellow Crane Tower, a speech with the theme of Yellow Crane Tower, and a folk legend performance with the theme of Yellow Crane Tower. The vivid image shows the Yellow Crane Tower culture in front of the public, allowing the public to relive the historical scene and deepen the impression of the Yellow Crane Tower culture. Learn more about the Yellow Crane Tower.

## **2.6 The state of the cultural industry in Wuhan.**

In recent years, Wuhan has issued a large number of policies to guide the planning of Wuhan's cultural industry. These targeted policies have played an important role in the use and dissemination of Wuhan's historical and cultural resources. On the other hand, they have also enriched the construction of Wuhan campus culture. For example: Yellow Crane Tower Fragrant Spice Industry Park, Green Brick Tea Industry Park, etc..

## **3 Effective Exploitation and Utilization of Cultural Resources to Promote the Sustainable Development of Cultural Industries.**

### **3.1 What is the cultural industry?**

The earliest research on the cultural industry was the criticism of the artistic and philosophical values of popular culture by the Frankfurt school in the 1930s. Adorno and Horkheimer first proposed the "culture education" in their "Enlightenment Dialectics". (Fang Hongting, 2011) After the 1980s spread to China, China's research on the cultural industry began in the 1990s. Scholars defined the

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cultural industry according to the specific conditions of the country. (Fang Yinheng, Wang Ruihua, 2016) In 2012, the National Bureau of Statistics defined the cultural industry as "a collection of production activities that provide cultural products and culture-related products to the public." This concept is still used today.

Usually we think that the content of the cultural industry is to provide cultural products or services; The core of the cultural industry is "creativity"(Fang Zheng, 2015). Cultural industry needs much content from cultural resources, cultural resources processing into the public demand of cultural products, so cultural industry often rely on cultural resources as the original creation of cultural resources to create value.

At present, the research on culture industry emphasizes on economic benefits and neglects social benefits. It ignores the social value and cultural value of the cultural industry. At the same time, there is less research on the promotion of cultural communication and other spiritual aspects. The University museum can use the school history, school badge and other special historical events as materials to create cultural industry creative products cultural shirts, handbag production, word of mouth folk stories, cultural maps, advertisements, promotional films, and so on. Then "Yellow Crane Tower" as the main body can also make souvenirs and other "Yellow Crane Tower" culture effectively developed and used.

### **3.2 How cultural resources contribute to the sustainable development of cultural industries**

More and more foreign scholars are paying more attention to the development benefits of cultural resources (Li Jinyu, 2015). We believe that cultural resources can promote economic development and also promote the development of cultural industries. The case study is used to prove that cultural resources promote the development of cultural industry. It is also possible to fully exploit historical and cultural resources from various forms such as cultural tourism and cultural performing arts.

#### **3.2.1 Digitization of Cultural Resources in Yellow Crane Tower to Promote the Sustainable Development of Wuhan Cultural Industry in the Context of the Internet of Things**

The cultural resources of Yellow Crane Tower will be digitally protected and effectively disseminated and inherited. For example: Collect and collate relevant documents and publish monographs, make microfilm, build a special database of "Yellow Crane Tower", and so on. Make visual products, such as: using 2D, 3D digital animation technology to reproduce the Yellow Crane Tower culture, give full play to the vitality of the Yellow Crane Tower cultural resources (Huang Yonglin, Tan Guoxin, 2012). Make this Wuhan cultural resources from generation to generation, so that it can be preserved sustainably.

#### **3.2.2 The development of school-based resources related to Yellow Crane Tower by colleges and universities specialized departments and libraries and Wuhan primary and secondary schools to promote the sustainable development of Wuhan cultural industry**

The university library mainly organizes librarians + faculty subject teachers + primary and secondary school subject teachers to form a research team. The cultural resources of the theme of Yellow Crane Tower are effectively integrated into the primary and secondary school subject materials, and the theme of Yellow Crane Tower is compiled. Primary and secondary school quality education school book. To study the teaching materials of the language and historical disciplines of primary and secondary school students and compile corresponding research cases, such as the architectural culture, celebrity culture, poetry culture, etc. of Yellow Crane Tower, and enrich the learning materials of primary and secondary school students. The purpose is to establish students to learn relevant knowledge from an early age, so that this cultural resource can be fundamentally passed down to promote the

### 3.2.3 Training primary and secondary school students to volunteer for the Yellow Crane Tower tourist destination to promote the sustainable development of the cultural industry in Wuhan

In conjunction with primary and secondary schools, we will train cultural volunteers to explain the Yellow Crane Tower, organize primary and secondary school students to visit the Yellow Crane Tower Cultural Tourism Point, train primary and secondary school students to become instructors of the Yellow Crane Tower Cultural Tourism Point, and increase the dissemination and inheritance of the cultural resources of the Yellow Crane Tower. The "Yellow Crane Tower" cultural resources are further passed down and sustainable so as to promote the sustainable development of Wuhan cultural industry.

### 3.2.4 Widely solicit cultural and creative industry activities with the theme of Yellow Crane Tower to promote the sustainable development of Wuhan cultural industry

Carry out bookmark design competitions marked by Yellow Crane Tower, cultural shirt design competitions, and the design and development of various related cultural products, such as: Li Bai's "Sending the Guangling of Meng Haoran" in the Tang Dynasty. In modern times, Mao Zedong's "Bodhi Man Yellow Crane Tower" and other poems are the themes for the design of cultural shirts.

### 3.2.5 Development of tourism products with the theme of Yellow Crane Tower Promoting the Sustainable Development of Wuhan Cultural Industry

Industrial Park produces cultural shirts, hats, scarves, bookmarks, mobile phone stickers, refrigerator stickers, travel bags, travel cups and other souvenirs, souvenir books, and so on. In addition to sales at tourist destinations, souvenirs with the theme of "Yellow Crane Tower" can be produced in conjunction with the Wuhan University Student Union and the University Museum and placed for sale in primary and secondary schools and universities.

According to statistics: In 2009, the number of tourists receiving tourists at the Yellow Crane Tower tourist destination was 1.5 %, the ticket income was 66.84 million yuan, and the total tourism income was 66.96 million yuan. The development of the Yellow Crane Tower cultural industry is only a single ticket income. The operating development model has not yet formed a complete cultural industry chain. It is not conducive to the effective development and sustainable development of cultural resources in Yellow Crane Tower (Ma Peihong, 2013). Therefore, while developing the cultural resources of the Yellow Crane Tower, it should also be carefully studied from the perspective of diversification and in-depth development. Only in this way can the sustainable development of the Yellow Crane Tower cultural industry be promoted.

## **4 The Domestic Should Draw on the Foreign Cultural Industry Development Strategy**

Our country should draw on the study of foreign cultural industry development strategy to explore how to choose the scientific, suitable and steady cultural industry development strategy from the cultural resources of each region of our country. In recent years, cultural industry development plans have been issued at various administrative levels from the central government and ministries to provinces, cities, and counties. However, whether the cultural industry plans are actually implemented or not has become a practical and urgent problem. In view of this, the government should implement the cultural industry development strategy to the operational level of the cultural industry. For example, to increase

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government attention, actively use technological innovation to achieve the sustainable development of the cultural industry, so as to maximize the realization of cultural resources to promote the sustainable development of the cultural industry (XieXuefang, ZangZhipeng, 2012).

## 5 Conclusion

The cultural management system and operating mechanism formed under the planned economy system affect the vitality and vitality of cultural development<sup>110</sup> Influenced by Jingchu culture, Wuhan's cultural resources contain rich Chu cultural factors, vigorously promote the Chu cultural spirit, and vigorously develop Wuhan's tourism and cultural resources. Under the background of the Internet of Things and large data, it is necessary to rely on the support of Internet of Things technology. The abundant Wuhan cultural resources will be digitally protected and effectively developed into a cultural industry. It will certainly promote the development of Wuhan's industrial economy and the sustainable development of Wuhan's cultural industry. Only in this way can it help to enhance the cultural self-confidence of the people and achieve the goal of cultural power. When advocating the sustainable development of cultural resources for cultural industries, the government must also consider the healthy development of cultural industries and the combination of social benefits, and avoid the emergence of various problems in the operation of online cultural industries. At the same time, it must also be led by the government. Like the United Kingdom's 10-year strategic plan for creative industries, the increase of funds for the development of museums, digital technology reforms, and so on (DCMS,2006.2011). Government dominance plays a decisive role in the sustainable development of the cultural industry.

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<sup>110</sup>Zhaolingyun, driven by the cultural wheel, crossed -- On advancing Hubei development with cultural development, [Http://www.cnhubei.com/200407/ca518549.htm](http://www.cnhubei.com/200407/ca518549.htm),[ EB/OL] .. 2004(07): 2207:19:10)

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## Research on the Curriculum System of International Cooperation Training of Excellent Art and Design Talents

Dai Fuxiang<sup>1</sup>, Dai Bo<sup>2</sup>

1 Graduate School, Wuhan University of Technology, Wuhan, P.R. China, 430070

2 School of Foreign Languages and Literature, Wuhan University, Wuhan, P.R. China, 430071

(E-mail: 26679038@qq.com, 876294058@qq.com)

**Abstract:** At present, there exist many problems in the training of art and design talents in China, such as backward curriculum setting, emphasizing skills over thinking, and low degree of internationalization. Therefore, it is of great importance to explore a curriculum system of internationally-cooperated training of excellent art and design talents adapted to the current social development, introduce foreign high-quality educational resources and advanced management experience, integrate the advantages of Chinese and foreign art and design education and improve the discipline construction of art education in China.

**Key words:** Art and Design; Internationally-Cooperated Training; Curriculum System

### 1 The Current Situation of Internationally-cooperated Training of Excellent Art and Design Talents

China's art and design education lacked the development experience and lagged behind the world development level for it starting late. With the development of globalization and informatization, the trend of higher education internationalization is accelerating. Therefore, if China's education wants to truly stand in the forest of the world, we must implement the "going globally" strategy, strengthen exchanges with developed countries, learn from the strengths of foreign countries, and constantly develop and strengthen ourselves, so as to cultivate top-notch talents with international perspective, comprehensive ability and creative thinking.

With the rapid pace of globalization, greater demands are being placed on our education system by constantly-changing world. The internationally-cooperated training system of excellent art and design talents is the requirement of fostering our art and design talents with international perspective to adapt the competitive international market and make our curriculum system stand out among the world art and design educations. In addition, the comprehensive art and design talents with competitiveness could benefit to boost Chinese cultural industry in order to enhance Chinese culture soft power and international competitiveness. It is of great strategic significance to enhance the overall national power as well as to construct an innovation-oriented country.

## **2 The Pattern of Internationally-cooperated Training for Excellent Art and Design Talents**

The model of internationally-cooperated training of excellent art and design talents refers to the model of establishing a scientific curriculum system and teaching content, adopting advanced teaching methods and strengthening the organic combination of various elements such as the construction of teaching staff under the guidance of the concept of excellent talents education through international cooperation, facing the industry, the world and the future, so as to cultivate top-notch talents who have strong innovative ability, practical ability and international competitiveness and can lead the development trend of art and design education.

At present, the main problems of the curriculum system of art and design specialty in China are as follows: single curriculum structure; unreasonable teaching hours; lack of international practice; outdated textbooks and courses and lack of international integration.

### **2.1 Curriculum structure**

Curriculum is the key to talent training. Therefore, the curriculum of international cooperation training of excellent art and design talents must be developed based on talent training objectives and different national conditions and academic conditions at home and abroad. It is especially crucial to strengthen communication and exchanges, develop a curriculum system suitable for the development of Chinese and foreign students and ensure the smooth development of teaching activities. The curriculum system of training excellent art and design talents consists of foundation courses, specialized courses, practical courses and graduation projects. The foundation courses are divided into public foundation courses and specialized foundation courses. The specialized courses are divided into specialized elective courses and specialized compulsory courses. The foundation courses are mainly taught in the first academic year, accounting for about a quarter of the whole curriculum system. The specialized courses are mainly taught in the second and third academic years, and the practical courses and graduation projects are finished in the fourth academic year. The course structure basically follows the principle of "basic first, and then specialized; theory first, and then practice". The study of basic theory is to accumulate knowledge and lay the foundation for professional practice, which helps students develop their comprehensive practical ability based on the basic theoretical knowledge and theories plays greater role in instructing practice for students.

### **2.2 Curriculum setup**

In the setting of public courses and foundation courses, attention should be paid to the cultivation of students' comprehensive quality. Humanities and social sciences courses related to the specialty should occupy a certain proportion in the curriculum system. In terms of setting of specialized courses, it is necessary to optimize and integrate domestic and foreign courses, so that students can master professional knowledge in the international perspective. The courses should be categorized to ensure the foundation and internationalization of the course, and both compulsory and elective courses should be included.

### **2.3 The construction of internationally-cooperated training system**

Taking the art and design specialty organized by Wuhan University of Technology and the University of Wales as an example. According to the different characteristics of Chinese and English students, and considering the different teaching modes and assessment modes, both parties divide the modular courses of the British side into specific specialized courses after full communication, and



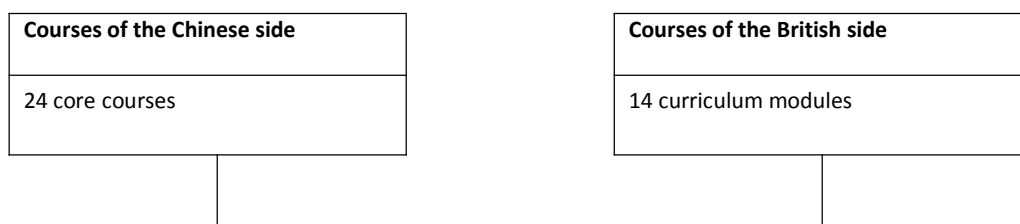
Proceedings of the 16th International Conference on Innovation & Management - 1833 - finally complete the curriculum assessment according to the modular assessment mode of the British side; at the same time, the curriculum should focus on the combination of theory and practice; both parties should jointly develop scientific, reasonable, standardized teaching materials that meet the needs of teaching and practice according to the syllabus, and constantly revise and improve the teaching materials according to students' feedback in classroom teaching and practice. Students of this Program will study for four years in Wuhan University of Technology (international foundation courses will be taught in the first year, and specialized courses will be taught in the last three years). The training program is jointly developed by the University of Wales and Wuhan University of Technology. The course teaching is jointly undertaken by senior teachers of both universities. Both universities use English or bilingual teaching, make full use of modern information technology, adopt advanced teaching methods, and devote themselves to the cultivation of inter-disciplinary art and design professionals with international vision, innovative consciousness and Chinese and Western cultural connotations.

The core of the curriculum system comes from the relevant professional programs of the University of Wales. Considering the characteristics of Chinese students and the differences in teaching modes, both universities have revised the original training plans and reached a consensus on adding appropriate language courses in the first and second academic years, so as to facilitate the study of bilingual courses in the upper grades and the study of all-English courses taught by teachers designated by the British universities, and meet the needs of students to continue their studies in foreign universities in the future at the same time. In the third and fourth academic years, the textbooks and teaching methods of the University of Wales are adopted. According to the agreement between both parties, 14 professional modular courses are divided into 24 core courses, which are taught in English or bilingual by teachers of the British side and Wuhan University of Technology respectively. Among them, 16 courses are taught by teachers of the Chinese side (1 assistant teacher is assigned to each course by the British side), and 8 courses are taught by teachers of the British side (1 assistant teacher is assigned to each course by the Chinese side). More than 50% of the teaching hours of the core courses are assigned to teachers of the British side. The course emphasizes the combination of theory and application. During the external verification of schoolwork, 24 courses are subject to unified assessment as 14 curriculum modules.

Taking the art and design curriculum system of BA arts and design of Wuhan University of Technology as an example, see the table below for details. This training program not only maintains the teaching quality evaluation system of the British side, but also ensures the logic of linking up traditional curriculum plans of the Chinese side and the acceptability of students' learning, and innovation and win-win results have been achieved.

### 3 An Example of Internationally-cooperated Training System for Excellent Art and Design Talents

**Table 1 Art and Design Curriculum System of BA Arts and Design of Wuhan University of Technology**





Course of the Chinese and British sides				
Nature	Class hours (proportion)	Credits (proportion)	Assessment method	Proportion of Chinese and foreign teachers
Public foundation course	624 (23%)	120 (23%)	Combination of homework assessment and examination assessment	A total of 24 core courses, of which 16 courses are taught by teachers of the Chinese side. More than 50% of the teaching hours of the core courses are assigned to teachers of the British side
Specialized foundation course	360 (13%)	52 (10%)	Combination of homework assessment and examination assessment	
Specialized elective course	144 (6%)	40 (7%)	Essays	
Specialized compulsory course	1560 (58%)	320 (60%)	Coursework	

#### 4 Results of Curriculum Reformation

One of the characteristics of Sino-foreign cooperation teaching is that students' English proficiency must meet the requirements of foreign parties and students can receive professional bilingual or all-English teaching without any troubles. In other words, English proficiency is the basis for students to achieve good professional knowledge, and is related to the realization of their career planning. Emphasis on students' English proficiency and ways to improve students' English learning can be varied: the curriculum setting should be scientific and reasonable, while offering foundation courses such as listening, speaking, reading, writing and grammar, academic writing and foreign cultural introduction courses can be offered appropriately. The organic combination of basic education and exam-oriented education can also be considered while offering courses. If necessary, social English training institutions can be introduced to provide intensive English training for students. In daily life, a lot of English activities shall be organized for students, such as English corner, oral English contest and so on. In addition, students should be actively provided with conditions for English learning, open foreign teachers' oral English training posts should be set up in colleges, and one-to-one English tutoring should be provided on a regular basis. Alternatively, if conditions permit, various activities with international students and friends should be organized. Only through various forms of intensive and interesting English training, can students' English level and English proficiency be greatly improved. After entering the upper grades, through bilingual teaching and all-English teaching, students' English can also be consolidated and improved, and satisfactory learning results can be achieved.

#### 5 Conclusion

In conclusion, a curriculum system of international cooperation training of excellent art and design talents need combine the foreign high-quality educational resources and advanced management experience with the current development to make innovation and optimization. Our curriculum system should focus on the actual situation (teaching resources, teachers ability, students horizon and practical experience, language level, etc.) and be promoted by the advanced foreign experience to explore a characteristic curriculum system of international cooperation training of excellent art and design talents adapted to the current social development and foster more talents with global horizon for our country.

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## **Research on Process Management of University Students with Learning Difficulties: From a Survey of Management Status**

Wang Xiao

School of Navigation, Wuhan University of Technology, Wuhan, P.R.China, 430070

(Email: 75170909@qq.com)

**Abstract:** Some university students' academic performances decline with courses failure in exams and low credits. Some even can not meet the syllabus's demand for graduation or drop-out. China's university students with learning difficulties have gradually increased in number and in problem types. These phenomena have aroused the attention of educational administrations and universities. Based on total quality management, this paper aims to explore the management status of university students with learning difficulties, and puts forward process management mechanisms for students with learning difficulties, so as to promote transformation of students with learning difficulties and education effect.

**Key words:** University; Students with learning difficulty; Process management; Empirical survey

### **1 Introduction**

Studies show that about 40% university student has learning difficulty in different degree and type (Tu & Hu, 2004); high fresh students' make-up examination rate is a general phenomenon in common universities; in the make-up examination of many courses, 78.3% of the students were above the key undergraduate admission score in the national entrance examination (Chen, 2001); compared with it before enrollment expansion, the graduation rate is on the decline. China's university students with learning difficulties have gradually increased in number and in problem types.

For a long time, domestic and international researches on learning difficulties have focused on basic education with higher education as its extensive study field (Tu & Hu, 2004). In overseas studies, "learning disabilities" is also known as "learning helpless", "learning disorders" or "under achiever" according to different study emphases. The American researchers widely use two theoretical definitions taking learning disability for the result of central nerve system disfunction, or a psychological disorder, which may be closely related to undeveloped academic potential, and may show oral or mental confusion throughout life (Kavale & Forness, 2000). Since the 1980s, researchers have made extensive use of theories and techniques of cognitive psychology to study learning disabilities or disorders from cognitive factors and non-cognitive factors (Waber et al., 2003). In higher education, several studies focus on learning strategies disorder of university freshman (Brinckerhoff et al., 1992); countermeasures for learning disabilities from different perspectives (Lindeberg, 1998). The domestic researches are mainly about education and management (Wang et al., 2018; Zhao & Tian, 2015; Wang, 2015; Wang, 2011), warning mechanism and methods (Xu & Chen, 2016; Wang & Luo, 2011), causes, status quo and support analysis (Zhao, 2018; Wang & Li, 2014; Zhao, 2013; Qiu, 2017; Pan & Hou, 2015), giving many realistic solution to problems. However, the present researchers emphasize description rather than analysis, emphasize enumeration rather than systemization, and emphasize result rather than process.

Considering domestic higher education situation, this study suggests university students with learning difficulties are those who can't meet periodic academic requirements due to course exam failure, make-up exam failure, retaken course exam failure, insufficient credit, academic warning, even lead to graduation deferment, or drop-out. This kind of learning difficulty is transformable. Under this reality, based on total quality management, this paper explores the management status of university students with learning difficulties, and puts forward process management mechanisms for students with learning difficulties, so as to promote transformation of students with learning difficulties and education effect.

## 2 The Management Status of University Students with Learning Difficulties

### 2.1 Interview survey design

To investigate the management status of university students with learning difficulties, this study selects the staff of student affairs and teaching affairs, head teachers of classes, student cadres of Wuhan University of Technology (WUT) as the survey objects. Teachers of various courses are not included yet because their participation in management is limited at present. "Interview Outline of Management Status of University Students with Learning Difficulties", involving 5 dimensions' subjective description and objective assessment, namely difficulty identification, difficulty evaluation, difficulty warning, difficulty assistance and performance evaluation consisted of 5 subjective questions and 5 objective questions. Objective questions are designed according to likert scale. The choice of "very good" represents 5 points, with "relatively good" 4 points, "common" 3 points, "poor" 2 points, and "very bad" 1 point respectively. A total of 75 people were interviewed, including 13 teaching affairs administrators, 32 counselors, 16 head teachers and 14 student cadres.

### 2.2 Interview survey results

Through analyzing 5 objective questions for the above 5 dimensions, the interviewees' assessment percentages and average scores are shown below.

**Table 1 Assessment Percentages of Management Status of University Students with Learning Difficulties**

Item	Very Good	Relatively Good	Common	Poor	Very Bad
Learning Difficulty identification	8.00%	30.67%	33.33%	18.67%	9.33%
Learning Difficulty Evaluation	10.67%	33.33%	26.67%	20.00%	9.33%
Learning Difficulty Warning	12.00%	37.33%	24.00%	18.67%	8.00%
Learning Difficulty Assistance	20.00%	42.67%	20.00%	13.33%	4.00%
Performance Evaluation	8.00%	25.33%	33.33%	20.00%	13.33%

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**Table 2 Average Scores of Management Status of University Students with Learning Difficulties**

Item	Very Good		Relatively Good		Common		Poor		Very Bad		Average Score
	Number	Score	Number	Score	Number	Score	Number	Score	Number	Score	
Difficulty identification	6	5	23	4	25	3	14	2	7	1	3.09
Difficulty Evaluation	8	5	25	4	20	3	15	2	7	1	3.16
Difficulty Warning	9	5	28	4	18	3	14	2	6	1	3.27
Difficulty Assistance	15	5	32	4	15	3	10	2	3	1	3.61
Performance Evaluation	6	5	19	4	25	3	15	2	10	1	2.95

It shows the interviewees highly appraise learning difficulty support with average value 3.61, and proportion of “very good” and “relatively good” 62.67%, which indicates great importance is attached to supporting students with learning difficulties. The interviewees grade learning difficulty performance evaluation the lowest with average value 2.95, and proportion of “poor” and “very bad” 33.33%, which indicates that current performance evaluation is the most unsatisfactory. Learning difficulty removal effectiveness should be improved.

Through analyzing 5 subjective questions for the above 5 dimensions, the results are as follows:

Among the interviewees, teaching affairs administrators’ identification mainly relies on exam results and failures. Counselors’ attentions are paid to class attendance and performance, daily self-management besides grades and exam failures. Head teachers rely on communication with student and cadres. Student cadres depend on daily differential performance to find potential learning difficulties. The surveyed problems for the item of “identification of students with learning difficulties” are: i) Long-term and continuing identification is needed due to study performance phased change and abundant information; ii) Be lack of uniform standards to define students with learning difficulties; iii) students with potential learning difficulties are easy to be neglected.

The counselors classify students with learning difficulties according to reasons, and determine difficulty according to management and credit requirements. Teaching affairs administrators inform counselors of exam results, courses failure, retaken courses, exam cheatings and academic warnings. Head teachers and student cadres make evaluations based on perceptual cognition. The surveyed problems for the item of “evaluation of students with learning difficulties” are: i) Be lack of division of difficulty degree; ii) There is no scientific, systematic standards for the classification of difficulties.

The counselors adopt various warning methods for various types of learning difficulties. A heart-to-heart talk, etc is a common choice. Teaching affairs administrators use “one-to-one” reminding for students who cheat in exams and get academic warning punishment. Head teachers and student cadres generally hold meetings and talks to remind problematic students. The surveyed problems for the item of “warning of students with learning difficulties” are lack of systematic, scientific warning standards and implementation plans.

The interviewees all stress assisting students with learning difficulties. According to the university's academic quality improvement plan, it adopted a series of assistance measures in 7 fields including academic situation familiarization, accurate assistance, joint-effort education, standardized management, home-school linkage, risk prevention and control, and monographic study. Counselors mainly take concrete measures to offer help. Teaching affairs administrators always take punishing measures, such as exam cheating punishment notification and academic warning notification. Head teachers and student cadres cooperate to carry out assistance work. The surveyed problems for the item of "assistance of students with learning difficulties" are: i) Be lack of a systematic support closed loop and existence of attenuation phenomenon of "emphasizing planning, neglecting implementation, weakening inspection and lacking rectification"; ii) Be lack of systematic conclusion, and operational regulatory writings.

The counselors record the help process and situation, and evaluate difficulty relief based on the students' actual performance and achievements. While teaching affairs administrators, head teachers and student cadres show little participation in performance evaluation. The surveyed problems for the item of "performance evaluation of students with learning difficulties" are: i) the work performance is not significant, and difficulty relief proportion is not high; ii) Students out of trouble are easy to get back into trouble; iii) quantitative evaluation is yet to be established.

### **3 Process Management of University Students with Learning Difficulties**

#### **3.1 Guiding theory**

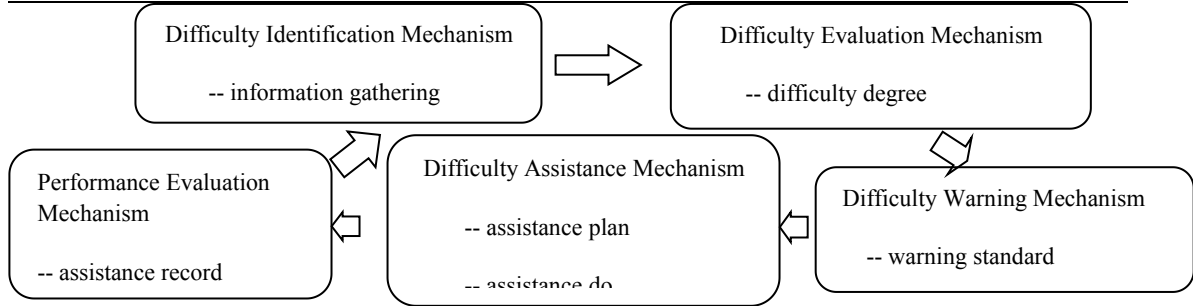
Total quality management (TQM) is taken as the guiding theory for process management of university students with learning difficulties. TQM is a quality-oriented, whole staff involved management method which aims to achieve long-term success through customer satisfaction and benefiting all the organizational members and society. It's a system of pre-control and overall control. Its core feature lies in the word "total", namely, quality management involving all staff, covering the whole process and reaching all ranges. In other words, staff involved in management is comprehensive; scope of management is comprehensive; object of management is comprehensive. TQM with "three totals" characteristics effectively helps to achieve process control and management.

#### **3.2 Principles**

The process management of students with learning difficulties in university should follow the following three principles: first, all staff participated identification and detection. It's necessary to motivate the participation of all staff, including teachers, management personnel, counselors, head teachers, and student cadres to participate in identifying and detecting students with learning difficulties constantly. Second, the whole process management. The process management of students with learning difficulties should run through the entire academic completion process until graduation. It's necessary to make precise and accurate solutions for every specific situation and problem. Third, all range coordination and assistance. It's necessary to cover all students with learning difficulties, all personnel offering support, all supporting systems, so as to make all resources coordination into effect.

#### **3.3 Mechanisms**

Several mechanisms should be established for the process management of university students with learning difficulties as shown in figure 1.



**Figure 1 Process Management Mechanisms of University Students with Learning Difficulties**

### 3.3.1 Difficulty identification mechanism

Difficulty identification is a crucial step in the process management of university students with learning difficulties. 1) information gathering. Relying on the enrollment management, teaching management, student management, teacher participation, and based on enrollment data, students basic information, freshman English placement test score, the mid-term exam achievement, the final exam grade, obtained credits information, failed subjects information and grades, students' overall learning performances are comprehensively gathered; Relying on class performance, attendance rate, morning and evening individual study participation, students' study enthusiasm and involvement information are gathered; Based on heart-to-heart conversation, daily behavior observation, classmates' feedback, students' learning objective and implementation information are gathered. 2) information analyzing. Students with learning difficulties or potential learning difficulties should be initially identified based on various information gathered. The gathering and analyzing scope should cover all students with the principles of "no one less" and "dynamic analyzing" in initial identification in order to avoid omissions.

### 3.3.2 Difficulty evaluation mechanism

Difficulty Evaluation is an important step in the process management of university students with learning difficulties. 1) difficulty degree. The degree of learning difficulty varies. It's necessary to establish 3 levels of difficulty, namely, severe difficulty, serious difficulty and general difficulty, for reasonable and efficient allocation of management resources. 2) difficulty types. There are many types of learning difficulties divided by different causes and manifestations, for example, 7 types of Internet addiction, specialty boredom, disjointed knowledge, insufficient motivation, psychological disorder, improper method, affairs troubled (Cui, 2010), as well as many subject bias, etc.

### 3.3.3 Difficulty warning mechanism

Difficulty warning is a necessary step in the process management of university students with learning difficulties. 1) warning standards. It's necessary to set hierarchical warning standards, namely 3-level warnings including red, yellow and blue warning standards which respectively represent three levels: severe, serious and general. Severe warning standards include those who fail 2/3 of the courses selected in one semester, those who miss 2/3 of the courses in one semester, those who do not take the exam without any reason, those who do not graduate until the 6th year in university (The longest period of schooling in university is 8 years generally.), and those who cheats twice in exams (at risk of expulsion). Serious warning standards include those who fail 1/3 of the courses selected in one semester, those who fail 1/3 of the courses selected in one semester, those who delay graduation or cheat in exams, those who obtain less than 27 grades in one year (27 grades a year is the lowerest requirement in WUT), etc. General warning standards include those who failed 3 courses and above in a semester, those who



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got 60 in 3 courses and above in the final exams, and those who have long-term poor learning state, habit and performance. 2) warning implementation. According to the above warning standards, warning implementation should be done respectively. General warning should be given to students themselves; whereas serious and severe warning should be given to students and their parents. It's also necessary to make a good communication between university and students' parents.

#### 3.3.4 Difficulty assistance mechanism

Difficulty assistance is the core step in the process management of university students with learning difficulties. 1) assistance plan. It's necessary to make individualized and accurate assistance plans and programs for students with learning difficulties, and carry out process control. 2) assistance do. Implement the assistance plans, and concentrate on mutual communication and the recipient's feedback. 3) assistance check. Check the consistency of assistance plan and implementation, and check the effect of implementation. It's necessary to carry out self-check, regular check and group supervision, and give feedbacks timely. 4) assistance act. It's necessary to solve the problems occurring during assistance process timely, to analyze and adopt students' feedbacks timely so as to provide support for next plan. The difficulty assistance mechanism forms a circular closed cycle to help students' transformation.

#### 3.3.5 Performance evaluation mechanism

Performance evaluation is the conclusive step of process management of university students with learning difficulties. 1) assistance record. Integrated assistance records show the traces of process management, providing basis for performance evaluation. 2) transformation effect. A hierarchical and phased effect evaluation index should be developed to evaluate the transformation effect judging from changing study attitude and condition, reducing difficulty level, or getting out of trouble.

## 4 Conclusion

This paper has made a survey of management status of university students with learning difficulties, put forward process management mechanisms, which helps to encourage and warn students so as to improve self-requirements and reduce learning difficulties, and helps to provide an effective management model for managing university students with learning difficulties. However, the management of students with learning difficulties is a systematic, long-term and repetitive work. The current problems are as follows. i) Most researches emphasize experience description and lack scientific and systematic construction based on empirical investigation; ii) The management of students with learning difficulties shows the periodic, repetitive and individualized characters, and difficulty transformation varies from person to person, time to time, and situation to situation. Differentiation should be considered in systematic research; iii) The performance evaluation of students with learning difficulties lacks quantitative indicators, and the effect are not significant or difficult to measure. It's expected to make further breakthroughs in the above three aspects.

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