

# An Empirical Analysis of Independent Innovation System in China's Enterprises

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**Abstract** Technological innovation is an effective way to increase the core competitive advantages in enterprises. The independent technological innovation is the main technological innovation. In China's enterprises the independent innovation system can be divided into four elements: the innovation environmental design, the independent research and development innovation, the independent management innovation and the independent marketing innovation. Innovation system design can provide a valid theory support for the independent innovation in China's enterprises. A measurement model is proposed for China's enterprises based on the results from Exploratory Factor Analysis (EFA) and Confirmatory Factor Analysis (CFA), which can provide the system with the realistic verification.

**Key words** Technological innovation; Independent innovation; Knowledge management; Fitting indexes

## 1 Introduction

Innovation refers to the creative activity in productivity, relations of production and superstructure of the theoretical innovation and the practical innovation<sup>[1]</sup>. From the micro-economic perspective, innovation refers to the technology innovation<sup>[2]</sup>. Technological innovation is a series of collective activities including research, development, production and commercialization of new technology or new product. Being one of technological and economic activities, it is the core of enterprises' technological progress. The annual survey of the main technology companies in the United States, which was made by Washington Industrial Research Institute, indicated that how to make innovation happen had become the first problem rather than the fifth one<sup>[3]</sup>. In Japan researchers said that if an enterprise's technological innovation investment only accounted for 1% of sales revenue, the enterprise was doomed to be defeated. If 5% or so, the enterprise was eligible to compete. If this proportion was reached 8%, the enterprise gained the competitive advantage. Obviously, the technological innovation has become an important means for enterprises to obtain a unique competitive advantage<sup>[4]</sup>.

The technological innovation includes the three major forms such as the independent innovation, the imitation innovation and the cooperation innovation. The independent innovation means that through their own efforts and exploration enterprises make technology breakthroughs, break down the technical difficulties, and rely on their own capacity to promote the innovation-related subsequent links, complete technology commercialization and obtain the commercial profit so as to achieve the desired target.

The independent innovation has three aspects. The first is called the primitiveness innovation, which aims to obtain the more science discoveries and the technical invention in the domain of science and technology. The second is named the integrated innovation, which aims to make the implement of integration of kinds of technique achievements in order to form the product or the industry with the high market competitiveness. The third is closely related with the digestion, absorption and re-innovation based on widely absorbing the global scientific achievements and importing the overseas advanced technology. Therefore, the independent innovation does not repel opening and cooperation, and the integrated technology can also have the independent innovation. The independent innovation does not necessarily need to start again completely from scratch. The digestion, absorption and improvement are also an integral part of the independent innovation<sup>[5]</sup>. The perfect independent innovation system must be built to enhance the ability of independent innovation, which mainly consists of the input mechanisms, the incentives mechanisms, the body-building mechanisms, the resource integration mechanisms, the intermediary service mechanisms, the cooperation development mechanisms of intellectual property, and the working mechanisms of innovative talents related to independent innovation<sup>[6]</sup>. The most important thing is to establish a body of independent innovation in enterprises to strengthen the independent innovation capacity in China's of enterprises. The dominant position of independent innovation is, first of all, to establish and strengthen innovation consciousness in

enterprises<sup>[7]</sup>.

## 2 Construction of Independent Technological Innovation System in China's Enterprises

**Table 1 Independent Technological Innovation System in China's Enterprises**

Elements	Indexes	Index Significance
Innovation Environmental Design	Innovation Organization Establishment <i>X1</i>	The enterprise has designed the effective innovation organization to implement the technological innovation strategy.
	Implementing Knowledge Management <i>X2</i>	The enterprise has implemented the knowledge management strategy to support the technological innovation.
	Innovation Strategy Deployment <i>X3</i>	The enterprise has formulated the science and the reasonable plan to the technological innovation strategy.
	The Construction of Innovation Culture <i>X4</i>	The enterprise has strengthened the culture construction to guide the technique innovation.
Independent R&D Innovation	Scientific and Technical Personnel Staffing <i>X5</i>	The enterprise has the adequate disposition of technical human capital to enhance R & D.
	Motivation Mechanism Design <i>X6</i>	The enterprise has designed the motivation mechanism to arouse the enthusiasm of the scientific and technical personnel.
	Innovation Funding Support <i>X7</i>	The enterprise has provided the adequate funding to support the ongoing R & D and innovation.
	Team Cooperation Consciousness <i>X8</i>	The enterprise has cultivated the teamwork spirit with the unity in complete sincerity.
Independent Management Innovation	A Great Improvement Related to Coordination Skills <i>X9</i>	The enterprise has strengthened the great improvement related to the coordination skills between the various functional departments.
	The Organization Structure Adjustment <i>X10</i>	The enterprise has constantly adjusted and optimized the organization structure to improve the management efficiency.
	The Good Information Communication <i>X11</i>	The enterprise has improved the communication environment relation to the internal management information.
	Enhancing the Decision-making Efficiency <i>X12</i>	The enterprise has adopted the new management methods to enhance decision-making efficiency.
Independent Marketing Innovation	Marketing Planning <i>X13</i>	The enterprise has made marketing plan to enhance marketing achievements.
	The Improvement of Marketing Pattern <i>X14</i>	The enterprise has constantly adjusted and improved the traditional marketing pattern.
	The Marketing Organization Management	The enterprise has constantly improved the management strategy for marketing organization.
	The Perfect Marketing Network <i>X16</i>	The enterprise has constantly developed and strengthened the existing marketing network.

According to OECD’s technological innovation ability investigation, those indicators, which can reflect enterprises’ technological innovation ability, are identified as the six key aspects: the development strategy for enterprises, the diffusion of innovation achievements, the information source and innovation barrier of enterprise’s innovation, enterprises’ innovation investment as well as enterprises’ innovation outputs.

In the Independent Innovation Capacity Analysis Report on China’s Enterprises, China’s National Bureau of statistics puts forward the evaluation system to strengthen the independent innovation capacity of enterprises from the technical innovation ability point of view, including four level indicators such as the potential technological innovation resource indicators, the evaluation indicators of technological innovation activities, the technical innovation output capacity indicators as well as the technical innovation environmental indicators. In the National Technological Innovation Project Outline, the technological innovation capability is defined as the innovation decision-making capacity, research and development capacity, engineering capacity, manufacturing capacity, marketing capacity, organization capacity, coordination capacity and resource allocation capacity<sup>[8]</sup>.

According to the above analysis, the independent innovation system involves four elements in China’s enterprises such as innovation environmental design ( $\zeta_1$ ), independent research and development innovation (R&D) ( $\zeta_2$ ), independent management innovation ( $\zeta_3$ ) and independent marketing innovation ( $\zeta_4$ ). Each innovation element can be broken down into four measurement indexes, resulting in a measurement system of 4 element and 16 indexes. The meaning of specific indicators is shown in Table 1.

### 3 Model Checking

#### 3.1 Pretest and pilot test

According to the questionnaire design on the basis of the above analysis, three senior experts in the field of technological innovation system who come from Xi’an Jiaotong University of China and Beijing Tiansheng Consultant Firm of China carry on the pre-test (Pretest) to the questionnaire. Six responders finish the questionnaire independently, and give the revision comment.

After pre-test, Pilot Test is made. Its objects are twenty-one students of 2007EMBA in Nanjing University. The final results show that the Cronbach’s  $\alpha$  value of various variables distributes between 0.7343 and 0.8911. According to Hou Jietai’s suggestion, as long as the Cronbach’s  $\alpha$  value is bigger than 0.7, its reliability can be accepted<sup>[9]</sup>. Therefore, it is concluded that the questionnaire have the enough reliability.

**Table 2 EFA Results**

Second-Level Targets	Factor 1	Factor 2	Factor 3	Factor 4
Innovation Organization Establishment <i>X1</i>	.812	.289	.361	3.21E-3
Implementing Knowledge Management <i>X2</i>	.806	7.60E-02	.368	.375
Innovation Strategy Deployment <i>X3</i>	.779	.187	.278	.354
The Construction of Innovation Culture <i>X4</i>	.792	.725	5.23E-3	.132
Scientific and Technological Personnel Staffing <i>X5</i>	5.22E-02	.652	.329	.212
Motivation Mechanism Design <i>X6</i>	.312	.653	.169	.387
Innovation Funding Support <i>X7</i>	.112	.712	.371	.196
Team Cooperation Consciousness <i>X8</i>	3.575E-02	.583	.205	2.24E-2
A Great Improvement Related to Coordination Skills <i>X9</i>	.430	.225	.689	.421
The Organization Structure Adjustment <i>X10</i>	.289	.304	.506	.271
The Good Information Communication <i>X11</i>	.312	.398	.527	.382
Enhancing the Decision-Making Efficiency <i>X12</i>	.423	2.22E-2	.672	.441
Marketing Planning <i>X13</i>	.501	.278	.237	.810
The Improvement of Marketing Pattern <i>X14</i>	.121	.252	.120	.822
The Marketing Organization Management	.527	.312	.115	.713
The Perfect Marketing Network <i>X16</i>	.317	.120	3.23E-2	.712
Cronbach’s $\alpha$	.7239	.7862	.7919	.7230
Cumulative variance (%)	22.312	35.008	59.641	83.210

### 3.2 Data collection

There are 400 enterprises samples. All respondents are the senior management of each unit. These samples are located in sixteen provinces and autonomous regions including Beijing, Tianjin, Shanghai, Shaanxi, Henan, Chongqing, Anhui, Gansu, Sichuan, Yunnan, Xinjiang, Guangdong, Hunan, Jiangsu and Zhejiang of China, which can effectively represent the overall distribution of technological innovation in enterprises.

### 3.3 Single retailer scale test

One hundred and thirty-six samples are selected to carry on Exploratory Factor Analysis (EFA) stochastically and undergo five revolving iterations. Finally, EFA results are shown in Table 2.

Research results indicate that the validity of the sample structure is good and the corresponding factor loading of each index is greater than 0.5.

### 3.4 Validity examination

The paper makes CFA through SPSS11.5 and LISREL8.7. The factor load parameter tabulation can be seen in table 3. Factors in the covariance matrix can be seen in Table 4.

**Table 3 The Factor Load Parameter Tabulation**

Factor Name	X1	X2	X3	X4	X5	X6	X7	X8
Factor Load	.27	.24	.23	.11	.21	.34	.37	.13
SE	.11	.08	.07	.08	.08	.09	.12	.09
T	2.4	3.0	3.1	1.6	2.6	3.8	3.1	1.6
Factor Name	X9	X10	X11	X12	X13	X14	X15	X16
Factor Load	.33	.46	.69	.24	.34	.23	.23	.41
SE	.11	.09	.13	.09	.11	.09	.11	.08
T	3.1	5.1	5.2	2.7	3.1	2.5	2.1	5.0

**Table 4 Factor Covariance Matrix**

	Environmental Design	R& D Innovation	Management Innovation	Marketing Innovation
Environmental Design	1.0			
R& D Innovation	0.69	1.0		
Management Innovation	0.71	0.21	1.0	
Marketing Innovation	0.66	0.18	0.23	1.0

## 4 Conclusion

It can be concluded in the factor covariance matrix that the essential factors of the innovation environment design typically have a strong relevance to some other three essential factors. Therefore, in the process of the independent technological innovation of China's enterprises, the scientific innovation environment design can promote the management innovation, the market innovation and R&D innovation effectively.

It can be concluded in the fitting index tabulation that the model fitting effect is good <sup>[10]</sup>. The independent technological innovation system designed for China's enterprises has the high reliability and the credibility.

It can be concluded in the factor load parameter tabulation that the factor loads of both indicator X4 and indicator X8 are short of the significance. Therefore, in the process of the independent technological innovation of China's enterprises, the innovation cultural construction basically lacks the remarkable influence on the innovation environment design, namely the level of China's enterprise culture is still at the primary condition, which need to be further strengthened. At the same time, the team cooperation consciousness has not had the substantive influence, which needs to be further enhanced.

It can be concluded in the factor load parameter tabulation that the factor loads of indicator X11 is high. Therefore, in the process of independent technological innovation of China's enterprises in the present stage, the convenient communication has the tremendous influence on the independent management innovation ability, namely the enhancement of the information communication efficiency can effectively enhance the efficiency of the independent management innovation.

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