

Analysis on Network Architecture of Discipline Growth in Innovative Universities

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Abstract: At present, the common feature of organizational growth theory is that the network provides the developmental elements of the organization. Based on the review of relevant researches, this paper proposes that the first-class discipline growth mechanism research has important theoretical and practical significance to the development of innovative universities. This paper defines the concept of innovative Universities, introduces the network analysis method, and proposes that the development of innovative university first-class discipline is the interaction of internal and external network resources, a network process which takes place around the formation of knowledge innovation activities. This paper argues that the basic academic network nodes include similar disciplines, different disciplines, professional associations, foundations, government, enterprises and other actors. The paper analyses the function of each network node, the connection of nodes among knowledge and information transfer chains, project cooperation chains, and social relation chains.

Key words: Innovative university; First-class disciplines; Network; Node

1 Introduction

In order to enhance the University's innovative capacity and competitiveness, since the 1990s, China has been committed to building world-class universities. But so far, how to build first-class universities is still being explored. Also, since the late 20th century, by the arrival of knowledge economy, industry demand for knowledge and the reduced funding for higher education of the government, the functions of universities in developed countries are experiencing a major shift. The social service functions of universities have been strengthened. It is starting from the margins of society to social centers, and is becoming a knowledge center. Massachusetts Institute of Technology, Stanford University and other world-class universities, with national and regional economic development needs, are converting university researches into science and technology, and using the gains to further nurture the university to achieve healthy functioning. At present, this trend is spreading in the worlds, and thus gave birth to a new university paradigm, that is innovative university. For the universities in China to develop into "Science Engineering Management" high-level research universities, they must conform to the trend of higher education to build innovative universities. Discipline is the body and cells of university; it is the foundation of personnel training, scientific research and social service. To build an innovative university, world-class disciplines should first be built. Thus, what an innovative university is and how the first-class disciplines in innovative universities can grow up have become urgent theoretical and practical issues that need to be solved.

2 Literature Review

Innovative university research. Etzkowitz Proposed a famous triple helix model in the 1990's. He thinks that the university-industry-government cooperate closely in the innovation process, each party not only fulfilling their traditional functions, but also the function of the other two parties, which forms an innovation stream to develop together^[1]. He believes that the future university goal is to become an entrepreneurial university. The emerging entrepreneurial university has five main components: a research team, the commercial potential research base, the intellectual property transfer mechanism, the ability to build companies in the university, and the integration of academic elements and commercial elements to form a new organizational model^[2]. Clark pointed out that the core of the entrepreneurial university is entrepreneurship, and he made his famous "five ways transformation" theory: a strong core leadership, expansion of the development of peripheral and diversified funding sources, a strong academic core, and entrepreneurial campus culture^[3]. Around the "academic capitalism", Slaughter believes that the entrepreneurial university is the university to

take some business operation modes in the changing situations^[4]. Tang Xiaoyan thinks that innovative university generates in the knowledge economy, based on development and innovation as the core concept^[5]. First-class disciplines growth mechanism. Tian Changlin thinks that it is impossible that all the disciplines will become the best in the world, and therefore research universities must find ways to support the most excellent subjects, turning them into the best in the world^[6]. Xu Xiaozhou thinks that the first class discipline includes large first-class projects, large platforms, masters, big results, and awards. Among them, the construction of large projects is the foundation of a discipline, and there should be a large project to form a large platform to bring together masters, with big achievements to get awards^[7]. Feng Xiangdong thinks that there are three most important strengths that promote discipline development, that is the internal logic of scientific development, scientific organizations, social needs and government intervention. Three forces work together to form a dynamic balance of discipline development mechanism^[8]. Xuan Yong declares that the formation of discipline organizations is the result of internal genes together with external environment, the natural evolution, self reproduction, external birth and active planting are the basic form of organization^[9]. From institutionalization process and rational evolution perspective, Fang Wen analyzes the growth of social psychology in Europe^[10]. Zhou Zhifa made analysis on how physics discipline in American universities turn into world-class subjects^[11]。

This paper argues that innovative university is the continuation that preserves and communicates knowledge, a tradition from the medieval times, and thus develop into multi-purpose agencies that create new knowledge and translate them into practical application. It is an integration of knowledge dissemination, production and application; it integrates academic, cultural and commercial advantages, to achieve a high integration of government-entrepreneur-university degree. It is a new university that seeks to fight for their own development and the promotion of social progress; it is a new stage of the development of high-level research university. On first-class discipline develop mechanisms of innovative university, the present study compares a single perspective, and therefore the research depth is not enough. This paper attempts to open the black box, to explore network architecture and growth nature of first-class discipline in the innovative university to provide theoretical support and practical reference for the construction of first-class academy in the innovative university.

3 The Network Growth Nature of First-Class Disciplines in Innovative Universities

At present, the transaction cost theory, the resource base theory, the organizational learning theory, the core competence theory, the evolutionary economics, and many other different theoretical schools have tried to explain the growth of organization. Although the perspective is different, but they all think the network provide elements that organization growth needs, which can be a particular resource, some kind of important knowledge or necessary capacity. This paper argues that the above theory can explain the growth of the organization network. Network growth has been able to benefit organizations, because organizations may need important growth resources from network, which includes both property and other tangible resources, including knowledge, ability and other intangible resources.

Throughout the history of first-class disciplines in innovative universities, it can be found that the development of first-class disciplines is closely linked with the network it embedded. The birth of disciplines is the formation of the Knowledge Innovation network that the internal group of scholars formed on the basis of common values, common goals or tasks, as a result of the integration internal resources. Disciplines continuously optimize internal resources, including the introduction of first-class academics, first-class laboratory equipment updates, top academic ranks, creating innovation atmosphere, team building and other cultures, and through the design of the institution, it continuously strengthens the internal network connection. With the development of the disciplines, the subject began to break through traditional boundaries, through a wide range of cooperation with similar and different disciplines,, professional associations, foundations, government, enterprises and other actors to achieve the knowledge and information sharing, get external resources needed and update the internal resources continuously to achieve the effective flow of internal and external resources. Through exchange and cooperation with external actors, disciplines can grasp academic front, closely connect with national strategic needs, and improve the learning and innovation capacity constantly to maintain sustainable competitive advantages. Thus, the development of first-class

disciplines in innovative universities is the result of internal and external network resources interaction; it is the network procedure around the disciplinary knowledge innovation activities.

4 The Network Architecture of First-Class Disciplines in Innovative Universities

4.1 The Network structure of first-class disciplines in innovative universities

Based on the above analysis, we can draw the network system diagram of first-class disciplines in innovative universities. This paper argues that the country's political, economic, scientific and educational environment and the context of school development strategies, the development of first-class disciplines in innovative universities is the result of internal and external network resources interaction. Discipline network is formed by nodes and connections, the basic nodes include similar and different disciplines, professional associations, foundations, government, enterprises and other actors.

4.2 Network node functions of first-class disciplines in innovative universities

Interaction between different disciplines is critical for the network knowledge innovation process. Only when each member has clear roles and duties, and division of labor subjects, can the network system dynamically exchange with the external environment to escalate network organization and development.

4.2.1 Discipline

Discipline is not only the classification of knowledge, but also the primary academic organization of a university, it is the basic cells of university organizations, and the production of discipline can be divided into two basic types: one is based on internal reasons in the discipline; the other is based on reasons other than purely academic impact of the discipline^[12]. Intra-disciplinary is the network organizations that the group of scholars form around the knowledge innovation. Once the discipline is produced, it will constantly focus the direction of academic researches, attract the best researchers participate in the study, while continually improving the disciplinary system and integrating internal resources. Through internal symposia such as afternoon tea and other academic activities knowledge is exchanged, and innovate culture, is actively created, enhancing the knowledge innovation and knowledge absorption capacity of disciplines.

4.2.2 Similar discipline

To maintain a competitive advantage, it is necessary to develop in comparing with others. The discipline must establish communication mechanisms with similar disciplines at home and abroad, through visits, symposia and other forms to follow the development trends timely and grasp the development of frontier subjects. According to discipline developing trends and the national and regional development needs, combining the characteristics and infrastructure of the discipline, and continuously adjusting the development strategy of discipline, planning the disciplinary construction and development, determining the goal, the main research direction, team building, personnel training, environmental and infrastructure conditions of disciplines to maintain a superior position.

4.2.3 Different discipline

The development of modern science and technology is showing a trend of cross-cutting, interpenetration, high integration, systematization and integration of multi-disciplines. The inter-discipline is becoming the age characteristics of scientific developments in contemporary times. Formal discipline organization is classified by disciplines in universities, to pursuit professional development and deepen single disciplines. The intersection of disciplines is often a new growing point, a new scientific frontier, where it is most likely to have major scientific breakthroughs that may lead to revolutionary changes in science^[13]. The interdisciplinary knowledge structure is to solve problems. A discipline must cooperate with different disciplines. Through establishing interdisciplinary research centers and other organizational forms, it breaks loose from the restrictions of traditional discipline classification, attracts the best teaching and research staff, grasps important research direction, finds excitement in the inter-disciplines, complements advantages, and solves complex problems that a single discipline cannot solve.

4.2.4 Professional associations

Professional associations includes the associations on the same subjects, interdisciplinary and intersectional organizations, domestic and international academic conferences that communicate regularly and the organization that assesses the development of a discipline and offer advice and suggestions. They are important platforms of knowledge sharing, information exchange, research.

Research consultation and cooperation among scholars. It is also an important way through which scholars take part in scientist's community and gain peer recognition. professional associations will promote the formulation of relevant national policies, thus contributing to the development of disciplines. Through taking part in professional association activities actively, the disciplines will grasp the front, exercising team members and get more resources for their own development.

4.2.5 Science Foundation

Various types of Science Foundation play an extremely important role to promote basic research and applied research, accelerate discipline construction, and discover and train outstanding talents. Funds can also play an active role to guide disciplines to participate in projects of the academic front and national needs, and promote the collaboration of government-enterprise-university. The first-class discipline in innovate university focuses on not only basic research, but also applied research, through obtaining Science Foundation supports, promote the development of disciplines continuously.

4.2.6 Government

Government is not only the knowledge innovation promoter, but also the innovation policy maker. It has an irreplaceable role in creating a knowledge innovation environment. Government actors serve as a bridge and link between network actors. And by the government's creating an innovative environment actively to promote knowledge, information flows quickly and efficiently. Government policy has an important impact on discipline develop mode, and even changes the academic research model. Government played an important role in the birth of first-class disciplines, the Manhattan Project, the radar engineering and other major projects during World War II in the United States. The government gave financial and policy assistance and support, which directly spawned a number of world-class disciplines.

4.2.7 Enterprise

A typical character of first-class disciplines in innovative universities is that the development of disciplines is closely integrated with economic and social development and cooperation with enterprises is an effective way to achieve this purpose. Enterprise is the main actor directly involved in innovation activities, and it is the key elements of the discipline network. Discipline knowledge, technical results only rely on the enterprise's products and realize value in the market to be able to complete the whole process of innovation. Through education and training, discipline provides new knowledge and new ideas which penetrate into enterprise decision-making and operation management. Through research, cooperation projects, disciplines get necessary production and practical knowledge, which they apply to teaching and research. Massachusetts Institute of Technology and Stanford University are models of school-enterprise cooperation. Through transforming university research results, accelerate the hatching and conversion of original scientific and technological achievements, establish new industries, and in turn further fostering university teaching and research, to achieve the rapid development of disciplines.

4.3 The relationship chain of first-class disciplines in innovative university network nodes

The network architecture of first-class disciplines in innovative university is make up with similar disciplines, different disciplines, professional associations, foundations, government, enterprises and other end point, there is also the relationship chain between these nodes join. There are some forms sums up.

4.3.1 Knowledge and information transfer chain

Through transferring knowledge and information continuously, the actors in disciplines network enhance network connection. Based on shared values and tasks within the disciplines, it forms the actors network. Internal disciplines, through regular academic exchanges, conferences, afternoon tea, and other forms of private communication, exchange knowledge and information, which improves the learning and innovation purposes continuously. Disciplines cooperate with similar and different disciplines, professional associations, foundations, government, business and other actors to exchange knowledge and information. Knowledge and information transfer is an important condition for the effective operation of the network. The faster that information and knowledge is transferred, the higher the efficiency of network operation. Similarly the stronger the network function is, the stronger the node innovative capability.

4.3.2 Project co-chain

Projects cooperation between Nodes will establish linking channel and trust mechanism. The more frequent and more extensive between Network node cooperation projects, the more closely linked the nodes will be. The project cooperation will play three roles in forming the network: first, carrying out a project cooperation will deepen mutual understanding, it will promote further

exchanges and co-operation between the actors in turn; Second, build trust, the actors will evaluate other actors, when carry out project cooperation to determine the possibilities of further cooperation; Third, based on understanding and trust, it will form cooperative culture and cooperative mechanism.

4.3.3 Social relation chain

Social relation chain is the relatively stable relations system that is formed through the interaction of individual members of a society. It is concerned with the interaction and connections between people. If each individual functions as a node, then academic community of shared values will be formed within the discipline. Through personal contacts within the discipline, close links are established. Outside the discipline, mobility between nodes will strengthen their bonds, including the hiring of tenure professors from other countries and short-term cross-border scholar visiting system and other forms of job mobility. It forms the social relation chain between individuals when internal and external disciplines interact. Through the chain of social relations, knowledge and information exchange quickly and efficiently. Meanwhile, the relatively stable social relations chain that people establish in one unit will be further expanded with the interaction; it will have a positive effect on promoting knowledge innovation.

5 Conclusions

This paper discusses the network growth nature of first-class disciplines in innovative universities, analyzes the structure of discipline network growth mechanism, and further explains the function of each network node and the connection between the network node chains. This paper argues that the interaction between network nodes promotes the evolution of discipline academic network structure and relationship, so that discipline could obtain the resources needed for development, which promotes the development of the discipline continuously. This paper argues that future research should focus on identify the elements of discipline network growth, further analyzes power generation, growth mechanisms, evolutionary mechanisms, learning mechanisms, innovative mechanisms, in order to deeply and systematically understand the mechanisms and factors that influence the development first-class disciplines in innovate universities.

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