

# Research on the Construction of School-Enterprise Cooperation Model Based on the Perspective of Knowledge Transfer “Quintuple Helix Mode”

Ting Wang

School of Public Affairs, University of Science and Technology of China, No.96 Jinzhai Road, Hefei, Anhui Province 230026, China

\* E-mail of the corresponding author: wang315@mail.ustc.edu.cn

## Abstract

School-enterprise cooperation is an important way and support for industrialization of science and technology production. It's not only beneficial to the scientific and technological output of universities, but also to improve firms' innovation performance and financial performance. However, there are still the problems existed in Chinese school-enterprise cooperation such as poor docking between scientific project and market, scattered innovation resources, unsustainable technology innovation, and lower quality results. The main reason is that the channel of knowledge transfer is single and lack of support from multiple functions of universities. Based on the perspective of knowledge transfer “quintuple helix mode”, this paper construct a multi-dimensional school-enterprise cooperation interaction channels from aspects of knowledge sharing platform, intermediary service agency, open communication forum, bidirectional embedded talent flow, trans-regional innovation and entrepreneurship park, specialized funds and venture investment systems. This model is conducive to the realization of universities' multiple functions in innovation and maximizes knowledge transfer effect, and further advance the deepening and efficiency of school-enterprise cooperation in China.

**Keywords:** school-enterprise cooperation, knowledge transfer, quintuple helix mode

## 1. Introduction

Universities undertake multiple functions such as education, scientific research, commercialization of research findings and social services, and they are the innovation sources for inputting frontier exclusive knowledge to enterprises, and provide the platforms of technology study and innovation to enterprises (Caulfield & Ogbogu 2015). On the other hand, universities themselves can also improve the scientific research quality through gaining market and technology information in the process of school-enterprise cooperation. Therefore, how to promote the mutual benefit and shared profits between universities and enterprises and other community of interests, how to speed up the commercialization of research findings and the application of high technologies become the important topics. However, there are still the problems existed in Chinese school-enterprise cooperation such as poor docking between scientific project and market, scattered innovation resources, unsustainable technology innovation, and lower quality results (Zhao, 2011), which influences the quality and efficiency of school-enterprise cooperation and leads to low corporate innovation level. Therefore, some enterprises who pursue the realistic benefits no longer take universities as the necessary cooperative partners, thus to further breach the school-enterprise cooperative relationship. Therefore, in the process of innovation paradigm stepping towards open-ended from closed-ended, which model can effectively promote the stable cooperation of Chinese school-enterprise thus to achieve the good effects? It demands us to consider urgently.

In fact, the mainly function of school-enterprise cooperation is to transfer knowledge among different organizations (Narayanan 2001). Namely, the knowledge acquisition channels are established by enterprises and universities to transfer the commercial scientific knowledge from universities to enterprises (Agrawal & Henderson 2002), and both parties can gain benefits in this process (Link & Scott, 2003). At present, the researches about school-enterprise knowledge transfer channel mainly focus on two kinds of traditional commercial mode including knowledge transaction and R&D cooperation. Knowledge transaction is mainly realized through the channels such as patent licensing authority, distribution of publication and purchase. R&D cooperation mainly shows as that enterprises gain the knowledge demanded for new products or services through mutual R&D project. There are few researches about multiple interactive mode of universities' academic participation and how to utilize universities to improve knowledge transfer effect (Jonsson *et al.* 2015). In view of this, the problems and challenges existed in the knowledge transfer process of Chinese school-enterprise cooperation are discussed firstly in this paper. Secondly, knowledge transfer “quintuple helix mode” of Elias,

Carayannis and Campbell (2010) is introduced. In the end, the multiple interactive channel of Chinese school-enterprise cooperation is constructed based on “quintuple helix mode”, profoundly exploring how universities’ scientific researches comprehensively participate in corporate innovative, play universities’ multiple functions in innovation and maximize knowledge transfer effect.

## **2. Challenges Faced by School-Enterprise Cooperation**

In the traditional Chinese school-enterprise cooperation mode, because of the differences existed in the aspects such as cultural atmosphere, interest demands, and management tools, a series of problems and challenges are emerged in knowledge transfer process of both schools and enterprises, as shown in the following:

### *2.1 Unstable School-Enterprise Cooperation Relationship*

When promoting the innovation performance, the scientific results achieved by Chinese universities are always based on product lifecycle and indirect demands of market development. Enterprises and universities tend to establish short-term connection depending on scientific projects. On the other hand, the relevant knowledge and sources gained by scholars from enterprises are also indirect, which is more complicated in comparison to universities who gain knowledge with the direct modes such as academic conference, public published articles, and peer communication. Due to the indirectness of cooperation, both parties’ relationship is hard to be effectively managed and maintained in a long run, which leads to inadequate use of the knowledge resources.

### *2.2 The Hardship of Tacit Knowledge Dominant in the Knowledge Transfer Process*

Because most of researches cost few years even several decades before being transferred to innovation results and successfully applied into enterprises’ production. The tacit knowledge is hard to be dominant because of the indirect connection between school and enterprise. In order to avoid this kind of dilemma, some Chinese policy makers and scholars even appeal school-enterprise cooperation to abide by the traditional commercial routines (such as patent and license) which are easy to code. It is easy to find out that this kind of fixed cooperation mode will greatly limit knowledge transfer to generate creativity and innovation in multiple channels. Therefore, improving universities’ knowledge coding capacity and enterprises’ knowledge absorbing capacity is the nonnegligible cooperation premise for both parties.

### *2.3 Big Difference of Value Appeal between School and Enterprise*

Enterprises always pursue short-term benefits, emphasize technology’s practicability, reliability and ROI, and lack of impetus to initiatively participate in school-enterprise cooperation in a long term. Thus, its investment in research funds is far less than that of large-scale enterprises, which doubtlessly reduces the enthusiasm of university cooperation. Moreover, Chinese universities may also tend to cooperate with large-scale state-owned enterprises and foreign enterprises because of unable to gain the first-hand data and documents with application value from the cooperation with enterprises, which greatly reduces the scope and innovation opportunities of school-enterprise cooperation. Sometimes, although both enterprises and universities have the intention to cooperate, there is also the possibility that the research filed demanded by enterprises is too narrow, and it needs to spend a lot for searching before matching the cooperative object in the field. How to eliminate deviation of conception and construct the mutual culture under the in-depth school-enterprise cooperation are also the problems which need to be solved urgently in school-enterprise cooperation at present.

### *2.4 High Risks for Failure of School-Enterprise Cooperation*

Although school-enterprise cooperation can help enterprises to integrate lots of external resources, the risks such as high cooperation cost, knowledge leakage, and out of control caused by complicated management may also be encountered by school-enterprise cooperation, thus to cause the failure of school-enterprise cooperation. On the other hand, enterprises lay more emphasis on technology R&D and innovation, and ignore the market risks and customers’ demands. The fast changing market environment influences technology products’ competitive edge and its future market prospect greatly, which demands both parties to adopt measures to balance technology innovation and market demands.

### 3. Knowledge Transfer “Quintuple Helix Mode”

In the school-enterprise cooperation process, the innovation depends on whether the knowledge can be extensively developed and utilized (Tidd *et al*, 1997). According to the series of researches conducted by Carayannis & Campbell (2006, 2009), Elias, Carayannis & Campbell (2010), and Carayannis & Rakhmatullin (2014), it can be seen that universities play multiple roles and functions when cooperating with enterprises to innovate. At first, universities only provided enterprises with the newest scientific findings within their discipline, but scholars didn’t consider whether the above findings can be accepted and utilized by enterprises or customers extensively. It causes the waste of lots of scientific results, with poor efficiency. Later, knowledge application and social demands are emphasized by scholars gradually, and integrated into universities’ knowledge innovation. They grant universities’ scientific results with the higher application value and social acceptance and focus on solving the problems in social economy and corporate development. Afterwards, universities’ functions in innovation become richer and focus on how to realize the effective cooperation of “industry-university-research”. For example, the scholar Etzkowitz (2001) proposed that the entrepreneurial universities should realize the commercialization of scientific achievements through establishing “office of technology transfer” and recruiting staff with business backgrounds, such as the new industries are derived through applying patent, license or utilizing scientific achievements. Carayannis & Campbell (2010) indicated that social media, social culture and arts should also be considered into the innovation system, which both increases the innovation resources in school-enterprise cooperation and extends the sources of corporate value creation. In the end, in order to realize the sustainable development of school-enterprise cooperation, the environmental elements should also be emphasized thus to solve all kinds of problems in school-enterprise cooperation, such as cultural conflict and cooperation trust . The theory of “the quintuple helix mode” of knowledge transfer is constructed ultimately.

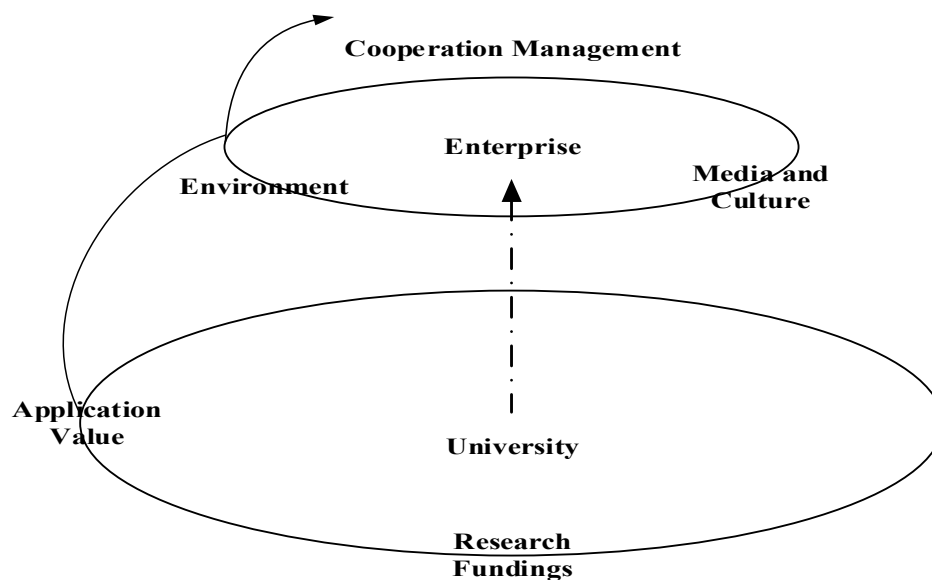


Figure.1 A Conceptual Framework of Knowledge Transfer “Quintuple Helix Mode”

To sum up, the five elements including scientific findings, application value, cooperation management, media and culture, and environment constructed “the quintuple helix mode” which promotes the development of school-enterprise innovation system. This theory indicates that the effect of knowledge transfer of school-enterprise cooperation is directly related to whether universities can comprehensively play multiple functions. It can be seen that if it wants to fully realize and reach the effective transfer of knowledge in the school-enterprise cooperation process, it must be based on the development of universities’ scientific achievements and the systematic school-enterprise docking mode.

### 4. Constructing Multiple Channels of School-Enterprise Knowledge Transfer

Based on the previous analysis, it’s not difficulty to find that universities and enterprises in China should interact

in a wider area. The increasing of innovation resources and the diversification of organizational support will have a positive impact on the cooperation between enterprises and universities. Therefore, on the strength of knowledge transfer “quintuple helix mode”, we construct a multi-dimensional school-enterprise cooperation interaction channels from aspects of knowledge sharing platform, intermediary service agency, open communication forum, bidirectional embedded talent flow, trans-regional innovation and entrepreneurship park, specialized funds and venture investment systems. This model can eliminate the possible risks and challenges in the process of school-enterprise cooperation, and achieve the best results of knowledge transfer.

#### *4.1 Open-Source School-Enterprise Knowledge Sharing Platform*

With the rapid development of global economy, it becomes hard to master market demands and technological commercialization through simply replying on intellectual resources of universities. Researches show that the content open platform in open-source production is an emerging knowledge production and share mode in the internet era (Black *et al*, 2011). This mode abides by open, comprehensive and collaborative innovation strategies, which can effectively forbid the phenomenon that team members are only willing to share the knowledge provided by others but not willing to share knowledge to others, and namely, it is the so-called “free-riding” behavior (Pee, 2017), with the typical cases being “Zhihu”, “I ask”, and “Baidu Baike”. Therefore, universities can also refer to open-source thinking when constructing knowledge share platform, take root in their own frontier scientific and technological achievements, and absorb the intellectual resources from many aspects such as government, enterprises and public. On this platform, the participants can simultaneously act as the roles of both publishers and recipients of knowledge, realize the free flow of knowledge and meet the personalized demands of partners. For example, universities can release the latest scientific and technological information and consultation services for enterprises to reference, while enterprises can provide product information, market demand and proprietary R&D knowledge for helping universities develop the market-oriented research direction, and meanwhile other interests community or individuals interested can also contribute their own creativity and resources. In addition, the government should also provide the necessary fund supports for platform construction and system maintenance, increase government information providing interface, and improve users’ right to know and convenience of information use.

#### *4.2 Intermediary Service Agency of School-Enterprise Cooperation*

The risks such as knowledge coordination, knowledge damaging and knowledge exposure are existed in the process of knowledge transferring, and these risks become the main obstacle for knowledge transfer of school-enterprise cooperation. Researches show that the key of knowledge transfer in school-enterprise cooperation is to be matched with the corresponding organizations and institutions (Raj Adhikari, 2010). In order to reduce the above mentioned risks and promote the knowledge communication and integration, universities should establish intermediary service agencies of school-enterprise cooperation, such as “school-enterprise cooperation office” and “technology transfer office (TTO)”, and recruit the interdisciplinary talents with scientific research, business and intellectual property protection background to be responsible for the matters related to school-enterprise cooperation. It is mainly because staff with multiple backgrounds can better understand and express the true demands of both parties, facilitate both parties to solve the differences existed in culture, language and cognition, maintain the interests of both school and enterprise, and promote both parties to reach the optimal cooperation agreement. To be specific, intermediary service agencies of school-enterprise cooperation should mainly undertake the following duties: first, improve the trust degree of partners, and create a harmonious atmosphere for both parties. Based on trust, help both parties solve the problems such as contents, channels, property rights and others of knowledge transfer. Second, positively identify the external cooperation opportunities matched with universities, and positively cooperate with other social groups such as intellectual property right organizations, venture investment companies, and governments, thus to provide both property rights and capital support for universities’ knowledge innovation. Third, take charge of knowledge coding and organizing to train enterprises’ staff. Technological knowledge is always hard to transfer and absorb, intermediary agencies should help scientific research groups to effectively code knowledge, and meanwhile, be responsible for connecting with scientific research groups’ members to conduct specialized knowledge training in enterprises, and improving enterprises’ staff’s absorption, application and innovation on scientific research achievements.

#### *4.3 Open Communication Forum for School-Enterprise Cooperation*

If universities hold school-enterprise cooperation communication forum regularly, it can provide scientific research staff and enterprises with the opportunity of open knowledge communication and in-depth discussion, thus to timely solve all kinds of problems encountered in cooperation and enhance both parties' understanding and trust. Before holding the communication forum, the organizer should inform cooperative enterprises and universities to submit the issues related to cooperation project in advance, and all issues will be published in the forum website, thus the cooperative teams, and scholars and staff interested can prepare the communication contents in advance. Thereafter, the organizer should summarize, select and classify the issues, and hold multiple seminars on the day of holding forum aiming at different themes. Meanwhile, the organizer can develop a specified module for school-enterprise communication in school official website or BBS to help both parties have a real-time understanding on the process of conferences and reduce the information asymmetry of both parties. Encourage both parties' members to interact at any moment, and improve the efficiency and quality of solving the cooperative issues.

#### *4.4 Bidirectional Embedded Talent Flow*

The flexible flow of senior technical personnel is one of the necessary environments for cooperative innovation. The process of flexible flow of technical personnel in different organizations and systems is also the process for the further innovation of R&D enterprises. In order to realize the deeper cooperative innovation, universities and enterprises should promote the flow and cooperation of technical personnel. Namely, corporate scientific research personnel exchange, communicate, or train in universities, and graduate students and doctoral students in universities participate in R&D or training in enterprises. The targeted majors in universities can sign cooperation agreement with enterprises, build scientific research cooperation teaching centers and united laboratories together, and invite teachers with double backgrounds of scientific research experience and corporate project experience to open lectures to guide students and staff in the project team. Meanwhile, school should establish the creative team system of school-enterprise cooperation based on mutual negotiation, formulate the matched "professional college with bipolar teaching" incentive evaluation mechanism, and provide generous treatment for academic staff, thus to stimulate the enthusiasm for project R&D. Through this kind of bidirectional embedded talent flow strategy, universities and enterprises can realize the optimal configuration of intelligent resources, deepen knowledge absorption and technical innovation, and realize the seamless connection of "industry-university-research" between universities and enterprises.

#### *4.5 Trans-regional Innovation and Entrepreneurship Park*

"Industry-university-research" service base is usually established in universities, which is beneficial for realizing the effective integration of campus resources. The good channel for school-enterprise cooperation is constructed, but with relatively limited campus resources, it is hard to form the resultant force between universities and enterprises. Therefore, universities should also integrate the trans-regional advantageous resources, establish the cooperation platform and scientific and technological innovation and entrepreneurship part which cover the whole region, and form the cross-border organization of joint participation by universities, scientific research institutions, enterprises and governments. This kind of new-type cooperative mode promotes the organic combination between trans-regional scientific and technological achievements and characteristic industrial clusters, which is beneficial for playing the scientific research advantages of universities and scientific research centers and integrating the advantageous innovation resources of both domestic and overseas, thus to guarantee the product R&D and commercialization to succeed powerfully.

#### *4.6 Cultivating the Specialized Funds and Venture Investment Systems*

The big funding gap is an important reason for the failed knowledge transfer of school-enterprise cooperation and the low transfer rate of scientific and technological achievements. Aiming at the conflict of interest between enterprises and universities, the government should allocate the specialized funds or cultivate venture investment systems macroscopically to make up the funding gap of universities and enterprises, and guarantee the innovation thinking to step toward commercialization stage as soon as possible. Firstly, at the early stage of school-enterprise cooperation, the government should establish the specialized funds to solve the problem of capital shortage. The main mode is that the government funds drive the nongovernmental capital to enter into industrial venture investment field, and the government funds only perform the transition role in this process.

After the nongovernmental venture investment enters into the healthy operation, enterprises should consider to reduce their proportion gradually, and even withdraw from those industrial fields with market competitiveness. Secondly, at the late stage of school-enterprise cooperation, both parties demand lots of financial support. At that time, the government can cultivate venture investment system to reduce corporate finance: ①Publish preferential tax policies, and issue financial subsidies, thus to reduce the acquisition cost for venture investment; ②Enhance and standardize financial information disclosure, and the government should directly establish the specialized institutions or authorize some organizations to professional evaluate corporate performance and investment value, thus to reduce the evaluation cost for small and middle-sized investors and make up the small and middle-sized investors' deficiencies existed in professional knowledge; ③Establish the effective venture capital prominent mechanism to increase the mobility of venture capital.

## 5. Conclusion

The effect of knowledge transfer has a significant impact on the performance of enterprise innovation performance and the industrialization of science and technology production in universities. Therefore, in order to achieve the maximum effectiveness of knowledge transfer, this paper based on the comprehensive analysis of university's five functions in the knowledge transfer "quintuple helix mode", constructs a multi-dimensional school-enterprise cooperation interaction channels from aspects of knowledge sharing platform, intermediary service agency, open communication forum, bidirectional embedded talent flow, trans-regional innovation and entrepreneurship park, specialized funds and venture investment systems. Among them, the knowledge sharing platform, intermediary service agency, trans-regional innovation and entrepreneurship park focus on expanding the breadth of knowledge transfer, to help enterprises develop knowledge boundary, ensure more collision and integration of ideas, and provide unlimited possibilities for enterprises innovation; On the other hand, the open communication forum, bidirectional embedded talent flow, and venture investment can promote the depth of knowledge transfer, enhance the desorption capacity of universities and the absorptive capacity of enterprises, help enterprises effective absorb and use of frontier knowledge. Thus, the functions of different channels discussed in this paper complement each other, and form a multi-dimensional and networked interactive mode of school-enterprise knowledge transfer.

## References

- Agrawal, A., & Henderson, R. (2002), "Putting Patents in Context: Exploring Knowledge Transfer from MIT". *Management Science*, 48(1), 44–60.
- Black, L. W., Welser, H. T., Cosley, D., & DeGroot, J. M. (2011), "Self-governance through Group Discussion in Wikipedia: Measuring Deliberation in Online Groups". *Small Group Research*, 42(5), 595-634.
- Carayannis, E. G., & Campbell, D. F. (2009), "'Mode 3' and 'Quadruple Helix': toward a 21st Century Fractal Innovation Ecosystem". *International Journal of Technology Management* 46(3-4), 201-234.
- Carayannis, E. G., & Campbell, D. F. (Eds.), (2006). "Knowledge Creation, Diffusion, and Use in Innovation Networks and Knowledge Clusters: a Comparative Systems Approach across the United States, Europe, and Asia". *Greenwood Publishing Group*.
- Carayannis, E. G., & Rakhmatullin, R. (2014), "The Quadruple/Quintuple Innovation Helixes and Smart Specialisation Strategies for Sustainable and Inclusive Growth in Europe and Beyond". *Journal of the Knowledge Economy* 5(2), 212-239.
- Caulfield, T., & Ogbogu, U. (2015), "The Commercialization of University-Based Research: Balancing Risks and Benefits", *Bmc Medical Ethics* 16(1), 1-7.
- Elias G. Carayannis, E. G., & Campbell, D., F., J. (2010), "Triple Helix, Quadruple Helix and Quintuple Helix and How Do Knowledge, Innovation and the Environment Relate To Each Other?". *International Journal of Social Ecology & Sustainable Development* 1:41-69.
- Etzkowitz, H. (2001), "The Second Academic Revolution and the Rise of Entrepreneurial Science". *IEEE Technology and Society Magazine* 20(2), 18-29.
- Jonsson, L., Baraldi, E., Larsson, L. E., Forsberg, P., & Severinsson, K. (2015), "Targeting academic engagement in open innovation: tools, effects and challenges for university management". *Journal of the Knowledge Economy* 6(3), 522-550.

Link, A. N., & Scott, J. T. (2003), "U.S. Science Parks: the Diffusion of An Innovation and its Effects on the Academic Missions of Universities". *International Journal of Industrial Organization* **21**(9), 1323-1356.

Narayanan, V. K. (2001), "Managing Technology and Innovation for Competitive Advantage". *Pearson Education India*.

Pee, L. G. (2017), "Altruistic Knowledge Sharing in Online Communities". In *Advanced Communication Technology (ICACT), 19th International Conference, IEEE*, 844-846.

Raj Adhikari, D. (2010), "Knowledge Management in Academic Institutions". *International Journal of Educational Management*, 24(2), 94-104.

Tidd, J., Bessant, J. R., & Pavitt, K. (1997), "Managing Innovation: Integrating Technological, Market and Organizational Change "(Vol. 4). Chichester: Wiley.

Zhao, Z. (2011), "School-Enterprise Cooperation in China's Vocational Education and Training", *Chapter I Developing Curricula and Qualification Systems*, 43.