

Research on Knowledge Creation and Knowledge Diffusion Mechanism of Industry University Research Cooperation Model —Take the Tobacco Industry ASAN Example

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Abstract: Knowledge creation is an important basis of national innovation strategy, and industry university research cooperation is an important way of knowledge creation. Exploring the knowledge diffusion mechanism of different industry university research cooperation modes is conducive to knowledge creation. A good knowledge creation mechanism can improve the level of knowledge creation. Taking the tobacco industry as an example, this paper improves the knowledge creation level of the tobacco industry by establishing the knowledge creation mechanism of the tobacco industry, so as to solve the technical bottleneck of the tobacco industry and increase the number of innovative products in the tobacco industry. Through combing the research of scholars, it is found that the research on the promotion of knowledge creation by industry university research cooperation mode is relatively rich, but the research from the perspective of the relationship between knowledge diffusion mechanism and knowledge creation mechanism is slightly insufficient. In order to improve the knowledge creation level of industry university research cooperation, this paper obtains the knowledge creation mechanism of different industry university research cooperation modes by using SECI knowledge creation model. Innovatively put forward the "double helix" relationship between knowledge creation and knowledge diffusion in industry university research cooperation, that is, the knowledge diffusion mechanism in different industry university research cooperation modes will affect the level of knowledge creation, which provides a theoretical basis for the main subject of industry university research cooperation to find a way to improve the level of industry university research cooperation.

Key words: industry university research cooperation; knowledge creation; knowledge diffusion; tobacco industry

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INTRODUCTION

Industry university research cooperation can greatly promote the economic performance of a country, region and even enterprises.¹ Many scholars have defined industry university research cooperation. The meaning of industry university research cooperation can be divided into broad sense and narrow sense, and knowledge can also be separated into explicit knowledge and tacit knowledge. From the perspective of knowledge creation and knowledge diffusion, industry university research cooperation in a broad sense refers to the organic combination of technological development, talent training and production activities of universities, enterprises and scientific research institutes under the influence of government, intermediary institutions, financial and venture capital institutions, and through knowledge diffusion on the principle of complementary advantages, mutual benefit and common development, Realize the cooperative process of knowledge creation. In a narrow sense, industry university research cooperation refers to the cooperation process in which universities, enterprises and scientific research institutes organically combine technology development, talent training and production activities, and realize knowledge creation through knowledge diffusion based on the principle of complementary advantages, mutual benefit and common development.

Since China's reform and opening up, the tobacco industry has begun to attach great importance to scientific and technological innovation. The strategy of "Prospering tobacco through science and education" centered on "technological progress" has led to the establishment of a tobacco scientific research cooperation center in China. Since its establishment, the center has comprehensively promoted the construction of innovative tobacco industry. Moreover, as the pillar industry of China's fiscal revenue, the importance of tobacco industry to national and local fiscal revenue is self-evident. The market scale of new tobacco products has increased year by year, but there

are still some key core technologies that are difficult to crack at this stage. The work of reducing coke and harm, reducing cost and increasing efficiency, improving quality and upgrading needs to be carried out in an orderly manner. Industry university research cooperation is one of the effective ways to solve the technical bottleneck.

Scholars have conducted rich research on the classification of industry university research cooperation modes, including the classification of close cooperation modes and loose cooperation modes according to different degrees of combination;² the classification of one-to-one cooperation modes and one to many cooperation modes according to the different number of cooperation between universities and enterprises;³ according to the different roles of the government, there are classification of market spontaneous mode and government leading mode;⁴ More scholars divide industry university research into market-oriented type, university research oriented type and government oriented type according to different leading forces.

The process of industry university research cooperation is a double helix rising process of knowledge diffusion and knowledge creation. Different modes of industry university research cooperation determine that the path of knowledge diffusion and participating members are different, and the level of knowledge creation is also distinct. Therefore, this paper divides the industry university research cooperation mode based on knowledge diffusion and knowledge creation. Granovetter first established the weak relationship theory. He pointed out that the embedding degree of economic subjects in the social network determines their strong and weak relationships in the network, and different strong and weak relationships lead to different roles of subjects in the network.⁵ Referring to Granovetter's division of embeddedness, this paper creatively puts forward the middle connection form between strong connection and weak connection. Therefore, according to the number of subjects and the strength of embedding type, the industry university research cooperation mode is divided into four types: Double Subject weak connection embedding mode, double subject medium connection embedding mode, double subject strong connection

embedding mode and multi-subject strong connection embedding mode.

The universities and research institutes in this study play an extremely similar role in knowledge creation and knowledge diffusion, so they are collectively referred to as university-research institutions. The double subject include university-research institutions and enterprises; The motivation of university-research institutions and enterprises to participate in industry university research cooperation determines whether the mode of industry university research cooperation adopts the embedded mode of strong connection, medium connection or weak connection. Changhong Yu called the industry university research cooperation mode sharing only explicit knowledge as loose cooperation mode, and the industry university research cooperation mode sharing tacit knowledge as close cooperation mode.² Therefore, based on the division method of this scholar, we regard the industry university research cooperation mode of creating and diffusing explicit knowledge in the form of indenture as a weak connection mode (technology transfer and entrusted Development); the industry university research cooperation mode of creating and diffusing tacit knowledge in the form of indenture as the medium connection mode (entrusted training); the industry university research cooperation mode of diffusing tacit knowledge and creating explicit knowledge in the form of equity cooperation as a strong connection mode (Technology development). Multi subjects include not only universities, scientific research institutes and enterprises, but also governments, intermediaries, financial and venture capital institutions. These subjects are collectively referred to as systematic environmental factors. The motivation of these system environments to participate in industry university research cooperation determines that industry university research cooperation is a

multi-agent participation model, some of them are in the form of contract and the rest are in the form of equity cooperation. The participation of this complex system environment is an essential factor in the diffusion of tacit knowledge from the diffusion source to potential users, and can promote the creation of explicit knowledge. Therefore, we regard it as a multi-agent strong connection embedding model (co construction entity, University Science Park, platform type).

KNOWLEDGE CREATION MECHANISM AND KNOWLEDGE DIFFUSION MECHANISM OF INDUSTRY UNIVERSITY RESEARCH BASED ON DUAL SUBJECT AND WEAK CONNECTION EMBEDDING MODEL

Knowledge Creation Mechanism of Industry University Research Based on Dual Subject and Weak Connection Embedding Model

The knowledge creation of dual subject and weak connection embedding model is produced within university-research institutions. Usually, there are two possibilities, one is pull type and the other is push type. Pull type refers to the process in which an enterprise finds market demand through market research and is unable or unwilling to develop new knowledge, then the enterprise will seek the ready-made knowledge of the university-research institutions, or entrust university-research institutions to research and develop on its behalf, and finally marketize the new knowledge; Push type is the process that university-research institutions have their own R&D ability, create new knowledge according to the experimental method, and then push it to the market. Whether it is push type or pull type, the knowledge created by the university-research institutions is explicit knowledge that is easy to spread, as shown in Figure 1. Byosiere also believes that weak connection is very important for the diffusion of explicit knowledge⁶. So, this mode is a knowledge creation mechanism, which is embodied in the explicit knowledge creation process driven by market demand and enterprise demand.

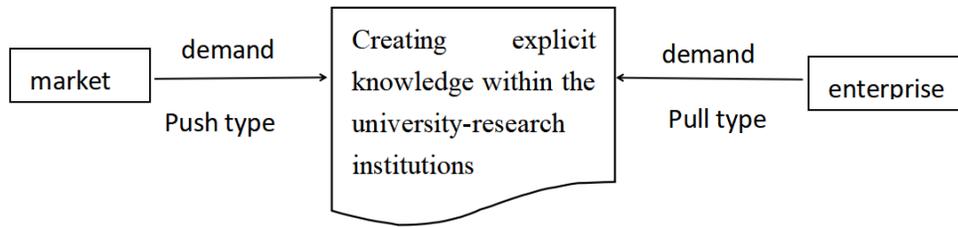


Figure 1 Knowledge creation process of industry university research based on dual subject and weak connection embedding model

This formal knowledge creation is that university-research institutions occupy a high central position and have more connections with other enterprises.⁷ This model builds a good channel for university-research institutions to obtain a large number of production and market information in enterprises.⁸ Then, university-research institutions make full use of their own human and intellectual resources and a good creative environment for scientific research to produce innovative explicit knowledge, that is, to realize knowledge creation. When the enterprise is lack of creativity, it will consider spending a certain amount of money to buy the knowledge created by the university-research institutions. The main purpose is to shorten the R&D time, save the R&D cost, shorten the technology gap, reduce the development risk, and obtain the competitive advantage. At the same time, enterprises should have strategies to cultivate their absorption and digestion ability, facilitate the better application of explicit knowledge in enterprises, and purposefully improve their internal creativity, so as to lay the foundation for their own knowledge creation. university-research institutions achieve the goal of industry university research cooperation by transferring technology and patents to enterprises.

Knowledge Diffusion Mechanism of Industry University Research Based on Dual Subject and Weak Connection Embedding Model

Due to the different background fields among the subjects, the industry university research based on dual subject and weak connection embedding model belongs to the diffusion of diversified knowledge among heterogeneous groups. Reagans believes that weak connections

can better act as non redundant knowledge across social boundaries than strong connections.⁹

Because in the industry university research cooperation, the weak connection between enterprises and university-research institutions makes the network members have a wide diversity.¹⁰ For example, enterprise has richer production experience and provides broader cutting-edge market information, and the university-research institutions has knowledge of different disciplines and is good at researching scientific research topics. Weak connection can make each subject have more time and energy to contact more cooperative subjects. This improves the breadth of interactive content between the two sides, can maintain the flexibility of dynamic evolution of cooperative relations, expand the scope of knowledge of industry university research cooperation and contact a variety of information, so as to stimulate the creative inspiration of scientific researchers, enrich the thinking and ideas of industry university research cooperation, and increase the flexibility of cooperative innovation organizations.¹¹ Rogers also proposed that heterogeneous networks are more likely to contain innovative new knowledge, and it has more advantages than homogeneous networks in knowledge diffusion.¹²

This mode is shown as a one-way knowledge flow, which is the diffusion from the explicit knowledge of the university-research institutions to the explicit knowledge of the enterprise, and then from the explicit knowledge of the enterprise to the tacit knowledge of the enterprise. Because university-research institutions develop technology, then they turn knowledge into explicit knowledge that is easy to spread, and transfer technology to enterprise, that is, the explicit knowledge of university-research institutions will become the explicit knowledge of enterprise; On the surface, the enterprise only buys

the explicit knowledge of the university-research institutions, but after the purchase, the enterprise must study and explore the hidden tacit knowledge. The application of explicit knowledge to the production process is not only the diffusion of explicit knowledge into the enterprise, becoming tacit knowledge in the minds of enterprise employees, but also the socialization of explicit knowledge. There are two ways of socialization: direct diffusion and indirect diffusion.¹³ direct diffusion is to directly transfer knowledge to enterprise members, and

indirect diffusion is to re edit knowledge that easy to understand and then transfer it to enterprise members.

Figure 2 shows the diffusion process from explicit knowledge to explicit knowledge and from explicit knowledge to tacit knowledge. The industry university research based on dual subject and weak connection embedding model is a traditional linear innovation model, that is, university-research institutions carry out basic theoretical research, while enterprise bring market-oriented experiments and commercial promotion into force.

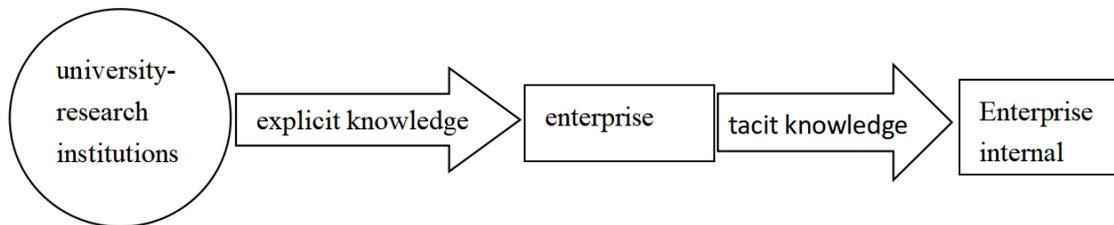


Figure 2 Knowledge diffusion process of industry university research based on dual subject and weak connection embedding model

Tobacco discipline has successively undertaken the tackling and development of major scientific research projects and horizontal joint projects of all provinces and countries, and achieved fruitful results. For example, Xie Jianping, a "tobacco academician", introduced Chinese herbal medicine, developed "Shennong extract", reduced the harmful components of smoke, and applied for the "science and Technology Award for Chinese cigarette application", which was widely adopted by the tobacco industry and achieved a good market effect. According to statistics, seven items of the tobacco industry have won the national science and Technology Progress Award in the past 10 years. In the past three years, it has achieved a cumulative new sales revenue of 173.574 billion yuan and a new profit and tax of 142.18043 billion yuan.

KNOWLEDGE CREATION MECHANISM AND KNOWLEDGE DIFFUSION MECHANISM OF INDUSTRY UNIVERSITY RESEARCH BASED ON DUAL SUBJECT AND MEDIUM CONNECTION EMBEDDING MODEL

Knowledge Creation Mechanism of Industry University Research Based on Dual Subject and Medium Connection Embedding Model

Lietal pointed out that in order to achieve fundamental innovation, partners involved in industry university research cooperation need to actively participate in the relevant organizational process of embedding tacit knowledge.¹⁴ The industry university research based on dual subject and medium connection embedding model is to send their members to each other's organization for learning and education according to the indenture, so as to improve their own knowledge reserve and practical ability. In this mode, the knowledge creation mechanism is reflected in the process of knowledge transfer by the face-to-face training and the formation of tacit knowledge. At the same time, enterprise can also realize the transmission of knowledge by lead students to practice. on this account, the knowledge is

transmitted to the university-research institutions in the informal form of hand-in-hand guidance,

and the university-research institutions forms its own tacit knowledge, as shown in Figure 3.

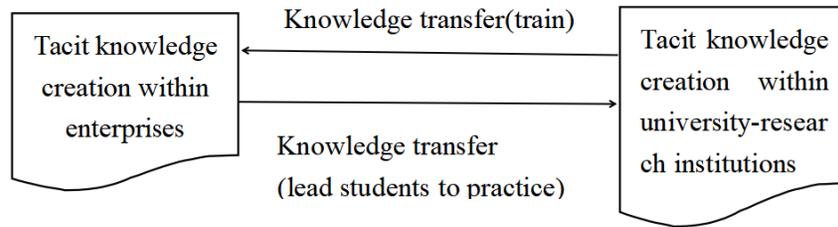


Figure 3 Knowledge creation process of industry university research based on dual subject and medium connection embedding model

Knowledge Diffusion Mechanism of Industry University Research Based on Dual Subject and Medium Connection Embedding Model

Practical research shows that the subtle forms such as master apprentice relationship, personnel flow and on-the-job training can more effectively promote the diffusion of tacit knowledge. In particular, informal communication is the preferred and important way of knowledge transfer and diffusion for most individuals.¹⁵Zenghui Yue also proposed a two-way knowledge diffusion model, which holds that when high knowledge individuals exchange knowledge with low knowledge individuals, they will get knowledge strengthening, and when low knowledge individuals exchange knowledge with high knowledge individuals, they will get knowledge enrichment, that is, obtain new knowledge.¹⁶

The performance of this model in knowledge diffusion is the diffusion process of tacit

knowledge from university-research institutions to enterprise, or the diffusion process of tacit knowledge from enterprise to university-research institutions. It is a one-way knowledge flow in two directions. On the one hand, in order to improve the basic theoretical knowledge and professional quality of employees, and even to obtain degrees, enterprise will send employees to universities for training and learning for a certain period of time, which is the process of tacit knowledge flow from universities to enterprise; On the other hand, in order to improve students' social practice ability, the school will add enterprise training links to the talent training plan, and relevant personnel of the enterprise will act as training teachers to guide students to practice. Some will also train students in the form of "order form", which is the process of the flow of tacit knowledge from enterprise to university. It is shown in Figure 4, that is, the diffusion of tacit knowledge to tacit knowledge

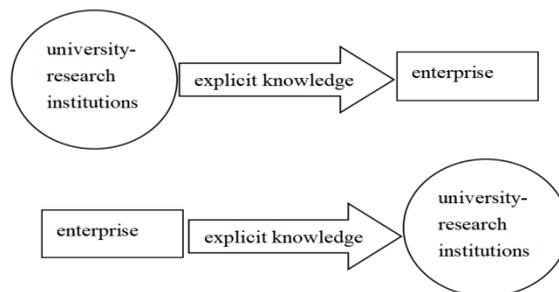


Figure 4 Knowledge diffusion process of industry university research based on dual subject and medium connection embedding model

The tobacco major of Henan Agricultural University has trained more than 500 practical talents and correspondence students for personnel in the tobacco industry. These enterprise personnel trained by colleges and universities

have performed well in their work, and many of them have taken important leadership positions or become the technical backbone of the industry.¹⁷ Zhengzhou oli Industrial Co., Ltd. has made outstanding achievements in transforming scientific research achievements into productivity.

While realizing its own development, the company takes out hundreds of thousands of yuan of funds to feed back teaching and scientific research every year. As the internship base of tobacco engineering specialty of Zhengzhou Institute of light industry, the company accepts a large number of students of this specialty to engage in scientific research, graduation thesis, production practice and other activities every year, making outstanding contributions to further strengthening the practical teaching link of this specialty.¹⁸ Some students of the tobacco class of Guangxi Agricultural Vocational and technical college went to tobacco company in Nandan county for comprehensive internship. It was the first year of the company to use the intensive curing house for tobacco curing. They were arranged to carry out the tobacco curing test in the intensive curing house day and night together with the technicians of the tobacco production unit of the company. After several heats of tobacco curing practice, Basically mastered the technology suitable for the curing of Nandan tobacco intensive curing barn, and was able to undertake the skill training for the curing personnel of relevant tobacco stations in the intensive curing barn, increasing the stock of their own tacit knowledge.¹⁹

MECHANISM OF INDUSTRY UNIVERSITY RESEARCH BASED ON DUAL SUBJECT AND STRONG CONNECTION EMBEDDING MODEL

Knowledge Creation Mechanism of Industry University Research Based on Dual Subject and Strong Connection Embedding Model

The dual subject strong connection embedding mode is that university-research institutions and enterprise jointly negotiate the investment proportion and modality (including venue, personnel and management form). The more common technology incubator management institutions include university science and technology parks established by universities themselves, technology research centers and cooperative research institutes funded by national government departments at all levels, etc, And special scientific and technological R&D institutions jointly established by universities and enterprises. In this mode, the knowledge creation mechanism is embodied in the knowledge creation platform created by the university-research institutions and enterprises to create explicit knowledge. The two sides convey tacit knowledge to the platform respectively, and the process of tacit knowledge is finally created by the integration of the two sides, as shown in Figure 5.

KNOWLEDGE CREATION MECHANISM AND KNOWLEDGE DIFFUSION

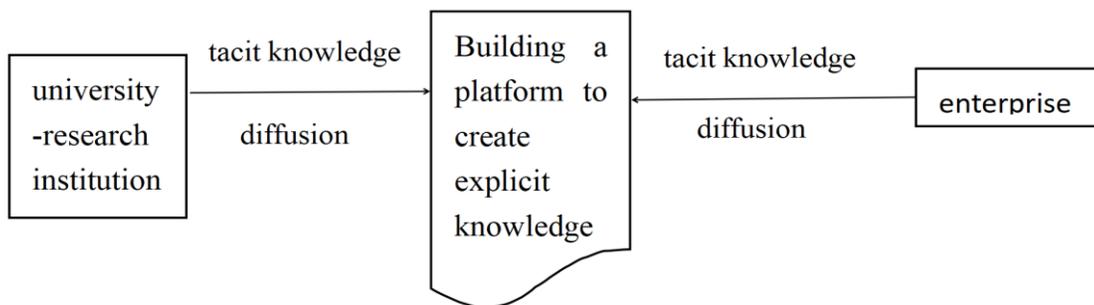


Figure 5 Knowledge creation process of industry university research based on dual subject and strong connection embedding model

Knowledge Diffusion Mechanism of Industry University Research Based on Dual Subject and Strong Connection Embedding Model

The industry university research based on dual subject and strong connection embedding model is that both sides jointly develop new

knowledge to meet the needs of the market. The two sides will cooperate together in agreed places, give play to their respective advantages, jointly apply for patents, publish academic papers and tackle key scientific research topics. However, due to the high embeddedness of tacit knowledge, it exists in the

ideas of professionals, such as the design inspiration and production experience of technicians. It can be understood by each other only through multiple interactions, which means that tacit knowledge must be transmitted with the help of strong relationships. Therefore, the strong relationship of industry university research cooperation is an important channel for the flow of tacit knowledge.²⁰The strong relationship determines the stronger willingness of both parties to cooperate with each other. At the same time, it also facilitates the information searchers to understand and learn new knowledge more quickly, and form a shared attitude and common belief, which will promote the in-depth communication of knowledge among the cooperation subjects. Because strong connection is better than weak connection to establish a common understanding of knowledge coding and decoding among project participants, it can continuously deepen the understanding and trust of both parties, and the

uncertain factors in the process of knowledge diffusion will be reduced.

The performance of this model in knowledge diffusion is that tacit knowledge flows out from both sides to form explicit knowledge, and then the explicit knowledge spreads to both sides to form tacit knowledge. It is a two-way knowledge flow. Because the university-research institutions and enterprises jointly establish a platform for exchange and cooperation. On this platform, both sides send technical experts and scholars to form innovative technologies through ideological collision and knowledge exchange. The process and results of new technology development play a positive role in promoting the knowledge storage of personnel of university-research institutions and enterprises, and form the tacit knowledge of technical experts and scholars, It provides a basis for the development of the next new technology. It is shown in Figure 6, that is, the diffusion of tacit knowledge to explicit knowledge.

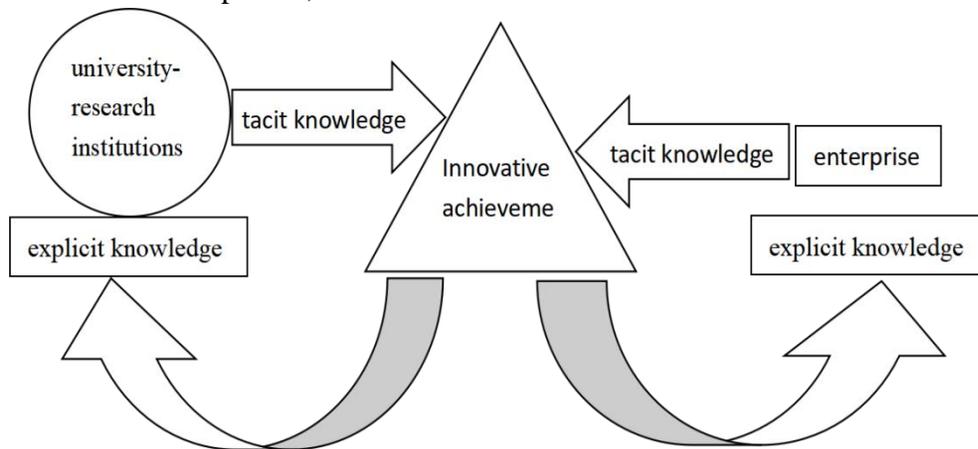


Figure 6 Knowledge diffusion process of industry university research based on dual subject and strong connection embedding model

This strong connection embedding model is a nonlinear innovation model developed on the basis of the traditional linear innovation model. It desalinates the linear innovation process, and each subject of industry, University and research carries out knowledge diffusion with the help of various platforms. When in a strong relationship, industry university research members can strengthen Inter Organizational Trust and long-term cooperation vision, reduce opportunistic threats, and be relatively united, trust

each other and mutually beneficial.²¹

Jinan tobacco has established a stable and efficient partnership with scientific research institutions such as Shandong University, Shandong University of Finance and economics, School of management of BeiJing University and Shandong Tobacco Research Institute, in order to solve the problem of imperfect construction of innovation platform.²² Zhengzhou University of Light Industry and Beijing cigarette factory, Nanjing cigarette factory, Shenzhen cigarette factory and other enterprises or enterprise groups signed a number of joint research projects, then

Xuchang imperial group and Dongsheng Group set up a research base in Zhengzhou University of Light Industry, the two sides in tobacco flavors and fragrances and improve the quality of cigarette products research cooperation. Zhengzhou Institute of light industry has signed a comprehensive cooperation agreement with Zhengzhou Tobacco Research Institute and Yunnan Hongta Group, agreeing that the two sides will conduct comprehensive cooperation in the fields of talent training, scientific research and joint training of master of Engineering in tobacco engineering to realize resource sharing.¹⁸ Guangdong China tobacco, together with Huabao international and Zhongshan University, has jointly built laboratories in the field of reconstituted tobacco leaves and tobacco chemistry to jointly carry out forward-looking research and development of new technologies, new topics and new applications, and strive to build a technological innovation system with enterprises as the main body and close integration of industry, University and research. Drexel University's Dornsife School of Public Health and Philadelphia Department of Public Health work together to evaluate PDPH projects and activities to reduce hazards and tobacco use. The survey results show that multisectoral partnerships should be established among universities, real estate and public health professionals.²³

KNOWLEDGE CREATION MECHANISM AND KNOWLEDGE DIFFUSION MECHANISM OF INDUSTRY UNIVERSITY RESEARCH BASED ON MULTI-SUBJECT AND STRONG CONNECTION EMBEDDING MODEL

Knowledge Creation Mechanism of Industry University Research Based on Multi-Subject and Strong Connection Embedding Model

Carayannis proposed that in knowledge creation, social stakeholders also build knowledge creation networks as innovation actors, that is, any organization can carry out basic research, bring interactive and nonlinear innovation into force, and weaken the absolute division among innovation subjects.²⁴ In the process of combining industry, University and research, the government creates a good institutional environment for the diffusion of technological innovation through reasonable institutional arrangements; In the process of technological innovation diffusion, science and technology intermediary organizations realize the continuous value-added of technology and improve the success rate of transfer by effectively connecting the transfer behavior of different actors such as universities, scientific research institutes, enterprises and governments; Financial institutions can provide effective capital supply for university technology transfer and realize the organic combination between different subjects; Venture capital institutions solve the bottleneck problem of lack of funds for the actors of technology transfer, and appropriately avoid the investment risk.

Multi subjects include not only universities, scientific research institutes and enterprises, but also governments, intermediaries, financial and venture capital institutions. In this mode, the knowledge creation mechanism is embodied in the platform of these subjects, and the tacit knowledge is conveyed to the platform by the subjects of industry university research cooperation. At the same time, the government and other cooperative environments convey explicit knowledge and tacit knowledge to the platform from various motives, as shown in Figure 7.

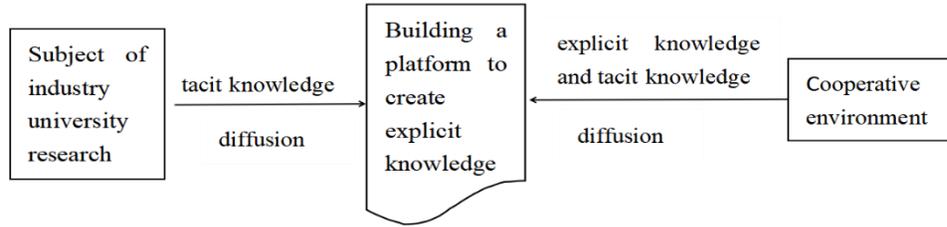


Figure 7 Knowledge creation process of industry university research based on multi-subject and strong connection embedding model

Knowledge Diffusion Mechanism of Industry University Research Based on Multi-Subject and Strong Connection Embedding Model

In addition to the main subjects of industry university research, the government, intermediaries, financial and venture capital institutions provide environmental factors for industry university research cooperation in terms of policy guidance, structural hole connection and capital guarantee. These environmental factors play an indispensable role on this platform. From the perspective of knowledge diffusion, it is mainly reflected in that while they cooperate with all parties of industry university research, they will spread policy, information and financial explicit knowledge and tacit knowledge to all subjects of industry university research cooperation. These subjects will obtain more diversified knowledge on this platform, the heterogeneity

of these knowledge is higher, and it is easier to create new knowledge through knowledge integration, as shown in Figure 8.

The motivation of knowledge diffusion in the industry university research cooperation consists of internal motivation and external motivation. The internal motivation is generated by the knowledge potential difference among the participants of the industry university research cooperation; the external motivation comes from the knowledge innovation environment of the industry university research cooperation, that is, various support environments such as policy environment, financial financing environment and intermediary environment. The motivation of multi-subject and strong connection cooperation mainly comes from the outside, and the supporting environment such as policy environment, financial financing environment and intermediary environment plays a major role.

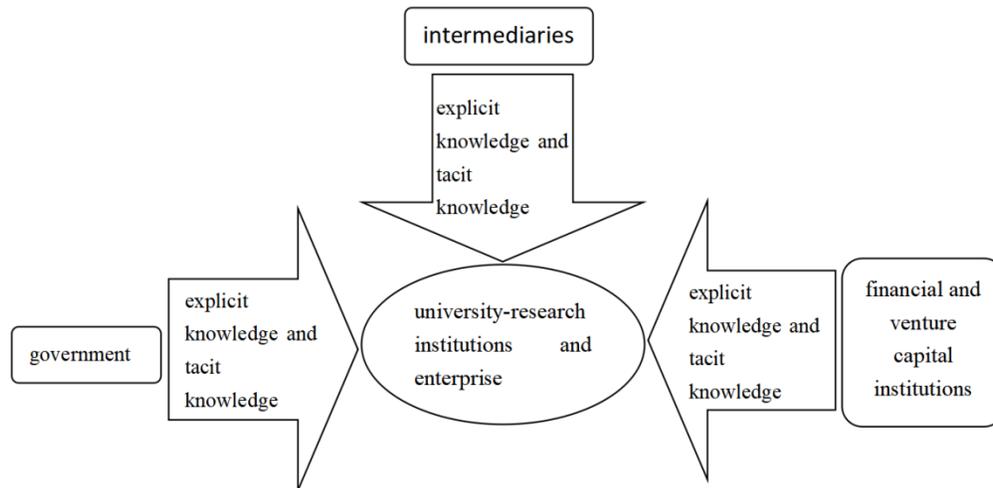


Figure 8 Knowledge diffusion process of industry university research based on multi-subject and strong connection embedding model

The US Food and Drug Administration’s (FDA) Center for Tobacco Products (CTP) funds a wide range of research studies.²⁵ Moreover, because the

tobacco discipline has made great contributions to talent training and scientific research in the construction process of the close combination of

industry, University and research in China, the State Tobacco Monopoly Bureau has established the "national physiological and biochemical research base of tobacco cultivation" on the basis of tobacco discipline. At present, most of the major scientific research projects undertaken by the base are directly assigned by the State Tobacco Monopoly Bureau as a task. In this process, the government has assumed an important leading role in knowledge diffusion and creation.¹⁷ In addition, the government also has various policies that have affected the development of the tobacco industry, such as strengthening tobacco control in public places, raising tobacco taxes, strengthening the control of new tobacco and flavored tobacco products, etc.²⁶

"Industry university research financial agency" is a multi-agent cooperation model developed after industry university research. However, China Tobacco mainly uses its own funds for financing, and rarely uses the financing of financial institutions for project construction. Moreover, compared with the relatively perfect science and technology intermediary service system in developed countries in the world, the utilization rate of China's tobacco intermediary service system is low.

THE RELATIONSHIP BETWEEN KNOWLEDGE CREATION AND KNOWLEDGE DIFFUSION UNDER THE MODE OF INDUSTRY UNIVERSITY RESEARCH COOPERATION

From the perspective of industry university research cooperation, knowledge creation is a

process in which each subject of industry university research uses their own field of knowledge to integrate knowledge and then create new knowledge through the collision of homogeneous and heterogeneous knowledge inside or outside the organization. Knowledge diffusion is considered to be the process of knowledge sharing among several individuals. Through the path of knowledge diffusion, individuals not only improve the level of their own knowledge exchange, but also guide the development direction of individual knowledge innovation.²⁷ Heping Xu also believes that the process of knowledge diffusion is a kind of "learning" activity, that is, the activity of obtaining the application of knowledge through purposeful and active learning or integrating the learned knowledge with existing knowledge to develop new knowledge.²⁸ Knowledge diffusion is the diffusion process of knowledge from the sender to the receiver. After receiving new knowledge, the receiver integrates it with its own knowledge to form new knowledge. The created new knowledge is diffused from the sender to the knowledge demander. Therefore, so knowledge is a "double helix" rising process in a loop, as shown in Figure 9. Therefore, knowledge creation, as an antecedent variable, is a process in which knowledge is created into new knowledge and then transmitted to the demand side through knowledge diffusion; As an antecedent variable, knowledge diffusion shows that after knowledge diffusion to the demander, the demander integrates its own knowledge with the externally absorbed knowledge to form a knowledge creation process of new knowledge.

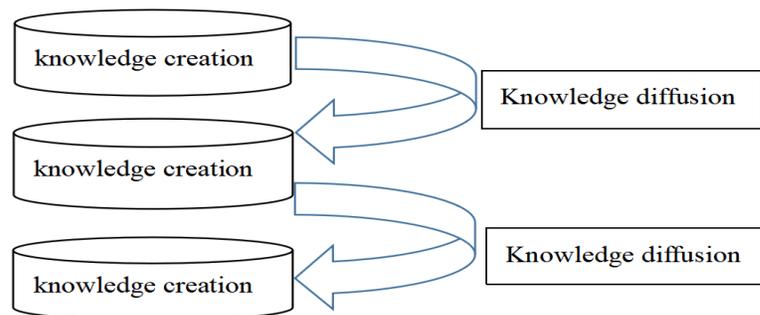


Figure 9 The "double helix" rising process of knowledge creation and knowledge diffusion

Different modes of industry university research cooperation will create different explicit knowledge and tacit knowledge. Similarly, there will be the diffusion of explicit knowledge and tacit knowledge among cooperative organizations. Every knowledge diffusion provides conditions for the creation of new knowledge, and knowledge creation also provides knowledge resources for knowledge diffusion. In order to improve the creation and diffusion of different types of knowledge, we need to choose different industry university research cooperation modes and use different industry university research cooperation mechanisms.

CONCLUSIONS AND RECOMMENDATIONS

"Tacit Knowledge Diffusion" in the Dual Subject and Weak Connection Embedding Model Helps "Explicit Knowledge Creation"

For university-research institutions, this model should absorb more tacit knowledge from the tobacco market and tobacco enterprises, that is, pay attention to the types of knowledge most needed in the market, identify the information most concerned by enterprises and capable of marketization, and finally form their own explicit knowledge creation; For tobacco enterprises, We should pay attention to the learning absorption mechanism of diffusing the explicit knowledge purchased by the researchers into tacit knowledge.

"Tacit Knowledge Diffusion" in the Dual Subject and Medium Connection Embedding Model Helps "Tacit Knowledge Creation"

For tobacco enterprises, tobacco research institutes and universities with tobacco majors, various communication channels should be established to facilitate the diffusion of tacit knowledge that is difficult to express in their minds to each other, increase the number of communication and form a long-term communication mechanism, so that the other party can create tacit knowledge that is easy to understand in their minds and help increase the total amount of knowledge of all parties.

"Tacit Knowledge Diffusion" in the Dual Subject and Strong Connection Embedding Model Helps "Explicit Knowledge and Tacit Knowledge Creation"

This mode should make full use of the cooperation platform for all parties of industry, University and research. The communication, exchange and cooperation on the platform are conducive to the creation of explicit knowledge and easier to create new technologies required by the tobacco industry. This formal communication is accompanied by the collision of ideas, and the tacit knowledge of collaborators has been further improved, which will produce more tobacco experts.

"Explicit Knowledge and Tacit Knowledge Diffusion" in the Multi-Subject and Strong Connection Embedding Model Helps "Explicit Knowledge and Tacit Knowledge Creation"

For the cooperative environment parties such as the government, this model should fully spread the explicit knowledge such as policies to the parties of industry, University and research, and provide them with various ideological and methodological support, and establish a perfect financial and intermediary service system to help the parties of industry, University and research create explicit knowledge; For industry university research parties, we should make full use of the cooperation platform for communication and cooperation, pay more attention to all kinds of explicit and tacit knowledge provided by the cooperation environment, and quickly form the creation of explicit and implicit knowledge.

Taking the tobacco industry as an example, this study obtains some suggestions to improve the knowledge creation level of different industry university research cooperation modes by studying the knowledge creation mechanism and knowledge diffusion mechanism of industry university research cooperation modes. However, due to the limited space, only the SECI conceptual model is used to study the mechanism of knowledge creation. Future research can take the knowledge diffusion model as the entry point for in-depth research.

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References

1. Zhao JB. Economic performance research, model and mechanism analysis of domestic university research cooperation in China. JiLin: Jilin University, 2012.
2. Yu C. Research on the choice of industry university research cooperative innovation mode based on enterprise technical capability. Dalian University of Technology, 2019.
3. Liu S. Research on the mode of industry university research cooperation in American research universities and Its Enlightenment to China. HuNan: Hunan Normal University, 2017.
4. Wang WY, Sun FQ, Shen Q. Classification, characteristics and selection of industry university research cooperation mode. China Science and Technology Forum, 2008, (05):37-40.
5. Granovetter M. Economic action and social structure: The problem of embeddedness. American journal of sociology, 1985, 91(3):481-510.
doi:<https://doi.org/10.1086/228311>
6. Byosiere P, Luethge DJ, Vas A, et al. Diffusion of organisational innovation: knowledge transfer through social networks. International Journal of Technology Management, 2010, 49(4):401-420.
doi:<https://doi.org/10.1504/IJTM.2010.030166>
7. Brass DJ. Being in the right place: A structural analysis of individual influence in an organization. Administrative science quarterly, 1984:518-539.
doi:<https://doi.org/10.2307/2392937>
8. Gnyawali DR, Madhavan R. Cooperative networks and competitive dynamics: A structural embeddedness perspective. Academy of Management review, 2001, 26(3):431-445.
doi:<https://doi.org/10.5465/amr.2001.4845820>
9. Reagans R, McEvily B. Network structure and knowledge

transfer: The effects of cohesion and range. Administrative science quarterly, 2003, 48(2):240-267.

doi:<https://doi.org/10.2307/3556658>

10. Rhee M. Network updating and exploratory learning environment. Journal of management studies, 2004, 41(6):933-949.

doi:<https://doi.org/10.1111/j.1467-6486.2004.00461.x>

11. Kraatz MS. Learning by association? Interorganizational networks and adaptation to environmental change. Academy of management journal, 1998, 41(6):621-643.

doi:<https://doi.org/10.5465/256961>

12. Rogers EM. Diffusion of innovation. New York: Free Press, 1995.

13. Wang JR, Pan JY. Research on knowledge diffusion in industry university research cooperation. China Science and Technology Forum, 2003, (04):74-76.

14. Li Y, Liu Y, Li M, et al. Transformational offshore outsourcing: Empirical evidence from alliances in China. Journal of Operations Management, 2008, 26(2):257-274.

15. Wu YH. Research on Influencing Factors of knowledge transfer at individual level in organization. Zhejiang University, 2004.

16. Yue ZH, Xu HY, Fang S. Research on knowledge diffusion modeling of scientific research cooperation network based on individual behavior. Journal of information, 2015, 34(08):819-832.

17. Wang YF, Liu HS, Shi XD, Xu ZC. Combine production, study and research to promote the leapfrog development of tobacco teaching and scientific research. Higher agricultural education, 2005, (03):63-66.

18. Huang DY. Expressing affection for tobacco and making industry advantages more prominent -- a documentary on the work of industry, University and research of Zhengzhou Light Industry Institute. Henan Education (College Edition), 2006, (09):52-53.

19. He YF, Jian F, Qun Q. Practice and Reflection on the talent training mode of industry university research cooperation in tobacco specialty. Technology and Industry, 2008, (11):68-72.

20. Simsek Z, Lubatkin MH, Floyd SW. Inter-firm networks and entrepreneurial behavior: A structural embeddedness perspective. Journal of Management, 2003, 29(3):427-442.

doi:https://doi.org/10.1016/S0149-2063_03_00018-7

21. Lavie D. Alliance portfolios and firm performance: A study of value creation and appropriation in the US software industry. Strategic management journal, 2007, 28(12):1187-1212.

doi:<https://doi.org/10.1002/smj.637>

22. Yuan JK, Gao ZC, Hang J. Construction of all-round innovation system of tobacco monopoly enterprises -- Exploration Based on enterprise standardization and the construction of industry university research platform. Economic Herald, 2013, (Z3):86-87.

23. Klassen Ann C, Lee Nora, Lopez Jessica P, B Chloe, C Ryan, T Muna, Realtors as Partners in Tobacco Control: Results from a Pennsylvania Survey. Tobacco Regulatory Science, 2020, 6(6):392-404(13).

doi:<https://doi.org/10.18001/TRS.6.6.3>

Zhang Hongyan et al.

Research on Knowledge Creation and Knowledge Diffusion Mechanism of Industry University Research Cooperation Model

— Take the Tobacco Industry as an Example

24. Carayannis EG, Campbell DFJ. Open innovation diplomacy and a 21st century fractal research, education and innovation (FREIE) ecosystem: building on the quadruple and quintuple helix innovation concepts and the “mode 3” knowledge production system. *Journal of the Knowledge Economy*, 2011, 2(3):327-372.

doi:<https://doi.org/10.1007/s13132-011-0058-3>

25. Price S, Chansky MC, Meissner HI, et al. Methods Development and Modeling Research: Contributions to Advancing TRS and Informing Regulations. *Tobacco Regulatory Science*, 2020, 6(6):436-439.

doi:[info:doi/10.18001/TRS.6.6.7](https://doi.org/10.18001/TRS.6.6.7)

26. Heng BQ. 2020 world tobacco development report (Part I). *Oriental Tobacco news*, 2021-06-03, (003).

27. Huang XJ. Knowledge diffusion performance of information journal hierarchical organization and its optimization strategy. *Scientific research*, 2011, 29(03):413-419.

28. Xu HP, Sun LY, Mu JF. Research on knowledge diffusion mechanism in Virtual Enterprise. *Science of science and management of science and technology*, 2002, (11):45-48.