

Knowledge Innovation Theory Research in China: A Review and Outlook (Postprint)

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Abstract

[Purpose / Significance] To provide readers with a relatively comprehensive understanding of domestic knowledge innovation theory research, while simultaneously offering reference ideas for subsequent research in related fields. [Method / Process] Primarily through the method of literature review, to systematically organize the research achievements of domestic knowledge innovation theory. [Results / Conclusions] Summarizes that China's knowledge innovation theory research mainly includes aspects such as evaluation and modification of the SECI model, organizational learning, knowledge innovation under the new economy, knowledge innovation incentives and evaluation, and knowledge innovation under openness. Potential development directions in the field of knowledge innovation include: evaluation and modification of the SECI model, the impact of organizational structural changes on organizational learning and knowledge innovation, knowledge innovation under the new economy, and the incentive and evaluation mechanisms for knowledge innovation.

Full Text

Review and Prospect of Knowledge Innovation Theory Research in China

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Abstract

[Purpose/Significance] This paper aims to provide readers with a more comprehensive understanding of domestic knowledge innovation theory research while offering reference ideas for subsequent studies in related fields. [Method/Process] Through literature review, this study systematically examines domestic research achievements in knowledge innovation theory.

[Result/Conclusion] The research summarizes that domestic knowledge innovation theory studies primarily focus on the evaluation and revision of the SECI model, organizational learning, knowledge innovation under the new economy, knowledge innovation incentives and evaluation, and knowledge innovation under open innovation. Potential development directions in the field include: evaluation and revision of the SECI model, the impact of organizational structural changes on organizational learning and knowledge innovation, knowledge innovation under the new economy, and knowledge innovation incentive and evaluation mechanisms.

Keywords: knowledge innovation; SECI model; organizational learning; incentive evaluation

1 Introduction

Knowledge innovation serves as an inexhaustible driving force and source for human civilization development, social progress, and economic prosperity. In a sense, human development is propelled by the accumulation and innovation of knowledge. Following the Industrial Revolution and the large-scale development of enterprises, scholars gradually recognized the importance of knowledge and conducted a series of studies. The proposal of Ikujiro Nonaka's knowledge spiral model (the SECI model) [1-3] marked new developments in knowledge innovation research within the knowledge economy environment, with subsequent studies in this field largely originating from this model. Although Chinese scholars started relatively late in this domain, their research has begun to take shape, particularly in the extended application of the SECI model.

Over the 30-plus years of reform and opening up, China's comprehensive national strength and economic level have undergone earth-shaking improvements. The development of productive forces, rapid increases in production efficiency, and the introduction of high technology and advanced management concepts have all greatly promoted national economic development and enriched social knowledge. Today, amid deepening globalization, we must innovate and dynamically apply knowledge on the basis of learning from others. Currently, reform has entered deep waters, and reform dividends are gradually disappearing. China faces the awkward situation where high-end industries are occupied by developed countries while low-end manufacturing is being seized by late-developing nations. Only through its own economic transformation can China escape this predicament and avoid falling into the "middle-income trap." The transformation and upgrading of various industries depend on continuous innovation and creation of industrial knowledge to form new productive forces and production relations. To address this issue, this paper reviews domestic research on knowledge innovation theory to provide reference and guidance for practice during China's economic transformation period.

2.1 Classification of Knowledge

“Knowledge” is a crucial concept in the field of philosophical epistemology, yet what constitutes knowledge remains a question that troubles thinkers worldwide, with no convincing answer to date. From the perspective of knowledge innovation theory, there are two primary classifications: one divides knowledge into explicit and tacit knowledge, while the other distinguishes between individual and common knowledge.

(1) Explicit and Tacit Knowledge: Philosophers such as Plato, Descartes, and Polanyi believe that knowledge can be divided into explicit and tacit knowledge. Explicit knowledge refers to knowledge that can be fully articulated through certain coding systems, whereas tacit knowledge cannot be expressed through such systems, including intuition, experience, and premonitions. The Chinese saying “can only be understood but not expressed in words” describes tacit knowledge.

(2) Individual and Common Knowledge: Ellie [4] argues that knowledge can be categorized as individual or common based on whether the knowledge carrier is an individual or a group. Common knowledge can be greater or less than individual knowledge, depending on the mechanism by which individual knowledge is converted into common knowledge. Generally, three characteristic indicators are used to analyze knowledge: *Tacitness*—the degree to which knowledge is codified; *Context specificity*—the degree to which knowledge depends on its environment; and *Dispersion*—the number of people in whom knowledge resides [5].

Although these two classifications approach knowledge from different angles, they are essentially the same in nature regarding the three characteristic indicators. Individual and tacit knowledge are prominent in terms of tacitness and context specificity but weak in dispersion, while common and explicit knowledge show the opposite pattern. In a sense, individual knowledge can be considered a form of tacit knowledge, while common knowledge can be viewed as explicit knowledge.

2.2 Concept and Characteristics of Knowledge Innovation

American scholar Amidon proposed in 1913 that knowledge innovation is the creation, evolution, exchange, and application of new ideas to provide marketable products and services for enterprises, national economies, and society [6]. This definition was termed “broad knowledge innovation” by Li Peipei and Zhong Haoqin [7], while the narrow view holds that knowledge innovation refers to the process of obtaining and creating new knowledge through scientific research. From a philosophical perspective, Nonaka introduced philosophers’ knowledge classification methods into organizational knowledge creation theory, viewing knowledge innovation as an infinite spiral cycle process from tacit knowledge to

explicit knowledge [1].

Obviously, Nonaka's understanding of knowledge innovation falls within a relatively narrow category and emphasizes tacit knowledge. Domestic scholars have conducted considerable research and revision on this, which will be discussed below. Building upon a deep understanding of the knowledge innovation concept and combining it with the characteristics of the knowledge economy era, Li Zhengfeng and Ye Jinfu [8] studied the features of knowledge innovation in the new era, proposing that knowledge innovation should possess four characteristics: The knowledge innovation process is a systematic network rather than a linear process; Knowledge innovation fully embodies cooperative interests rather than competitive interests; Knowledge innovation is market-oriented, with knowledge innovation achievements aiming to achieve market value; and

Knowledge innovation involves large investment, high risk, and long research cycles. These characteristics reflect the complexity and difficulty of knowledge innovation activities in the new era while also demonstrating the important position of knowledge innovation in this era.

2.3 Knowledge Innovation Model—The SECI Model

As a pioneer in knowledge management and the father of knowledge creation theory, Ikujiro Nonaka's contribution to knowledge innovation theory is foundational. Nonaka systematically studied the experiences of Japanese manufacturing enterprises in achieving global leadership, distinguishing between corporate explicit and tacit knowledge and arguing that tacit knowledge primarily functions within enterprises [1-3]. In 1991, Nonaka published "The Knowledge Creating Company" in *Harvard Business Review*, proposing the knowledge spiral creation process. In 1995, he formally introduced the SECI model in "On the Active Process of Knowledge Creation," comprehensively discussing the knowledge field—"Ba"—and the result and support of knowledge innovation—knowledge assets. The transformation model is shown in Figure 1 [Figure 1: see original paper].

The SECI model proposed by Nonaka is undoubtedly the cornerstone of knowledge innovation and knowledge management theory systems. After studying this model, numerous scholars have questioned and further revised it while fully affirming its theoretical value.

- (1) **Socialization (also called groupization) process**—from tacit knowledge to tacit knowledge: Acquiring others' tacit knowledge through shared experiences and making it one's own, such as in master-apprentice relationships.
- (2) **Externalization process**—from tacit knowledge to explicit knowledge: Expressing tacit knowledge through writing or storing it on computers.
- (3) **Combination (also called synthesis) process**—from explicit knowledge to explicit knowledge: Connecting and transforming team explicit knowledge

created in the externalization process into organizational explicit knowledge.

(4) Internalization process—from explicit knowledge to tacit knowledge: Individuals digesting and absorbing explicit knowledge obtained from various media channels and converting it into personal tacit knowledge.

Additionally, Nonaka proposed four types of “Ba” for these processes, which Yu Liming called “knowledge fields” [10]. These four “Ba” are: originating Ba, dialoguing Ba, exercising Ba, and systematizing Ba. The socialization process requires originating Ba; externalization needs the role of dialoguing Ba; combination requires support from system Ba; and internalization requires practice Ba.

3 Domestic Scholars’ Research on Knowledge Innovation

Domestic research on knowledge innovation began almost after the turn of the century. Statistics on the number of papers retrieved from CNKI (China National Knowledge Infrastructure) using “knowledge innovation” as a keyword show that Chinese scholars have maintained high enthusiasm for knowledge innovation research. Since the first academic paper with “knowledge innovation” as a keyword was published in 1997, specific statistics are shown in Figure 2 [Figure 2: see original paper]. Over the 15-year period from 2000 to 2014, there has generally been high and stable enthusiasm for knowledge innovation research, particularly with relatively more publications from 2006 to 2010. This period coincided with the “Eleventh Five-Year Plan,” which emphasized industrial technology progress strategy, institutional innovation strategy, and human resource priority development strategy, focusing on improving the quality and efficiency of economic growth. The prominent position of industrial technology progress strategy reflected national requirements and expectations for enterprise independent innovation, bringing opportunities for knowledge innovation development.

3.1 Evaluation and Revision of the SECI Model

Rao Yong [11] was the first to conduct a relatively comprehensive and in-depth review of Nonaka’s SECI model and the Ba concept, summarizing three theoretical values and three defects of the SECI model, as shown in Table 1 .

Subsequently, Rui Mingjie et al. [12] conducted further analysis on this evaluation, affirming the first two theoretical values mentioned by Rao Yong but offering different perspectives on the third theoretical value and the first two defects proposed by Rao Yong. On this basis, they reorganized the theoretical values and main defects of Nonaka’s SECI model, as shown in Table 2 .

After analyzing the theoretical values and defects of the SECI model, Rui Mingjie et al. borrowed Porter’s value chain concept and proposed a knowledge innovation model with a feedback mechanism based on the dynamic knowledge

value chain. By analyzing the knowledge value chain, they depicted the organizational knowledge innovation process, dividing knowledge innovation into several main stages: knowledge acquisition, knowledge fusion, knowledge creation, knowledge protection, and knowledge diffusion. Finally, based on Nonaka's three basic modules of the knowledge creation model—knowledge field, knowledge creation process, and knowledge assets—they established a new organizational knowledge innovation model, creating a new complete system for knowledge innovation models.

Building on Rui Mingjie et al.'s research, Xu Ruiping et al. [9] conducted further exploration and research, revising their proposed dynamic value chain knowledge innovation model. They argued that in the entire dynamic model of knowledge innovation, the three aspects of knowledge field, knowledge creation process, and knowledge assets would also undergo knowledge diffusion and transfer, rather than unidirectional diffusion and transfer from knowledge field to knowledge assets. This more completely embodies the enterprise knowledge innovation process.

Additionally, Geng Xin et al. [13] also evaluated and further revised the SECI model, proposing three theoretical values and two defects of the model (see Table 3), and put forward the IDE-SECI model.

From the above scholars' evaluation and revision of the SECI model, it can be seen that the theoretical value of Nonaka's SECI model has been fully affirmed, making a foundational contribution to subsequent research. However, there are slight differences in the understanding of its defects. It is precisely this diversified, multi-angle, and multi-level understanding of the model's defects that has enabled scholars to enrich and systematize the extension of the SECI model.

3.2 Organizational Learning and Knowledge Innovation

From the above research on the revision of the SECI model, it is found that knowledge transfer innovation and learning within and between organizations are inseparable. The concept of the learning organization is precisely based on this relationship. In fact, when Nonaka proposed the mutual transformation between tacit and explicit knowledge, it was also within the context of enterprise organizations [14].

Yuan Qiaoyun et al. [14] believe that organizational learning and knowledge innovation have a reciprocal causal relationship and cannot be separated. Organizational learning is the fundamental process in knowledge innovation, and innovative knowledge promotes further organizational learning. They extracted this relationship from numerous domestic and foreign scholars' research in related areas. Liu Xisong et al. [15], in their study of the self-organizing characteristics of knowledge innovation systems, believe that the spiral-driven process of knowledge innovation has certain self-organizing characteristics, which are mainly strengthened by learning and communication within and outside the

organization.

3.3 Knowledge Innovation Under the New Economy

The so-called “new economy” refers to a new economic phenomenon characterized by sustained economic growth coexisting with low inflation and low unemployment rates, built on the basis of information technology revolution and institutional innovation. It first appeared in a series of articles published in *Business Week* on December 30, 1996. Since joining the WTO, China’s information technology industry has developed rapidly, with a series of high-tech industrial parks being established successively. Economic development has brought new opportunities for the development of knowledge innovation theory. Knowledge innovation is a dynamic process, and its models and systems differ under different economic situations and backgrounds. Chinese scholars have conducted research in the following areas:

(1) Knowledge Innovation Under Industrial Clusters. Industrial clusters are spatial agglomerations of market entities concentrated in certain regions, closely connected through criss-crossing network relationships, representing a new spatial economic organization form between market and hierarchy. This organizational form is an inevitability and trend of modern economic development. Its formation promotes information exchange, knowledge sharing and dissemination, talent mobility, development of knowledge production institutions, and sharing of infrastructure—creating favorable environments and conditions for knowledge innovation [16].

Zhao Tao et al. [16] studied the knowledge innovation system under industrial clusters, analyzing the favorable conditions for knowledge innovation promoted by industrial clusters. They proposed an element analysis model for the innovation system framework and a knowledge innovation process analysis model under the industrial cluster environment, clarifying the influencing factors and innovation process of knowledge innovation in this context. From the perspective of knowledge innovation, clusters can promote knowledge innovation and diffusion, improve knowledge utilization efficiency, and achieve industrial and product innovation.

Li Zhengfeng et al. [8] used the GEM model to conduct an in-depth analysis of influencing factors on knowledge innovation capabilities within industrial clusters, discussing how basic elements, enterprise elements, and market elements promote knowledge innovation. This provides reference opinions for central and local governments in economic construction.

Knowledge innovation under industrial clusters emphasizes the sharing and exchange of explicit knowledge, forming dual economies of scale for both knowledge and economy. The sharing and exchange of explicit knowledge can stimulate the creation of individual tacit knowledge, thus forming a certain dynamic knowledge spiral process.

(2) Knowledge Innovation Under Low-Carbon Economy. The low-carbon economy is an important measure for China to achieve economic transformation and sustainable development. Knowledge innovation under the low-carbon economy refers to the continuous pursuit of new developments in low-carbon technology, exploration of new low-carbon economic evolution laws, creation of new low-carbon economic theories, development of new low-carbon economic research methods, and accumulation of new low-carbon economic knowledge through knowledge management based on the acquisition, processing, and sharing of low-carbon economy or related low-carbon technology knowledge. It also involves continuously applying knowledge to new fields to achieve re-innovation, thereby promoting low-carbon technology progress and sustained growth of the low-carbon economy. The knowledge innovation process is one of knowledge generation, transfer, and application. Categories of knowledge innovation under the low-carbon economy include research on knowledge innovation for low-carbon economic development, low-carbon technology innovation, low-carbon concept innovation, low-carbon institutional innovation, low-carbon management innovation, and low-carbon cultural innovation [17].

Wang Xiwei et al. [17] studied the knowledge innovation process under the low-carbon economy, systematically dividing the types of knowledge innovation under the low-carbon economy. Based on the SECI model, they proposed an internal SECI model and an external IIE-SECI model for the industrial technology chain system under the low-carbon economy. They also summarized the knowledge innovation structure of the industrial technology chain based on industrial clusters under the low-carbon economy, providing excellent ideas for clarifying the research on knowledge innovation processes and systems under the low-carbon economy.

S. Arvanitis et al. [18] analyzed the technology and knowledge transfer network activities between research institutions and enterprises in the industrial chain in Switzerland, proposing cooperation methods for technology and knowledge transfer between research institutions and private enterprises. J. Markard et al. [19] analyzed from a systems perspective the characteristics of the main technological innovation system, the composition of subjects in the technological innovation system, and activities in the technological innovation system in the Swiss natural gas industry under a low-carbon environment. Domestically, Yuan Deyu [20] was the first to propose from the perspective of technological process theory and morphology that implementing the strategy of revitalizing the country through science and technology should promote knowledge innovation and technological innovation centered on industrial technology. Hong Yong et al. [21] proposed that the realization of economic catch-up strategies in developing countries should rely on the coordinated development of industry and technology, especially the coordinated development of core industrial chains and core technology chains.

3.4 Research on Incentive Mechanisms and Evaluation of Knowledge Innovation

How to better promote knowledge innovation research and application in China is another major issue studied by Chinese scholars, mainly including two aspects: incentive research for basic knowledge innovation led by university research teams and incentive research for knowledge innovation based on enterprises.

(1) Incentives and Evaluation for Basic Research Knowledge Innovation. Basic research innovation is the most fundamental, original, and important innovation, and the role of universities in basic innovation within the national innovation system cannot be underestimated. University scientific research innovation teams are the mainstay of this original innovation system, mostly relying on key laboratories or engineering centers, focusing on major basic and applied research as the main research direction, and forming teams for the purpose of knowledge innovation [22]. Designing reasonable incentive mechanisms for these teams can effectively promote knowledge innovation in basic research. Zhao Limei et al. [23] established a model based on university research funding support and research management to deeply study effective incentive mechanisms for knowledge innovation among research team members. They examined the motivations of team members for knowledge innovation and argued that intrinsic motivation is the main factor promoting members' knowledge innovation. Finally, they proposed a knowledge innovation incentive mechanism combining "current funding and future rewards" to strengthen the intrinsic motivation for knowledge innovation. Wang Xiaohong et al. [24] studied the knowledge innovation process and characteristics of university interdisciplinary teams from dual perspectives of innovation units and innovation individuals, constructing a knowledge innovation model for interdisciplinary teams under the dual perspectives.

(2) Incentives and Evaluation for Enterprise Knowledge Innovation. Enterprise knowledge innovation incentives require effectively enhancing organizational knowledge innovation and forming dynamic competitive advantages for enterprises. Wu Bing et al. [25] conducted in-depth research on incentive mechanisms for collaborative knowledge innovation among enterprise members in supply chains. Based on game theory model analysis, they proposed incentive design strategies for collaborative knowledge innovation and put forward four basic prerequisites for supply chain members to achieve collaborative knowledge innovation. Li Wenhui [26] conducted evaluation research on enterprise knowledge innovation capabilities, constructing an evaluation index system for enterprise knowledge innovation capabilities from a knowledge management perspective, and used a fuzzy comprehensive evaluation model to comprehensively evaluate enterprise knowledge innovation capabilities. She also proposed six basic principles for constructing this index system: systematicness, operability, linkage, dynamism, representativeness, and effectiveness, aiming to provide references for future construction of enterprise knowledge innovation capability evaluation models.

3.5 Knowledge Innovation Research Under Open Innovation

The concept of open innovation was first proposed by H. Chesbrough in 2003. With the development of Internet technology, channels and methods for people to acquire and publish information have become increasingly flexible. Under these circumstances, how to sustainably maintain enterprise innovation vitality is another major area of knowledge innovation studied by many Chinese scholars in recent years. Under the open innovation model, knowledge innovation mainly occurs in the externalization and combination stages, that is, knowledge sharing. The research content mainly includes knowledge sharing strategies and risks.

(1) Knowledge Sharing Strategies. Under the open innovation system, how to effectively conduct knowledge sharing and identify key factors affecting knowledge sharing is the first problem that needs to be solved. Wu Ting et al. [27] studied knowledge sharing mechanisms under industry-university-research alliances, analyzing in detail the advantages of knowledge sharing under the open innovation model: reducing innovation costs, improving innovation efficiency, and dispersing innovation risks. They proposed a knowledge sharing process mechanism under industry-university-research alliances, analyzed the obstacles to knowledge sharing under such alliances, and proposed ways and mechanisms to improve knowledge sharing in industry-university-research alliances. Zhang Yongcheng et al. [28] studied knowledge sharing strategies from a network perspective, arguing that knowledge sharing in networks can be enhanced through the sharing incentives of focal enterprises, establishing a sharing atmosphere and relationships, and improving sharing techniques and methods. Regarding dynamic factors in knowledge sharing, Peng Zhenglong et al. [29] used dynamic theory to establish a dynamic factor model for inter-organizational knowledge resource sharing, analyzing three modes of knowledge sharing causality from internal enterprise to external environment, providing a solid theoretical foundation for subsequent researchers to identify key driving factors of knowledge sharing under the open innovation model.

(2) Knowledge Sharing Protection Mechanisms. Under open innovation, intellectual property protection for knowledge sharers is an important factor in maintaining knowledge sharing. Zhang Ruihong [30] systematically studied the knowledge sharing protection system under open innovation, proposing the overall model and operation mode of the knowledge protection system under open innovation, providing good theoretical support for research on knowledge sharing protection under the open innovation model. Liu Zhengchi et al. [31] conducted in-depth research on the protection mechanism for specialized knowledge sharing in innovative enterprises, exploring the impact of knowledge relevance and specialized knowledge access rights on specialized knowledge sharing from the dilemma of specialized knowledge acquisition. Ge Qiuping [32] studied the property rights risk dimensions and prevention of knowledge transfer, proposing a series of measures to achieve optimal benefits of knowledge transfer while reducing risks.

4 Prospects for Knowledge Innovation Research in China

Knowledge innovation is an indispensable part of national innovation system development and an important source of national innovation. Continuous research on knowledge innovation can effectively drive national innovation development. China is currently in an economic transformation period, with various industries and sectors needing to rely on innovation for optimization, upgrading, and transformation. Knowledge innovation is the fundamental force driving enterprise optimization and transformation, and there is an urgent contemporary demand for knowledge innovation research. Based on the above review of Chinese scholars' research on knowledge innovation, the author makes the following research prospects:

(1) Further evaluation and revision of Nonaka's SECI model can be made from multiple aspects, angles, and levels, or re-evaluation and re-revision can be conducted based on previous evaluations and revisions. Especially with the rapid development of mobile Internet, enterprises can deeply engage with consumers, and a consumer-centered enterprise operation era is quietly emerging. Attempts can be made to apply the SECI model for knowledge innovation processes between producers and consumers, even establishing dynamic knowledge innovation models for marketing systems. Additionally, research on the application of the SECI model can extend not only to economic fields but also to natural sciences such as physics. For example, Shi Liping et al. [33] used the Bohr atomic model to explain the SECI knowledge innovation process.

(2) Research on the impact of organizational structural changes on organizational learning and knowledge innovation. The rapid development of the Internet has made enterprise organizational structures more flattened and organizational learning more convenient and faster. This improvement in the degree of explicit or common knowledge can promote the creation of individual or tacit knowledge, thus forming a certain dynamic knowledge spiral process. How to better leverage the interaction between organizational learning and knowledge innovation amid organizational structural changes in the Internet era is a question worthy of further exploration and research by scholars.

(3) There are many aspects of knowledge innovation under the new economy worthy of research. For example, how to establish knowledge innovation models under "Internet Plus" is a major theme. Internet Plus traditional industries is an effective model for industrial and economic structural transformation and upgrading, and how to effectively conduct knowledge innovation and play the essential driving role of knowledge innovation under this new model is crucial. Meanwhile, from a national strategic perspective, under the policy drive of the "Belt and Road Initiative," domestic enterprises need to effectively enhance their international competitiveness in the process of going

global, which requires fully leveraging the essential utility of knowledge innovation. Furthermore, with further globalization and China's knowledge stock being far lower than that of developed countries, the Matthew effect in knowledge innovation behavior places Chinese enterprises at a relative disadvantage in knowledge innovation. Only by integrating into the global innovation system can China improve its innovation capabilities and international competitiveness more quickly.

(4) The incentive and evaluation mechanisms for knowledge innovation also deserve further in-depth exploration and research by scholars. From the perspective of management and human nature, incentives are effective means and methods to promote employees' work capabilities, allowing them to feel the existence and enhancement of their own value. Similarly, for knowledge innovation researchers, a good incentive mechanism is needed to make them feel the existence and enhancement of their own value. Evaluation can help enterprise employees recognize their strengths and weaknesses during work processes and make targeted corrections and improvements. The same applies to knowledge innovation, especially for profit-oriented enterprises. Evaluating enterprise knowledge innovation can rapidly improve knowledge innovation efficiency, win more benefits for enterprises, and give them stronger competitiveness. Therefore, research in these two areas remains worthy of in-depth and sustained effort.

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Note: Figure translations are in progress. See original paper for figures.

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