THE INFLUENCE OF NETWORK CAPABILITY AND KNOWLEDGE SHARING ON INNOVATION PERFORMANCE OF TECHNOLOGY-BASED SMEs

BY

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Abstract

This study adopts a quantitative research methodology, aiming to 1) investigate the definition and dimensioning of network capabilities. 2) investigate the impact of the four dimensions of network capabilities on innovation performance .3) Investigate the relationship between the four dimensions of network capabilities and knowledge sharing .4) Investigate the relationship between network capabilities, knowledge sharing, and innovation performance. A quantitative study was conducted with samples from 423 Hi-tech SMEs in East China.

For the path coefficient analysis of the structural equation model, it was learned that network planning ability, network relationship ability, network occupancy ability, and network utilization ability have a positive and direct influence on innovation performance, with path coefficients of 0.16, 0.16, 0.25, and 0.20 ($p<0.05$). Explicit and tacit knowledge sharing positively affect innovation performance with path coefficients of 0.18, 0.17 ($p<0.05$). Explicit and tacit knowledge sharing play a full or partial mediating role in the two relationship paths between network capability and innovation performance. The coefficients of NPC-EKS-IP and NOC-TKS-IP paths are 0.01 and 0.02 ($p>0.05$), and all other mediating roles are significant, with 95% confidence intervals.

(Total 267 pages)

Keywords: Network Capability, Knowledge Sharing, Innovation Performance, Hi-tech SMEs

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Chapter 1

Introduction

1.1 Research Background

(1) The complex market environment poses new challenges to Hi-tech SMEs.

Under the background of the rapid development of the Internet economy, China's industrial structure adjustment has achieved remarkable results, and China's marketization process has also achieved rapid development. The non-scientific and technological SMEs that can be used as a successful case of the combination of economy and science and technology are the only ones. Hi-tech SMEs generally refer to knowledge-intensive economic entities in which the staff engaged in science and technology work accounts for a relatively high proportion of all employees, the products or services produced and sold are rich in high-tech content, and the R&D funds account for more than 2%-5% of the annual sales of the enterprise. According to relevant statistics, about 65% of China's patents, more than 75% of technological innovation, and more than 80% of new products are invented and developed by science and technology SMEs. Therefore, promoting the innovation performance of small and medium-sized science and technology enterprises for national scientific and technological progress, economic construction, and social harmonious development is of great value and far-reaching significance. Science and technology SMEs have become the backbone of China's independent innovation ability and have played an essential role in promoting national economic growth, social harmony, and stable development. The market environment is unpredictable, and an enterprise that needs to learn how to innovate and keep pace with The Times will face the risk of being eliminated by the market. In today's increasingly open and volatile external competitive environment, innovation is essential in enhancing high-tech SMEs' market competitiveness. Enterprises are forced to restructure their competitiveness by

changing how they acquire resources and capabilities and constantly cultivating and shaping their dynamic competitive advantages to enhance environmental adaptability (Xu, 2021). Compared with large enterprises, high-tech SMEs have more limited network capabilities and resources. Therefore, in a highly competitive environment, they should own network capabilities and gain the competitiveness of sustainable development in the industrial chain. It is a crucial issue for high-tech SMEs in the future (Lu, 2023).

(2) The closed innovation mode restricts the innovation of Hi-tech SMEs

Generally speaking, the lack of network ability quickly leads to the closed innovation of small and medium-sized enterprises in science and technology, which makes their research and development tend to be introverted. Small and medium-sized science and technology enterprises conduct independent research and development based on their existing technical characteristics. In a dynamic environment, they lack resources, technology, and knowledge sharing with members of the organization, and it is challenging to grasp innovative ideas and market trends, which quickly increases the risk rate of research and development failure or market elimination, resulting in a tremendous waste of resources (Tan, 2024). For small and medium-sized enterprises with diversified products, diversified markets, and high technical complexity, if they want to avoid the imbalance of input and output ratio, they need to eliminate the mode of entirely relying on self-research and development. To enhance the competitive advantage of small and medium-sized enterprises in science and technology, it is necessary to improve the management level and productivity of small and medium-sized enterprises in science and technology and promote innovation. (Hua and Li, 2023). In the context of open innovation, hi-tech SMEs have increasingly realized the importance of this and have started to improve their innovation performance by cooperating with external organizations. In the growth process, solid network capabilities, learning and using, and moderate and efficient introduction of excellent external resources are needed to maintain a competitive advantage.

Figure 1.1 below is an excerpt of the innovation vitality score table of some small and medium-sized science and technology enterprises in Shaanxi Province.

Fifteen electronic information enterprises, 14 biomedical enterprises, 14 new energy enterprises, 13 new materials enterprises, and 12 optical and mechanical enterprises were surveyed. The innovation vitality of enterprises in biomedicine and electronics is relatively strong. In contrast, the level of innovation vitality of enterprises in the field of optmechanics is relatively average. The level of innovation vitality of SMEs in science and technology has a more significant impact on the enterprise's network capability, knowledge level, innovation organization management, and innovation environment, indicating that the internal innovation resource input, the coordination of health and organization relations, knowledge utilization, and results transformation status occupy a significant position in the enterprise innovation vitality (Xie, 2022). The classification of technologic-based SMEs in this study aims to determine the SME company profile based on selected open innovation network dimensions in the Italian manufacturing sector, in which small and medium-sized enterprises are classified as having 50 to 100 employees and 100 to 500 employees, respectively.

Table 1.1 Score table of innovation vitality of small and medium-size technology-based enterprises in five fields

Enterprise field	**Comprehensive score**	**Score grade**	**Ranking**
Electronic information field	86.55	stronger	2
Biomedical field	88.36	stronger	1
New energy field	83.65	stronger	3
New material field	80.34	stronger	4
Opto-electromechanical field	78.87	normal	5

Source: National Bureau of Statistics, 2021

(3) Current research status of network capability and innovation performance

Scholars have studied the direct impact of network capability on innovation performance. Parid and Ortqvist (2015) Based on the analysis of survey data from technology-based small Swedish companies, network capability helps to create and develop stable production relationships between enterprises and different upstream

and downstream enterprise organizations, thus increasing the innovation performance of enterprises. Faroque and Morrish (2017) surveyed export start-up garment companies in Bangladesh. They proposed that network capability can directly and positively affect the company's business processing and export performance, thus improving the innovation performance of the enterprise. Imanto, Prijadi and Kusumastuti (2019), through an empirical study of small and medium-sized enterprises in Indonesia, found that network capability can improve the value of enterprise products and services by exploring and utilizing network resources, thus improving the innovation performance of enterprises.

Scholars introduce mediating variables to study the path mechanism between network competence and innovation performance. Indirect influence Through knowledge management (Zhu, 2011), knowledge acquisition (Su, 2017), absorptive capacity (Jiang and Wu, 2018), and other intermediary roles to indirectly promote the improvement of enterprise performance. Zhang, Sun, Pei, and Qi (2015) case analysis of China's incubation industry shows that network capability will indirectly affect enterprises' financial, growth, and innovation performance through the three dimensions of network structure, network centrality, structural hole, and heterogeneity. When Tu, Wang, Zhang, and He (2019) studied the innovation behavior of entrepreneurial enterprises based on a dynamic environment, they pointed out that entrepreneurs' network capability impacts the progressive innovation performance of enterprises through resource acquisition. Based on the knowledge management process, Xu (2021) took Chinese SMEs based on science and technology as an example to explore the impact of inter-organizational learning through knowledge management on the innovation performance of SMEs based on science and technology. Knowledge management has attracted more and more attention from enterprises. Knowledge sharing, the core link of knowledge management, has become a powerful way for enterprises to create resources and transfer knowledge (Xu, 2021). Therefore, this paper introduces knowledge sharing as an intermediary variable into the innovation performance model of network capability-knowledge-sharing-technology-based SMEs for continuous in-depth discussion and deepening.

1.2 Statement of Problem

Through the research background analysis, it is found that network capability has become one of the essential channels for enterprises to solve the shortage of information and resources. Network capability can bring abundant resources, knowledge, and information to enterprises. However, a realistic problem is how enterprises can acquire network capability and obtain network resources, knowledge, and information to improve their innovation performance.

According to the resource-based view, enterprises occupying the core position in the network and having efficient social relationships (such as mutual trust, commitment, and joint problem-solving) have become essential resources for enterprises to enhance market competitiveness (Hao, Mi, and Yu, 2019). Compared with general resources, such heterogeneous resources obtained in the network are often complex to imitate, unique and irreplaceable, and become a vital resource to enhance the competitiveness of enterprises (Pang and Li, 2022). Second, network capabilities can optimize the relationship between enterprises and partners, thus improving innovation performance. In the era of the sharing economy, the network scale, network structure, and network cooperation built by focus enterprises are more complex than before, and it is difficult for a single enterprise to quickly and comprehensively grasp the latest and most valuable knowledge and information. Especially for SMEs in science and technology, their rapid development is unrestricted by the internal environment, such as lack of funds, shortage of talents, and backward management. It is also affected by unstable factors, such as different strategic goals and cultures among network members. Therefore, how can enterprises improve their network capabilities and effectively manage cooperative relationships in the network portfolio? Realizing full communication and interaction between partners and continuously improving the competitive advantage of enterprises will become essential issues enterprises face.

Although network capability plays a vital role in improving innovation performance and forming network cooperation relationships, there are still many

failed cases of strategic cooperation between enterprises and partners. Statistics show that less than 50% of strategic cooperation networks are successful (Zheng and Li, 2020). The above research shows that the probability of success in cooperative networks is low, and the reasons for failure are various. For example, enterprises ignore matching partner resources when constructing the network cooperation portfolio. The resource complementarity between enterprises and partners could be more substantial in cooperation. The low consistency of cooperation objectives and the poor integration of enterprise culture led to the weak ability of cooperation and innovation in the business process, resulting in the decline of enterprise competitiveness. In the era of the sharing economy, the network scale, network structure, and network cooperation relationship built by focus enterprises are more complex than before. In the network cooperation combination, due to the cultural differences of enterprises, different organizational practices, and inconsistent strategic goals of enterprises, the unstable factors of the cooperation network are further increased, and the evolution process of network cooperation combination is more uncertain. The requirement for enterprise network capability is further increased. Therefore, improving their network capabilities, effectively managing the cooperative relationship in the network portfolio, achieving full communication and interaction between partners, and constantly improving the competitive advantage of enterprises will become essential issues enterprises face.

With the intensification of competition at home and abroad, the innovation process of small and medium-sized enterprises in science and technology has high risks. In the rapidly changing environment, the knowledge, technology, and resources required for innovation activities of small and medium-sized enterprises in science and technology are increasingly complex. Even large enterprises cannot fully possess all the elements needed for innovation. Therefore, SMEs in science and technology must cross the boundaries of enterprises and obtain the support of external partners in terms of resources and capabilities (Oakey, 2013). From the perspective of Hi-tech SMEs, it is often difficult for enterprises to evaluate their own technology research and development level, and it is impossible to confirm whether technology research and development lacks heterogeneous technical knowledge, which are all obstacles to

enterprises' innovation activities (Lv, 2020). Under the requirements of the era of open innovation, whether small and medium-sized technology-based enterprises can cross the enterprise boundary, obtain resource support from external relationship networks, and achieve effective integration of internal and external resources has become an essential factor determining the innovation ability of enterprises. Only by making full use of the external network relations of enterprises, cultivating the network capabilities of enterprises, and solving the problems faced by technological innovation, such as insufficient funds and lack of R&D personnel, can the continuous improvement of innovation performance be achieved and long-term market competitive advantages be maintained.

Consultant Jin Daren believes that compared with foreign enterprises, China's supply chain management system needs a practical and feasible enterprise management strategy, and the inventory, capital, and financial budget are not rigorous. The product cost is high; the cost management method needs to be scientific; Information flow, logistics, capital flow, business processes, and value streams must be integrated and unified. There is an apparent gap between the innovation level of small and medium-sized science and technology enterprises in China and that of the same-level enterprises in developed countries. This gap has seriously affected the improvement of economic efficiency and competitiveness of small and medium-sized scientific and technological enterprises in China. To change this, practical innovation is necessary. For Chinese science and technology SMEs to examine whether the relevant decisions of science and technology SMEs are scientific from the principles and actions of enterprise resource planning (ERP), supply chain management (SCM), enterprise reorganization (ER), and information technology (IT), they must learn network capabilities and knowledge, that is, network capabilities and knowledge sharing in this study. To enhance the competitive advantage of small and medium-sized enterprises in science and technology, it is necessary to improve the management level and productivity of small and medium-sized enterprises in science and technology and promote innovation. (Chen & Jiang, 2019). Thus, in the context of open innovation, increasingly hi-tech SMEs have realized the importance of

cooperation and have started to obtain resources through cooperation with external organizations to improve innovation performance (Feng, Zhang & Sun, 2017).

1.3 Research Question

This paper studies how small and medium-sized enterprises in science and technology have network capability, access to external information, technology, knowledge, and other resources, and improve innovation performance. The influence of network capability on innovation performance through knowledge sharing still needs to be further explored. In particular, for Hi-tech SMEs in the open context, due to their limited resources, workforce, and knowledge, faced with the complexity of the external environment, it is urgent to cultivate network capabilities and reconstruct resource systems to obtain competitive advantages. The acquisition of network capability is inseparable from sharing knowledge among network members, and sharing knowledge among network nodes can make up for the deficiency of individual enterprise resources. Based on previous research results and from a new perspective of knowledge sharing (explicit knowledge sharing, implicit knowledge sharing), this paper expounds on the relationship path of the positive effect of enterprise network capability on the innovation performance of Hi-tech SMEs through knowledge sharing (explicit knowledge sharing, implicit knowledge sharing). It provides a reference for improving the innovation performance of Hi-tech SMEs. The research questions are as follows:

1) What is the relationship between network capability and the innovation performance of Hi-tech SMEs?

2) What is the specific way that network capability affects the innovation performance of small and medium-sized science and technology enterprises?

3) How does knowledge sharing affect the innovation performance of Hi-tech SMEs?

4) Does knowledge sharing mediate between network capability and Innovation performance? Innovation performance?

1.4 Research Objectives

1.4.1 To study network competence's definition and dimension division to lay the foundation for the following empirical research.

1.4.2 To study the impact of four network capability dimensions on Hi-tech SMEs' innovation performance.

1.4.3 To study the relationship between the four dimensions of network capability and knowledge sharing (explicit and implicit knowledge sharing).

1.4.4 To study the relationship between knowledge sharing (explicit knowledge sharing and implicit knowledge sharing) and the four dimensions of network capability and innovation performance.

1.5 Research Significance

This study aims to clarify the influence mechanism of network capability and knowledge sharing on the innovation performance of high-tech SMEs and how intermediary variables act on it to supplement the deficiencies of relevant studies. It has important theoretical and practical significance.

1.5.1 Theoretical Significance

This paper discusses the influence of network capability on enterprise innovation performance from the perspective of knowledge sharing, which has important theoretical significance. First, it enriches the knowledge-sharing theory. From the influence mechanism of network capability on enterprise innovation performance, this paper profoundly explores how different dimensions of network capability construct the perspective of knowledge sharing, which further enriches the theory of knowledge sharing. Secondly, it expands the theory of enterprise innovation

performance. How to innovate and obtain sustainable competitive advantages to improve the innovation performance of enterprises is always the main content of entrepreneurs' concern. Enterprises have different network capabilities (NCS) in the industrial chain. Knowledge sharing is used to obtain core resources such as network resources, skills, and knowledge, which can help enterprises improve innovation performance. Finally, the research on the effect of network capability on enterprise performance has always been the object of academic attention. However, as for the research on high-tech SMEs with more prominent innovation methods and innovation management, most scholars' research focuses on improving performance through external mechanisms, such as integrating, absorbing, and utilizing external knowledge or external relationships and resources. The study on the improvement of internal network capability still needs to be improved. Taking this as an opportunity, this paper builds a theoretical model of "network capability - knowledge sharing - innovation performance" of science and technology SMEs. It clarifies the relationship between various variables, which is of great significance for improving the core competitiveness of high-tech SMEs.

1.5.2 Practical Significance

High-tech SMEs have high technological innovation and fast knowledge iteration and are currently the fundamental entities for economic growth. This paper discusses the influence of network capability on the innovation performance of high-tech small and medium enterprises and finally puts forward suggestions and measures to improve innovation performance and network capability, which provides a reference for the sustainable development of high-tech small and medium enterprises. First of all, it gives suggestions for improving enterprise network capability. Because of the small-scale development and limited resources of high-tech SMEs, they need help to adapt to environmental changes. Therefore, improving one's network capability, increasing initiative from the intrinsic, taking the initiative to obtain network information and resources, occupying the favorable position of the network, and stabilizing the network relationship are more conducive to improving one's competitiveness. Secondly, it provides ideas for enterprises to improve

innovation performance. The improvement of the performance of high-tech SMEs not only depends on the development of their own scientific and technological level and patented technology but also through sharing the resources and knowledge among network members, giving play to the initiative to create through network capability, and improving their performance. Therefore, this paper puts forward suggestions on innovation performance from the perspectives of network capability and knowledge sharing, which has important reference significance for enterprises to reduce costs, improve resource utilization, and obtain sustainable development.

1.6 Research Technical Route

The core content of this paper is to explore the mechanism of network capability on scientific and technological innovation performance. Research questions are obtained through background understanding, theoretical analysis is carried out, basic theoretical models are constructed, and research hypotheses are obtained. Then questionnaire survey was used to collect data for empirical analysis to test the hypothesis. Finally, the research conclusion is drawn. The specific roadmap is drawn as shown in Figure 1.1

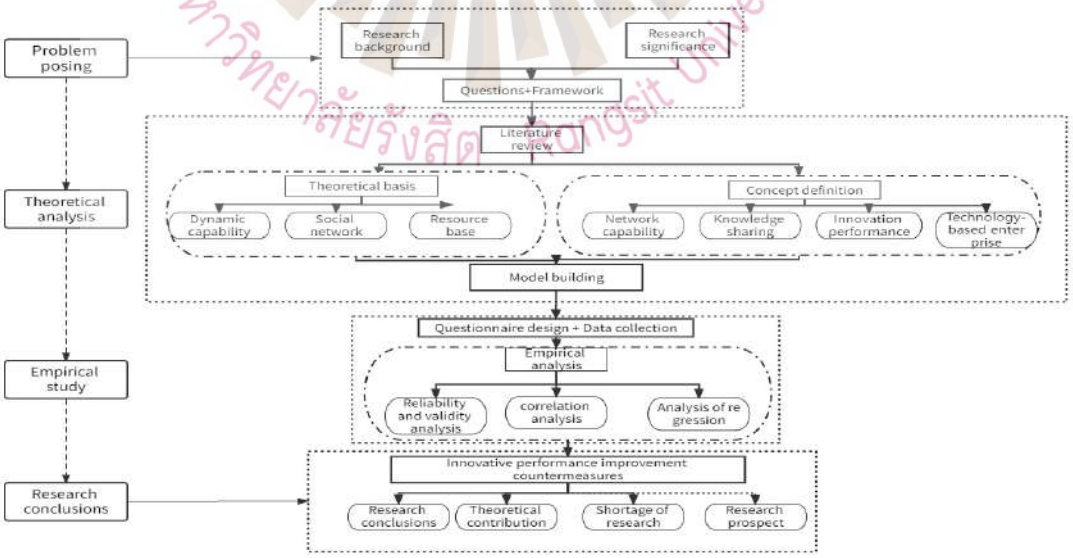

Figure 1.1 Technology Roadmap

Source: Researcher, 2022

According to Figure 1.1 above, the paper is divided into five chapters, and the overall idea is as follows.

Chapter One: Introduction. This chapter explains the background and significance of the topic of the impact of network capability on the innovation performance of small and medium-sized technology-based enterprises, as well as the research questions, objectives, contents, definitions of terms, and innovations of this paper.

Chapter Two: Literature review. It is divided into two parts. Firstly, it reviews the theoretical sources of network competence - core competence and social network. Secondly, the network capability, knowledge sharing, science and technology SMEs are reviewed in detail, and the shortcomings of the above research are summarized. Finally, a hypothesis model is proposed.

Chapter Three: Research Methods. This chapter introduces the research methods in detail. This paper mainly adopts a quantitative research method. Design reasonable variables for the survey objects, collect data through questionnaires and conduct preliminary analysis to ensure rigorous data science.

Chapter Four: Research results. Descriptive analysis, reliability and validity analysis, and correlation analysis of the valid sample data are carried out, followed by fitting degree testing, path analysis, and mediation analysis of the structural equation model, and finally, the hypothesis testing results are summarized.

Chapter Five: Conclusion and Suggestion. Firstly, this paper summarizes the research conclusions and then puts forward relevant suggestions to improve the innovation performance of small and medium-sized technology-based enterprises. Finally, it expounds the shortcomings of this study and points out the direction of future research.

1.7 Definition of Terms

Network Capability（NC）: In this paper, Zheng and Li (2020) adopted the change process of cooperation capability and defined network capability as follows: By identifying external network values and opportunities, enterprises develop, maintain, manage, and utilize network relationships at all levels to screen and acquire core and rare resources such as knowledge in the network and guide the dynamic capabilities of network development. Network capability is divided into four dimensions: network planning capability, network relationship capability, network occupying capability, and network utilization capability.

Network Planning Ability （NPC）: In the development process, enterprises have clear goals, sensitive identification of opportunities, match network resources according to their development strategies, accurately predict the development direction of partners, and make appropriate adjustments (Liu, 2019).

Network Relationship Ability (NRC): The ability of network relationship is reflected in the diversified network cooperation and innovation relationship. The ability of enterprises to deal with property rights, interests, and responsibilities to carry out, coordinate, and optimize the cooperation relationship, including relationship exchange, relationship optimization, and relationship coordination (Ren, 2010).

Network Occupying Ability (NOC): The network occupying ability of enterprises can occupy a position in the center of the network, improve the reputation of enterprises, usually obtain more information from more channels than other enterprises, improve the accuracy of mastering information (Yu, 2020), shorten the contact path with other network members, and thus improve the efficiency of learning from various network partners.

Network Utilization Ability (NUC): Through the use of internal and external networks, enterprises can improve the efficiency of innovation, and enterprises can re-apply the knowledge resources obtained by knowledge sharing through employees' learning to practice and further expand so that internal skills and external knowledge are deeply integrated to produce innovative results (Xing, Wang, Zhu, and Zhang, 2019)

Knowledge Sharing（KS）: The mutual communication and interactive learning between enterprises and partners, as well as between enterprises, are realized through various methods and means to improve the innovation ability of both parties or the two-way knowledge flow process of collaborative creation of new products or services (Wang, 2024).

Explicit Knowledge Sharing（EKS）: Often viewed from a rational perspective, explicit knowledge is highly encoded knowledge, which can be expressed in the form of data, formulas, graphs, etc., or transmitted and shared among various subjects through books, documents, and other means (Deng, Duan, & Wibowo, 2023).

Tacit knowledge Sharing (TKS): refers to the knowledge transfer between supply chain partners through face-to-face interaction, sharing experience, observation, and imitation. It is an individual's potential knowledge regarding experience, skills, attitudes, and beliefs that outsiders cannot acquire and understand (Eslami, Achtenhagen, Bertsch and Lehmann, (2023).

Innovation Performance (IP): Under the influence of constantly changing internal and external environment, the enterprise deeply explores the internal and external organizational structure, realizes knowledge sharing based on network cooperation, and achieves innovation performance that cannot be achieved through

independent operation through the integration, allocation, and optimization of network innovation resources (Guo and Li, 2023).

High-tech SMEs refer to enterprises established by relying on a specific scientific and technological achievement or cutting-edge technology, most of which have scientific and technological advantages; such enterprises have high growth, high flexibility, considerable development potential, and promising future income expectations (Zhang, 2023).

1.8 Research Contributions

This paper may produce the following innovations in the process of research, which are:

1.8.1 The definition and dimension of network capability are expounded. Based on the literature review, this study deepens network capability into four dimensions, which are network planning capability, network relationship capability, network occupying capability, and network utilization capability. These four different dimensions of network capabilities can solve specific problems for the innovative development of science and technology SMEs. It can not only help small and medium-sized enterprises in science and technology to obtain resources, knowledge, and skills, but also better manage problems such as contradictions in the industrial chain, and has never proposed new research ideas and entry points from the perspective of time.

1.8.2 This paper discusses the mechanism of network capability on the innovation performance of high-tech SMEs. Taking knowledge sharing (explicit knowledge sharing, implicit knowledge sharing) as the intermediary variable, the research path of network capability-knowledge sharing and innovation performance is constructed. Previous studies on innovation performance were mostly conducted from a single variable or perspective. In this paper, knowledge sharing is introduced as an

intermediary variable, which greatly deepens the influence path of network capability on innovation performance.

1.8.3 Taking high-tech SMEs as research objects, the model is verified quantitatively. The research on innovation performance mainly starts from the manufacturing and service industry and adopts theoretical discussion and case study. From a quantitative point of view, this paper verifies the theoretical model and proposes a path to improve the innovation performance of high-tech

Chapter 2

Literature Review

In this chapter, the author will first explain the theoretical basis of network capability. Secondly, the author will discuss in detail the related concepts, influencing factors, dimension division of high-tech SMEs, network capability, knowledge sharing, and innovation performance mentioned in the previous chapter. The author will discuss four dimensions of network capability in detail, namely (a) network planning capability, (b) network relationship capability, (c) network occupying capability, and (d) network utilization capability; Two dimensions of knowledge sharing, namely (a) explicit knowledge sharing, (b) implicit knowledge sharing. Finally, the author will explain the influence mechanism between network capability, knowledge sharing, and innovation performance.

2.1 Relevant Theoretical Basis

2.1.1 Competitive advantage based on competence view

(1) Core competence theory

Sirmon, Hitt & Ireland (2007) believe that holding valuable, rare, non-imitable, and hard-to-replace resources is necessary for enterprises to obtain competitive advantages. However, enterprises also need to manage these resources effectively and integrate and optimize the allocation of resources owned by enterprises. According to Sirmon et al. (2007), enterprise capability includes the resource combination capability to acquire, accumulate/develop, and divest resources, bundle and integrate resources, and use appropriate strategies. Rubin (1973) believes that the original state of resources

owned by enterprises is static, and static resources cannot directly generate competitive advantages for enterprises; instead, they need to play a higher utility and value through a proper allocation process. Cohen & Manion (1989) believe that the management, organization, and utilization of static resources are the necessary conditions to tap their value and obtain economic rent, which is the basis for enterprise resources to become the source of competitive advantage. The most effective use of the resources owned and controlled by the enterprise is the basic premise and requirement for the enterprise to make any strategy and decision to obtain economic benefits (Grant, 1991).

After the 1980s, relevant management scholars believed that the internal capability of an enterprise must adapt to the external environment to give play to the source of competitive advantage. With the development of the Internet, resources that are scarce and difficult to imitate and replace for enterprises are gradually weakening. Until Prahalad & Hamel (1990) and other scholars put forward the concept of core competence, believing that enterprises need to cultivate and enhance their core competence to obtain long-term competitiveness, the theory of core competence has gradually become the forefront and hot spot in the field of strategic management and has attracted much attention. According to the connotation of the core competence theory, there are two understandings: First, from the perspective of composition, it is believed that the core competence of an enterprise includes its R&D capability, manufacturing capability, and marketing capability (Meyer & Utterback, 1994). Scholars of this kind of understanding pay special attention to core technical competence (Patel & Pavitt, 1994); Second, from the perspective of whether an enterprise's core competence can be replaced by external imitation, it is believed that an enterprise's core competence refers to its proprietary information knowledge, and the unique and heterogeneous knowledge system that is not easy to be imitated by competitors is the source of an enterprise's core competence (Barton, 1992). The acquisition, creation, and application of knowledge exist in the whole process of cultivating core competence. Summarizing these two kinds of understanding about the core competence of enterprises, it can be considered that the core competence of enterprises is the excellent research and development ability, manufacturing ability,

and marketing ability, and the ability can be abstracted into the acquisition, creation, and application of knowledge. Core competence mainly refers to a kind of internal enterprise which, by coordinating different production skills of enterprises and combining accumulated knowledge of various technologies, not only attaches importance to internal accumulation and technological innovation adapted to the external environment but also takes into account the coordination of all aspects of internal capabilities of enterprises, strengthens core competence through internal and external knowledge and complementary integration. Bring one or more of the organization's businesses to an industry-leading level (Kevin, Stephen & Patricia, 1997).

(2) Dynamic capability theory

With the further development of strategic management theory and research, Teece, Pisano & Shuen (1997) put forward the theory of enterprise dynamic capability. Dynamic capability theory focuses on the research of vertical and dynamic problems and pays attention to the continuous cultivation, improvement, and reconstruction of heterogeneous capabilities of enterprises. Based on different research perspectives, different theoretical viewpoints have been formed, which mainly include the view of ability integration, the view of dynamic resources, and the view of convention.

First, the ability integration view. This view holds that enterprise dynamic capability is the ability to integrate and reconfigure internal and external resources and capabilities. Teece et al. (1997) believe that enterprise dynamic capability must be able to quickly self-adjust and update, follow up, and adapt to the rapidly changing external environment, that is, enterprise dynamic capability is the ability of enterprise self-renewal. Their research found that no matter how the external environment changes, those successful enterprises can always give full play to the coordination, integration, and allocation of resources, and can show excellent flexible product innovation ability. Huang and Chen (2004) believe that dynamic capability is an enterprise's maintenance of basic capability that can be the source of its competitive advantage. The capability integration approach proposes an innovative

approach to re-create value based on existing resources. With more resources as support, there will be more possible ways of resource integration and allocation optimization, resulting in more new technologies and new products of different enterprises, thus enhancing the competitive advantage and innovative performance of enterprises.

Second, dynamic resource view. The view of dynamic resources is that the dynamic ability of resource combination and utilization is the source of obtaining and maintaining competitive advantage. Eisenhardt & Martin (2000) believed that dynamic capability refers to the organizational process and strategic process in which an enterprise intentionally changes its resource base to cope with or create external market changes. The process consists of integrating, reconfiguring, and acquiring and stripping resources. Luo (2000) believes that enterprise dynamic capability refers to the ability of an enterprise to acquire, create, adjust, accumulate, and apply resources and capabilities that can bring economic returns during the continuous search for competitive advantages over competitors. Dynamic capability can be seen as the ability to acquire, integrate, combine, and diversify resources in response to a changing external environment (Blyler, 2003). The dynamic resource view is based on the resource-based theory and takes some discussions of the capability integration view as a reference, thereby endowing the static view of the past with dynamic characteristics according to the changes in the external environment. The acquisition, adjustment, and creation of resources cannot be separated from the enterprise's ability as the background support, which is the basic premise for the enterprise's resource acquisition, transformation, and utilization to match the external environment. In other words, the acquisition adjustment and creation of resources are the sources for enterprises to create heterogeneity and adapt to the external environment to win competitive advantages.

Third, the view of convention. The convention is that the dynamic capability of the enterprise is based on the organization's management. Kathleen (1998) believes that the dynamic capability of an enterprise is a routine process or management that can be recognized and identified within the enterprise. This view

holds that enterprise dynamic capability includes the ability to integrate resources and acquire and transfer resources. Winter (2003) believes that enterprise dynamic capability refers to the ability of an enterprise to expand and update its original common capability, or to create organizational practices. Dynamic capability is a stable collective activity pattern that can be tracked and learned in the process of performance improvement. This pattern can influence the generation and change of organizational practices, then promote new practices that are more favorable to the development of the organization and the improvement of organizational processes, and finally promote the competitive advantage of the enterprise. Therefore, the improvement of the organization's self-renewal ability at the process level has an important impact on the improvement of the organization's development performance.

Therefore, based on the theory of enterprise core competence and enterprise dynamic competence, the source map of enterprise competitive advantage can be obtained, as shown in Figure 2.1

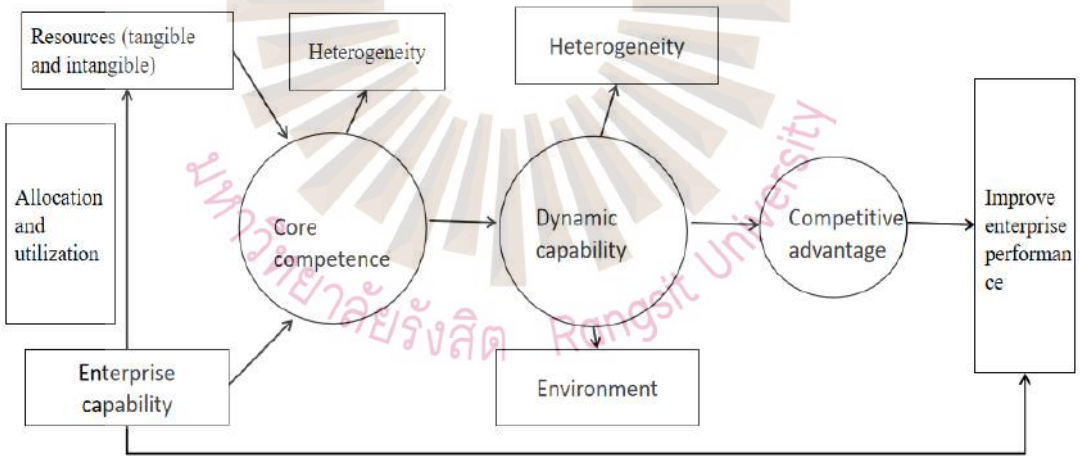

Figure 2.1 Sources of enterprise competitive advantage based on competence theory

Source: Liu, 2019

2.1.2 Competitive advantage based on social network

The concept of network is initially basic in the field of sociology. After decades of research and improvement, social network theory has gradually developed into a very representative theory in sociology and has gained more and more

recognition. Jackson & Watts (1999) believe that a social network is the connection point of individuals or organizations connected by a given social relationship. In the highly competitive environment of the 21st century, it is difficult for enterprises to cope with the huge competitive pressure by themselves (Sun, Song, and Chen, 2019). Especially for small and medium-sized enterprises, in the highly competitive environment, they gradually take the initiative to pursue resources, products, or services in the external network, and embed them into the current value creation system of the enterprise, to differentiate themselves from their competitors (Ndubisi & Matanda, 2011), and form competitive advantages supported by the resource concept. Create more economic benefits for enterprises. In the social network theory, the relationship between the seller and the consumer is no longer a simple one but extends to the relationship of network stakeholders (Wang, 2021). In the view of value co-creation, enterprises have gone beyond formal organizational boundaries and are embedded in a network where customers and other stakeholders interact to jointly create and share value (Payne, Ballantyne & Christopher, 2005). According to the social network theory, the access of enterprises to information, resources, knowledge, and other network resources in the network is often related to the position occupied by enterprises in the network, the relationship between network members, and the degree of relationship utilization (Xue, Zhang, Zhang and Ren, 2023), and the corresponding enterprises must also have strong network capabilities to strengthen the network relationship.

Based on the above analysis, it can be concluded that social network theory provides enterprises with multi-channel access to resources and capabilities in the context of highly developed Internet information technology, a more open market environment, and intensifying competition. Enterprises and many external entities participate together to form a mutually beneficial and shared network, which promotes closer contact between enterprises and speeds up the contact and cooperation between enterprises and suppliers, competitors, scientific research institutions, etc. Through the interaction among various participants in the network and the established relationship based on trust and mutual benefit, inter-organizational resources can flow in the network, which continuously provides valuable resources

and opportunities for the development and innovation of enterprises. The value mining and realization of these network resources is the key to the multi-agents participating in co-creation. See Figure 2.2 for details.

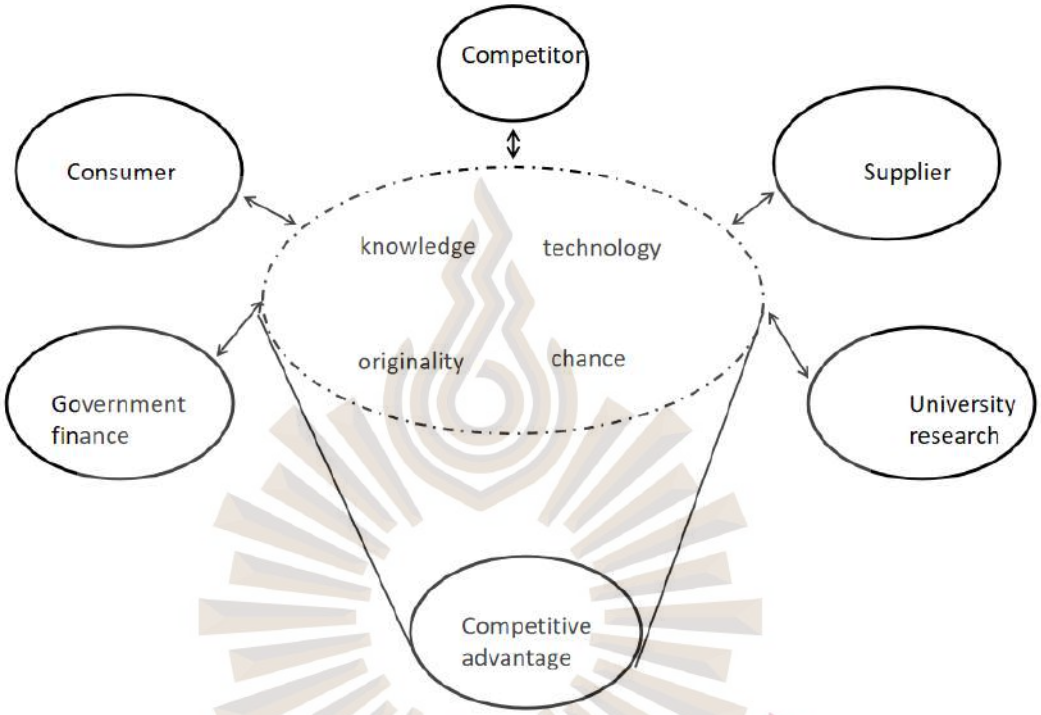

Figure 2.2 Competitive advantage of enterprises in resource acquisition and exchange based on social network theory

Source: Researcher, 2022

2.2 High-tech Small and Medium-sized Enterprises

Definition of technology-based SMEs. At present, the concept of high-tech small and medium-sized enterprises is not uniform in the world and is generally called high-tech enterprises in the world. In 2017, the Chinese government issued the document "Evaluation Measures for High-tech Small and Medium-sized Enterprises ", pointing out that high-tech small and medium-sized enterprises rely on a certain number of scientific and technological personnel engaged in scientific and technological research and development activities to obtain independent intellectual

property rights and transform them into high-tech products or services. To achieve sustainable development of enterprises.

Characteristics of high-tech SMEs

Small scale, high flexibility. Hi-tech SMEs, limited by their industry characteristics, have smaller scales and lower entry thresholds, and can quickly make decisions on problems in the process of operation. However, because of its small scale, the ability to obtain market resources, the ability to deal with network relations is low, resulting in a high elimination rate of enterprises.

High returns, high risks. Because of their own intellectual property rights and technology, Hi-tech SMEs can generate higher profits in their industry, but the market environment and the iteration of science and technology also make them have higher competitive pressure and face higher business risks.

Fast innovation and high R and D investment. The number of science and technology and talents of high-tech small and medium enterprises plaintiff yuan the national manufacturing average. In the era of the digital economy, it invests higher research and development expenditure every year, constantly innovates its products and services, eliminates old products and services, and gives itself a firm foothold in the industrial chain.

At present, the research on high-tech small and medium enterprises focuses on the following aspects. (1) Open up financing barriers, enrich financing channels, and maintain sustainable competitiveness. (Wang, 2022) used the panel data of 674 GEM enterprises as samples to study the innovation impact mechanism of digital financial inclusion on high-tech small and medium enterprises. (2) Some scholars provide competitiveness for their growth from the perspective of partnership. For example (Malik et al, 2011) present the results of 10 case studies of SMEs in Zhejiang Province, China, seeking to determine the extent to which external partnerships have helped them become more innovative and competitive. A case study

approach was used to explore SMEs in the electronics sector in Brisbane, Australia, to identify drivers and barriers to business-to-university research partnerships. (3) Recent scholars have begun to study the relationship between high-tech SMEs and innovation performance from the perspectives of network strategic position, capital, government subsidies, tax incentives, and digital transformation capability. For example, aimed to analyze whether there is indeed a link between strategic alliances, intellectual capital, and organizational performance in industrial-technology SMEs. (Liu, 2023) Conducted an in-depth study on the government's tax and fee reduction from four perspectives of enterprise innovation performance, guided the improvement of enterprise innovation ability, and in this context, the impact on the innovation performance of high-tech SMEs.

The above scholars have analyzed the competitiveness and innovation of high-tech small and medium enterprises from different perspectives, but few scholars have studied their innovation performance from the perspectives of network capability and knowledge sharing. Therefore, from the perspective of network capability and knowledge sharing, this paper will deeply explore the mechanism of influencing the innovation performance of member units.

2.3 Network Capability Literature Review

2.3.1 Concepts of Network Capability

In the 1990s, social networks were adopted by the economics profession and later developed in management. With the advent of digital networking, resource-based theory, social network theory, and network capability theory have been paid more and more attention by academic circles. Network capability has become a research hotspot in educational circles in recent years. Hakansson (1987) first proposed network capability from the perspective of strategy and intelligence. Network capability enables enterprises to obtain more resources through relationships and interactions with other partners in the industrial chain in the network

environment. Therefore, in the relationship network, enterprises maintain good cooperation with upstream and downstream partners, finance, workforce, logistics, and other customers and eliminate risks between each other, which has become the key for enterprises to obtain competitive advantages. Thus, network capability evolved from social networks to become A means and tool for firms to acquire resources (Tichy, Tushman and Fombrun, 1979).

Since Hakansson (1987) put forward "Network Capability," many scholars in the academic circle have studied and expanded the definition of network capability to different degrees. The following table is the author's summary of the network capability academic research.

Table 2.1 Summarizes the research on related concepts of network capability

The Author	Time	Concept
Moller	1999	Network capability is the ability of an enterprise to integrate and utilize the resources of its partners.
Ren	2010	Network capability is developing, managing, and operating external network relationships, acquiring resources that meet one's growth, and working with partners to solve problems.
Liu	2012	From the perspective of department function, network capability (NC) is embedded in the cooperation and operation between internal and external individuals.
Yu	2013	External knowledge network capability (NC) refers to the connection between enterprise strategic planning and external knowledge sources, sharing and obtaining control and information benefits in the two-way flow of knowledge.

Table 2.1 Summarizes the research on related concepts of network capability (Continued)

The Author	Time	Concept
Ma	2015	Network capability improves the innovation ability of enterprises by obtaining information, knowledge, and other resources.
Wang	2017	From the strategic level, help enterprises identify opportunities, coordinate internal and external relations, and create value for enterprises.
Liu Fang	2019	At the strategic level, network capabilities can help enterprises identify opportunities and coordinate internal and external relationships, thus creating value for enterprises.
He	2021	Network capability is to identify opportunities, obtain advantageous network positions, establish cooperative relationships, and thus improve cooperative innovation performance.
Wang, Ma and Li	2023	The utility model uses the existing knowledge, technology, and resources within an enterprise to build a network and network system in a real-time changing network. Using this network structure can more effectively obtain scarce resources and create value, enhance the comprehensive status of the enterprise network, and improve the network guidance ability. (Adopted in this article)
Yuan, Liu, Zhang, and Xia	2024	Network capability refers to the ability to perceive, grasp, and transform external cooperative relationships.

Moller & Halinen (1999) argue that network relationships rapidly replace traditional markets. This poses a significant challenge for managing industrial enterprises and high-tech companies. This means high-tech companies must build intricate corporate networks, forming research and development networks and supplier and sales networks. Taking Huawei as the research object, Zhang (2019) studied the influence mechanism between enterprise network location, isolation mechanism, and network capability through grounded theory. They explained the evolution trend of "Single relationship type - Platform research and development type - cross-border multiple types" in enterprise network location when network location and "Network Pressure" do not match. The interaction of network capabilities and isolation mechanisms directly impacts the enterprise's phased network location. Wang (2023) believes that network capability is used to build networks and network systems by using various existing knowledge, technologies, and resources within enterprises in a real-time changing network.

Through the above analysis, many authors have different views, but some similarities exist: (1) Network capability occupies a favorable position from the strategic position by identifying network opportunities; (2) Network capability builds cooperation among enterprise members to use this cooperation relationship to obtain needed resources, workforce, and knowledge. (3) The ability to coordinate internal and external relations, seize development opportunities according to changes in the market environment, and create corporate value.

2.3.2 Network Capability influencing factors

Network capability is affected by various factors inside and outside the enterprise. He (2021) believes that enterprise network capability is affected by external factors such as government, market environment, maintenance of inter-enterprise network relationships, and corporate culture. Pittaway (2004) believes that the main

benefits of enterprise network cooperation behavior include: Supplementing knowledge and technical ability; Protecting property rights where there is a contract. Being a vital tool for acquiring external knowledge.

Jiang and Tang (2018) constructed a conceptual framework of network capability- knowledge accumulation - knowledge management and pointed out in the framework of "resource-capability-relationship" that the enterprise's network resource repair ability can positively affect the enterprise's knowledge accumulation. Explored the relationship between enterprises' strategic network identity and market performance in the corporate network cooperative relationship network. The above is an overview of the influencing factors from the external environment and internal management of enterprises.

2.3.3 Network Capability constitutes dimensions

Since network capability was proposed in 1987, different scholars have studied it from various angles and divided the dimensions of network capability from different theoretical bases. Some studies are conducted from the external network and internal architecture, some are performed dynamically and statically, and some are conducted from the strategic and operational levels. Table 2.2 below is the author's summary of the academic research on the network capability dimension.

Table 2.2 Overview of the dimensions of the network capability division

References	Time	Network capability dimension
Ritter	1999	From the perspective of network task execution and network task qualification, network competencies are divided into specific relational task execution, cross-relational task execution, professional qualification, and social qualification.

Table 2.2 Overview of the dimensions of the network capability division (Continued)

References	Time	Network capability dimension
Moller & Halinen	1999	It is divided into Network Vision, Network construction, portfolio management, and Relationship management from the business management perspective.
Xu	2008	It is divided into three aspects: strategy, network, and relationship, as well as network conception ability, role management ability, and portfolio management ability, aiming at reducing risks, integrating resources, and reducing costs for enterprise members in the network.
Gao, Yun and Ma	2010	Closure brings backwardness, and enterprises seek innovation in an open environment. From this perspective, network capability is divided into network strategy capability, network process capability, network knowledge, and network relationship capability.
Fang	2011	From the dynamic and static combination perspective, it can be divided into network planning, configuration, operation, and occupying ability.
Ma	2015	From the perspective of a combination of dynamic and static, it is divided into network vision ability, network integration ability, and network debugging ability.
Bai	2016	Network planning capability, network configuration management capability, network occupying capability.
Liu	2019	From a strategic and functional perspective, it is divided into network planning, construction, management, and utilization capabilities.

Table 2.2 Overview of the dimensions of the network capability division (Continued)

References	Time	Network capability dimension
Mohammadreza & Arasti	2021	Network development ability and network management ability.

As seen from the above, various dimensions of network capability are reflected in enterprise operations, and most of the research directions are the same or similar. Different scholars have established the framework of network competence from the perspectives of strategy, function, and relationship. From the above scholars' classification of enterprise network capability, Fang (2011) theoretical research on enterprise network capability is more suitable for practical understanding and application. Based on the further expansion of his theoretical study, this paper combined the investigation and interview of the middle and senior managers of dozens of Hi-tech SMEs. The enterprise network capability is defined as the enterprise's dynamic ability to obtain information and resources by identifying the external network value and opportunity and developing, maintaining, and utilizing the network relationship at all levels. At the same time, the network capability is divided into network planning capability, network occupying capability, network relation capability, and network utilization capability at the strategy and function (peration) levels.

2.3.4 The influence of network capability on innovation performance

In previous studies, enterprises embedded in the network have specific capabilities, such as strategic network capability (Hagedoorn, Roijakkers and Van Kranenburg, 2006), network competence (Ritter, 1999; Ritter et al.,2002; Ritter & Gemunden, 2003), network management capability (Moller & Halinen, 1999), interaction capability (Johnsen & Ford, 2006), relational capability (Lorenzoni & Lipparini, 1999; Collins & Hitt, 2006), According to the research of scholars, the

purpose of cultivating these abilities is to improve the competitive advantage of enterprises more effectively. This requires enterprises to be more able to obtain resource advantages, occupy a good position, and maintain a good interactive relationship with cooperative units. Holmen and Pedersen (2003) believe that although the concepts of these capabilities proposed by scholars are slightly different, these capabilities are embedded into enterprises based on the particular form or characteristics of enterprise networks and become an essential means for enterprises to obtain competitive advantages in the network environment. Walter, Auer, and Ritter (2006) studied that network competence and entrepreneurial orientation can effectively utilize organizational relationships to improve organizational performance. Torkkeli (2016) and other scholars believe that network capability is a crucial resource for enterprises, and they take small and medium-sized enterprises as the research object to study the relationship between network capability and regional cultural differences. Based on customer behavior and financial performance, Zhang (2017) believes that network capability can positively affect product-based services. Bao (2017) takes China's tourism industry as an example and believes that through network capability, network cooperation can be established, resource advantages can be obtained, and the tourism resource development model can be accelerated. Liu & Jiang (2018), based on the network capability theory, inter-organizational relationship theory, resource-based theory, and innovation theory, took extensive sample data as the research object. With resource allocation as the independent variable, network capability as the moderating variable, and amphibious innovation performance of high-tech small and medium enterprises as the dependent variable, the empirical study finds that network capability positively regulates the relationship between resource allocation and amphibious innovation of high-tech small and medium enterprises. (Zheng & Du , 2011) clarified the concept of dynamic capability from a knowledge-based perspective and discussed the mechanism of dynamic capability's influence on innovation performance in the network environment. Design/Methods/Methods - A seven-point Likert questionnaire

was designed to measure dynamic capabilities, innovation performance, and network embeddability, and 218 Chinese manufacturing companies were surveyed. Promoting network development can help improve enterprise cooperation and innovation performance, which has seen the reverse U-shaped sky system. Currently, most studies only verify the direct impact of network capability on innovation performance, and only a few literatures study the intermediate variables between network capability and innovation performance. There is only a limited number of literatures on intermediate variables, and the role path of network capability in promoting innovation cannot be fully explained. It can be seen that there is room and necessity for further research on the mechanism of network capability's influence on the innovation performance of high-tech small and medium enterprises. Therefore, this study introduces knowledge sharing into the relationship between enterprise network capability and innovation performance and the mechanism between enterprise network capability and innovation performance.

2.4 Literature Review on Knowledge Sharing

The advantages of knowledge resources have exceeded the improvement of traditional resources for enterprises, but acquiring and managing intangible assets is more complicated. Therefore, managing and utilizing knowledge resources is essential for enterprises to obtain competitive advantages (Liu Fang, 2019). Knowledge management is an activity process of acquiring, integrating, and utilizing knowledge through knowledge sharing (Wang & Noe, 2010). As the core link of knowledge management, knowledge sharing is the driving force of knowledge innovation and can realize continuous value improvement (He, 2021).

2.4.1 Concepts of Knowledge Sharing

The research on knowledge sharing (KS) began at the end of the last century. After Grant (1996) put forward the knowledge-based view, the academic community began to pay attention to the relevant research on knowledge management, but a unified answer has yet to be yet to be reached.

Knowledge sharing is a behavioral process in which individuals exchange their explicit and tacit knowledge, which includes both the flow of knowledge between two parties and the digestion and absorption of flowing knowledge by both parties. Wang and Noe (2010) pointed out that knowledge sharing refers to the exchange and dissemination of information and experience related to tasks and technologies among individuals or groups to help solve problems faced by others or put forward new ideas. In the digital environment, knowledge sharing exists not only in technology research and development cooperation but also in innovation collaboration such as alliance, which makes the enterprise innovation system form a knowledge-sharing network from suppliers to consumers, and from internal enterprises to external stakeholders (Shao et al., 2023). Liu Fang (2019) took the knowledge management process as a mediating variable and conducted an empirical study to explore the influence of network capability on innovation performance through the mediating role of knowledge management under the dynamic environment. Tsai (2002) used the social network perspective of organizational coordination to study the effectiveness of the coordination mechanism on knowledge sharing in the network within an organization, which is composed of cooperation and competition among organizational units. (Yan, Kuang & Wang, 2016) reveals that personal interests promote knowledge sharing while costs hinder knowledge sharing. Gu and Feng (2023) believe that knowledge sharing means that enterprises exchange and share their knowledge with other enterprises to promote the flow of knowledge among enterprises, and enterprises can use such knowledge to create value for

enterprises while increasing their knowledge reserves. Based on this, the author sorted out the representative definition of knowledge sharing, as shown in Table 2.3 below.

Table 2.3 Research summary of knowledge sharing concepts

The Author	Time	Creative Commons Definition
Ipe	2003	Knowledge sharing is the process by which knowledge held by an individual is transformed into aform that can be understood, absorbed, and used by others. Knowledge sharing will result in the shared ownership of knowledge by both the sender and the receiver.
Amayah	2013	Knowledge sharing is when members of an organization share aspects of knowledge such as skills to help others solve problems within the organization.
Ritala, Olander, Michailova & Husted	2015	Knowledge Sharing is a knowledge exchange activity conducted by companies in order to achieve win-win cooperation with partners.
Du Pengcheng et al	2018	Knowledge sharing is a process in which members of an organization share skills and other aspects of knowledge to help others solve problems within the organization, and knowledge owned by individuals becomes group ownership through reciprocal dissemination.
Tang, Chen & Chen	2018	Knowledge sharing is the interaction of knowledge between employees within an organization or between business departments.

Table 2.3 Research summary of knowledge sharing concepts (Continued)

The Author	Time	Creative Commons Definition
He	2021	Knowledge Sharing promotes innovation in enterprises by designing both explicit and implicit knowledge to interact between departments.
Deng, Duan and Wibowo	2022	From the perspective of market exchange and communication, it is considered that enterprise knowledge sharing is the process of knowledge participation in the market, and it is a two-way activity of knowledge communication.
Yang	2023	Knowledge Sharing Behavior refers to individuals. The act of exchanging their own knowledge with other members of the organization and creating new knowledge.

To sum up, although there is no unified concept of knowledge sharing, many scholars have focused their research on it. The "output - reception - re-creation" of knowledge is discussed. Knowledge sharing emphasizes the communication and transformation of knowledge. In this process, the sharing party helps the receiving party, and the two parties further learn together to generate new knowledge, which promotes the continuous learning of both parties and realizes more knowledge sharing (Pihlajamaa, Kaipia, Aminoff & Tanskanen, 2019). As a process of knowledge exchange and sharing among different subjects, knowledge sharing is the core of innovation and a crucial link in the knowledge management process of enterprises (Zhang, 2023). Therefore, knowledge sharing is understood in this study as transmitting knowledge among network members to other network members and then realizing knowledge transformation and re-creation—finally, promoting the innovation performance of small and medium-sized enterprises in science and

technology. Knowledge sharing is generally summarized from enterprise, individual, and innovation perspectives, as shown in Figure 2.3 below.

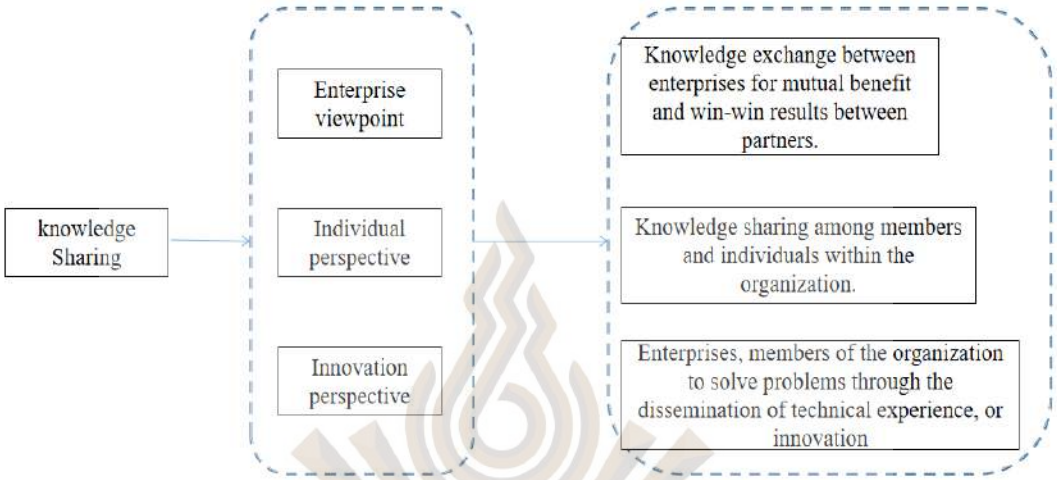

Figure 2.3 Research perspective of knowledge sharing

Source: Researcher, 2022

2.4.2 Influencing factors of knowledge sharing

From the perspective of context, inter-organizational knowledge sharing is influenced by context (Wang & Noe, 2010). Discusses how to continuously encourage members of the QQ knowledge exchange group to share knowledge from context and autonomous motivation. Through structural equation verification, reciprocity, learning, and altruism significantly positively affect the willingness to continue sharing and knowledge sharing. Autonomy support, perceived usefulness, and relevance support indirectly affect the willingness to continue sharing through the mediating effects of different autonomous motivations. A study by Yoon (2020) explored knowledge sharing among hyper-competitive employees. Based on trait activation theory, it is found that social and task-related situational factors can mediate the effects of hyper-competitiveness on politics and job control in knowledge-sharing organizations. (Nikabadiet & Zamanloo, 2012) aim to propose the influence of supply chain strategy and business strategy on knowledge sharing strategy in the supply chain of Iran's automotive industry. The purpose of (Sang et.al.,

2019) is to explore the influence mechanism of job satisfaction and positive influence on knowledge sharing among project members in China's construction industry and to test the moderating effect of organizational commitment between them, to find new ways to continuously improve the performance of knowledge sharing within Chinese project management organizations from the perspective of psychology.

From the perspective of technology, technical resources can promote knowledge-sharing activities. Information technology can facilitate knowledge sharing by facilitating systems and tools to promote knowledge sharing (Seba et al., 2012), (Sudirman,2014) aims to identify and analyze the influences of knowledge-sharing mechanisms, supporting tools or media, cultural approaches, incentives, and inhibitors of knowledge sharing among employees in PTIncoTbk support and engineering Services (SES) in Indonesia. The above results are obtained through data regression analysis. The empirical results of Lekhawipat, Wei & Lin (2018) show that organizational and technical barriers are related to individuals' efforts and abilities in knowledge sharing. Zhang, Chen and Lv (2021) Risk assessment of knowledge sharing among technology alliance partners based on topics. It puts forward that technology alliance is the influencing factor of knowledge sharing risk and establishes the comprehensive evaluation index system of knowledge sharing risk of technology alliance.

From the perspective of employees, there are employee helpfulness and knowledge self-efficacy (Lin, 2007), employee self-efficacy and greed, employee personal motivation, and interpersonal relationships (Sondergaard et al., 2007). As well as the length of contact and interaction between employees, social networks, trust, and differences in employees' cultural backgrounds (Zhang, Sun and Xiang, 2020). Employee trust plays a key role (Alkurdi et al., 2017). Reference to self-determination theory (Wang, Liu & Xing, 2015) examines a model that describes the effects of various types of motivation on employee knowledge-sharing behavior (KSBs). The data analysis of 259 employees in 34 organizations shows that hard reward, soft reward, and organizational benefit altruism are significant factors

affecting employees' subjective responsibility, and soft reward and winning reward are key motivators affecting employees' knowledge sharing.

The above review shows that many factors, such as culture, competition, motivation, technology, incentive, network cooperation, and trust relationships, affect knowledge sharing. Therefore, the factors that influence knowledge sharing cannot be explained from one aspect. Moreover, the existing literature rarely studies knowledge sharing in the innovation process among SMEs. Therefore, the mechanism of knowledge sharing in the innovation process between SMEs needs to be further explored.

2.4.3 Dimensions of knowledge sharing

The The research on knowledge sharing is mainly explained from the aspects of communication and knowledge transformation. Knowledge sharing is transferring knowledge from one party to another (Zhou, 2015). This review mainly expounds on the one-dimensional and multidimensional aspects of knowledge sharing.

Divide it from a one-dimensional perspective. From a one-dimensional perspective, scholars mainly study knowledge-sharing from the perspectives of knowledge-sharing behavior (Lee, 2004), knowledge-sharing attitude (Chow & Chan, 2008), and knowledge-sharing ability (Kim & Lee, 2006). Chinese scholar Jin Hui (2013) studied the relationship between rational behavior and knowledge sharing, indicating that employees' attitudes and subjective norms of knowledge sharing positively affect their willingness to share knowledge.

From a multidimensional perspective. The most classic two-dimensional division is explicit knowledge sharing and implicit knowledge sharing (Reychav & Weisberg, 2010; Wang, L. & Wang, Z., 2012; He, 2021). Many other scholars divided knowledge sharing into knowledge sharing quality and knowledge sharing scope according to the effect of knowledge sharing (Duan, 2018). Through case analysis and empirical analysis, they proved the resource integration ability, alliance network, and

internal mechanism of knowledge sharing, and they put forward substantive suggestions for building the internal mechanism of the industrial alliance. In addition, according to the research needs, other scholars divided knowledge sharing into the following categories: Knowledge sharing identification, knowledge sharing implementation, and knowledge sharing integration (Dai and Hu, 2016) ; General knowledge sharing, general knowledge collection, critical knowledge sharing, and critical knowledge collection (Wang, 2016) ; Exploratory and exploitative knowledge sharing (De Vries, Schepers, Van Weele & Van der Valk, 2014).

Based on the above dimensions, the research object of this paper is small and medium-sized technology-based enterprises. According to the characteristics of high technology, high technology, and high innovation, knowledge sharing is divided into two dimensions: explicit and implicit. There are significant differences between explicit and implicit knowledge sharing in anthems, sharing channels and ways, and the impact on new performance (Li, 2019). Therefore, more valuable research results will be obtained by exploring the anthems and performance results of the influence of enterprise network capability based on knowledge sharing on innovation performance.

2.4.4 Explicit and tacit knowledge sharing

Knowledge sharing refers to the process of communication and discussion between knowledge owners and recipients aimed at expanding the value of knowledge through various channels between strategic alliances (Huo, Mi & Yu, 2019; Hassandoust, Subasinghagem & Johnston, 2022). Knowledge is usually categorized into two types: explicit and tacit (He, 2021).

Explicit knowledge is usually viewed from a rational perspective. It is highly encoded knowledge that can be represented in data, formulas, charts, etc. It can be disseminated and shared among various subjects through books, documents, and other means (Deng et al., 2022). Explicit knowledge is usually easy to store, retrieve, and share and can be disseminated and used through written documents, databases,

software programs, and other means (Eslami, Achtenhagen, Bertsch, & Lehmann, 2023). Based on the literature review, explicit knowledge-sharing practices may include the following (Eslami et al., 2023): network partners refer to published scientific and technical literature for strategic planning, jointly develop product and service specifications, and jointly build product and service databases. In her study, Li Xiaohong (2012) measured explicit knowledge sharing based on the sharing channels of knowledge sharing based on six questions: "There is an Informaionization platform for knowledge sharing in the cluster," "Researchers in the cluster enterprises regularly exchange and cooperate on scientific and technological knowledge," and so on. "etc., with a reliability coefficient of 0.864. This study used a Likert 7-point scale to assess explicit knowledge sharing in four dimensions, based on the scale of He (2021). The table below:

2.4.5 Relationship between Knowledge sharing and innovation performance

Knowledge sharing, as the core of the knowledge management process, indicates that a single enterprise cannot innovate research and develop by itself, and needs to obtain the required

Table 2.4 Scale of explicit knowledge sharing

Numbered	Item
EKS1	Regular sharing with partners: technical research and development/service information
EKS2	Regularly share with partners: information on quality control of technology/services
EKS3	Frequently shared with partners: information on technical components/service details
EKS4	Frequently share with partners: information on market and customer needs.

Source: Sherwood and Covin, 2008

In this study, tacit knowledge sharing refers to knowledge transfer between supply chain partners through face-to-face interactions, shared experiences, observations, and imitations. It is the latent knowledge of individuals in terms of experience, skills, attitudes, beliefs, etc., which is not easily accessible and understood by outsiders (Eslami et al., 2023). Tacit knowledge has low expressive power; it is difficult to encode, transmit, and diffuse and costly to share. Tacit knowledge can only be understood through perception and observation during interactive communication, which takes more time and cost. Due to the great difficulty in collecting and diffusing tacit knowledge, it is challenging to integrate and assimilate knowledge recipients, which creates an obstacle to knowledge sharing. Wang, Wang & Liang (2014), through a survey of 228 Chinese high-tech firms using Structural Equation Modeling (SEM), found that tacit knowledge sharing has a significant impact on the three components of intellectual capital, i.e., human capital, structural capital, and relational capital have significant contributions, while explicit knowledge sharing has only a weak effect on human capital and structural capital. When studying the impact of industry-university research on cooperation performance, Xu (2018) confirmed that explicit knowledge sharing and tacit knowledge sharing play a mediating role in the impact of cooperation performance. This illustrates that tacit knowledge is equally essential for developing science and technology-based enterprises, although not quickly disseminated and valued. Based on the literature review, tacit knowledge-sharing practices may include the following (Eslami et al., 2023). Network partners often collect information from sales and production sites, explore and share new inspirations, communicate frequently to build a common vision, and conduct research and share findings. Li (2012) measured tacit knowledge sharing based on four items: “frequent formal or informal meetings between firms” and “joint research projects by researchers from firms in the cluster,” with a reliability coefficient of 0.887. This study was conducted by He and Guo-Wen (2012), who found that the network partners often collect information from sales and production sites, communicate and share new ideas, and conduct research and share findings. The study used a Likert 7-point scale to assess tacit knowledge sharing in four dimensions based on the scale of He (2021). The table below:

Table 2.5 Tacit Knowledge Sharing Measurement Scale

Numbered	Item
TKS1	Often shared with partners: know-how behind technology/service implementations
TKS2	Often shared with partners: know-how to solve technical/service problems or unexpected technical/service issues
TKS3	Often shared with partners: know-how to break through technical/service problems/technical/service limitations.
TKS4	Often shared with partners: Experience in understanding and judging market and customer needs.

Source: Sherwood and Covin, 2008

2.4.5 Relationship between knowledge sharing and innovation performance

As a core aspect of the knowledge management process, knowledge sharing suggests that individual firms need to help vote, research, and develop independently and access the required resources through external networks. (Hu et.al., 2009) Taking 621 employees of international tourism hotels as survey subjects, the study found that knowledge sharing and team culture can promote the innovative services of tourism workers in the network and continuously improve the service process of the supply side of the tourism industry. (Han, 2019) proved that the key factors of high firms' innovative performance are sharing knowledge with other firms in the same cluster and utilizing dynamic capabilities to absorb, integrate, and create knowledge by studying 238 firms in an industrial cluster belonging to the automotive, optoelectronics, and microwave communications industries in Fujian Province, China.

Many domestic and foreign scholars have verified the impact of knowledge sharing on enterprise performance from inside and outside the enterprise. For example, foreign scholars Afriyie, Duo & Ibn Musah, (2018), by investigating 437 small and medium enterprise service companies operating in the Ashanti and Greater Accra regions of Ghana, confirmed that the type of innovation and knowledge sharing has a significant and vital role in firm performance and that knowledge sharing plays

the role of a full mediator in the Relationship between the type of innovation and the firm's marketing performance. (Yu and Kim, 2020) collected 341 valid questionnaires from members of Chinese subsidiaries of Korean multinational corporations and verified that knowledge sharing positively affects dynamic capabilities and dual dexterity innovation, and dual dexterity innovation has a significant effect on subsidiary performance. The Relationship between dual dexterity innovation and firm performance was verified. Dual dexterity is positioned as the emergence of developmental and exploratory innovations. (Ying, 2021) explored the impact of group citizenship behavior on service innovation performance in the Chinese context based on the mediating role of organizational commitment and knowledge sharing, using the Smart PLS 3.0 statistical software package and validated. However, domestic scholars agree on the Relationship between knowledge sharing and innovation performance. Xu (2021) used Hi-tech SMEs (Small and Medium-sized enterprises) as a survey sample to explore the Relationship between inter-organizational learning, knowledge management process, and innovation performance. It was verified that knowledge sharing, as the core aspect of knowledge management, is where enterprises create, share, and finally utilize knowledge through knowledge creation, knowledge sharing, and knowledge utilization, thus positively affecting enterprise performance. The above studies on knowledge sharing mainly focus on how knowledge sharing affects innovative behavior in organizations.

In the context of network capability, the impact of knowledge sharing on the innovative behavior of enterprises and the joint impact of transactional systems on knowledge sharing and innovative behavior have yet to be studied sufficiently. Wang (2012) established a research model based on 89 high-tech enterprises in Jiangsu Province, verifying that knowledge sharing is not only directly and positively correlated with performance but also affects the innovation of the enterprise, and the innovation, in turn, contributes to the performance of the enterprise. Some scholars from the information people, therefore this paper, with Chinese science and technology-based small and medium-sized enterprises (Hi-tech SMEs) as a sample, in the context of networking, to explore the conceptual model of network capability-knowledge sharing-enterprise innovation performance. (Zhao, Xu, Cai &

Liang, 2020) investigate the Relationship between knowledge sharing and organizational innovation performance, focusing on the mediating role of absorptive capacity and individual creativity. Design/methodology/approach based on the knowledge base view and organizational learning theory (Zhao et al., 2020) proposed a model to validate the effects of inbound and outbound knowledge sharing on organizational innovation performance based on previous studies (Bhatti et al., 2020) in exploring the relationship between high-performance work systems (HPWS), innovation and knowledge sharing in project-based organizations. Adopting the Ability, Motivation, and Opportunity (AMO) framework under the HPWS theory, it is hypothesized that AMO-enhanced practices in project-based organizations lead to an increase in employees' innovative performance through the mediating role of knowledge sharing. (Li, 2020) aimed to investigate the influence mechanism of supply chain relationship quality on knowledge sharing and firms' innovation performance in supply chain collaborative innovation. Based on the literature review (Lo, Tian & Ng, 2021) developed a research model to investigate the relationship between top management support and knowledge sharing and the mediating role of affiliation and trust. Combining the knowledge base view of the firm and the dichotomous perspective of knowledge transfer (Zhang et al., 2021), the relationship between coordination of new product development and innovation success, as well as the mediating roles of knowledge sharing and knowledge hiding, were explored. Based on the social network theory, He (2021) explored the Relationship between knowledge sharing and innovation performance based on previous research with a survey sample of 716 science and technology-based small and medium-sized enterprises (Hi-tech SMEs). Since then, in the context of network capability, many enterprises have begun to study the impact of network capability on innovation performance through the mediating role of knowledge sharing.

2.5 Literature Review on Innovation Performance

2.5.1 Concepts of innovation performance

Since the research object of this study is Hi-tech SMEs, the innovation performance of this study specifically refers to the innovation performance of Hi-tech SMEs. Unless otherwise specified, the innovation performance of this study refers to the innovation performance of Hi-tech SMEs.

Academic research on innovation performance began early, and the Organization for Economic Cooperation proposed three measures of innovation performance in 1997: sales revenue share, sales volume dimension, and revenue from new products. Zhang (2015) believes that enterprise innovation performance refers to the enterprise's competitive advantage realized by the joint action of external relevant policies and internal innovation resources such as talent, technology, and capital. Sun (2013) focuses on the innovation input of enterprises and believes that innovation performance not only includes the efficiency and effectiveness of enterprises' innovation activities but also includes the process results of the interaction of various factors in the innovation process, such as the enhancement of enterprises' innovation capability, the improvement of industrial structure and internal production process, and the generation of new concepts, etc. Lu (2020), from the perspective of innovation output, translates innovation performance into enterprises' innovation resources and resources and then transforms innovation performance into enterprises' innovation resources. From the perspective of innovation output, Lu (2020) transforms innovation performance into innovation resources of enterprises, which are ultimately reflected in the benefits gained by enterprises, i.e: economic output, scientific and technological output, and social output. From the perspective of the innovation effect, some scholars believe that enterprise innovation performance is the innovation success output by the enterprise through technological innovation, and it is

the quantification of innovation results and behaviors (Xu, 2021). It includes the development and implementation of innovation activities. Innovation resources and capabilities are successfully transformed into innovation activities, leading to innovation market success (Wang, 2021). Xiao, Shen & Qian, (2021) defined *innovation performance* as the comprehensive evaluation of innovation activities or outputs accomplished by innovation subjects in a particular environment (under the network) through acquiring innovation resources and knowledge, utilizing them, and actively cooperating with external partners for innovation.

In the above studies, most scholars study from the organizational level, combining innovation performance with new products, services, technologies, and processes (Ernst, 2001). Few scholars cut their research from the perspective of network capability and network relationships. On this basis, this paper conducts an in-depth study on the mechanism of network capability's influence on the innovation performance of hi-tech SMEs.

2.5.2 Influencing factors of enterprise innovation performance

Different scholars have different perspectives on the research of innovation performance influencing factors. Enterprise innovation performance influencing factors are mainly focused on the environment, structure, organization, and individual level 4; enterprises should not only pay attention to R & D indexes but also pay attention to the influence of non-R & D indexes such as the government, the market, the network, and other non-R & D indexes. (Zhan, 2017).

The environmental level mainly refers to the general industrial environment, culture, competition, and other factors. (Sohn, Kim & Jeon, 2016) constructed a structural equation model (SEM) based on a hypothetical national innovation structure with seven factors for inputs (institutions, human capital, research, infrastructure,

market maturity, and business maturity) and outputs (knowledge and technology outputs, and creative outputs), and found that business maturity and infrastructure have the most potent direct and indirect effects on creative outputs, respectively. Du, Yao, Fang & Wang (2018) utilized the data of cross-border M&A deals on technology sourcing initiated by Chinese firms from 2003 to 2012, and the smaller the cultural differences, the smaller the absolute and relative knowledge scale of the target firms, and the larger the size of the M&A, the larger the technological knowledge base of Chinese firms, and the better the innovation performance. The structural level mainly refers to the external relationship embedded in the enterprise, the relationship between the enterprise and its suppliers, customers, and other stakeholders in the industrial chain. Wallin (2017) takes Swiss manufacturing enterprises as an example and analyzes and finds that the enterprise data connected to the external network helps the enterprise to absorb the external knowledge and realize significant benefits from the subsequent innovation. Organizational level: (Aggarwal & Kapoor (2019) The purpose of (Aggarwal & Kapoor, 2019) is to provide an overview of the existing literature on knowledge transfer, to highlight the influencing factors of knowledge transfer mechanisms, and to provide a theoretical framework for studying the impact of knowledge transfer on the innovation performance of strategic alliances. The individual level refers to the effects of factors within the firm on innovation performance, such as technological innovation, R&D teams, and other personal factors. Su et al. (2017) examined data from 310 Chinese-listed firms and suggested that the political ties between entrepreneurs and local governments hurt technological innovation performance. Other influential work. Asgari (2021) aimed to examine the impact of factors influencing open innovation (OI) intensity from three components, namely collaborative innovation, resource search, and external R&D, as well as the effect of OI intensity on SME commercialization performance, including (Wang & Hu, 2020). The above is a review of the research on the factors influencing

firms' innovation performance from four levels: environmental, structural, organizational, and individual.

2.5.3 The relationship between variables

According to the research results of scholars in Chapters 2.1, 2.2, and 2.3, it is widely found that network capability has a direct or indirect effect on innovation performance, and knowledge sharing has a direct or indirect effect on innovation performance. Enterprises with good network capabilities will have a head start in discovering and establishing cooperation. They will be able to manage better and apply the relationship network to realize the effective acquisition and transfer of knowledge and integrate existing knowledge within the enterprise, ultimately enhancing its innovation level (Ren & Tong, 2021).

Jiamin (2019) proposed how network embedding and knowledge sharing work on innovation performance in a network alliance environment and found that knowledge sharing among R&D alliance partners is conducive to core firms' access to external knowledge and skills and enhances their innovation performance; at the same time, in the context of network diversification, strong political ties between the firms and the government can weaken the impact of R&D alliance network on the firm's exposure to potential risks of knowledge leakage and misappropriation. Migdadi (2020) introduced the knowledge management process and integrated the relationship between the knowledge management process (knowledge creation, sharing, storage, documentation, and acquisition), innovation capabilities (product, process, and marketing as well as organizational and organizational performance (operational, financial, and product quality) within the framework of networked environments. The effects of knowledge management processes on innovation capabilities, innovation capabilities on organizational performance, and the effects of knowledge management processes on innovation capabilities were empirically tested. In the international market environment, Chatterjee, Chaudhuri, & Vrontis (2021) investigated the relationship between dynamic capabilities and firms' innovative capabilities through knowledge sharing by taking a multinational subsidiary perspective. In its research

model, absorptive capacity is introduced as a moderating role. It affects the relationship between a firm's knowledge-sharing activities and its dynamic capabilities, such as perceiving, seizing, and transforming. Knowledge sharing is the most critical process in knowledge management, which enables knowledge-intensive organizations to promote innovation and gain competitiveness (Lo et al., 2021). Lu, Deng, Yu, Song, & Liu (2021) explored the mediating role of information sharing and innovation capability in the relationship between network linkages and SMEs' financing performance through a questionnaire survey of 208 finance managers responsible for supply chain finance in Chinese SMEs, verifying how weak and robust linkages in supply chain networks affect SMEs' financing performance through the mediation of information sharing and innovation capability. The above reviews the relationship between network capabilities, knowledge sharing, and innovation performance over the last five years. The research on the network capability on the innovation performance of Hi-tech SMEs is at a preliminary stage, especially the "dark box" of the network capability's influence on the innovation performance of Hi-tech SMEs through knowledge sharing is still in a vague state and needs to be opened urgently.

Many scholars mentioned above have related research results on the impact of network capability, knowledge sharing, and performance. However, there are still some shortcomings, as follows:

(1) Most of the existing research focuses on the innovation of the business model of science and technology-based small and medium-sized enterprises (Hi-tech SMEs) (Liu, 2019), the performance of digital transformation (Zhang, 2022), the construction and operation of enterprise innovation ecosystems (Wang, Liu & Xing, 2015), and the research on the influencing factors of innovation vitality and evaluation (Chen & Zhu, 2015), Moreover, there needs to be more mechanism models, especially quantitative research, for the role of network capabilities in the innovation performance of science and technology-based small and medium-sized enterprises (Hi-tech SMEs). Wang (2017) constructed a research model with an open innovation perspective for the mechanism of the interaction of corporate capabilities

and their competence model, environmental turbulence, and innovation performance, which provides ideas for this paper.

(2) More studies have been conducted on the direct impact of knowledge sharing on the innovation performance of science and technology-based small and medium-sized enterprises (Hi-tech SMEs). However, more research is needed on the mechanism of the mediating role of knowledge sharing in influencing the network capabilities and the innovation performance of science- and technology-based small and medium-sized enterprises (Hi-tech SMEs). Therefore, it is necessary for future research to explore the mediating role of knowledge sharing in influencing innovation performance;

(3) Network capability is an important contextual variable that affects the relationship between the innovation performance of Hi-tech SMEs, and most of the existing studies have used the influence of a single element inside and outside the enterprise on innovation performance. More research is needed on the role mechanism of network capability in influencing the innovation performance of hi-tech SMEs to explain better the relationship between network capability, knowledge sharing, and innovation performance.

2.6 Related Studies

2.6.1 The studies on network capability and innovation performance

The acquisition of firm performance requires firms to develop and utilize the acquired resources effectively and create new products and services. Hagedon (2006) argues that dynamic capabilities can influence the behavior, state, or process of a firm's participation in network activities (Collins & Hitt, 2006), which affects the performance and competitive advantage of the firm's participation in network activities. Dynamic capabilities are several columns that construct, configure, and integrate various resources that match themselves to adapt to changes in the internal and external environment of the market (Huang, Yu & Huang, 2023). This study

continues this logic and considers network capability as an ability possessed by a firm, the skillful ability to acquire and use resources (Wang, Ma & Li, 2023). Previous studies have pointed out that network resources exist in the enterprise network. Therefore, this study considers that the target of network capability is the most important external environment for enterprise innovation, namely the innovation network.

Thus, network capabilities naturally improve the organization of the innovation network in which a firm is embedded and can manage the relationships of cooperative members in the network. Through network capability, various information, resources, technology, and knowledge distributed in the partnership can be effectively integrated, optimized, and innovated. Network enterprises can use the network capabilities to make the innovation network configuration more conducive to the realization of their own goals, i.e., to be conducive to the direction of improving innovation performance.

Under the pressure of limited resources and market competition, the newly entered Hi-tech SMEs are not independent individuals but more subjects that can actively connect with the outside world. The above innovation network can provide critical resources, information, knowledge, etc., for the new entrants of Hi-tech SMEs (Liu & Jiang, 2018); at the same time, within the innovation network, the emotional relationships such as trust that it carries with itself provide a platform for learning and communication for Hi-tech SMEs (Zhou, 2015). Therefore, it can better promote the sharing of all kinds of tacit knowledge, thus contributing to the rapid improvement of the performance of small and medium-sized science and technology enterprises.

(1) Network planning capability and innovation performance

Network planning capability focuses on strategic thinking when participating in an innovation network. Teece (1998) argues that strategic-level planning capability

can accurately grasp market information, determine the goals and directions of enterprise technological innovation, promote the enterprise's active participation in the network activities to build and communicate with partners, and strengthen the enterprise's identity in the network, to obtain deeper information (Liu, 2019). Network planning helps enterprises find the gap between the knowledge they possess and that of others to improve the learning intention and motivation (Greve, 2005) and then improve enterprise innovation performance.

Good network planning ability can help enterprises screen more stable and reliable partners and identify market opportunities from a keen perspective (Xiao, 2013). Enterprises attach importance to innovation activities from the strategic level, which will be reflected in the acquisition of resources, activity layout, and process optimization, which is conducive to the enterprise to conduct innovative activities to guide and play a role in promoting enterprise learning, which in turn improves innovation performance (Karabulut, 2015). Ma and Gao (2016) suggest that more robust network planning capabilities have a more comprehensive range of channels, allowing enterprises to have more opportunities for innovation and enabling resource integration through enterprises to support the development and implementation of innovation. For Hi-tech SMEs (Small and Medium Enterprises), network planning capabilities enable them to plan their network behavior and allocate appropriate resources according to their goals. Innovation performance is promoted through good interaction in the network, product innovation, patent innovation, and new technology development. Based on the above analysis, hypothesis H1a is derived.

H1a: Network planning ability positively affects the innovation performance of hi-tech SMEs.

(2) Network relationship capability and innovation performance

Relationship management capability is embodied in the diversified network cooperation and innovation relationship, the ability of enterprises to deal with property rights, interests, and responsibilities to carry out, coordinate, and optimize the cooperation relationship, including relationship exchange, relationship optimization, and relationship coordination (Ren, 2011). In the process of network development, enterprises need to continuously search and screen potential partners, as well as continuously maintain cooperative relationships and deal with cultural differences and geographical or business philosophy differences, which are reflected in the enterprise's relationship management capabilities (Moller & Halinen, 1999). If the above is not handled well, it may increase the cost of business operations, and problems such as unclear property rights, unclear responsibilities, and communication difficulties may occur, thus affecting innovation performance.

Effective network relationship capabilities not only help enterprises to select and evaluate network partners to gain knowledge (Wang, 2017) but also help network enterprises to establish direct links. This link can establish the identity confirmation mechanism of partner enterprises, which is the active participation of network members in the network, improving partners' information exchange and knowledge sharing (Hou & Gao, 2022).

From the perspective of resources, an enterprise's innovation level and performance depend on the resources it owns and has at its disposal (Fang, 2008). A high level of network relationship ability helps to resolve conflicts in the cooperative network. It is conducive to forming a relationship of mutual trust and mutual benefit, which leads to smoother access to the resources required by the enterprise. For example, the closer the relationship with the supplier, the better the enterprise can evaluate and judge the extent to which the resources provided by the supplier meet the needs of the enterprise (Wang & Song, 2020). Therefore, Hi-tech SMEs (small and medium-sized enterprises) have a higher demand for innovation needs and

heterogeneous resources, so having better network relationship capabilities can help enterprises obtain heterogeneous resources, resolve conflicts, and develop mutually trusting and mutually beneficial cooperative relationships to gain competitive advantages for enterprises. Based on the above analysis, hypothesis H1b is derived.

H1b: Network relationship capability has a positive effect on innovation performance

(3) Network Possession Capability and Innovation Performance

Enterprises with network occupancy ability can occupy a position at the center of the network, shorten the connection path with other network members (Xin, 2017), and thus improve the efficiency of learning from each network partner. Firms occupying a position at the center improve the firm's reputation, usually obtain more channels of information than other firms, and improve the accuracy of mastering information (Yu, 2020). (Yu, 2022) used 227 Chinese innovation network firms as a sample to examine the role of "collective reputation perception" as a critical variable in promoting innovation performance. As the reputation status of a firm increases, other firms are willing to exchange information with high-reputation firms, which inevitably overflows some essential information and technologies, which is favorable to the innovation and development of Hi-tech SMEs. The network occupancy capability helps firms to be centrally located in the innovation network, and it effectively establishes a firm's network position in terms of its relative position to other network members. Therefore, for Hi-tech SMEs (small and medium-sized enterprises), network dominance capability improves the density (Gang, 2008), strength, and longevity (Dhanaraj & Parkhe, 2006) of the connections between Hi-tech SMEs and network members, which can improve the level of innovation performance of the firm. Based on the above analysis, hypothesis H1c.

H1c: Network occupancy capability has a positive effect on innovation performance

(4) Network utilization ability and innovation performance

By utilizing internal and external networks, enterprises can improve innovation efficiency and realize the improvement of innovation. The improvement of innovation efficiency is reflected both externally and internally. Externally, the research of Ma and Dong (2011) also proves the role of network capability in the acquisition of adequate external information and the realization of mutual benefits in multi-party cooperation. In order to achieve superior innovation performance, organizations must combine internal R&D strategies with the knowledge available in the supply network. (Narasimhan & Narayanan, 2013), based on absorptive capacity and duality theory, suggest how firms can effectively combine their internal innovation activities with the available knowledge in the supply network to obtain superior innovation results and thus achieve innovation goals. (Parida & Örtqvist, 2015), based on regression analysis of survey data from Hi-tech SMEs (small and medium-sized enterprises), verified the impact of network capabilities (ability to leverage external relationships), ICT capabilities (ability to use strategically for business purposes) and financial slack (unused and uncommitted financial resources) on the innovation performance of small firms. Internally, network capabilities help to improve the ability to communicate between business sectors. Whether it is the communication of internal technology or administrative capacity at the managerial level, it can affect innovation performance by improving technical skills and, thus, innovation performance. Based on the above analysis, hypothesis H1d is derived.

H1d: Network utilization capability is positively correlated with innovation performance.

2.6.2 The studies on network capability and knowledge sharing

Knowledge sharing (explicit and tacit knowledge sharing) refers to the donation and collection of knowledge between different knowledge departments in Hi-tech SMEs (Miao, Shi & Yao, 2016). Sharing one's insights is a typical behavior of employees, divided into formal knowledge, informal knowledge, donated knowledge, and knowledge collection elements (Xu, 2021). Knowledge sharing is more important than knowledge creation because knowledge is retained in employees and is only as crucial once this knowledge is shared and applied (Al-Husseini & Elbeltagi, 2015).

(1) Network Planning Caompetencies and Knowledge Sharing

Network planning capability focuses on strategic thinking. This capability enables organizations to select partners, establish partnerships, and maintain stable relationships based on the overall strategy for business development (Fang, 2008). Enterprises with solid network planning ability can clarify development goals, collect partners (Liu, 2019), plan network partnerships, and search for information, knowledge, technology, and capabilities that meet enterprise development needs (Sha & Zhou, 2013). At the same time, enterprises with strong network planning ability can ensure the matching of both partners' resources in the cooperation process and explore more heterogeneous resources (Liu, Yuan & Sun, 2023). Based on the common interests of the partners, explicit and implicit knowledge sharing can be realized to promote the formation of innovative achievements. Maintaining cooperation with more other potential cooperative enterprises, the more potential contact cooperative enterprises, the more it can reduce the irreplaceability of existing partners and promote the enterprise to become a link between other partners, which is conducive to the formation of more opportunities for explicit and tacit knowledge sharing between the enterprise and its partners (Xu, 2018). Based on the above reasons, this paper proposes the following hypotheses.

H2a: Network planning capability has a positive effect on explicit knowledge sharing

H2b: Network planning capability has a positive effect on tacit knowledge sharing

(2) Network Relationship Competence and Knowledge Sharing

Network relationship competencies emphasize coordinating specific partnerships (He, 2021). Moller and Halinen (1999) argue that by building competencies oriented toward network management, portfolio management, and relationship management, network firms can establish trust and information-sharing mechanisms among partners, thereby increasing the knowledge that firms obtain from their network partners. In the absence of trust and proper incentives for employees, knowledge is seldom shared, and in this case, even when it is shared, it is seldom implemented or applied. In this case, innovation and risk-taking stop, organizational cooperation and alliances cease, and Hi-tech SMEs cannot create innovative performance. With all kinds of emotional support among network members, mainly the excellent exchange and communication platform constructed by entrepreneurial networks, the rapid spillover and sharing of all kinds of tacit knowledge can be better facilitated, which is also conducive to the enhancement of the entrepreneurial performance of small and medium-sized science and technology enterprises (Tu, Wang, and Zhang, 2019).

Network relationship capability can, on the one hand, timely and adequately resolve contradictions, disagreements and even conflicts between Hi-tech SMEs and specific partners (Xu, 2021), maintain regular cooperation between Hi-tech SMEs and specific partners, reduce uncertainty, and thus promote the entrepreneurial performance of Hi-tech SMEs and their partners' entrepreneurial performance, and

realize the sharing of explicit and tacit knowledge (Zhao, Xu, Cai & Liang, 2020); on the other hand, the relationship management capability can further stimulate the partners' enthusiasm for cooperation and innovation, and promote further exchanges of knowledge and technology between the two parties, to realize their mutual goals and enhance the innovation performance of the enterprises (Miao, Shi, &Yao, 2016).

Based on the above reasons, this paper puts forward the following suggestions.

H2c: Network relational competence has a positive effect on explicit knowledge sharing

H2d: Network relationship competence has a positive effect on tacit knowledge sharing

(3) Network occupancy ability and knowledge sharing

Network occupancy ability can occupy a crucial position in the network and become the focal point of knowledge and information flow of network members. Thus, it can obtain the latest technological information (Fang, 2010). As new entrants, Hi-tech SMEs face many challenges in their development and growth in the market environment of resource scarcity and fierce competition. The network occupancy ability can help Hi-tech SMEs occupy the core position, proactively pool resources, and quickly compensate for the disadvantages of new entrants. By occupying a core position, enterprises can analyze the accuracy of multi-channel information and thus improve the accuracy of information acquisition (Bell, 2005).

On the other hand, as mentioned above, network occupancy can improve the reputation of hi-tech SMEs. The partners in the network are always willing to exchange information and technology with high reputation and high and low position firms. In the process, the critical information and technology resources are inevitably

overflowed. Therefore, this dramatically increases the probability and scope of knowledge sharing. Based on the above reasons, this paper makes the following assumptions.

H2e: Network occupancy capacity has a positive effect on explicit knowledge-sharing

H2f: Network occupancy ability has a positive effect on tacit knowledge sharing

(4) Network Utilization Ability and Knowledge Sharing

For enterprises, tangible resources, including material resources, are limited. In contrast, intangible resources such as knowledge, technology, and information can be reused, and new, valuable resources can be created in the process of reuse (Liu, 2007).

Li (2022) points out that the sharing of scientific and technological resources is the behavior of enterprises through the integration of existing resources to make scientific and efficient use of them and constantly push forward the new so that their value continues to increase. Therefore, knowledge resources are scientific and technological, and knowledge sharing is closely related to the enterprise's ability to utilize resources. Enterprises reapply the knowledge resources acquired through knowledge sharing to practice and expand them through employee learning. They then exchange them with employees of other enterprises so that internal skills and external knowledge are deeply integrated to produce innovative results (Xing, Wang, Zhu, & Zhang, 2019). These innovative results obtained through value creation can be further used as high-quality resources for enterprises to share knowledge externally, which is conducive to Hi-tech SMEs to exchange core knowledge from partners to better meet their own needs and interests and can expand the exchange channels of

knowledge resources, which not only improves the quality of knowledge sharing but also broadens the scope of knowledge sharing.

Based on the above reasons, this paper makes the following hypotheses.

H2g: Network utilization ability has a positive effect on explicit knowledge sharing

H2h: Network utilization ability has a positive effect on tacit knowledge sharing

2.6.3 The studies on Knowledge sharing and innovation performance

The key to innovation activities is to apply new knowledge to commercialize and create value forHi-tech SMEs (Feng, Zhang & Sun, 2017). Corporate innovation activities imply the process of members contributing tacit technologies and knowledge to create and validate new products. Finally, the knowledge gained by individuals in the innovation process is disseminated to different departments and even to different organizations. Knowledge sharing is the donation and collection of knowledge between different knowledge departments inHi-tech SMEs (Miao, Shi & Yao, 2016). Sharing one's insights is a common behavior of employees. Knowledge sharing is more important than knowledge generation because knowledge is retained among employees and it is not as important until this knowledge is shared and applied (Al-Husseini & Elbeltagi, 2015). Therefore, knowledge sharing is one of the main forms of reducing uncertainty when reforming technological systems.

Knowledge sharing can promote innovation in teams, departments, or entire organizations (Wu, Sun & Liu, 2017). This is because, knowledge sharing facilitates the flow of knowledge among employees, which makes the amount of information

within the enterprise grow exponentially, which helps the members of the organization to obtain more knowledge and lays the foundation for the generation of innovative ideas (Qammach, 2016). Moreover, due to the differences in the knowledge possessed by different employees within the organization, employees in the process of knowledge communication and exchange can obtain a broader vision of thinking, deepen the understanding of the different knowledge encountered, thus sparking ideas and generating new ideas about products, services, and workflows (Lan, Qu & Xia, 2020), which in turn improves the performance of the enterprise through innovation. Most SMEs are small and micro-enterprises, with simple personnel composition and flatter organizational structure, which provides convenient conditions for knowledge exchange and sharing among employees, and it is easy to form an organizational learning atmosphere of knowledge sharing, which is more conducive to the role of knowledge sharing in promoting innovation and performance enhancement. Based on this, this paper proposes the following hypotheses.

H3a: Explicit knowledge sharing has a positive impact on the innovation performance of Hi-tech SMEs.

H3b: Tacit knowledge sharing has a positive effect on the innovation performance of SMEs.

2.6.4 The mediating role of knowledge sharing

This chapter discusses the influence of the four dimensions of network capability on the innovation performance of Hi-tech SMEs and the influence of the four dimensions of network capability on knowledge sharing (explicit and tacit knowledge sharing). Based on the definition of mediating variables, it can be deduced that the four dimensions of network capabilities affect the innovation performance of

Hi-tech SMEs through the mediating role of knowledge sharing (explicit and tacit knowledge sharing).

(Afuah, 1998; Chen, 2017; Feng Weiyi et al., 2017) suggested that the key to innovation activities is to apply new knowledge to commercialize and create value for Hi-tech SMEs. Firms' innovation activities imply how members contribute tacit technologies and knowledge to create and validate new products. Finally, the knowledge individuals gain in innovation is spread to different departments and organizations. (Casanueva, Castro, & Galán, 2013; Jian & Wu, 2018) Both point out that knowledge sharing and enhanced knowledge utilization can improve innovation performance. In product development, innovation enhances communication and interaction among members, which triggers the need for knowledge and the development of various knowledge activities for knowledge integration. Therefore, KM (including knowledge sharing) has a typical relationship with innovation activities. Knowledge management improves innovation and organizational performance by enabling an environment for creating, acquiring, sharing, organizing, and utilizing knowledge (Andreeva & Kianto, 2011).

Knowledge sharing is the donation and collection of knowledge between different knowledge departments in technology-based Hi-tech SMEs (Becerra-Fernandez, Sabherwal, 2010; Miao Qing et al., 2016). Sharing one's insights is a typical behavior of employees, which can be classified into formal knowledge, informal knowledge, donated knowledge, and knowledge collection elements (Taminiau et al., 2009). Knowledge sharing is more important than knowledge generation because knowledge is retained among employees, which is only as crucial once this knowledge is shared and applied (Al-Husseini & Elbeltagi, 2015). (Wang, 2017) studied the complex relationship between critical factors affecting firms' innovation performance in supply chain networks with 236 Chinese firms and verified that knowledge sharing partially mediates the relationship between collaborative

innovation activities and firms' innovation performance through multiple regression. (Kim & Shim, 2018) aimed to determine the structural relationship between social capital, knowledge sharing, innovation and SMEs performance in tourism clusters, confirming that knowledge sharing positively impacts SMEs performance through innovation.

Enterprises can obtain more information about market and customer information, industrialized application of knowledge technology, and related technical guidelines and principles from each other through explicit knowledge sharing with partners. In contrast, enterprises can obtain more experience in market and customer information and industrialized application techniques of knowledge technology from each other through tacit knowledge sharing with partners. Thus, both explicit and tacit knowledge sharing are beneficial to accumulating valuable knowledge resources between both parties, enhancing their respective innovation capabilities. Based on the above reasons, this paper makes the following hypotheses.

H4a: Explicit knowledge sharing has a mediating role in network planning capability and innovation performance of Hi-tech SMEs.

H4b: Explicit knowledge sharing mediates between network relationship capability and innovation performance of Hi-tech SMEs.

H4c: Explicit knowledge sharing mediates between network occupancy capacity and innovation performance of Hi-tech SMEs.

H4d: Explicit knowledge sharing mediates between network utilization capability and innovation performance of Hi-tech SMEs.

H4e: Tacit knowledge sharing mediates between network planning capability and innovation performance of Hi-tech SMEs.

H4f: Tacit knowledge sharing mediates between network relationship capability and innovation performance of Hi-tech SMEs.

H4g: Tacit knowledge sharing mediates between network occupancy capability and innovation performance of Hi-tech SMEs.

H4h: Tacit knowledge sharing mediates between network utilization ability and innovation performance of Hi-tech SMEs.

2.7 Research Framework

Based on the above research review and referring to the research results, this chapter deeply discusses how the network capability affects the innovation performance of small and medium-sized technology-based enterprises. Significantly, the mediating effect of knowledge sharing (explicit and implicit knowledge sharing) on the above paths is emphasized. Figure 2.4 below.

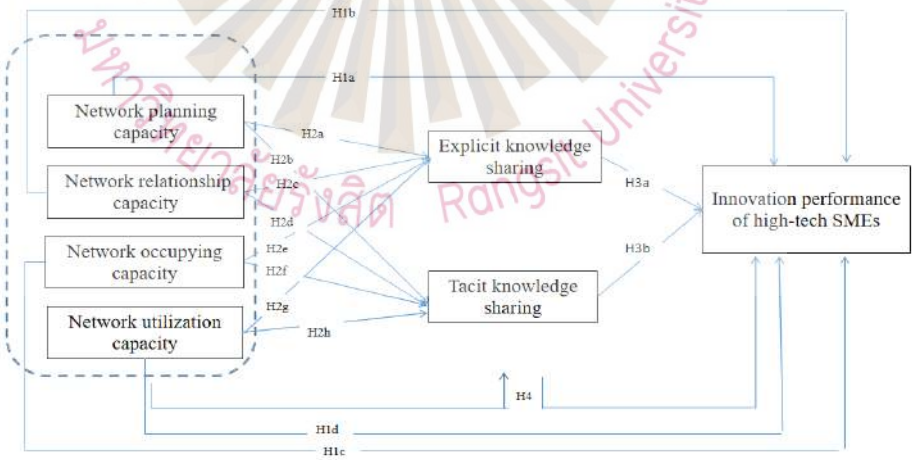

Figure 2.4 Construct Research Framework

Source: Researcher, 2023

The relationship among variables in Figure 2.4 above shows that the focus of this study is divided into the following parts.

1) Research on network capability and innovation performance of Hi-tech SMEs. Network capability can realize the dynamic allocation and integration of information, knowledge, technology, creativity, and other resources for the innovation of Hi-tech SMEs (Lavie, 2007, 2009). Moreover, this will be conducive to enhancing the value of Hi-tech SMEs; that is, network capability can directly impact the innovation performance of Hi-tech SMEs.

2) The impact of knowledge sharing on the innovation performance of Hi-tech SMEs. Knowledge sharing improves the rate of employees' creation, sharing, and utilization of knowledge, which will give full play to employees' abilities and thus have a particular impact on the innovation of Hi-tech SMEs; that is, knowledge sharing can affect the innovation performance of Hi-tech SMEs.

3) The mediating role of knowledge sharing. In the interaction mechanism between network capability and the innovation performance of Hi-tech SMEs, knowledge sharing plays a bridging role; that is, network capability impacts the innovation performance of Hi-tech SMEs through knowledge sharing. Knowledge sharing accelerates the creation and sharing of knowledge within SMEs, and knowledge sharing can promote the utilization efficiency of knowledge, which has a particular impact on the innovation performance of SMEs.

4) The direct effect of network capability on knowledge sharing. Enterprises with solid network capability can ensure the matching degree of resources of both parties in the cooperation process, excavate more heterogeneous resources (Vassolo, Anand, and Folta, 2004). deal with conflicts among members, coordinate relations, and thus facilitate knowledge sharing among members. According to the theory of knowledge sharing (explicit knowledge sharing and implicit knowledge sharing), the innovation activities of enterprises and partners need the interaction and communication of both sides in information, knowledge, technology, and other fields

to achieve the integration of knowledge and technology, and then create more new products and services.

Table 2.6 Summary of research hypotheses

Hypothetical content	**Hypothetical content**
H1a	Network planning ability has a positive impact on innovation performance.
H1b	Network relationship ability has a positive effect on innovation performance
H1c	Network occupying capacity has a positive effect on innovation performance
H1d	Network utilization ability has a positive promoting effect on innovation performance.
H2a	Network planning ability has a positive effect on explicit knowledge sharing
H2b	Network planning ability has positive influence on tacit knowledge sharing
H2c	Network relationship ability has positive influence on explicit knowledge sharing
H2d	Network relation ability has positive influence on tacit knowledge sharing
H2e	Network space occupying ability has a positive effect on explicit knowledge sharing
H2f	Network occupying capacity has a positive effect on tacit knowledge sharing
H2g	Network utilization ability has a positive effect on explicit knowledge sharing

Table 2.6 Summary of research hypotheses (Continued)

Hypothetical content	Hypothetical content
H2h	Network utilization ability has a positive influence on tacit knowledge sharing
H3a	Explicit knowledge sharing has a positive impact on innovation performance of SMEs
H3b	Tacit knowledge sharing has a positive impact on innovation performance of small and medium-sized technology-based enterprises
H4a	Explicit knowledge sharing plays an intermediary role between network planning ability and innovation performance of high-tech SMEs
H4b	Explicit knowledge sharing plays an intermediary role between network relationship ability and innovation performance of high-tech SMEs
H4c	Explicit knowledge sharing plays an intermediary role between network space occupying ability and innovation performance of high-tech SMEs
H4d	Explicit knowledge sharing plays an intermediary role between network utilization ability and innovation performance of high-tech SMEs
H4e	Tacit knowledge sharing plays an intermediary role between network planning ability and innovation performance of high-tech SMEs
H4f	Tacit knowledge sharing plays an intermediary role between network relationship ability and innovation performance of high-tech SMEs

Table 2.6 Summary of research hypotheses (Continued)

Hypothetical content	Hypothetical content
H4g	Tacit knowledge sharing plays an intermediary role between network space occupying ability and innovation performance of high-tech SMEs
H4h	Tacit knowledge sharing plays an intermediary role between network utilization ability and innovation performance of high-tech SMEs

Chapter 3

Research Methodology

This paper uses the quantitative method as the primary data collection method. The tools used include questionnaires that pass many tests. Quantitative research suits this topic because the more tissues, the more reliable the analysis results. This chapter focuses on the preliminary data preparation required for empirical research, including research design, study population, data collection, and development of survey tools and measurement scales. In the last section, statistical methods are discussed. This study uses the structural equation model to verify the hypothesis.

We collected the data in the early stage by arranging the questionnaire, thinking about the questions repeatedly, and adopting efficient questionnaire methods. By reading much relevant literature, we determined the variable measurement method for this study. Among them, the variables mainly include network planning ability, network relationship ability, network occupying ability, network utilization ability, explicit knowledge sharing, tacit knowledge sharing, and enterprise innovation performance, which are seven detailed indicators. This study uses a structural equation model to reflect the impact of network capability and knowledge sharing on the innovation performance of Hi-tech SMEs.

3.1 Population and Samples

3.1.1 Population

The population of this study comes from Hi-tech SMEs that have been established for more than three years, have innovative behaviors, or have specific extensive data capabilities. These Hi-tech SMEs satisfy two conditions: first, they have high technological content and obvious technological attributes, which often require enterprises to invest a large amount of financial support in R&D and innovation; second, they rely on a certain number of scientific and technological personnel to engage in scientific and technological research and development activities, and obtain independent intellectual property rights and transform them into high-tech products or services. On the official website of the provincial science and technology management department, the evaluation indexes are described in detail in the context of the times, including the three categories of scientific and technological personnel, scientific and technological achievements, and R&D investment. The provincial science and technology management departments declare and scrutinize the list of eligible science and technology-based small and medium-sized enterprises. The list is then publicized on the official website of the provincial science and technology department.

The industries in which the subjects of this study are located are mainly from East China, consisting of 140,000 SMEs of science and technology whose organizations are registered with the Market Supervision Bureau and audited by the Ministry of Science and Technology of the People's Republic of China (Ministry of Science and Technology of the People's Republic of China, 2021). Because these regions are economically active, the industries in which the sample enterprises are located include biomedical, electronic information, new materials, new energy, optoelectronics, etc., which means that the sample enterprises selected for the research are well represented.

3.1.2 Sample Size

The research sample comes from the non-probability sampling-snowball sampling method, and the unit of analysis is at the organizational level. The following describes the 440 sample organizations.

Step 1: Check the conditions. Because a sufficient sample size will make the results more reliable, this sample comes from Hi-tech SMEs audited and approved by the Provincial Department of Science and Technology. According to the minimum number of samples for structural equation modeling cited by Bollen (1989) for analysis, he suggested that the number of samples and parameters should be considered. Thus, the number of samples will be proportional to the number of parameters. According to Silpcharu (2005), the present study meets the conditions for calculating the sample size using Yamane's sample size. The reasons for this are as follows: first, because our overall capacity is determined (source NSO); second, Yamane's formula effectively avoids the problem of too large or too small a sample size, thus ensuring the accuracy and reliability of the findings. Thirdly, it allows the researcher to set the error tolerance flexibly according to his/her needs and conditions, thus resulting in a more accurate and practical sample size.

Step 2: This paper used Yamane's sample size formula to estimate the sample size (1970 cited in Silpcharu, 2005).

Yamane's sample size formula (1970 cited in Silpcharu, 2005)

$$n = \frac{N}{(1 + Ne^2)} \tag{3-1}$$

N is the total population, n is the sample size, and e is the acceptable error. The total number of Hi-tech SMEs in East China is the total number of 140,000

(National Bureau of Statistics of China, 2023), with an acceptable error of 5%. Therefore, the minimum sample size was calculated to be 400 and the effective sample size for this study was 440.

3.1.3 Sampling method

The sampling method used to collect questionnaires was mainly a non-probability sampling-snowball sampling method. The main reason is that this method effectively expands the scope of the study and is particularly suitable for finding those groups that are less likely to be directly contacted or have relatively little information in Hi-tech SMEs (Ren, 2010).

The snowball sampling method, or crony sampling or recommendation sampling, is used to find respondents in a sparse total. It is mainly applied to totals where the distribution of units could be more concentrated and more accessible, such as science and technology-based small and medium-sized enterprises (SMEs), a particular type of business. The principle of this method is that some respondents are randomly selected and interviewed first. Then, they are asked to provide some other respondents belonging to the target aggregate under study, and the respondents, after that, are selected according to the clues formed (Ren, 2010). In this way, the sample is like a snowball, changing from small to large and gradually covering a more comprehensive research group. The specific steps are as follows:

First, determine the initial sample. First, we contacted the relevant government departments (Provincial Department of Science and Technology, Provincial Administration of Market Supervision) to obtain representative SMEs of science and technology in the region, and the relevant departments helped to distribute the questionnaires; The relevant departments help to distribute questionnaires; at the same time, MBA and EMBA students in several universities screen out those who

meet the conditions and invite them to fill out questionnaires in the above list of students; we can also rely on the resources that the members of the group have, and ask them to fill out questionnaires from their alums who work in Hi-tech SMEs. It is also possible to use the resources available to the research group members to distribute the questionnaire to the alums and their colleagues working in science and technology-based small and medium-sized enterprises (Zhang, 2023).

Second, conduct a preliminary investigation: conduct an in-depth investigation on the initial samples to understand their business situation, technological innovation ability, market strategy, and other information. At the same time, ask them whether they know other Hi-tech SMEs with similar characteristics or situations and ask them to provide contact information or relevant information about these enterprises.

Third, expand the sample scope. Find new Hi-tech SMEs through the above methods, conduct further distribution, and ask them again whether they know other related enterprises. In this way, the sample keeps expanding like a snowball.

Fourth, continue until the research needs are met. The above process was repeated continuously until the sample size or coverage met the research needs. Throughout the process, a wide range of enterprises from different regions and industries were selected to ensure that the sample enterprises come from diverse sources and the accuracy and reliability of the research results (Xu, 2021).

3.2 Research Instrument

A questionnaire survey is a kind of data collection method that is simple, convenient, and flexible. It is widespread in academic research and is also a general way for researchers to obtain first-hand data for empirical research. In order to ensure

the reliability and reference significance of the research results, the questionnaire design should follow the principles of science and rationality (He, 2021). The study used an electronic survey to collect data, which was distributed through Questionstar.

In order to measure the variables of this study objectively, realistically, accurately and scientifically as far as possible, the scale design mainly follows the following principles on the basis of referring to the mature methods at home and abroad :(1) As far as possible, refer to scales that are directly related to the main variables of this study, have high reliability and validity values and have been widely verified; (2) The structure of the questionnaire items should be reasonable, and items with similar themes and similar scales should be arranged together as far as possible to avoid thinking jumps of the respondents; (3) The statement content of the measurement item should be easy to be understood by the survey object to avoid ambiguity in the text content; (4) The questionnaire items should involve the privacy of the respondents; (5) The questionnaire items will be modified and improved by experts and academic teams at last, and (6) the reliability and validity of small samples will be tested after the examination. Finally, a large-scale formal questionnaire survey was conducted.

This study adopts the Likert seven-level scoring method, that is, "1" represents strongly disagree, "2" means disagree, "3" means somewhat disagree, "4" means neither agree nor disagree, "5" means somewhat agree, "6" means agree, "7" means strongly agree.

Questionnaire design is usually carried out in three steps:

First, based on reading the critical literature at home and abroad, the relevant variables were sorted out, and the content validity of the variables was clarified.

Second, consult experts and academic teams. The topic and variable concepts will be studied to consult expert opinions, and whether the content is accurate and complete will improve the reliability of the questionnaire design.

Third, communicate with middle and senior managers of high-tech SMEs, check whether the language of the questionnaire is easy to understand, remove ambiguity, judge whether the item Settings are reasonable, and modify appropriately to determine the final questionnaire (Wang & Hu, 2017).

3.3 Measurement

3.3.1 Network capability

The dimension of network capability in this study refers to the dimension division of network capability by Fang (2008), He (2021), Moller and Halinen (1999), etc. The network capability is divided into four dimensions: network planning capability, network relationship capability, network occupying capability, and network utilization capability. In this paper, based on improving the researchers above, the measurement is carried out based on 16 items. Ritter, Wilkinson & Johnston (2002) first divided network capability into two large dimensions (task execution and qualification conditions) and four sub-dimensions and measured the network capability based on 22 items. According to their research results, the network capability of the four sub-dimensions had high reliability and validity measurement indicators. Walter, Auer & Ritter (2006) divided network competence into four dimensions: enterprise relationship skills, awareness of partnership, internal communication ability, and collaboration arrangement, and measured them based on 19 items. According to their research results, the network competence of these four sub-dimensions has high reliability and validity measurement indicators.

A domestic scholar, Zhang (2015), constructed 21 items from four dimensions, including network vision ability, network construction ability, relationship optimization ability, and portfolio management. Based on Xu & Wu (2014) divided the dimensions of network capability into three dimensions: network conception capability, network role capability, and network positioning capability, and measured them based on 15 items. Zhang, Jiang, Wu, & Li, (2018) measured network capability by six network connection items and five network scale items. He (2021) sets network vision ability, network construction ability, portfolio management ability, and relationship management ability and measures them based on 19 items. Liao, Jin, Jiang & Gao (2023) Based on the reference Walter, the network competence scale is divided into 12 items, which are as follows: 1) Being able to share resources with partners through network relationships 2) understanding the goals, potential and strategies of our partners 3) We can identify potential partners 4) We can build good relationships with our business partners 5) We are flexible in dealing with our partners 6) We can solve problems with our partners 7) We understand our partners 'markets 8) We understand our partners' products/programs/services 9) We know the potential and weaknesses of our competitors 10) Internal communication is usually cross-project and cross-domain 11) Company management and employees can provide timely feedback 12) internal communication is usually spontaneous.

The following initial scale is proposed based on the dimensions and item settings of network capability proposed by the above scholars, combined with the reliability and validity indicators required by this research. Dimension of network capability in this study refers to the dimension division of network capability by Fang (2008), He (2021), Moller and Halinen (1999), etc. The network capability is divided into four dimensions: network planning capability, network relationship capability, network occupying capability and network utilization capability. In this paper, on the basis of improving the aforementioned researchers, the measurement is carried out

based on 16 items. Ritter et al. (2002) first divided network capability into two large dimensions (task execution and qualification conditions) and four sub-dimensions, and measured the network capability based on 22 items. According to their research results, the network capability of the four sub-dimensions had high reliability and validity measurement indicators. Walter et al. (2006) divided network competence into four dimensions: enterprise relationship skills, awareness of partnership, internal communication ability and collaboration arrangement, and measured them based on 19 items. According to their research results, the network competence of these four sub-dimensions has high reliability and validity measurement indicators.

A domestic scholar, Zhang (2015), constructed a total of 21 items from four dimensions, including network vision ability, network construction ability, relationship optimization ability and portfolio management. Based on Xu & Wu (2014) divided the dimensions of network capability into three dimensions: network conception capability, network role capability and network positioning capability, and measured them based on 15 items. Zhan et al. (2018) measured network capability by six items of network connection and five items of network scale. He (2021) sets network vision ability, network construction ability, portfolio management ability and relationship management ability, and measures them based on 19 items. Liao, Jin, Jiang & Gao (2023) Based on the reference of Walter, the network competence scale is divided into 12 items, which are as follows: 1) Being able to share resources with partners through network relationships 2) we understand the goals, potential and strategies of our partners 3) We are able to identify potential partners 4) We are able to build good relationships with our business partners 5) We are flexible in dealing with our partners 6) We are able to solve problems with our partners 7) We understand our partners' markets 8) We understand our partners' products/programs/services 9) We know the potential and weaknesses of our competitors 10) Internal communication is usually cross-project and cross-domain 11) Company management and employees are able to

provide timely feedback 12) internal communication is usually spontaneous.

Based on the dimensions and item Settings of network capability proposed by the above scholars, and combined with the reliability and validity indicators required by this research, the following initial scale is proposed.

Table 3.1 Measurement scale of Network capability

Variable dimension	**Serial number**	**Measurement content**	**Measurement basis**
Network planning capacity	NPC1	We are good at analyzing the degree of matching between our own development strategy and network resources.	Cenamor, Parida & Wincent (2019) Wu & Xu (2001), Mu (2016); Freeman (1977), Owen-Smith (2004); Fang (2008)
	NPC2	We are keen to identify cooperation opportunities in development	
	NPC3	We have clear goals and guidelines for cooperation	
	NPC4	We know our strategy for building long-term relationships with potential partners	
Network	NRC1	We emphasize that cooperation is based on trust	

Table 3.1 Measurement scale of Network capability (Continued)

Variable dimension	Serial number	Measurement content	Measurement basis
relationship capacity	NRC2	We know our strategy for building relationships with potential partners	
	NRC3	Compared with its peers, the company has more partners of all types, including universities, research institutes, essential suppliers and customers in the industry	
	NRC4	We can properly manage differences and conflicts in the network of cooperation	
Network occupying capacity	NOC1	We have a solid ability to occupy a central position in the network of partnerships	Liu (2019); Liao Minchao, Jin Jiamin, Jiang Yushi & Gao (2023); Wu (2015); He (2021)
	NOC2	We often act as a bridge between other partners	
	NOC3	We can communicate quickly with all our partners without relying on third parties to deliver information.	
	NOC4	We were able to occupy a central position and get more resources	

Table 3.1 Measurement scale of Network capability (Continued)

Variable dimension	Serial number	Measurement content	Measurement basis
Network utilization capacity	NUC1	Can we think about how to develop the relationship from the perspective of partners	
	NUC2	We have a solid ability to develop mutual trust and mutual benefit with our partners	
	NUC3	Within an enterprise, departments often exchange information and resources to accomplish tasks together (reverse problem). Enterprises always need to rely on third parties to communicate with partners	
	NUC4	The contracted partners rarely take the initiative to break off the cooperative relationship with the enterprise	

3.3.2 Knowledge sharing

In the network environment, on the one hand, enterprises will produce a large number of written design drawings, technical reports, technical maps, paper materials, patent information, experimental data, process flow or service innovation instructions, and other explicit knowledge in the form of text coding. In this paper, we

define this kind of encoding as explicit knowledge sharing; encoded knowledge is regularly or irregularly shared between enterprises and scientific research institutions and between enterprises and partners. In addition, knowledge that is difficult to encode. For example, tacit knowledge such as expertise, technical know-how, and personal experience is shared regularly or irregularly in cooperation between enterprises and research institutions and between enterprises and other partners based on their experience, observation, feedback, demonstration, and mutual learning. (Li, 2011)

According to the above analysis, this study divides knowledge sharing into two variables: explicit knowledge sharing and implicit knowledge sharing. Different scholars have measured two dimensions of knowledge sharing. Lee (2001) divided explicit knowledge sharing into: "We share each other's commercial building with our service providers Letters and reports, "We share with our service providers or business manuals, models and methods," "We share with our service providers our success and failure stories," "We share with our service providers our business knowledge obtained from newspapers, magazines, periodicals, television, and other channels," Cronbach's a=0.901; The study measures tacit knowledge sharing based on four items: "We share with our service providers the technical know-how gained from work experience," "We share with our service providers knowledge such as' knowing where 'and' knowing who ',"" We share with our service providers the expertise and skills gained from education and training, "Cronbach's a=0.797. Sherwood and Covin (2008) measured explicit knowledge sharing on five items: "written technical description knowledge" and "technology development documents," and measured implicit knowledge sharing on six items: Explicit knowledge sharing measured based on five items: "Written technical specification knowledge," "technical development documents," and so on.

This study refers to the research achievements of Sherwood and Covin (2008), Lee (2001), and other scholars, combined with the characteristics, research needs, and reliability and validity measurement indicators of this study, and put forward the initial knowledge sharing scale. Table 3.3 follows.

Table 3.2 Measurements of Knowledge sharing

Variable dimension	**Serial number**	**Measurement content**	**Measurement basis**
Explicit knowledge sharing	EKS1	Often share technical research and development, service, project progress reports, and other information with partners.	Sherwood and Covin (2008); Chiu and Lin 2022; Eslami Achtenhagen, Bertsch, & Lehmann (2023); He (2021)
	EKS2	Often share with partners technical, service quality control information	
	EKS3	Often share information with partners: technical composition, service details	
	EKS4	Frequent sharing with partners: information on market and customer needs	
Tacit knowledge sharing	TKS1	Often share with partners: experience and know-how behind the implementation of technology and services	Sherwood and Covin (2008); He (2021);

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Table 3.2 Measurements of Knowledge sharing (Continued)

Variable dimension	Serial number	Measurement content	Measurement basis
	TKS2	Often share with partners: know-how to solve technical, service, or unexpected technical/service problems	Chiu and Lin (2022)
	TKS3	Often share with partners: experience and know-how to break through technical and service problems/technical/service limitations	
	TKS4	Often shared with partners: understanding and judging experience of market and customer needs	

3.3.3 Innovation performance of High-tech SMEs

The paper referred to in this study (Lai, Hsu, Lin, Chen, & Lin, 2014) divided the innovation performance of small and medium-sized science and technology into market and product performance. The appendix lists the final version of the questionnaire item after item purification and factor analysis. Table 3.4 shows the measurement items of innovation performance variables of high-tech small and medium enterprises in this study.

Table 3.3 Measurement scale of high-tech small and medium-sized enterprises

Variable dimension	Serial number	Measurement content	Measurement basis
Innovation performance of Hi-tech SMEs)	IP1	The company's customers have high requirements for products and technologies	Lai (2014); Xie and Liu (2021); Li, Wang, Wu, Zhu, & Song (2021)
	IP2	Senior executives are very satisfied with the innovative products and technologies	
	IP3	Our company's market share continues to grow	
	IP4	Our company's profit margin is increasing year by year	
	IP5	We can come up with some original solutions to problems by learning	
	IP6	We will actively support innovative ideas	
	IP7	We can turn innovative ideas into practical applications	
	IP8	Due to the development of product innovation, the time to market for similar products is shortened	

3.4 Instrument Testing

3.4.1 Validity

This study sent invitations for consistency testing of project objectives to five experts. Considerations included the Index of Conformance (IOC) in the operational definitions. This aspect consists of the question's meaning, the language's accuracy, and other points.

The results of the consistency index are as follows.

+1 refers to the relationship between the problem and the operational definition

0 refers to the uncertainty of the relationship

-1 means that there is no relationship between the problem and the operation

Five professional professors from Qilu University of Technology were asked to be the experts, and the criteria for selecting the subject matter experts were as follows:

1) A lecturer or researcher involved in measurement and assessment education with experience in lecturing and more than three years of research using the LISREL model.

2) Two professors or researchers involved in SME research with more than three years of lecturing and research experience.

3) Two professors or researchers involved in Internet research with more than three years of lecturing and research experience.

An index of objective consistency (IOC) of the items was used to determine the validity of the content. Item Objective Consistency (IOC) evaluated the questionnaire's items in a range of scores from -1 to +1. Modifications were made to the items with scores below 0.5. On the other hand, items with scores above or equal to 0.5 were retained (Greithuijsen, Eijck, Haste, Brok, Skinner & Mansour, 2014).

The results of the scoring of network competence are shown in AppendixC1-AppendixC11.

After checking, according to the results of Kanjanawase (2001), questions above 0.50 will be selected. Other questions will be modified with the advice of subject matter experts. The results showed that all the questions in the questionnaire of this thesis had an index of coherence (IOC) between 0.60 and 1.00; therefore, all the questions in the questionnaire of this study will be selected.

3.4.2 Reliability

After the questionnaire of this study was tested for item objective congruence (IOC), the scale was pretested before data collection to assess the reliability of this study (Hinkin, Tracey, & Enz, 1997). Cronbach's and Cronbach's alpha test, commonly used in various studies, was used to test the reliability of the measurement scale. Reliability coefficient scores are generally recognized as critical values, with Cronbach's Cronbach's alpha of 0.70 defined as "adequate," 0.80, and 0.90 as "good" and "excellent," respectively. "excellent" (Lv, 2020).

(1) Pre-survey reliability analysis

For this study, a pre-survey questionnaire was administered to 30 managers or middle and senior managers of technology-based SMEs to determine how the questionnaire could be improved to minimize response errors (Converse and Presser, 1986) and to assess the flow of the question pattern and the timing of the questionnaire to maintain the interest and attention of the respondents (Bolton & Ruth, 1986- 1998). The data collected was only used as a reliability analysis and not as data for the formal research.

Table 3.4 Reliability analysis of pre-survey data

Items	Cronbach's Alpha	N of Items
NC	0.93>0.70	16
KS	0.92>0.70	8
IP	0.99>0.70	8
Questionnaire	0.95>0.70	32

The reliability analysis results in Table 3.4 show that the Cronbach's coefficient of the total web competence questionnaire is 0.93. Cronbach's coefficient of the total web competence questionnaire is more significant than 0.70, which shows that the web competence questionnaire is reliable. The Cronbach's coefficient of the total knowledge-sharing questionnaire is 0.92. The Cronbach's coefficient of the total knowledge-sharing questionnaire is greater than 0.70, which shows that the reliability of the knowledge-sharing questionnaire is good. The Cronbach's coefficient for the innovation performance questionnaire is 0.99, and the coefficient is greater than 0.70, which shows that the reliability of the innovation performance questionnaire is good. The Cronbach's coefficient of the whole questionnaire is 0.95, which is greater than 0.7, indicating that the reliability of the entire questionnaire is good. Therefore, the questionnaire of this study passes the reliability test.

(2) Formal research reliability test

The reliability test tests the reliability of the questionnaire based on the survey data, usually using the Cronbach coefficient for testing. It is generally believed that Cronbach's coefficient is above 0.90, indicating the questionnaire's reliability is very good. Cronbach's coefficient of 0.80-0.90 indicates that the reliability of the questionnaire is relatively good. Cronbach's coefficient of 0.70-0.80 indicates that the questionnaire needs to be revised. Cronbach's coefficient below 0.70 indicates that the questionnaire needs to be revised. This time, the Cronbach coefficient is used to test the network capability questionnaire, knowledge sharing questionnaire, and innovation performance questionnaire, and the test results are shown in Table 3.16.

Table 3.5 Reliability analysis

Items	Cronbach's Alpha	N of Items
NC	0.89	16
KS	0.91	8
IP	0.98	8
Questionnaire	0.96	32

The results of the reliability analysis in Table 3.5 show that the Cronbach's coefficient of the total questionnaire of network competence is 0.89, the Cronbach's coefficient of the total questionnaire of network competence is more significant than 0.80, which shows that the reliability of the questionnaire of network competence is relatively good. The Cronbach's coefficient of the total knowledge sharing questionnaire is 0.91, and the Cronbach's coefficient of the total knowledge sharing questionnaire is more significant than 0.90, which shows that the reliability of the knowledge sharing questionnaire is excellent. The Cronbach's coefficient of the innovative performance questionnaire is 0.98, which is more significant than 0.90, which shows that the reliability of the creative performance questionnaire is excellent.

The Cronbach's coefficient of the whole questionnaire is 0.96, and the coefficient is more significant than 0.9, which shows that the reliability of the entire questionnaire is excellent. Therefore, the data from the formal research of this study passed the reliability test and can be further analyzed.

3.5 Data Collection

Used for scientific research is the primary purpose of this survey; the interviewees understand the real purpose of the whole process; the information filled in can show its valid will and subjective views, and the interviewee's related information will be strictly confidential; fill out the questionnaire will not cause any negative impact on the interviewees. Participants' personal information will be anonymized, and they have the right not to answer any questions that make them uncomfortable. You may also decide to withdraw from this study at any time without any penalties or consequences. In this way, it will be maximized to ensure that the recovered questionnaires are authentic and reliable and have some scientific research value. Throughout the process of data collection and sampling, we have conducted actual research on some enterprises synchronously to understand the real status of enterprises' network capability (network planning capability, network relationship capability, network occupancy capability, network utilization capability), knowledge sharing (explicit knowledge sharing, implicit knowledge sharing), and innovation performance of Hi-tech SMEs.

Electronic distribution was the primary method of questionnaire collection for this survey. Given that this survey focuses on the ability of enterprises to manage external relations, the respondents should have an overall understanding of the enterprise, so the managers or professional and technical personnel of an enterprise are selected to better grasp the environment, management, and performance of the entire

enterprise from the organizational level. Among them, the Hi-tech SMEs come from the official website of the Provincial Department of Science and Technology, the Bureau of Industry and Commerce, audited and approved by the Hi-tech SMEs.

The sampling method of this collection of questionnaires mainly uses the non-probability sampling-snowball sampling method; the specific steps are as follows. The following three main ways were taken to collect data by snowballing: first, we contacted the relevant government departments responsible for the statistics of Hi-tech SMEs (Provincial Department of Science and Technology, Provincial Market Supervision Administration, etc.) to obtain representatives of representative Hi-tech SMEs in our region, and were helped by the relevant departments in distributing the questionnaires. Secondly, we distribute questionnaires to the WeChat groups of MBA and EMBA students in several universities, screen out those who are qualified, and invite them to fill in the questionnaires in the above lists so that more qualified managers or professional and technical personnel can fill in the questionnaires through snowballing; thirdly, we distribute the questionnaires to the alums and their colleagues who are working in science and technology SMEs with the help of the resources of the research group members and the mentors' resources. Colleagues working in SMEs. Finally, through the snowballing method, people can find similar enterprises through their social networks and collect questionnaires from alums working in Hi-tech SMEs. When selecting enterprises for the study, enterprises from different regions and industries were widely chosen to ensure the diversity of the sample enterprises.

3.6 Data Analysis

Because of the four dimensions of network capability in the conceptual model, explicit knowledge sharing, tacit knowledge sharing, and measurement of innovation performance of Hi-tech SMEs are challenging to observe. In this study, the

structural equation (SEM) causality model will be used to estimate, and AMOS software will measure the relationship between the above items and latent variables. Multiple goodness-fit indexes were used to evaluate the correspondence of the model, verify the hypothesis, and analyze it. Before verifying the hypothesis, descriptive statistics, reliability and validity analysis, and correlation analysis of the data were conducted with SPSS. Data analysis in this study is divided into the following stages:

(1) Descriptive statistical analysis

Descriptive statistical analysis mainly explains the general situation of enterprise sample data. First, the mean value and standard deviation of enterprise sample data are calculated and collected by SPSS statistical software to describe the survey objects' characteristics briefly. This study carries out statistical analysis from the industry type of the enterprise, the establishment time of the enterprise, the scale of the enterprise's employees, the nature of the enterprise (state-owned enterprise, collective enterprise, etc.), and other indicators. Secondly, the Skewness and Kurtosis indexes were used to assess the data quality and determine whether the data was normally distributed (Tabachnick & Fidell, 2007). Variables are normally distributed when they are at the center of a distribution. When skewness and kurtosis values are zero, the distribution is normal (Pallant, 2005). According to Curran, West, & Finch (1996), skewness $<\pm 2$ and kurtosis $<\pm 7$ is acceptable. This is to ensure that AMOS's correlation analysis can be used. Finally, a univariate analysis method was used for preliminary data analysis to describe the key features of the observations. Table 3.6 shows the range of mean values for the questionnaire items, respondents' responses, and an interpretation of the mean values collected from the research data. In this study, the variables can be interpreted from the respondents' responses on a scale of 7 from very high to very low.

Table 3.6 Mean interpretations

Mean	Respondent' s answer	Interpretation
6.15- 7.00	Strongly agree	Very High
5.29– 6.14	Agree	High
4.43– 5.28	Slightly agree	Slightly High
3.57– 4.42	Neutral	Neutral
2.72– 3.56	Slightly disagree	Slightly Low
1.86– 2.71	Disagree	Low
1.00– 1.85	Strongly disagree	Very Low

Source: Converse and Presser, 1986

(2) Correlation analysis

In this paper, Pearson correlation analysis is used to research the correlation coefficient matrix between the four dimensions of network competence, tacit knowledge sharing, explicit knowledge sharing, and the innovation performance of Hi-tech SMEs, and to test the correlation degree of the critical variables in this study. This study needs to verify the correlation between seven variables of four dimensions of network capability, namely explicit knowledge sharing, implicit knowledge sharing, and innovation performance of Hi-tech SMEs, and test the multicollinearity problem between each variable. The number of relationships should not exceed 0.80. If it exceeds 0.80, the researcher should consider cutting or combining some duplicate variables to test the multicollinearity problem between the individual variables. The structural equation model of the survey data was analyzed after the correlation degree, and multicollinearity of various variables in this study was no problem.

(3) Confirmatory factor analysis (CFA)

The content validity test was conducted above using IOC to ensure the content validity of the questionnaire items. Before the formal test, validated factor analysis (CFA) was conducted for structural validity testing. The structural validity of the questionnaire was analyzed using the correlation coefficients between latent variables, the model path coefficients, and the model fit indices (Yi, 2018). Using the structural equation modeling method for the figurative analysis of validation factors on extensive sample data, the measurement model in structural equation modeling is used for validation factor analysis, which reflects the relationship between latent and measurable variables and latent variables on top of its theoretical foundation.

(4) Structural Equation

Due to the four dimensions of network capability, explicit knowledge sharing, and tacit knowledge sharing in the research conceptual model,

The measurement of the innovation performance of SMEs in science and technology is challenging to observe. For this reason, this study will use structural equation modeling (SEM) to measure the relationship between the above items and latent variables using AMOS software statistical tests. Each variable in the conceptual model is first analyzed using factor analysis to calculate the factor loadings and obtain the factor scores as the observed values of the above latent variables.

Generally, validation of a model using structural equation modeling involves four steps: model building, fitting against the research model, estimating the degree of fit based on empirical indicators, and model testing. The sequence of testing hypotheses: path test of the direct influence of the four dimensions of network capability on the innovation performance of SMEs in science and technology; path test of the direct influence of the four dimensions of network capability on knowledge

sharing (explicit knowledge sharing, tacit knowledge sharing); path test of the direct influence of knowledge sharing (explicit knowledge sharing, tacit knowledge sharing) on innovation performance; mediation of knowledge sharing (explicit knowledge sharing, tacit knowledge sharing); total model test. Test: total model test.

The relevant indicators evaluated the model as shown in Table 3.7 (Wu, 2010). In this study, we also refer to Hou, Wen, and Cheng (2004), and use the absolute fitness index and value-added fitness index to evaluate the model and select χ2 /df, RMSEA, GFI, TLI and CFI, which have been widely recognized by academics, as the model evaluation indexes. According to Kline (2011), a set of fit indices must be applied to check the overall fit of the measurements. Table 3.7 below gives the acceptable levels of many types of goodness-of-fit metrics used in SEM (Hair, Anderson, Babin & Black, 2010).

Table 3.7 Model Fit Index

Model Fit index	Value	References
1. Chi-Square/Degree of Freedom (CMIN/DF)	< 3.00	Hair et al. (2010)
2. Comparative fit index (CFI)	> 0.90	Kline (2010)
3. Goodness of fit index (GFI)	> 0.80	Schumacker and Lomax (2004)
4. Normalized fit index (NFI)	> 0.90	Hair et al. (2010)
5. Relative fit index (RFI)	> 0.90	Hair et al. (2010)
6. Tucker Lewis index (TLI)	> 0.90	Hair et al. (2010)
7. Incremental fit index (IFI)	> 0.90	Hair et al. (2010)
8. Root mean square error of approximation (RMSEA)	< 0.08	Kline (2010)

In order for the model to fit, the value for Chi-square/ Degree of freedom has to be less than 3.00 (Hair et al., 2010). The comparative fit index (CFI) has to be more than 0.90 (Kline, 2011). The goodness of fit index (GFI) has to be more than 0.80 (Schumacker & Lomax, 2004). Four of the eight indices, which include Normalized fit index (NFI), Relative fit index (RFI), Tucker Lewis index (TLI), and Incremental fit index (IFI), must be more than 0.90 (Hair et al., 2010). Last, Root Mean Square Error of Approximation (RMSEA) has to be less than 0.08 (Kline, 201

Chapter 4

Research Results

4.1 Descriptive Statistics

Four hundred fifty questionnaires were distributed in this study, and 440 questionnaires were recovered. After excluding some invalid questionnaires, we finally got 423 valid questionnaires, and the validity rate of the questionnaires was 94.00%.

Table 4.1 Descriptive statistics of study variables

Enterprise feature	**Category**	**Frequency (number)**	**Frequency (%)**
Nature of business	State-owned	178	42.1%
	Private enterprise	177	41.8%
	Joint Venture	45	10.6%
	Else	23	5.4%
Established	Within 3 years	73	17.3%
	3-5 years	101	23.9%
	More than 5 years	249	58.9%
Enterprise scale	1-49 people	114	27%
	50-100 people	158	37%
	More than 100 people	151	35.7%

According to Table 4.1, in terms of the distribution of the sample, among the enterprises in this survey, the nature of the enterprise is state-owned enterprises 178, accounting for 42.10%; private enterprises 177, accounting for 41.80%; joint ventures 45, accounting for 10.6%; and there are 23 others, accounting for 5.40%. Regarding the number of years of enterprise establishment, 73 or less than three years, accounting for 17.30%, 101 or 3-5 years, 23.90%, and 249 or more than five years, accounting for 58.90%. In the distribution of enterprise size, 114 (27.00%) have less than 49 employees, 158 (37.40%) have 50-100 employees, and 151 (35.70%) have more than 100 employees.

The questionnaire has several latent variables, including network planning ability, network relationship ability, network occupancy ability, network utilization ability, explicit knowledge sharing, implicit knowledge sharing, and innovation performance. Suppose we want to eliminate the influence of the number of questionnaires on the scores of the latent variables. In that case, we can summarize the scores of each latent variable first and then divide it by the number of questionnaires included in each latent variable to get the scores of the latent variable. Then, we can do a descriptive analysis of the latent variables and their dimensions. A descriptive analysis was performed. Descriptive statistics were used to count the basic situation of the variables in this study, and normality tests were performed on all the variables in this study to ensure that the data conformed to the state distribution. The statistical results are shown in Table 4.2

Table 4.2 Descriptive statistics of study variables

Variables	Symbol	Minimum	Maximum	Mean	Std. Deviation	Level
Network Planning Ability	NPC	1.00	7.00	4.25	2.01	Neutral
Network Relationship Ability	NRC	1.25	7.00	4.61	1.93	Slightly high
Network Occupancy Ability	NOC	1.00	7.00	3.95	1.95	Neutral
Network Utilization Ability	NUC	1.00	7.00	4.04	1.85	Neutral
Explicit Knowledge Sharing	EKS	1.00	7.00	4.07	1.86	Neutral
Tacit Knowledge Sharing	TKS	1.00	7.00	4.50	1.91	Slightly high
Innovation Performance	IP	1.50	7.00	4.42	1.95	Neutral

The descriptive statistics of the research variables in Table 4.1 show that the mean value of network planning ability is 4.25, with a standard deviation of 2.01. the mean value of network relationship ability is 4.61 with a standard deviation of 1.93, the mean value of network occupancy ability is 3.95 with a standard deviation of 1.95, and the mean value of network utilization ability is 4.04 with a standard deviation of 1.85. Overall, the sub-dimensions of network ability the mean value of the sub-dimensions of network competence is 3.90-4.65, which indicates that the respondents' network competence is at a medium level and still needs to be improved, and only the network relationship competence (Mean = 4.61) is slightly high. The mean value of explicit knowledge sharing is 4.07, with a standard deviation of 1.86; the mean value of implicit knowledge sharing is 4.50, with a standard deviation of 1.91. The mean value of knowledge-sharing is also at a medium level, and the

enterprises' knowledge-sharing ability is at a medium level. The mean value of knowledge sharing is also at a medium level, and the knowledge sharing of enterprises still needs to be improved, in which the tacit knowledge sharing (Mean = 4.61) is slightly high. In addition, the mean value of innovation performance is 4.42, and the standard deviation is 1.95. The mean value of innovation performance is also at a medium level, and enterprises still need to improve innovation performance further.

4.2 Correlation Analysis

The results of analyzing the seven potential variables considering the Pearson product-moment correlation coefficient show 21 Pearson correlation coefficients for the relationship between them. A significant correlation exists between the correlations with a statistical level of 0.01. All correlations are in the same direction (positive correlation coefficients). The range of variation of the coefficients was 0.13-0.46. In this study, Pearson correlation analysis was used to analyze the correlations between the study variables, and the results are shown in Table 4.3

Table 4.3 Correlation analysis among study variables

	NPC	**NRC**	**NOC**	**NUC**	**EKS**	**TKS**	**IP**
NPC	1.00						
NRC	0.25**	1.00					
NOC	0.46**	0.31**	1.00				
NUC	0.13**	0.35**	0.26**	1.00			
EKS	0.28**	0.34**	0.42**	0.44**	1.00		
TKS	0.34**	0.39**	0.32**	0.35**	0.54**	1.00	
IP	0.34**	0.33**	0.43**	0.34**	0.40**	0.37**	1.00

Note**:** **. Correlation is significant at the 0.05 level (2-tailed)

In the results of correlation analysis in Table 4.3, it shows that there is a significant positive correlation between network planning ability and network relationship ability (r=0.25, P<0.05), network planning ability and network occupancy ability (r=0.46, P<0.05), network planning ability and network utilization ability (r=0.13, P< 0.05), there is a significant positive correlation between network planning capability and explicit knowledge sharing (r=0.28, P<0.05), there is a significant positive correlation between network planning capability and tacit knowledge sharing (r=0.34, P<0.05), and there is a significant positive correlation between network planning capability and innovation performance (r=0.34, P<0.05). There is a significant positive correlation between network relationship capability and network occupancy capability (r=0.31, P<0.05).

There is a significant positive correlation between network relationship capability and network utilization capability (r=0.35, P<0.05), significant positive correlation between network relationship capability and explicit knowledge sharing (r=0.34, P<0.05), significant positive correlation between network relationship capability and implicit knowledge sharing (r=0.39, P<0.05), and significant positive correlation between network relationship capability and innovation performance (r=0.39, P<0.05). significant positive correlation (r=0.33, P<0.05).

There is a significant positive correlation between network occupancy capability and network utilization capability (r=0.26, P<0.05), a significant positive correlation between network occupancy capability and explicit knowledge sharing (r=0.42, P<0.05), a positive correlation between network occupancy capability and tacit knowledge sharing (r=0.32, P<0.05), and a positive correlation between network occupancy capability and innovation performance relationship (r=0.43, P<0.05).

There is a positive correlation between network utilization capacity and explicit knowledge sharing (r=0.44, P<0.05), network utilization capacity and tacit

knowledge sharing (r=0.35, P<0.05), and network utilization capacity and innovation performance (r=0.34, P<0.05). There is a positive correlation between explicit knowledge sharing and tacit knowledge sharing (r=0.54, P<0.05), and a positive correlation between explicit knowledge sharing and innovation performance (r=0.40, P<0.05). There is a positive relationship between tacit knowledge sharing and innovation performance (r=0.37, P<0.05).

The relationship number should not be more than 0.80, If it exceeds 0.80, the researcher should consider cutting or merging some of duplicated variables. The analysis used the SPSS program for Windows. All of the above variables reached significance at 0.05 level, indicating that there is a significant positive correlation between the variables under study.

4.3 Normality Test

There are two conditions that need to be met when conducting SEM analysis, firstly, the sample is large enough, scholars believe that samples larger than 200 can be conducted SEM, and secondly, the data meets the normal distribution, the skewness and kurtosis of each of the topics of this study are shown in the table below in Table 5.4, from which it can be seen that the skewness and kurtosis are lower than 3, which indicates that the data meets the normal distribution, and the correlation analysis can be carried out in the AMOS.

Table 4.4 Skew Index and Kurtosis Index

Items	Mean	Std. Deviation	Skewness	Kurtosis
NPC1	3.99	2.28	-0.03	-1.53
NPC2	4.14	2.20	-0.03	-1.56
NPC3	4.39	2.19	-0.28	-1.36
NPC4	4.48	2.20	-0.35	-1.20

Table 4.4 Skew Index and Kurtosis Index (Continued)

Items	Mean	Std. Deviation	Skewness	Kurtosis
NRC2	4.68	2.13	-0.46	-1.34
NRC3	4.38	2.06	-0.22	-1.23
NRC4	4.46	2.01	-0.62	-0.84
NOC1	3.72	2.10	0.16	-1.33
NOC2	3.90	2.14	0.04	-1.54
NOC3	4.11	2.15	-0.06	-1.39
NOC4	4.08	2.09	-0.26	-1.21
NUC1	4.18	2.17	-0.21	-1.43
NUC2	4.17	2.15	-0.19	-1.52
NUC3	3.50	1.97	0.39	-1.11
NUC4	4.32	2.14	-0.40	-1.18
EKS1	3.55	2.26	0.17	-1.64
EKS2	4.56	1.84	-0.48	-0.95
EKS3	4.27	2.04	-0.44	-1.05
EKS4	3.93	2.24	-0.10	-1.49
TKS5	4.22	2.32	-0.32	-1.55
TKS6	4.89	1.85	-0.77	-0.49
TKS7	4.58	1.99	-0.68	-0.74
TKS8	4.30	2.15	-0.44	-1.26
IP1	4.58	1.98	-0.39	-1.34
IP2	4.75	1.95	-0.36	-1.53
IP3	4.63	1.94	-0.39	-1.29
IP4	4.57	2.30	-0.49	-1.44
IP5	4.30	2.11	-0.33	-1.53
IP6	4.22	1.98	-0.32	-1.41

Table 4.4 Skew Index and Kurtosis Index (Continued)

Items	Mean	Std. Deviation	Skewness	Kurtosis
IP7	4.00	2.11	-0.36	-1.53
IP8	4.29	1.84	-0.22	-1.32

The normality test results in Table 4.4 show that all items' Skewness Index (SI) is between -0.77and0.39, and the Kurtosis Index (KI) is between -1.55and-0.49. Based on previous research, the Skewness and Kurtosis values between -3 and 3 are acceptable, and the data is normally distributed (Tabachnick & Fidell, 2007). Note You can perform AMOS related analysis.

4.4 Confirmatory Factor Analysis

Structural validity was verified by validation factor analysis. The seven latent variables of the analytic measurement model are as follows: network planning capacity, network relationship capacity, network occupancy capacity, network utilization capacity, explicit knowledge sharing, tacit knowledge sharing, and innovation performance for validity testing. The results are shown in Figures 4.1-4.3 and Tables 4.5-Tables 4.10

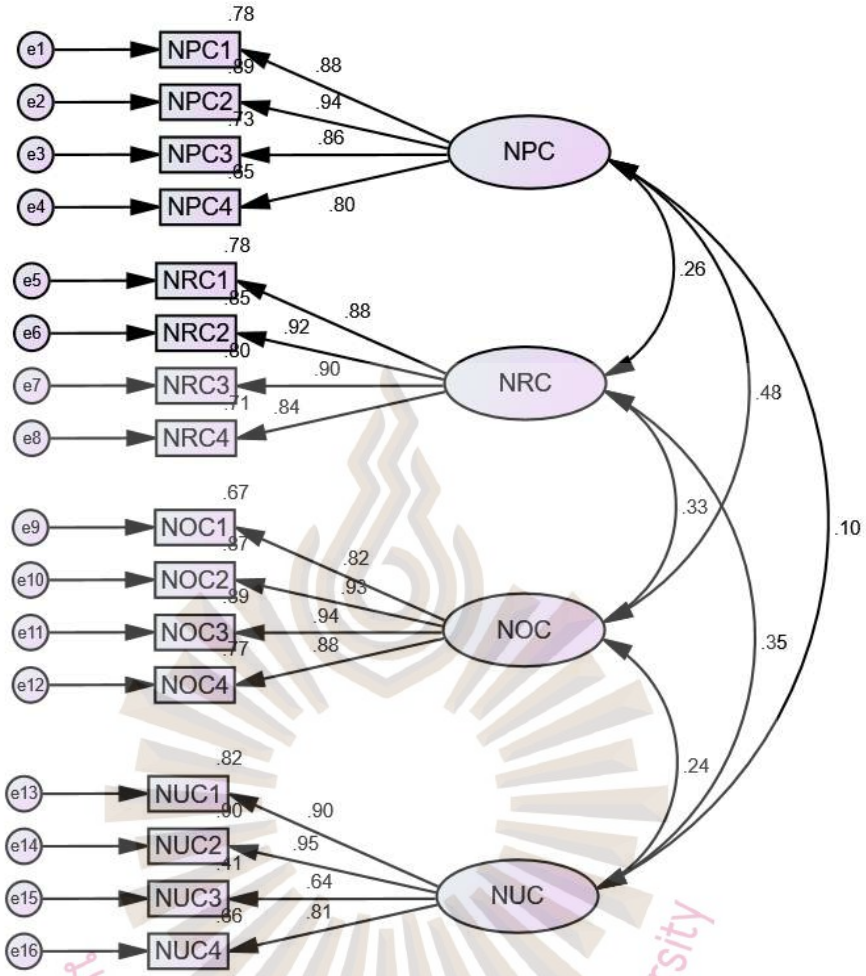


Figure 4.1 The Confirmatory Factor Analysis of Latent Variable:

Four dimensions of network capability

From Figure 4.1, the factor loading of each observed variable is found as follows: Network planning capability（NPC1-NPC4）= 0.80-0.94, Network relationship capability (NRC1-NRC4) = .84 - .92, Network occupying capability (NRC1-NRC4) = .82 - .94, Network utilization capability (NRC1-NRC4) = .64 -.95. As there is no observed variable with the factor loading of less than 0.30, no observed variable of the latent variable is cut off.

Table 4.5 Fitting results of confirmatory factor analysis Table

Goodness of Fit Index	Recommended Values	Model Fit Summary	Criteria
X^2/df	<5.00	2.29	Yes
RMSEA	<0.08	0.03	Yes
GFI	>0.90	0.93	Yes
NFI	>0.90	0.96	Yes
RFI	>0.90	0.95	Yes
IFI	>0.90	0.91	Yes
TLI	>0.90	0.97	Yes
CFI	>0.90	0.91	Yes

According to the fitting results of the validation factor analysis in Table 4.41, Fitting index X^2/df=2.29，RMSEA=0.03，GFI=0.93，NFI=0.96，RFI=0.95，IFI=0.91，TLI=0.97，CFI=0.91, The fitting indexes all reached the standard, and the fitting degree was good.

Table 4.6 Results of factor load coefficient

Factor	Items	SE	Z(CR)	P	Standardized-E	AVE	CR
NPC	NPC1	-	-	-	0.88	0.76	0.93
NPC	NPC4	0.04	21.79	0.00	0.80		
NPC	NPC3	0.04	24.58	0.00	0.86		
NPC	NPC2	0.04	29.79	0.00	0.94		
NRC	NRC1	-	-	-	0.88	0.79	0.94
NRC	NRC4	0.04	23.60	0.00	0.84		
NRC	NRC3	0.03	26.94	0.00	0.90		
NRC	NRC2	0.04	28.63	0.00	0.92		
NOC	NOC1	-	-	-	0.82	0.80	0.94

Table 4.6 Results of factor load coefficient (Continued)

Factor	Items	SE	Z(CR)	P	Standardized-E	AVE	CR
NOC	NOC4	0.05	22.40	0.00	0.88		
NOC	NOC3	0.05	25.11	0.00	0.94		
NOC	NOC2	0.05	24.68	0.00	0.93		
NUC	NUC1	-	-	-	0.90	0.70	0.90
NUC	NUC4	0.04	22.75	0.00	0.81		
NUC	NUC3	0.04	15.37	0.00	0.64		
NUC	NUC2	0.03	30.55	0.00	0.95		

The analysis results in Table 4.42 show that the standardized factor loading coefficients are all greater than 0.60. The mean-variance extracted values of AVE and construct reliability CR for network planning ability are 0.76 and 0.93. The mean-variance extracted values of AVE and construct reliability CR for network relationship ability are 0.79 and 0.94. The mean-variance extracted values of AVE and construct reliability CR for network occupancy ability are the mean-variance extracted values of AVE and construct reliability CR for network utilization ability are 0.70 and 0.90. The AVE of each variable is more than 0.50, and the CR value is more than 0.70, indicating that the questionnaire's validity is relatively good. The Composite Reliability (CR) values are acceptable at more than 0.70 (Fornell & Larcker, 1981). The Average Variance Extracted (AVE) values were acceptable at more than 0.50 (Diamantopoulos & Siguaw, 2000).

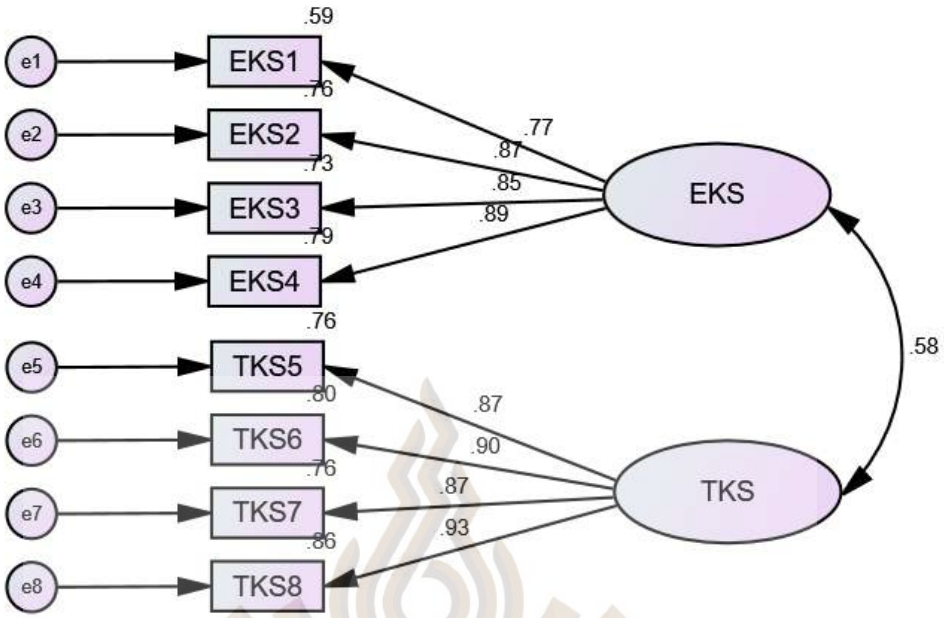


Figure 4.2 The Confirmatory Factor Analysis of Latent Variable:

Explicit knowledge sharing and implicit knowledge sharing

From Figure 4.2, the factor loading of each observed variable is found as follows: Explicit knowledge sharing（EKS1-EKS4）= 0.77-0.89, Tacit knowledge sharing (TKS1-TKS44) = .87 - .93, As there is no observed variable with the factor loading of less than 0.30, no observed variable of the latent variable is cut off.

Table 4.7 Fitting results of confirmatory factor analysis

Goodness of Fit Index	**Recommended Values**	**Model Fit Summary**	**Criteria**
X^2/df	<3	2.66	Yes
RMSEA	<0.08	0.04	Yes
GFI	>0.90	0.93	Yes
NFI	>0.90	0.91	Yes
RFI	>0.90	0.95	Yes

Table 4.7 Fitting results of confirmatory factor analysis (Continued)

Goodness of Fit Index	Recommended Values	Model Fit Summary	Criteria
IFI	>0.90	0.98	Yes
TLI	>0.90	0.96	Yes
CFI	>0.90	0.93	Yes

According to the fitting results of confirmatory factor analysis in Table 4.7, fitting indexes X2/df=2.66, RMSEA=0.04, GFI=0.93, NFI=0.91, RFI=0.95, IFI=0.98, TLI=0.96, CFI=0.93 meet the standard. The fitting degree is better.

Table 4.8 Results of factor load coefficients

Factor	Items	Estimate	SE	Z(CR)	P	Standardized-E	AVE	CR
EKS	EKS1	1.00	-	-	-	0.77	0.72	0.91
EKS	EKS4	1.14	0.06	19.57	0.00	0.89		
EKS	EKS3	1.00	0.05	18.75	0.00	0.85		
EKS	EKS2	0.92	0.05	19.22	0.00	0.87		
TKS	TKS5	1.00	-	-	-	0.87	0.80	0.94
TKS	TKS8	0.99	0.04	28.19	0.00	0.93		
TKS	TKS7	0.86	0.04	24.87	0.00	0.87		
TKS	TKS6	0.82	0.03	26.22	0.00	0.90		

The results of the analysis in Table 4.8 show that the standardized factor loading coefficients are all greater than 0.60.The mean variance extracted values AVE and construct reliability CR for explicit knowledge sharing (EKS) are 0.72 and 0.91.The mean variance extracted values AVE and construct reliability CR for tacit knowledge sharing (TKS) are 0.80 and 0.94.The AVE of the two variables is greater than 0.50 and the CR values were greater than 0.70, indicating that the validity of the questionnaire was relatively good.

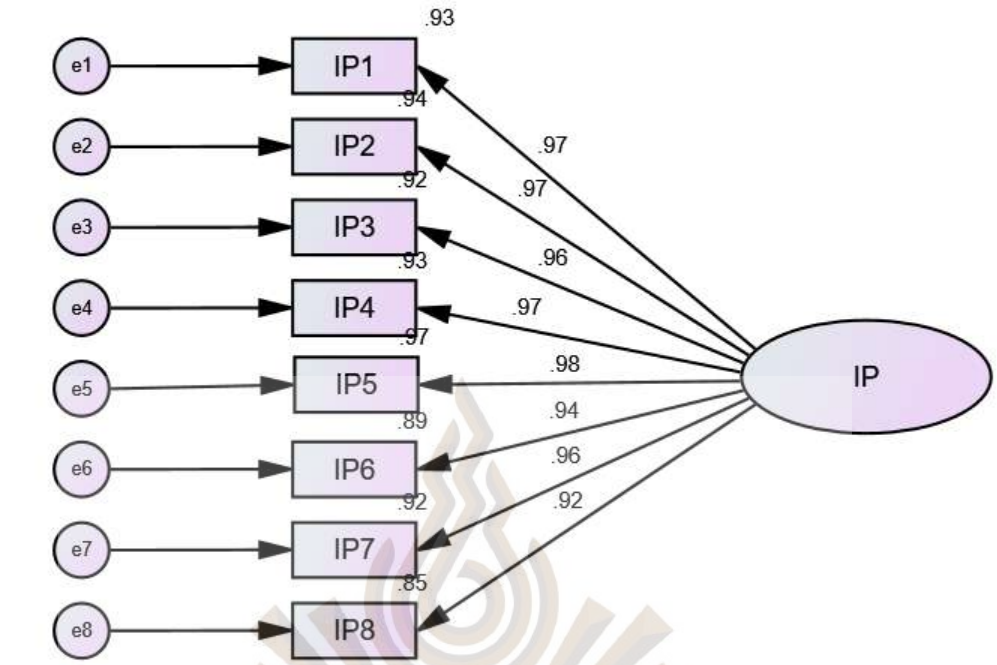


Figure 4.3 The Confirmatory Factor Analysis of Latent Variable: Innovation performance

From Figure 4.3, the factor loading of each observed variable is found as follows: Innovation Performance（IP1-IP8）= 0.92-0.98. As there is no observed variable with the factor loading of less than 0.30, no observed variable of the latent variable is cut off.

Table 4.9 Confirmatory factor analysis fitting results

Goodness of Fit Index	**Recommended Values**	**Model Fit Summary**	**Criteria**
X^2/df	<3	2.69	Yes
RMSEA	<0.08	0.07	Yes
GFI	>0.90	0.96	Yes
NFI	>0.90	0.96	Yes
RFI	>0.90	0.95	Yes

Table 4.9 Confirmatory factor analysis fitting results (Continued)

Goodness of Fit Index	Recommended Values	Model Fit Summary	Criteria
IFI	>0.90	0.97	Yes
TLI	>0.90	0.97	Yes
CFI	>0.90	0.98	Yes

According to the fitting results of confirmatory factor analysis in Table 4.9, fitting indexes X^2/df=2.69, RMSEA=0.07, GFI=0.96, NFI=0.96, RFI=0.95, IFI=0.97, TLI=0.97, CFI=0.98 meet the standards. The fitting degree is better.

Table 4.10 Results of factor load coefficients

Factor	Items	Estimate	SE	Z(CR)	P	Standardized-E	AVE	CR
IP	IP1	1.00	-	-	-	0.97	0.92	0.99
IP	IP6	0.97	0.02	45.82	0.00	0.94		
IP	IP5	1.08	0.02	62.82	0.00	0.98		
IP	IP4	1.16	0.02	54.10	0.00	0.97		
IP	IP3	0.97	0.02	51.21	0.00	0.96		
IP	IP2	0.99	0.02	56.48	0.00	0.97		
IP	IP8	0.88	0.02	41.09	0.00	0.92		
IP	IP7	1.05	0.02	50.94	0.00	0.96		

The analysis results in Table 4.10 show that the standardized factor load coefficients are all greater than 0.60. The average variance of innovation performance extracted value AVE and construction reliability CR were 0.72 and 0.99. The AVE and CR values of the variables were more significant than 0.50 and 0.70, indicating that the validity of the questionnaire was relatively good.

4.5 Analysis of Difference in Basic Characteristics of Research Variables

This study used one-way ANOVA to compare the mean of a variable among groups of network capability, knowledge sharing, and innovation performance on firm size and educational qualification.

Table 4.11 Analysis of variance of research variables on firm size

Variables	Enterprise Size	N	Mean	Std. Deviation	F	P
Network capability	Up to 49	114	3.61	1.38	47.64	0.00
	50-100 people	158	3.93	1.01		
	More than 100 people	151	4.96	1.24		
Knowledge sharing	Up to 49	114	3.69	1.80	63.85	0.00
	50-100 people	158	3.69	1.10		
	More than 100 people	151	2.89	1.47		
Innovation performance	Up to 49	114	3.85	1.98	14.67	0.00
	50-100 people	158	4.22	1.82		
	More than 100 people	151	5.06	1.89		

The analysis results in Table 4.11 shows that network capability has a significant difference in enterprise scale (F=47.64, P<0.05), knowledge sharing has a significant difference in enterprise scale (F=63.85, P<0.05), and innovation

performance has a significant difference in enterprise-scale (F=14.67, P<0.05). The results show that large enterprises have a high level of enterprise network capability but a relatively low knowledge sharing. Small and medium-sized enterprises tend to have higher knowledge sharing, but the enterprise network capability is significantly lower than that of large enterprises.

Table 4.12 Analysis of differences in academic qualifications of research variables

Variables	**Educational background**	**N**	**Mean**	**Std. Deviation**	**F**	**P**
Network capability	High school and below	52	3.08	1.43	35.73	0.00
	College/Undergraduate	252	4.17	1.07		
	Graduate student	119	4.80	1.44		
Knowledge sharing	High school and below	52	2.97	1.84	28.31	0.00
	College/Undergraduate	252	4.26	1.39		
	Graduate student	119	4.92	1.74		
Innovation performance	High school and below	52	3.74	2.17	4.77	0.01
	College/Undergraduate	252	4.41	1.78		
	Graduate student	119	4.74	2.13		

As shown in the analysis results in Table 4.12, there are significant differences in network ability in the educational background (F=35.73, P<0.05), knowledge sharing in the educational background (F=28.31, P<0.05), and innovation performance in the educational background (F=4.77, P<0.05).

4.6 Hypothesis Testing

This study tested the baseline model by structural equation modeling after correlation analysis. The test results are shown in Table 4.13 and Figure 4.4

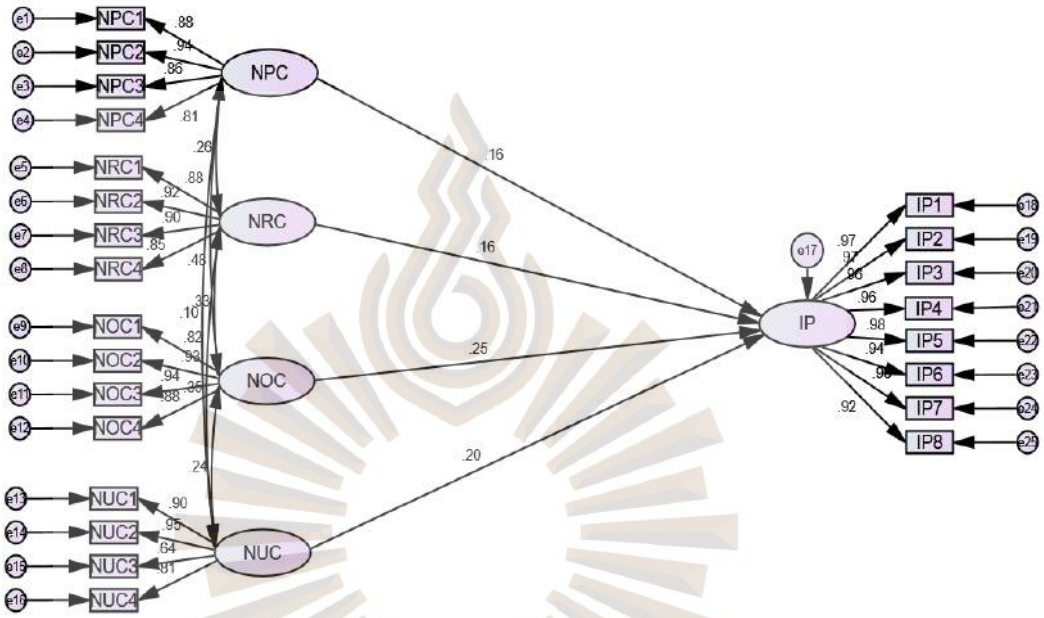


Figure 4.4 Baseline path analysis results

Table 4.13 Results of baseline model fitting

Goodness of Fit Index	Recommended Values	Model Fit Summary	Criteria
X^2	-	645.37	-
df	-	242	-
X^2/df	<3.00	2.67	Yes
RMSEA	<0.08	0.05	Yes
GFI	>0.90	0.95	Yes
NFI	>0.90	0.96	Yes
RFI	>0.90	0.94	Yes

Table 4.13 Results of baseline model fitting (Continued)

Goodness of Fit Index	Recommended Values	Model Fit Summary	Criteria
IFI	>0.90	0.97	Yes
TLI	>0.90	0.96	Yes
CFI	>0.90	0.97	Yes

The fitting results of the benchmark model in Table 4.13 show that X2/df=2.67, RMSEA=0.05, GFI=0.95, NFI=0.96, RFI=0.94, IFI=0.97, TLI=0.96, CFI=0.97, and the fitting values all meet the fitting standard, indicating that the fitting degree of the model is relatively good.

Table 4.14 Analysis results of the benchmark model (I)

	Path		*β*	*S.E.*	*C.R.*	*P*
IP	←	NPC	0.16	0.06	3.07	<0.01
IP	←	NRC	0.16	0.06	3.15	<0.01
IP	←	NOC	0.25	0.06	4.86	<0.001
IP	←	NUC	0.20	0.05	4.11	<0.001

In the results of the benchmark model analysis in Table 4.14, it is shown that Network Planning Capability (NPC) has a significant positive predictive effect (β=0.16, P<0.05) on Innovation Performance (IP), and H1a validation passes. Network Relationship Capability (NRC) has a significant positive predictive effect (β=0.16, P<0.05) on innovation performance (IP), H1b validation passed. Network Occupancy Capability (NOC) has a significant positive predictive effect on innovation performance (IP) (β=0.25, P<0.05), H1c validation passed. Network Utilization Capability (NUC) has a significant positive predictive effect on innovation

performance (IP) (β=0.20, P<0.05), H1d validation passed.

4.7 Testing the Mediating Effect of Explicit Knowledge Sharing

The structural equation model is used to test the mediating effect of explicit knowledge sharing, and the test results are shown in Table 4.15 and Table 4.16

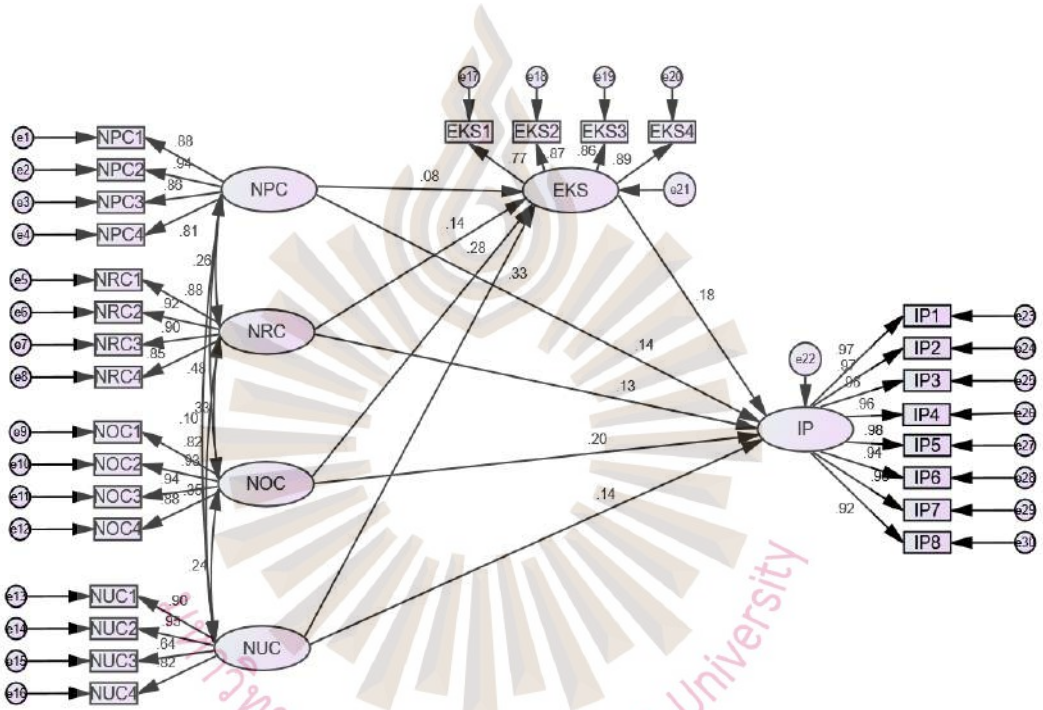


Figure 4.5 Results of the mediating effect of explicit knowledge sharing

Table 4.15 Fitting results of explicit knowledge sharing model

Goodness of Fit Index	Recommended Values	Model Fit Summary	Criteria
X^2	-	783.24	-
df	-	335	-
X^2/df	<3	2.34	Yes
RMSEA	<0.08	0.06	Yes
GFI	>0.90	0.95	Yes

NFI	>0.90	0.96	Yes

Table 4.15 Fitting results of explicit knowledge sharing model (Continued)

Goodness of Fit Index	Recommended Values	Model Fit Summary	Criteria
RFI	>0.90	0.94	Yes
IFI	>0.90	0.91	Yes
TLI	>0.90	0.96	Yes
CFI	>0.90	0.98	Yes

As shown in the fitting results of the explicit knowledge sharing model in Table 4.15, X2/df=2.34, RMSEA=0.06, GFI=0.95, NFI=0.96, RFI=0.94, IFI=0.91, TLI=0.96, CFI=0.98, all of which meet the fitting standards. It shows that the model fits well.

Table 4.16 Path Analysis Results (1)

	Path		***β***	***S.E.***	***C.R.***	***P***
EKS	←	NRC	0.14	0.05	2.89	<0.05
EKS	←	NOC	0.28	0.05	5.10	<0.001
EKS	←	NUC	0.33	0.05	6.52	<0.001
EKS	←	NPC	0.08	0.05	1.55	>0.05
IP	←	EKS	0.18	0.06	3.26	<0.01
IP	←	NPC	0.14	0.05	2.83	<0.01
IP	←	NRC	0.13	0.06	2.62	<0.01
IP	←	NOC	0.20	0.06	3.80	<0.001
IP	←	NUC	0.14	0.06	2.71	<0.01

As shown in the path analysis results in Table 4.16, network planning ability (NPC) did not have a significant positive prediction effect on explicit knowledge sharing (EKS) (β=0.08, P>0.05), and H2a verification failed. Network relationship

ability (NRC) had a significant positive prediction effect on explicit knowledge sharing (EKS) (β=0.14, P<0.05), and the H2c test was passed. Network occupying power (NOC) had a significant positive prediction effect on explicit knowledge sharing (EKS) (β=0.28, P<0.05), and H2e verification was passed. Network utilization ability (NUC) had a significant positive prediction effect on explicit knowledge sharing (EKS) (β=0.33, P<0.05), and the H2g test passed. Explicit knowledge sharing (EKS) had a significant positive predictive effect on innovation performance (β=0.18, P<0.05), and the H3a test passed.

Table 4.17 Results of the mediation effect analysis of explicit knowledge sharing

Path	*Value*	*Lower 95% CI*	*Upper 95% CI*
NPC→EKS→IP	0.01	-0.001	0.04
NRC→EKS→IP	0.03	0.01	0.06
NOC→EKS→IP	0.05	0.02	0.09
NUC→EKS→IP	0.06	0.02	0.11

In the results of the mediation effect analysis in Table 4.17, it is shown that there is no mediation effect of explicit knowledge sharing (EKS) between the relationship of network planning capability (NPC) and innovation performance, and H4a validation fails because its confidence interval contains 0 and network planning capability (NPC) does not have a significant predictive effect on explicit knowledge sharing (EKS). Explicit knowledge sharing (EKS) has a mediating effect between the relationship of network relationship capability (NRC) and innovation performance with an effect value of 0.03 and a confidence interval of [0.01, 0.06], H4b validation passed. There is a mediating effect of explicit knowledge sharing (EKS) between the relationship of network occupancy capacity (NOC) and innovation performance with an effect value of 0.05 and a confidence interval of [0.02, 0.09], and H4c validation passed. There is a mediating effect of explicit knowledge sharing (EKS) between the

relationship of network occupancy capacity (NUC) and innovation performance with an effect value of 0.06 and a confidence interval of [0.02, 0.11], and H4d validation passed.

4.8 Testing the Mediating Effect of Tacit Knowledge Sharing

Structural equation model is used to test the mediating effect of tacit knowledge sharing, and the test results are shown in Table 4.18 and Table 4.20

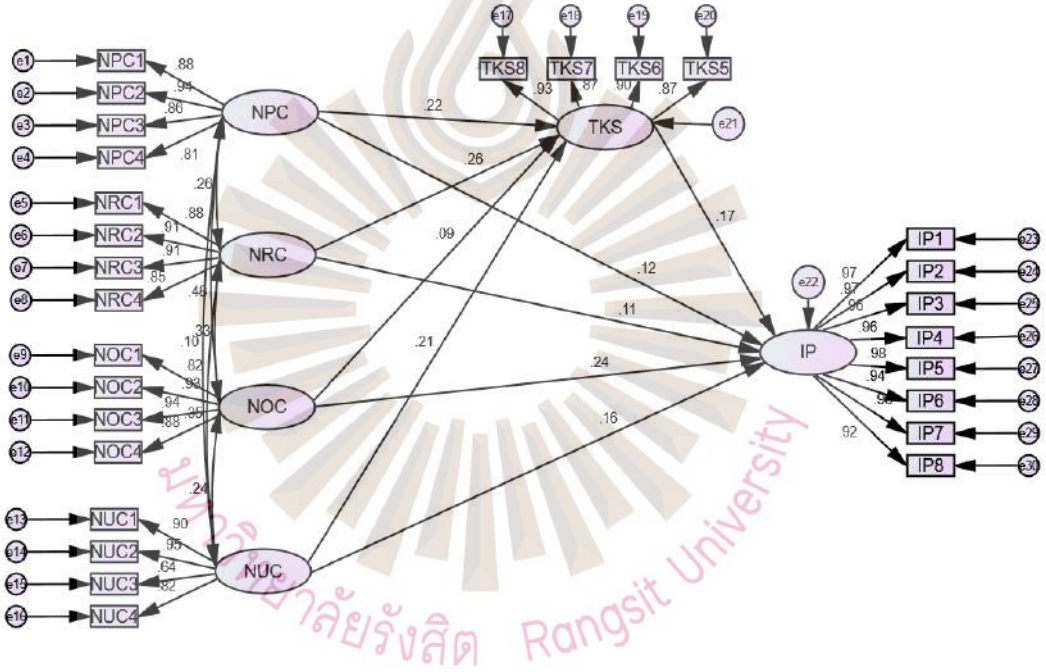


Figure 4.6 Graph of results of mediating effect of tacit knowledge sharing

Table 4.18 Fitting results of tacit knowledge sharing model

Goodness of Fit Index	Recommended Values	Model Fit Summary	Criteria
X^2	-	835.32	-
df	-	335	-
X^2/df	<3	2.49	Yes
RMSEA	<0.08	0.04	Yes

Table 4.18 Fitting results of tacit knowledge sharing model (Continued)

Goodness of Fit Index	Recommended Values	Model Fit Summary	Criteria
GFI	>0.90	0.95	Yes
NFI	>0.90	0.92	Yes
RFI	>0.90	0.93	Yes
IFI	>0.90	0.94	Yes
TLI	>0.90	0.95	Yes
CFI	>0.90	0.92	Yes

In the results of fitting the Tacit Knowledge Sharing (TKS) model in Table 4.18, it is shown that $X^2/df=2.49$, RMSEA=0.04, GFI=0.95, NFI=0.92, RFI=0.93, IFI=0.94, TLI=0.95, and CFI=0.92, and the fit indices meet the fit criteria, which indicates that the model has a relatively good fit.

Table 4.19 Path analysis results (II)

	Path		*β*	*S.E.*	*C.R.*	*P*
TKS	←	NRC	0.26	0.06	5.03	<0.001
TKS	←	NOC	0.09	0.06	1.72	>0.05
TKS	←	NUC	0.21	0.06	4.18	<0.001
TKS	←	NPC	0.22	0.06	4.10	<0.001
IP	←	NPC	0.12	0.06	2.34	<0.05
IP	←	NRC	0.11	0.06	2.25	<0.05
IP	←	NOC	0.24	0.05	4.61	<0.001
IP	←	NUC	0.16	0.05	3.36	<0.001
IP	←	TKS	0.17	0.05	3.24	<0.01

In the path analysis results in Table 4.19, it is shown that Network Planning Capability (NPC) has a significant positive predictive effect on Tacit Knowledge

Sharing (TKS) (β=0.22, P<0.05), and H2b validation is passed. Network Relational Capability (NRC) has a significant positive predictive effect on tacit knowledge sharing (TKS) (β=0.26, P<0.05), H2d validation passed. Network Occupancy Capability (NOC) does not have a significant positive predictive effect on tacit knowledge sharing (TKS) (β=0.09, P>0.05), and H2f validation fails. Network Utilization Capability (NUC) is a significant positive predictor of tacit knowledge sharing (TKS) (β=0.21, P<0.05), H2h validation passed. Tacit Knowledge Sharing (TKS) has a significant positive predictive effect (β=0.17, P<0.05) on Innovation Performance (IP) H3b validation passed.

Table 4.20 Results of mediation effect analysis of tacit knowledge sharing

Path	***Value***	***Lower 95% CI***	***Upper 95% CI***
NPC→TKS→IP	0.04	0.01	0.07
NRC→TKS→IP	0.04	0.01	0.08
NOC→TKS→IP	0.02	0.00	0.04
NUC→TKS→IP	0.03	0.01	0.07

In the results of mediation effect analysis in Table 4.20, it is shown that there is no mediation effect of Tacit Knowledge Sharing (TKS) between the relationship of Network Occupancy Capability (NOC) and Innovative Performance, as its confidence interval contains 0 and Network Occupancy Capability (NOC) is not a significant predictor of Tacit Knowledge Sharing (TKS), the H4g validation is not passed. There is a mediating effect of tacit knowledge sharing (TKS) between the relationship of network planning capability (NPC) and innovation performance with an effect value of 0.04 and a confidence interval of [0.01, 0.07], and the H4e validation passes. There is a mediating effect of Tacit Knowledge Sharing (TKS) between the relationship of Network Relationship Competence (NRC) and Innovation Performance with an effect value of 0.04 and a confidence interval of [0.01, 0.08], H4f validation passed. There is a mediating effect of Tacit Knowledge Sharing (TKS) between the relationship of

Network Utilization Capability (NUC) and Innovation Performance with an effect value of 0.03 and a confidence interval of [0.01, 0.07], H4h validation passed.

By comparing Figure 4.5 and Figure 4.6, where NRC→EKS,β=0.14, while NRC→TKS,β=0.26, indicates that network relationship capability has a greater positive predictive effect on implicit knowledge sharing.NOC→EKS,β=0.28, while NOC→TKS, the test fails, so that network occupancy capability has a positive predictive effect on explicit knowledge sharing only. NUC→EKS,β=0.33,while NUC→TKS,β=0.21,suggests that network utilization capability has a greater effect on explicit knowledge sharing.NPC→EKS,test fails,while NPC→TKS,β=0.22,suggests that network planning capability has a positive predictive effect on tacit knowledge sharing.

4.9 General Model Test

Structural equation modeling was used to test the mediating effects of explicit and tacit knowledge sharing, and the results of the tests are presented in Tables 4.21 -Tables 4.23

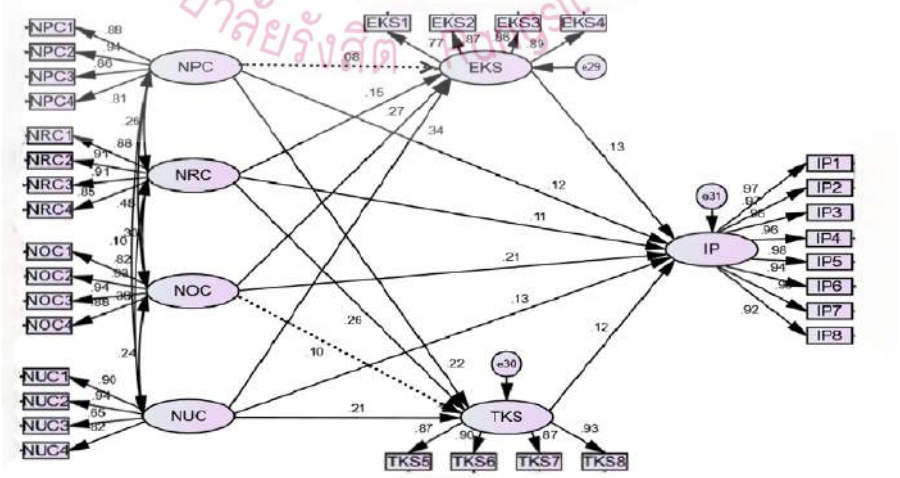
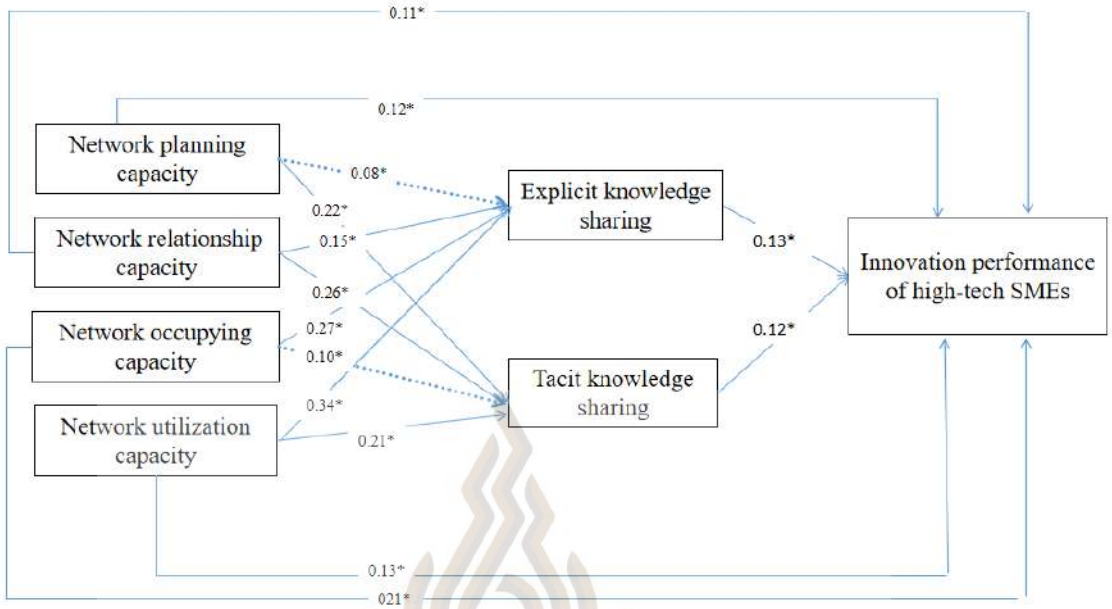


Figure 4.7 Results of General Model Testing Figure



Note: * is p-value < 0.05, ** is p-value < 0.01, *** is p-value < 0.001

Figure 4.8 Path Analysis

Table 4.21 General Model Fit Results

Goodness of Fit Index	**Recommended Values**	**Model Fit Summary**	**Criteria**
X^2	-	957.59	-
df	-	444	-
X^2/df	<3	2.16	Yes
RMSEA	<0.08	0.07	Yes
GFI	>0.90	0.95	Yes
NFI	>0.90	0.96	Yes
RFI	>0.90	0.95	Yes
IFI	>0.90	0.92	Yes
TLI	>0.90	0.97	Yes
CFI	>0.90	0.92	Yes

As shown in the total model fitting results in Table 4.21, X^2/df=2.16, RMSEA=0.07, GFI=0.95, NFI=0.96, RFI=0.95, IFI=0.92, TLI=0.97, CFI=0.92, all of which meet the fitting standards, indicating that the fitting degree of the model in this study is relatively good.

Table 4.22 Results of path analysis (iii)

Path			***β***	***S.E.***	***C.R.***	***P***
EKS	←	NRC	0.15	0.05	2.98	<0.05
EKS	←	NOC	0.27	0.05	5.07	<0.001
EKS	←	NUC	0.34	0.05	6.62	<0.001
TKS	←	NUC	0.21	0.06	4.37	<0.001
EKS	←	NPC	0.08	0.05	1.65	>0.05
TKS	←	NOC	0.10	0.06	1.79	>0.05
TKS	←	NRC	0.26	0.06	5.03	<0.001
TKS	←	NPC	0.22	0.06	4.11	<0.001
IP	←	EKS	0.13	0.06	2.33	<0.05
IP	←	NPC	0.12	0.06	2.36	<0.05
IP	←	NRC	0.11	0.06	2.12	<0.05
IP	←	NOC	0.21	0.06	3.87	<0.001
IP	←	NUC	0.13	0.06	2.52	<0.05
IP	←	TKS	0.12	0.05	2.26	<0.05

Table 4.23 Results of mediation effect analysis of the total model

Path	***Value***	***Lower 95% CI***	***Upper 95% CI***
NPC→EKS→IP	0.012	-0.001	0.041
NRC→EKS→IP	0.021	0.002	0.059
NOC→EKS→IP	0.037	0.004	0.082
NUC→EKS→IP	0.047	0.003	0.101

Table 4.23 Results of mediation effect analysis of the total model (Continued)

Path	*Value*	*Lower 95% CI*	*Upper 95% CI*
NPC→TKS→IP	0.027	0.003	0.065
NRC→TKS→IP	0.033	0.003	0.078
NOC→TKS→IP	0.012	0.000	0.037
NUC→TKS→IP	0.027	0.003	0.063

As shown in the results of the mediation effect analysis of the total model in Table 4.23, explicit knowledge sharing (EKS) has no mediation effect on the relationship between network planning ability (NPC) and innovation performance, because its confidence interval contains 0[-0.001,0.041]. And network planning ability (NPC) has no significant predictive effect on explicit knowledge sharing (EKS). Explicit knowledge sharing (EKS) has an intermediary effect on the relationship between network relational competence (NRC) and innovation performance, with effect size of 0.021 and confidence interval of [0.002, 0.059]. Explicit knowledge sharing (EKS) has an intermediary effect on the relationship between network space occupying power (NOC) and innovation performance, with effect size of 0.037 and confidence interval of [0.004, 0.082]. Explicit knowledge sharing (EKS) has an intermediary effect on the relationship between network utilization capability (NUC) and innovation performance, with effect size of 0.047 and confidence interval of [0.003, 0.101].

Tacit knowledge sharing (TKS) has no mediating effect on the relationship between NOC and innovation performance, because its confidence interval contains 0, and NOC has no significant predictive effect on tacit knowledge sharing (TKS). Implicit knowledge sharing (TKS) has an intermediary effect on the relationship between network planning ability (NPC) and innovation performance, with effect size of 0.027 and confidence interval of [0.003, 0.065]. Implicit knowledge sharing (TKS) has an intermediary effect on the relationship between network relational capability

(NRC) and innovation performance, with effect size of 0.033 and confidence interval of [0.003, 0.078]. Implicit knowledge sharing (TKS) has an intermediary effect on the relationship between network utilization capability (NUC) and innovation performance, with effect size of 0.027 and confidence interval of [0.003, 0.063].

4.10 Hypothesis Summary

Table 4.24 Summary of hypothesis validation

Hypothesis	Hypothesis content Test results	Results
H1a	Network planning capabilities have a positive impact on innovation performance	PASS
H1b	Network relationship capability has a positive effect on innovation performance	PASS
H1c	Network occupancy capability has a positive impact on innovation performance	PASS
H1d	Network utilization capability has a positive effect on innovation performance	PASS
H2a	Network planning capability has a positive effect on explicit knowledge sharing	NO
H2b	Network planning capability has a positive effect on tacit knowledge sharing	PASS
H2c	There is a positive effect of network relationship capability on explicit knowledge sharing	PASS
H2d	There is a positive effect of network relationship capability on tacit knowledge sharing	PASS
H2e	Network occupancy ability has a positive effect on explicit knowledge sharing.	PASS

Table 4.24 Summary of hypothesis validation (Continued)

Hypothesis	Hypothesis content Test results	Results
H2f	Network occupancy ability has a positive effect on tacit knowledge sharing	NO
H2g	Network utilization ability has a positive effect on explicit knowledge sharing	PASS
H2h	Network utilization ability has a positive effect on tacit knowledge sharing	PASS
H3a	Explicit knowledge sharing has a positive effect on innovation performance of Hi-tech SMEs.	PASS
H3b	Tacit knowledge sharing has a positive effect on innovation performance of Hi-tech SMEs	PASS
H4a	Explicit knowledge sharing mediates between network planning capability and innovation performance of Hi-tech SMEs.	NO
H4b	Explicit knowledge sharing mediates between network relationship capability and innovation performance of Hi-tech SMEs.	PASS
H4c	The mediating role of explicit knowledge sharing in network occupancy capacity and innovation performance of Hi-tech SMEs.	PASS
H4d	Explicit knowledge sharing mediates between network utilization ability and innovation performance of Hi-tech SMEs.	PASS
H4e	Tacit knowledge sharing mediates between network planning capability and innovation performance of Hi-tech SMEs.	PASS

Table 4.24 Summary of hypothesis validation (Continued)

Hypothesis	Hypothesis content Test results	Results
H4f	Tacit knowledge sharing mediates network relationship capability and innovation performance of Hi-tech SMEs.	PASS
H4g	Tacit knowledge sharing mediates network occupancy capacity and innovation performance of Hi-tech SMEs.	NO
H4h	The mediating role of tacit knowledge sharing in network utilization capability and innovation performance of Hi-tech SMEs.	PASS

Chapter 5

Conclusion and Recommendations

This study takes SMEs in science and technology in China as the research object to explore the role of the mechanism between network capability, knowledge sharing, and innovation performance of SMEs in science and technology. Based on the dynamic capability theory and social network theory, the constantly enriched cooperation methods and knowledge management models among enterprises, the relationship between network capability, knowledge sharing, and innovation performance of Hi-tech SMEs is systematically analyzed. This chapter summarizes the hypothesized results in Chapter 4, discusses the results, and then gives suggestions for the future innovation development of Hi-tech SMEs and prospects for future academic research.

5.1 Conclusion

The result of data analysis to satisfy the research's objectives. The details are as follows.

1) A total of 423 valid samples were collected in this study. Each variable of the questionnaire was validated using the mean value. The mean values of the sub-dimensions of network capability were all in the range of 3.90-4.65, the mean values of explicit and tacit knowledge sharing were in the range of 4.07-4.5, and the mean value of innovation performance was 4.42, which is mainly in the middle level and needs to be further improved.

2）A Summary of the Findings of Inferential Statistics

The Analysis of Pearson's Correlation Coefficient of 7 latent variables. The relationship between latent variables is mainly found in the same direction with r = .13 - .46 at a statistical significance level of .01. It indicates that there is a positive correlation between all seven latent variables. The normality test of the data from 423 survey samples showed that the skewness values (SI) of all the question items were between -0.77 and 0.39 and the kurtosis values (Kurtosis Index: KI) were between -1.55and -0.49. Based on previous research, the Skewness and Kurtosis values between -3 and 3 are considered acceptable with the data being distributed normally (Tabachnick & Fidell, 2007). Increased confidence in data collection.

3）Confirmatory Factor Analysis (CFA)

From the first step of confirmatory factor analysis of the latent variables of Network Capacity, the factor loading of each observed variable is as follows: Network planning capability（NPC1-NPC4）=0.80-0.94, Network relationship capability (NRC1-NRC4) = .84 - .92, Network occupying capability (NRC1-NRC4) = .82 - .94, Network utilization capability (NRC1-NRC4) = .64 -.95. As there is no observed variable with the factor loading of less than 0.30, no observed variable of the latent variable is cut off. In addition, the measurement model is consistent with empirical data, and the eight indicators identified pass the following criteria: X2/df=2.29 (<5.00),RMSEA=0.03(<0.08),GFI=0.93(>0.80),NFI=0.96>0.80(>0.90),RFI=0.95(>0.90)IFI=0.91, TLI=0.97(>0.90), CFI=0.91(>0.90). The mean-variance extracted values of AVE and construct reliability CR for network planning ability were 0.76 and 0.93. The mean-variance extracted values of AVE and construct reliability CR for network relationship ability were 0.79 and 0.94. The mean-variance extracted values of AVE and constructed reliability CR for network occupancy ability were 0.80, which would be honored at 0.94. The mean-variance extracted values of AVE and construct for

network utilization ability were 0.70 and 0.90. The mean-variance extracted values of AVE for each variable were more significant than 0.50 (Diamantopoulos & Siguaw, 2000), and CR values were greater than 0.70. reliability CR were 0.70 and 0.90. The AVE for each variable was greater than 0.50 (Diamantopoulos & Siguaw, 2000), and the CR value was greater than 0.70 (Fornell & Larcker, 1981), indicating that the validity of the questionnaire was relatively good. Increased confidence in data collection.

From the CFA analysis of the second latent variable, namely advertising attitude, the factor loads of each observed variable of explicit knowledge sharing (EKS) and tacit knowledge sharing (TKS) are as follows: Explicit knowledge sharing (EKS1-EKS4) = 0.77-0.89, Tacit knowledge sharing (TKS1-TKS44) = .87 -.93, As there is no observed variable with the factor loading of less than 0.30, no observed variable of the latent variable is cut off. Besides, the measurement model is found to be congruent with the empirical data as eight determined indices pass the criteria as follows:Chi-square/df=2.66(<5.00),GFI=.93(>.90),RMSEA=0.04(<0.08),CFI=.93(>0.90), NFI=0.91(>.90), RFI=0.95(>.90), IFI=0.98(>.90) TLI=0.96(>.90). Finally, the mean-variance extracted values of AVE and construct reliability CR for explicit knowledge sharing (EKS) were 0.72 and 0.91. The mean-variance extracted values of AVE and construct reliability CR for tacit knowledge sharing (TKS) were 0.80 and 0.94. The AVE of the two variables was greater than 0.50, and the CR value was greater than 0.70, which indicated that the validity of the questionnaire was relatively good.

From the analysis of CFA of the third latent variable, namely Innovation Performance, the factor loading of each observed variable of Attitude towards Brand is as follows: Innovation Performance (IP1-IP8) = 0.92-0.98. As there is no observed variable with the factor loading of less than 0.30, no observed variable of the latent

variable is cut off. There is no variable with a factor loading of less than 0.30; thus, no observed variable is cut off. Besides, the measurement model is found to be congruent with the empirical data as eight determined indices pass the criteria as follows: X/df=2.69，RMSEA=0.07，GFI=0.96，NFI=0.96，RFI=0.95，IFI=0.97, TLI=0.97，CFI=0.98，the fit metrics all met the requirements and the fit was relatively good. Finally, the mean-variance extracted value AVE and construct reliability CR for innovation performance were 0.72 and 0.99. The AVE of the variable is greater than 0.50 (Diamantopoulos & Siguaw, 2000), and the CR value is greater than 0.70 (Fornell & Larcker, 1981), which indicates that the validity of the questionnaire is relatively good.

4) One-way analysis of variance (ANOVA)

One-way ANOVA was used to analyze the variability of network capability, knowledge sharing, and innovation performance regarding firm size and educational qualifications. The results showed that there was significant variability in network capability in terms of firm size (F=47.64, P<0.05), knowledge sharing in terms of firm size (F=63.85, P<0.05), and innovation performance in terms of firm size. There is a significant difference (F=14.67, P<0.05). There is a substantial difference in network capability in terms of education (F=35.73, P<0.05), knowledge sharing in terms of education (F=28.31, P<0.05), and innovation performance in terms of education (F=4.77, P<0.05).

The results show that large enterprises have high corporate network capabilities but relatively low levels of knowledge sharing. In contrast, small-sized enterprises tend to have higher knowledge sharing but significantly lower corporate network capabilities than large-sized enterprises; large-sized enterprises have strong corporate network capabilities, which enable them to acquire external value resources quickly, develop external relationship networks, and improve their innovation

performance. However, the internal network effectiveness of large-scale enterprises is not high, and they cannot effectively digest and absorb the resources obtained from the outside, which may have a reverse effect on enterprise innovation. Although small-sized enterprises are limited by network capacity to some extent, due to the small size of the enterprise, only a few levels, and not complicated departmental settings, communication and coordination between the enterprise's internal Network are relatively straightforward. Therefore, knowledge sharing promotes innovation significantly, compensating for the weakness of the external network capacity of the SMEs to a certain extent. Regarding the one-way ANOVA on educational qualifications, the results indicate that the higher the academic qualifications, the better the level of variables, such as the enterprise's network capacity.

5) The Analysis of the Structural Equation Model

In this part, we will look at the four dimensions of network capability (network planning capability, network relationship capability, network occupancy capability, and network utilization capability) on the impact of innovation performance, the mediating role of explicit knowledge sharing, the mediating role of implicit knowledge sharing, and the total model test

The results of analyzing the direct, indirect, and total effects of the variables in the structural equation model of Hi-tech SMEs through network capability knowledge sharing Through the analysis of the established structural equation model, it is found that the model is consistent with the empirical data at a statistical significance level of 0.001, therefore, the direct, indirect, and total effects of the variables in the structural equation model of the success factors of the online Netflix video advertisements in influencing the consumers' willingness to buy are summarized as follows The total effects of the variables are summarized as follows:

The objectives of this research can be confirmed with sufficient evidence to support the claims of the hypotheses with a 95% confidence level. The results of the tested hypotheses are presented as follows:

1) The four dimensions of network capability have a positive direct effect on innovation performance. The path coefficients are analyzed as follows: network planning capability has a significant positive predictive effect on innovation performance, $\beta = 0.16$; network relationship capability has a significant positive predictive effect on innovation performance, $\beta = 0.16$; network occupancy capability has a significant positive predictive effect on innovation performance, $\beta = 0.25$; and network utilization capability has a significant positive predictive effect on innovation performance, $\beta = 0.20$. Explanation Hypotheses H1a-H1d are passed.

2) Mediating effect test of explicit knowledge sharing. The path coefficients are analyzed as follows: network relationship capability (NRC) has a significant positive predictive effect on explicit knowledge sharing (EKS), $\beta=0.14$; H2c validation passes. Network Occupancy Capability (NOC) has a significant positive predictive effect on explicit knowledge sharing (EKS) ($\beta=0.28$, $p<0.05$); H2e validation passed. Network Utilization Capability (NUC) has a significant positive predictive effect on Explicit Knowledge Sharing (EKS) ($\beta=0.33$, $P<0.05$) and H2g validation passed. Explicit knowledge sharing (EKS) has a significant positive predictive effect on innovation performance ($\beta=0.18$, $P<0.05$), H3a passes. Network Planning Capability (NPC) does not have a significant positive predictive effect on explicit knowledge sharing (EKS) ($\beta=0.08$, $P>0.05$), and H2a validation is not passed. Meanwhile, in the NPC→EKS→IP path, the H4a validation fails because its confidence interval is [-0.001,0.04], therefore. The other mediating effects are NRC→EKS→IP with an effect value of 0.03, NOC→EKS→IP with an effect value of 0.05, and NUC→EKS→IP with an effect value of 0.06. Therefore, all H4b-H4d validations passed.

3) Mediating effect test of tacit knowledge sharing. The path coefficients are as follows: network planning capability (NPC) has a significant positive predictive effect (β=0.22, P<0.05) on tacit knowledge sharing (TKS), and the H2b validation passes. Network Relational Capability (NRC) has a significant positive predictive effect on tacit knowledge sharing (TKS) (β=0.26, P<0.05) and H2d validation passed. Network Occupancy Capability (NOC) does not have a significant positive predictive effect on tacit knowledge sharing (TKS) (β=0.09, P>0.05), and H2f validation failed. Network Utilization Capability (NUC) is a significant positive predictor of tacit knowledge sharing (TKS) (β=0.21, P<0.05) and H2h validation passes. Tacit knowledge sharing (TKS) has a significant positive predictive effect (β=0.17, P<0.05) on innovation performance (IP) H3b validation passed. Meanwhile, in the NOC→TKS→IP path, because of its confidence interval [0.00,0.04], therefore, H4g validation fails. NPC→TKS→IP, with an effect value of 0.04, H4e validation passes; NRC→TKS→IP, with an effect value of 0.04, H4f validation passes; NUC→TKS→IP, with an effect value of 0.03, H4h validation passes.

5.2 Discussion

1) The connotation and dimensions of network capability.

Further enrichment and improvement are made based on the research of Ren (2010) and Liu (2019). By combing the previous literature and combining the elements of enterprise network capability components, network capability is divided into network planning capability, network relationship capability, network occupancy capability, and network utilization capability. Network planning capability belongs to strategic capability, and the other three belong to functional (operational) network capability. Through scale construction, data collection and analysis, and verification of hypotheses by structural equations, this study proposes a 34-item scale to effectively measure network capability, which provides suggestions for guiding the

innovation and development of Hi-tech SMEs regarding their network capability.

2) The four dimensions of network capability positively affect the innovation performance of Hi-tech SMEs.

This paper empirically proves that network planning capability, network relationship capability, network occupancy capability, and network utilization capability significantly impact innovation performance. This coincides with the research results of Wu, Sun, & Liu, (2017), and Zhou (2020) on the facilitating effect of network capability on the innovation performance of Hi-tech SMEs. The reason why enterprises actively cultivate network capabilities and partners to build network partnerships and other activities is to better communicate and interact with relevant partners, to adapt to the needs of enterprise development in the era of networking, and to continuously enhance the enterprise's innovation capacity and thus enhance enterprise performance.

Research shows that Chinese enterprises should cultivate and improve their network capability in four ways. First, I want to develop sound strategic planning ability, to be able to perceive and identify partner information proactively, to seek competitive advantages, and to plan and think with a strategic perspective. Second, the network relationship capability should be emphasized based on trust. On the one hand, it makes full use of the relationship resources of partner enterprises; on the other hand, it solves problems such as conflicts and financial constraints through trust-based cooperative relationships. In addition, good relationship coordination ability enables enterprises to adjust their behaviors and strategies promptly according to the dynamic nature of the network environment to create new development opportunities. Thirdly, the higher the network position occupied by Hi-tech SMEs, the more helpful it is for market information exchange and economic and technological cooperation between the enterprises and members of other organizations. Fourthly,

S&T SMEs ultimately obtain resources through internal and external networks, which can only be fully communicated and utilized to improve the innovation capacity of internal and external sectors of the enterprise. Knowledge, resources, information, and capital must be fully expressed and exchanged internally between organizations to achieve mutual benefits ultimately.

Therefore, the paper verifies through theoretical and empirical analyses that, by improving the network capability, SMEs of science and technology can encourage enterprises to utilize information and resources from external networks and fully improve their technological level through internal communication and learning so as to improve their innovation performance. As a manager of the enterprise, I pay attention not only to the construction of the network but also to the network's operation, maintenance, and other management work.

3) Knowledge sharing positively affects the innovation performance of Hi-tech SMEs.

This study fully supports the hypothesis that knowledge sharing (explicit and tacit knowledge sharing) positively affects innovation performance through empirical research. Explicit knowledge sharing has a positive impact. This aligns with the findings of Jean & Sinkovics (2010), Hu, Horng & Sun (2009). On the one hand, it regulates and enhances the behavior of close interaction and communication among network members in each network cooperation portfolio by improving the flow of resources such as relevant technical data, experimental parameters, product design drawings, relevant papers, technical diagrams, patents, and process specifications in network cooperation portfolios; on the other hand, explicit knowledge sharing in relevant technical data, experimental parameters, product design drawings, related thesis, technical mapping, patents and process flow specification and other resources in the mutual sharing, in the cooperative innovation activities will have more robust

innovation than competitors (He, 2021).

4) Knowledge sharing: a mediator of the effect of firms' network capability exertion

This study empirically verifies that knowledge sharing (explicit and tacit knowledge sharing) plays a partial mediating role. This study is similar to the findings of Wang, Chen & Fang (2018). Specifically, as follows:

Explicit knowledge sharing (EKS) has a mediating effect on the relationship between network relationship capability (NRC) and innovation performance, with an effect value of 0.021 and a confidence interval of [0.002, 0.059]. There is a mediating effect of explicit knowledge sharing (EKS) between the relationship of network occupancy capacity (NOC) and innovation performance with an effect value of 0.037 and a confidence interval of [0.004, 0.082]. Explicit knowledge sharing (EKS) has a mediating effect on the relationship between network utilization capability (NUC) and innovation performance, with an effect value of 0.047 and a confidence interval of [0.003, 0.101]. There is a mediating effect of Tacit Knowledge Sharing (TKS) between the relationship of Network Planning Capability (NPC) and Innovation Performance with an effect value of 0.027 and a confidence interval of [0.003, 0.065]. Tacit Knowledge Sharing (TKS) has a mediating effect on the relationship between Network Relational Capability (NRC) and Innovation Performance with an effect value of 0.033 and a confidence interval of [0.003, 0.078]. Tacit Knowledge Sharing (TKS) has a mediating effect on the relationship between Network Utilization Capability (NUC) and innovation performance with an effect value of 0.027 and a confidence interval of [0.003, 0.063].

On the other hand, explicit knowledge sharing (EKS) does not have a mediating effect on the relationship between network planning capability (NPC) and

innovation performance, as its confidence interval contains 0 [-0.001, 0.041]. Although Network Planning Capability (NPC) dramatically improves the development planning of firms, they may be more focused on short-term business objectives for Hi-tech SMEs. The reasons for this are analyzed as follows: first, the market and technological environments in which Hi-tech SMEs operate are usually characterized by a high degree of uncertainty, and this uncertainty may lead to more significant risks and challenges in network planning, which in turn affects the role of network planning capabilities for explicit knowledge sharing. Second, because of limited resources, hi-tech SMEs may be more inclined to invest their resources in technology development and market expansion rather than network planning. Thirdly, in the Chinese context, corporate culture and interpersonal networks significantly impact organizational behavior. Suppose firms ignore the impact of cultural differences and interpersonal relationships in the network planning process. In that case, then network planning capabilities may not be able to play a full role, affecting explicit knowledge sharing.

Tacit knowledge sharing (TKS) does not have a mediating effect on the relationship between network occupancy capacity (NOC) and innovation performance because its confidence interval contains 0, and network occupancy capacity (NOC) does not have a significant predictive effect on tacit knowledge sharing (TKS). The reasons for the analysis are as follows: firstly, the promotion effect of network location centrality on the innovation performance of enterprises is because the higher the degree of network location centrality of an enterprise, the more it helps the enterprise to cooperate with other organizations in technological development and market information exchange and interaction, and improves the efficiency of innovation. Location centrality significantly improves the informatization advantage of enterprises, thus enabling them to make rapid responses and countermeasures to technological changes and updates. However, most Chinese SMEs are low-level

nodes in the global manufacturing network, with a low degree of network centrality or even at the network's edge, making it difficult for them to directly access the direct knowledge sharing of the international flagship enterprises. They are in a disadvantaged and passive position in the exchange of information. Therefore, it is of great significance for Chinese enterprises to improve their dominant position in the industrial value chain and innovation through independent innovation and to transition from low-level suppliers to high-level suppliers until the establishment of a global manufacturing network centered on themselves in order to improve the innovation performance of Hi-tech SMEs. Secondly, due to its difficulty in communicating and expressing characteristics, tacit knowledge is often difficult to effectively transmit and share through traditional network occupation or organizational structure. In Hi-tech SMEs, the transfer and sharing of such knowledge relies more on informal communication and interaction among employees than network occupancy capabilities.

5.3 Recommendations

5.3.1 Business Development Recommendations

Due to the limited nature of knowledge, technology, capital, and other elemental resources, science and technology-based small and medium-sized enterprises result in increased innovation riskiness and high difficulty. In the open innovation network environment, many enterprises must realize how to build and effectively manage and utilize the network. The innovation and development of Hi-tech SMEs still need to be constrained by different industries, regions, years, and other factors, which will become problematic for enterprises.

(1) Enterprises improve the level of each dimension of network capability

The research of the article shows that Hi-tech SMEs should start from the following four dimensions to enhance their enterprise network capability: First, cultivate good network development planning capability (NPC), have a clear network perception and identification capability, and clarify the selection criteria, scope of cooperation and expected goals of partners. Regularly evaluate and adjust the network planning to ensure that it is consistent with the enterprise's overall strategy, strengthen market research, understand industry dynamics and market demand, and provide data support for network planning. Second, establish good network relationship capability (NRC). Emphasize trust-based cooperative relationships, including suppliers, customers, competitors, etc., to achieve resource sharing and mutual benefit. Enhance the enterprise's credibility and reputation and win partners' trust through honest operation and quality service. Strengthen cooperation with universities, research institutions, and other external organizations to broaden knowledge sources and technology channels. Thirdly, attach importance to the enterprise's ability to occupy a favorable position in the industry network, i.e., network dominance. Enhance the enterprise's industry influence through technological innovation and market expansion. Actively formulate industry standards and rules to improve the enterprise's industry voice and status. Pay attention to the industry development trend and emerging technologies, and adjust the network occupation strategy in time. Fourth, Network Utilization Capability (NUC). Evaluate the future value of collaborators and make full use of network resources, including information, technology, talents, etc., to enhance enterprises' innovation ability and market competitiveness. Establish an effective network resource integration mechanism to achieve optimal allocation and efficient use of resources. Strengthen the construction of network culture within the enterprise and improve the staff's knowledge and ability to utilize network resources.

(2) Establish a knowledge-sharing platform and build an intermediary for network capability to play an influential role

Build an internal knowledge-sharing platform, including an explicit knowledge sharing (EKS) and a tacit knowledge sharing (TKS) platform. Facilitate the exchange of experience and knowledge sharing among employees. Encourage employees to transform their knowledge, experience, and skills into shared resources for the enterprise; promote cross-departmental cooperation and exchanges; break down departmental barriers and promote collaboration and exchanges between different departments to realize cross-departmental dissemination and application of knowledge. Regularly organize cross-departmental meetings or seminars to encourage employees to share experiences and explore problems.

Introduce external knowledge resources through exchanges and cooperation with partners, customers, and other organizations. Pay attention to the cutting-edge dynamics of the industry and the latest research results, and timely transform external knowledge into the innovation power of the enterprise.

(3) Combining network capability and knowledge sharing to improve enterprise innovation performance

In the network economy era, acquiring external resources has become a meaningful way to improve innovation performance for Hi-tech SMEs. Therefore, enterprises establish and maintain network relationships to improve the ability to acquire resources and take network capacity as the focus of the construction of enterprise strategic development. Whether access to external resources can contribute to the development of Hi-tech SMEs also depends on building their own internal networks. This requires increasing inter-departmental and intra-departmental trust and creating an accessible communication environment by formulating institutional rules

that do not touch the psychological precautions of knowledge sharing. In conclusion, the enterprise can only better absorb and utilize external network resources through effective internal network management of tacit knowledge and technology to improve innovation performance.

5.3.2 Academic Recommendations

(1) Expansion of sample scope

The sample of this paper chooses the Hi-tech SMEs in the eastern developed regions, and it can also expand the scope of the study to collect the data of Hi-tech SMEs nationwide extensively.

(2) Refinement and depth of variable dimensions

Due to the dynamic nature of networks, the formation and evolution of a particular network varies over time, and future research can consider the factor of environmental dynamics. We can incorporate environmental dynamics into the relationship of "network capability-knowledge sharing-innovation performance" and study the different influence intervals of environmental dynamics or the various levels of ecological dynamics.

5.4 Limitations and Prospects

This paper proposes the mechanism of the role of network capabilities in influencing the innovation performance of Hi-tech SMEs. It uses survey data from Chinese enterprises to argue the proposed hypotheses. However, this paper has the following areas for improvement that need to be explored. First, the network in this paper generally refers to the external network. In contrast, in applying network technology in Hi-tech SMEs, the influence of internal network effectiveness and the

interaction between the two should also be considered. Secondly, the research model in this paper does not consider the perturbation factors of some control factors, such as enterprise scale, enterprise attributes, etc. Third, the dynamics of the environment, with the development of time, and whether the dynamics of enterprise network capability are affected by the environment and other factors will be further researched.

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Appendices

Appendix A

Questionnaire

QUESTIONNAIRE

Dear Sir/Madam

My name is YAN ZHANG . I am studying for a Doctoral's degree in Business Administration at Rangsit University. I am conducting a research titled "The influence of network capability and knowledge sharing on innovation performance of Hi-tech SMEs" which the expected results are that network capability has direct and indirect effects on innovation performance through knowledge sharing.

You are invited to take part in this research study because your business meets the research needs.For this purpose, the questionnaire consists of five parts. Part 1: 8 questions regarding general information of the interviewee. Part 2: 16 questions about network capability.Part 3: 8questions about knowledge sharing. Part 4: 8 questions about innovation performance. and Part 5 for additional opinions.You will take 15minutes to complete the questionnaire. The researcher will request the responses from you by the actual situation of your own.

Please answer the questions as honestly as possible. Your response will be kept strictly confidential and will only be used for research purposes and your personal details will be anonymized. You have the right to not answer any questions that cause you to feel uncomfortable. You may also decide to withdraw from this study at any time without any penalty or consequences.

If you have questions about the research or questionnaire, you can contact us at Huilong Community, Tourism Road, Lixia District, Jinan City, Shandong Province, China during working hours or contact via phone number +8618653116158.

This research project has been reviewed and approved by the Research Ethics Committee of Rangsit University. If you have any queries, please do not hesitate to contact the Research Ethics Office of Rangsit University, 52/347 Phahonyothin Rd., Tambon Lak Hok, Amphoe Muang, Pathum Thani Province, 12000, Thailand (Building 1, 5th Floor, Room 504), Tel. 66-2791-5728, Fax 66-2791-5689.

Thank you for kindly participating in the questionnaire.

With kind regards

YAN ZHANG

Part 1: Please answer your basic information

1. How many years has your company been established?

○3 years or less

○3-5 years

○5 years and above

2. The size of your company:

○49 employees or less

○50- 100 employees

○101 and above

3. Your company's industry areas are:

○ Electronic Information

○ Biological medicine

○ New materials

○ opto-mechatronics

○ New energy and high efficiency and energy saving

○ High-tech services

○ Resources and Environment

○ Agriculture and rural areas

○ Ation and Aerospace

○ Other

4. Nature of your company:

○ State-owned Enterprises

○ Private enterprises

○ Joint Ventures

○ Others

5. Your position in your company:

○ Chairman or General Manager

○ Intelligent Department manager

○ Key Technical Personnel

○ Others

6. Your position level:

○ Junior Managers

○ Middle managers

○ Senior Management

7. Your current working years in the company:

○ Less than 3 years

○3-5 years

○6-8 years

○9- 11Years

○12 years and above

8. Your education:

○ Senior high School (including technical secondary school

○ Undergraduate and junior college

○ Master degree or above

Part 2: Measurement of variables such as network capability

For the following questions, judge the actual situation of the enterprise according to the description of each item in accordance with "1 to 7". "1" means strongly disagree, "2" means disagree, "3" means somewhat disagree, "4" means neither agree

nor disagree, "5" means somewhat agree, "6" means agree, "7" means strongly agree. Please choose the number according to your true feelings.

	What are your network capabilities actually like?	strongly agree		disagree			-----strongly	
NPC1	We are good at analyzing the matching degree between our own development strategy and network resources	1	2	3	4	5	6	7
NPC2	We are keen to identify cooperation opportunities in development	1	2	3	4	5	6	7
NPC3	We have clear goals and guidelines for cooperation	1	2	3	4	5	6	7
NPC4	We know our strategy for building long-term relationships with potential partners	1	2	3	4	5	6	7
NRC1	We emphasize that cooperation is based on trust	1	2	3	4	5	6	7
NRC2	We know our strategy for building relationships with potential partners	1	2	3	4	5	6	7
NRC3	Compared with its peers, the company has more partners of all types, including universities, research institutes, important suppliers and customers in the industry	1	2	3	4	5	6	7
NRC4	We can properly manage	1	2	3	4	5	6	7

	differences and conflicts in the network of cooperation							
NOC1	We have a strong ability to occupy a central position in the network of partnerships	1	2	3	4	5	6	7
NOC2	We often act as a bridge between other partners	1	2	3	4	5	6	7
NOC3	We are always able to communicate very quickly with all our partners without relying on third parties to deliver information	1	2	3	4	5	6	7
NOC4	We were able to occupy a central position and get more resources	1	2	3	4	5	6	7
NUC1	We can think about how to develop the relationship from the perspective of partners.	1	2	3	4	5	6	7
NUC2	We have a strong ability to develop mutual trust and mutual benefit with our partners	1	2	3	4	5	6	7
NUC3	Within an organization, departments often exchange information and resources to accomplish tasks together (reverse problem)	1	2	3	4	5	6	7
NUC4	The contacted partners rarely take the initiative to break off the cooperative	1	2	3	4	5	6	7

relationship with the enterprise

Part3 knowledge sharing

For the following questions, judge the actual situation of the enterprise according to the description of each item in accordance with "1 to 7". "1" means strongly disagree, "2" means disagree, "3" means somewhat disagree, "4" means neither agree nor disagree, "5" means somewhat agree, "6" means agree, "7" means strongly agree. Please choose the number according to your true feelings.

	What is the reality of knowledge sharing in your company?	strongly agree		disagree			-----strongly
EKS1	Often share with partners: technical research and development/service, project progress reports and other information	1	2	3	4	5	6	7
EKS2	Often shared with partners: Information on technical/service quality control	1	2	3	4	5	6	7
EKS3	Often shared with partners: Information on technical components/service details	1	2	3	4	5	6	7
EKS4	Often shared with partners: Information on market and customer needs	1	2	3	4	5	6	7
TKS1	Often shared with partners: know-how behind technology/service	1	2	3	4	5	6	7

	implementation							
TKS2	Often share with partners: know-how in solving technical/service problems or unexpected technical/service problems	1	2	3	4	5	6	7
TKS3	Often share with partners: experience and know-how to break through technical/service problems/technical/service limitations	1	2	3	4	5	6	7
TKS4	Often share with partners: understanding and judging experience of market and customer needs	1	2	3	4	5	6	7

Part4.innovation performance

For the following questions, judge the actual situation of the enterprise according to the description of each item in accordance with "1 to 7". "1" means strongly disagree, "2" means disagree, "3" means somewhat disagree, "4" means neither agree nor disagree, "5" means somewhat agree, "6" means agree, "7" means strongly agree. Please choose the number according to your true feelings.

	What is the reality of your company's innovation performance?	strongly agree		disagree				-----strongly
IP1	The company's customers have high requirements for products and technologies	1	2	3	4	5	6	7
IP2	Senior executives are very satisfied with the innovative products and	1	2	3	4	5	6	7

	technologies							
IP3	Our company's market share continues to grow	1	2	3	4	5	6	7
IP4	Our company's profit margin is increasing year by year	1	2	3	4	5	6	7
IP5	We can come up with some original solutions to problems by learning	1	2	3	4	5	6	7
IP6	We will actively support innovative ideas	1	2	3	4	5	6	7
IP7	We can turn innovative ideas into practical applications	1	2	3	4	5	6	7
IP8	Due to the development of product innovation, the time to market for similar products is shortened	1	2	3	4	5	6	7

Part 5: Additional opinions

……

……

Appendix B

The Evaluation of IOC of the Research Tool

The influence of network capability and knowledge sharing on innovation performance of Hi-tech SMEs

（For Expert 1）

By

YAN ZHANG

Hi-tech SMEs have become the backbone of China's independent innovation capability, and the network capability and resources possessed by Hi-tech SMEs are more limited, and the network capability has become one of the important channels for Hi-tech SMEs to solve the problem of insufficient information and resources. In the competitive environment, how Hi-tech SMEs can own the network capability and obtain the competitiveness of sustainable development in the industrial chain is an important issue for the future development of Hi-tech SMEs.

This study aims to achieve three objectives: 1) To study the impact of network capability on innovation performance of small and medium-sized technology 2) To study the relationship between network capability (NC) and knowledge sharing .3) To study the influence of knowledge sharing on innovation performance of small and medium-sized technology-based enterprises. on innovation performance of small and medium-sized technology -based enterprises. This paper adopts a quantitative research method, the instruments for data collection are the instruments for data collection are questionnaires. The data are mainly from Hi-tech SMEs in East China, because these regions have active economies and high levels of innovation. The survey respondents are mainly managers of Hi-tech SMEs (Small and Medium-sized Enterprises). Strict confidentiality is maintained for the interviewees, and filling out the questionnaires will not have any negative impact on them, which ensures the authenticity and reliability of the data.

The following table consists of twelve parts: the first part of the basic information, the second part of the four dimensions of network capability, the third

part of the two dimensions of knowledge sharing, the fourth part of the four dimensions of network planning capability, and the fifth part is

four dimensions of network relationship capability, part 6 four dimensions of network occupancy capability, part 7 four dimensions of network utilization capability, part 8 four dimensions of explicit knowledge sharing, part 9 four dimensions of tacit knowledge sharing, part 10 eight dimensions of innovation performance, part 11 sixteen dimensions of network capability, and part 12 eight dimensions of knowledge sharing.

I hope you can spare your valuable time to participate in this study.

Thank you very much.

Yan Zhang

Researcher

Index of Item-Objective Congruence (IOC) Part I. Basic Information 第一部分　基本信息					
The expert is kindly requested to examine each item of the research instrument for its content validity.		Expert's Review			
NO.	Questionnaire for Participants (Single choice question) **Items**	**Agree** **+1**	**Not Sure** **0**	**Disagree** **-1**	**Comment**
1	How many years has your company been established? 您所在企业成立了几年： ○3 years or less 3年及以内 ○3-5 years 3-5年 ○5 years and above 5年及以上	√			
2	The size of your company 您所在企业的规模： ○49 employees or less 49人及以内	√			

	○50- 100 employees 50-100人 ○50- 100 employees 101人及以上				
3	Your company's industry areas are: 贵公司的行业领域为: ○Electronic Information 电子信息 ○Biological medicine 生物医药 ○New materials 新材料 ○opto-mechatronics 光机电一体化 ○New energy and high efficiency and energy saving 新能源与高效节能 ○High-tech services 高技术服务 ○Resources and Environment 资源与环境 ○Agriculture and rural areas 农业与农村 ○Ation and Aerospace 航空与航天 ○Other 其他	√			
4	Nature of your company: 贵公司的性质： ○State-owned Enterprises 国有企业 ○Private enterprises 合资企业 ○Joint Ventures 民营企业 ○Others 其他	√			
5	Your position in your company: 您在贵公司担任的职务 ○Chairman or General Manager 董事长或总经理 ○Intelligent Department manager 关键技术人员 ○Key Technical Personnel 智能部门经理 ○Others 其他	√			

6	Your position level: 您的职位级别： ○Junior Managers 基层管理者 ○Middle managers 中层管理者 ○Senior Management 高层管理者	√			
7	Your current working years in the company: 目前您在该企业的工作年限: ○Less than 3 years 3年以下 ○3-5 years 3-5年 ○6-8 years 6-8年 ○9- 11Years 9-11年 ○12 years and above 12年及以上	√			
8	Your education: 您的学历： ○High school (Including secondary school) 高中 (含中专） ○Bachelor's Degree and College 本科及大专 ○Master's Degree or above 硕士及以上	√			

Index of Item-Objective Congruence (IOC)

Part II Importance of the four secondary dimensions in relation to network capacity

第二部分　四个二级维度相对于网络能力的重要程度

The expert is kindly requested to examine each item of the research instrument for its content validity.		Expert's Review			
NO.	Questionnaire for Participants (Single choice question) **Items**	**Agree** **+1**	**Not Sure** **0**	**Disagree** **-1**	**Comment**
1	Network planning capacity 网络规划能力	√			
2	Network relationship capacity 网络关系能力	√			

3	Network occupying capacity 网络占位能力	√			
4	Network utilization capacity 网络利用能力	√			

Index of Item-Objective Congruence (IOC)

Part III Importance of the two secondary variables relative to knowledge sharing
第三部分　两个二级变量相对于知识共享的重要程度

The expert is kindly requested to examine each item of the research instrument for its content validity.		Expert's Review			
NO.	Questionnaire for Participants (Single choice question) **Items**	**Agree** **+1**	**Not Sure** **0**	**Disagree** **-1**	**Comment**
1	Explicit knowledge sharing 显性知识共享	√			
2	Tacit knowledge sharing 隐性知识共享	√			

Index of Item-Objective Congruence (IOC)

Part IV The Importance of the Four Issues Relative to Network Planning Capabilities
第四部分　四个问题相对于网络规划能力的重要程度

The expert is kindly requested to examine each item of the research instrument for its content validity.		Expert's Review			
NO.	Questionnaire for Participants (Single choice question) **Items**	**Agree** **+1**	**Not Sure** **0**	**Disagree** **-1**	**Comment**
1	We are good at analyzing how well our development strategy matches our network resources 我们善于分析自身发展战略与网络资源的匹配程度	√			
2	We are keen to recognize partnership opportunities in		√		

	development 我们在开发中能敏锐识别合作机会				
3	We have clear goals and action guidelines for cooperation 我们有清晰的合作目标和行动准则	√			
4	We are well aware of the strategies to build long-term relationships with potential partners 我们很清楚以何种策略与潜在合作伙伴建立长期关系	√			

Index of Item-Objective Congruence (IOC) Part V. Importance of the Four Issues Relative to Network Relationship Capacity 第五部分 四个问题相对于网络关系能力的重要程度					
The expert is kindly requested to examine each item of the research instrument for its content validity.		Expert's Review			
NO.	Questionnaire for Participants (Single choice question) **Items**	**Agree** **+1**	**Not Sure** **0**	**Disagree** **-1**	**Comment**
1	We emphasize that cooperation is based on trust 我们强调合作基于信任	√			
2	We know how to build relationships with potential partners. 我们清楚以何种策略与潜在合作伙伴建立关系	√			
3	We have more partners of various types than our peers, including universities, research institutes, key suppliers and customers in the industry. 与同行相比，本企业拥有更多的各种类型的合作伙伴，包括大学、研究所、行业内重要的供应商和客户等	√			
4	We are able to deal with differences and conflicts in our partner network 我们能够妥善处理合作网络中的分歧和冲突问题	√			

Index of Item-Objective Congruence (IOC)

Part VI The Importance of the Four Issues Relative to Network Occupancy Capacity

第六部分　四个问题相对于网络占位能力的重要程度

The expert is kindly requested to examine each item of the research instrument for its content validity.		Expert's Review			
NO.	Questionnaire for Participants (Single choice question) **Items**	**Agree** **+1**	**Not Sure** **0**	**Disagree** **-1**	**Comment**
1	We have a strong ability to be at the center of a network of partnerships. 我们具有很强的占据合作关系网络中心位置的能力	√			
2	We often act as a bridge between other partners 我们经常成为其他合作伙伴间的沟通桥梁	√			
3	We are always able to communicate very quickly with all partners without having to rely on third parties to pass on information. 我们总是能非常快地与所有合作伙伴沟通而不用依赖第三方来传递信息	√			
4	We are able to take center stage and gain access to more resources. 我们能够占据中心位置从而获得更多的资源		√		

Index of Item-Objective Congruence (IOC)

Part VII. Importance of the four issues relative to the ability to utilize the network

第七部分　四个问题相对于网络利用能力的重要程度

The expert is kindly requested to examine each item of the research instrument for its content validity.	Expert's Review

NO.	Questionnaire for Participants (Single choice question) Items	Agree +1	Not Sure 0	Disagree -1	Comment
1	We are able to think about the development of the relationship from the partner's point of view. 我们能从合作伙伴的角度来思考如何发展双方关系	√			
2	We have a strong ability to develop mutual trust and mutual benefit with our partners. 我们具有很强发展与合作伙伴之间相互信任、互惠互利的能力		√		
3	Within the company, departments often exchange information and resources to accomplish tasks together (reverse problem) The company always uses a third party when communicating with its partners. 企业内，部门之间经常交换信息和资源共同完成任务(反向问题）企业在与合作方沟通时总是需要借助第三方	√			
4	Our partners rarely discontinue their relationships with us. 已联系的合作方很少主动中断与本企业的合作关系	√			

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Part VIII The Importance of the Four Questions in Relation to Explicit Knowledge Sharing

第八部分　四个问题相对于显性知识共享的重要程度

The expert is kindly requested to examine each item of the research instrument for its content validity.		Expert's Review			
NO.	Questionnaire for Participants (Single choice question) Items	Agree +1	Not Sure 0	Disagree -1	Comment
1	Regular sharing with partners: information on technology	√			

	development/service, project progress reports, etc. 与合作伙伴经常共享：技术研发/服务、项目进度报告等信息资料				
2	Regularly share with partners: information on quality control of technology/services 与合作伙伴经常共享：技术/服务质量控制方面的信息资料	√			
3	Frequently shared with partners: information on technical components/service details 与合作伙伴经常共享：技术构成/服务细节方面的信息资料	√			
4	Frequently share with partners: information on market and customer needs. 与合作伙伴经常共享：市场和客户需求方面的信息资料		√		

Index of Item-Objective Congruence (IOC) Part IX The Importance of the Four Questions Relative to Tacit Knowledge Sharing 第九部分　四个问题相对于隐性知识共享的重要程度					
The expert is kindly requested to examine each item of the research instrument for its content validity.		Expert's Review			
NO.	Questionnaire for Participants (Single choice question) **Items**	**Agree** **+1**	**Not Sure** **0**	**Disagree** **-1**	**Comment**
1	Often shared with partners: know-how behind technology/service implementation 与合作伙伴经常共享：技术/服务实施背后的经验诀窍	√			
2	Often shared with partners: know-how to solve technical/service problems or unexpected technical/service problems.		√		

	与合作伙伴经常共享：解决技术/服务问题或意外技术/服务问题 经验诀窍				
3	Often shared with partners: know-how to break through technical/service problems/technical/service limitations 与合作伙伴经常共享：突破技术/服务难题/技术/服务局限的经验诀窍	√			
4	Often shared with partners: Experience in understanding and judging market and customer needs. 与合作伙伴经常共享：对市场和客户需求的理解和判断经验	√			

Index of Item-Objective Congruence (IOC)

Part X. Importance of the eight issues relative to innovation performance

第十部分　八个问题相对于创新绩效的重要程度

The expert is kindly requested to examine each item of the research instrument for its content validity.		Expert's Review			
NO.	Questionnaire for Participants (Single choice question) **Items**	**Agree** **+1**	**Not Sure** **0**	**Disagree** **-1**	**Comment**
1	The company's customers have high requirements for products and technology 公司的客户对产品和技术有很高的要求	√			
2	Customers are very satisfied with the company's products and technology 客户对公司的产品和技术非常满意	√			
3	Our company's market share continues to grow 我们公司市场份额持续增长	√			
4	Our company's profitability increases every year	√			

	我们公司的利润率逐年提高				
5	We can learn to come up with original solutions to problems 我们可以通过学习提出一些独创性的问题解决方案	√			
6	We proactively support innovative ideas 我们会主动支持具有创新性的思想	√			
7	We are able to translate innovative ideas into practical applications 我们能够把创新性的想法转化成实际应用		√		
8	Shorter time to market for similar products due to the development of product innovations 由于产品创新的发展，类似产品上市的时间缩短	√			

Index of Item-Objective Congruence (IOC) Part XI. Importance of the sixteen issues in relation to network capacity 第十一部分　十六个问题相对于网络能力的重要程度					
The expert is kindly requested to examine each item of the research instrument for its content validity.		Expert's Review			
NO.	Questionnaire for Participants (Single choice question) **Items**	**Agree** **+1**	**Not Sure** **0**	**Disagree** **-1**	**Comment**
1	We are good at analyzing how well our development strategy matches our network resources 我们善于分析自身发展战略与网络资源的匹配程度	√			
2	We are keen to recognize partnership opportunities in development 我们在开发中能敏锐识别合作机会		√		
3	We have clear goals and action guidelines for cooperation 我们有清晰的合作目标和行动准则	√			

4	We are well aware of the strategies to build long-term relationships with potential partners 我们很清楚以何种策略与潜在合作伙伴建立长期关系	√			
5	We emphasize that cooperation is based on trust 我们强调合作基于信任	√			
6	We know how to build relationships with potential partners. 我们清楚以何种策略与潜在合作伙伴建立关系	√			
7	We have more partners of various types than our peers, including universities, research institutes, key suppliers and customers in the industry. 与同行相比，本企业拥有更多的各种类型的合作伙伴，包括大学、研究所、行业内重要的供应商和客户等	√			
8	We are able to deal with differences and conflicts in our partner network 我们能够妥善处理合作网络中的分歧和冲突问题	√			
9	We have a strong ability to be at the center of a network of partnerships. 我们具有很强的占据合作关系网络中心位置的能力	√			
10	We often act as a bridge between other partners 我们经常成为其他合作伙伴间的沟通桥梁	√			
11	We are always able to communicate very quickly with all partners without having to rely on third parties to pass on information. 我们总是能非常快地与所有合作伙伴沟通而不用依赖第三方来传递信息	√			
12	We are able to take center stage and gain access to more resources. 我们能够占据中心位置从而获得更多的资源	√			

13	We are able to think about the development of the relationship from the partner's point of view. 我们能从合作伙伴的角度来思考如何发展双方关系		√		
14	We have a strong ability to develop mutual trust and mutual benefit with our partners. 我们具有很强发展与合作伙伴之间相互信任、互惠互利的能力	√			
15	Within the company, departments often exchange information and resources to accomplish tasks together (reverse problem) The company always uses a third party when communicating with its partners. 企业内，部门之间经常交换信息和资源共同完成任务(反向问题）企业在与合作方沟通时总是需要借助第三方	√			
16	Our partners rarely discontinue their relationships with us. 已联系的合作方很少主动中断与本企业的合作关系	√			

Index of Item-Objective Congruence (IOC) Part XII. Importance of the eight issues in relation to knowledge-sharing 第十二部分 八个问题相对于知识共享的重要程度					
The expert is kindly requested to examine each item of the research instrument for its content validity.		Expert's Review			
NO.	Questionnaire for Participants (Single choice question) **Items**	**Agree** **+1**	**Not Sure** **0**	**Disagree** **-1**	**Comment**
1	Regular sharing with partners: information on technology development/service, project progress reports, etc. 与合作伙伴经常共享：技术研发/服务、项目进度报告等信息资料	√			
2	Regularly share with partners: information on quality		√		

	control of technology/services 与合作伙伴经常共享：技术/服务质量控制方面的信息资料				
3	Frequently shared with partners: information on technical components/service details 与合作伙伴经常共享：技术构成/服务细节方面的信息资料	√			
4	Frequently share with partners: information on market and customer needs. 与合作伙伴经常共享：市场和客户需求方面的信息资料	√			
5	Often shared with partners: know-how behind technology/service implementation 与合作伙伴经常共享：技术/服务实施背后的经验诀窍	√			
6	Often shared with partners: know-how to solve technical/service problems or unexpected technical/service problems. 与合作伙伴经常共享：解决技术/服务问题或意外技术/服务问题 经验诀窍	√			
7	Often shared with partners: know-how to break through technical/service problems/technical/service limitations 与合作伙伴经常共享：突破技术/服务难题/技术/服务局限的经验诀窍	√			
8	Often shared with partners: Experience in understanding and judging market and customer needs. 与合作伙伴经常共享：对市场和客户需求的理解和判断经验	√			

The influence of network capability and knowledge sharing on innovation performance of Hi-tech SMEs

（For Expert 2）

By

YAN ZHANG

Hi-tech SMEs have become the backbone of China's independent innovation capability, and the network capability and resources possessed by Hi-tech SMEs are more limited, and the network capability has become one of the important channels for Hi-tech SMEs to solve the problem of insufficient information and resources. In the competitive environment, how Hi-tech SMEs can own the network capability and obtain the competitiveness of sustainable development in the industrial chain is an important issue for the future development of Hi-tech SMEs.

This study aims to achieve three objectives: 1) To study the impact of network capability on innovation performance of small and medium-sized technology 2) To study the relationship between network capability (NC) and knowledge sharing .3) To study the influence of knowledge sharing on innovation performance of small and medium-sized technology-based enterprises. on innovation performance of small and medium-sized technology -based enterprises. This paper adopts a quantitative research method, the instruments for data collection are the instruments for data collection are questionnaires. The data are mainly from Hi-tech SMEs in East China, because these regions have active economies and high levels of innovation. The survey respondents are mainly managers of Hi-tech SMEs (Small and Medium-sized Enterprises). Strict confidentiality is maintained for the interviewees, and filling out the questionnaires will not have any negative impact on them, which ensures the authenticity and reliability of the data.

The following table consists of twelve parts: the first part of the basic information, the second part of the four dimensions of network capability, the third

part of the two dimensions of knowledge sharing, the fourth part of the four dimensions of network planning capability, and the fifth part is

four dimensions of network relationship capability, part 6 four dimensions of network occupancy capability, part 7 four dimensions of network utilization capability, part 8 four dimensions of explicit knowledge sharing, part 9 four dimensions of tacit knowledge sharing, part 10 eight dimensions of innovation performance, part 11 sixteen dimensions of network capability, and part 12 eight dimensions of knowledge sharing.

I hope you can spare your valuable time to participate in this study.

Thank you very much.

Yan Zhang

Researcher

Index of Item-Objective Congruence (IOC) Part I. Basic Information 第一部分　基本信息					
The expert is kindly requested to examine each item of the research instrument for its content validity.		Expert's Review			
NO.	Questionnaire for Participants (Single choice question) **Items**	**Agree** **+1**	**Not Sure** **0**	**Disagree** **-1**	**Comment**
1	How many years has your company been established? 您所在企业成立了几年： ○3 years or less 3年及以内 ○3-5 years 3-5年 ○5 years and above 5年及以上	√			
2	The size of your company 您所在企业的规模：	√			

	○49 employees or less 49人及以内 ○50- 100 employees 50-100人 ○50- 100 employees 101人及以上				
3	Your company's industry areas are: 贵公司的行业领域为: ○Electronic Information 电子信息 ○Biological medicine 生物医药 ○New materials 新材料 ○opto-mechatronics 光机电一体化 ○New energy and high efficiency and energy saving 新能源与高效节能 ○High-tech services 高技术服务 ○Resources and Environment 资源与环境 ○Agriculture and rural areas 农业与农村 ○Ation and Aerospace 航空与航天 ○Other 其他	√			
4	Nature of your company: 贵公司的性质: ○State-owned Enterprises 国有企业 ○Private enterprises 合资企业 ○Joint Ventures 民营企业 ○Others 其他	√			
5	Your position in your company: 您在贵公司担任的职务 ○Chairman or General Manager 董事长或总经理 ○Intelligent Department manager 关键技术人员 ○Key Technical Personnel 智能部门经理 ○Others 其他	√			

6	Your position level: 您的职位级别： ○Junior Managers 基层管理者 ○Middle managers 中层管理者 ○Senior Management 高层管理者	√			
7	Your current working years in the company: 目前您在该企业的工作年限: ○Less than 3 years 3年以下 ○3-5 years 3-5年 ○6-8 years 6-8年 ○9- 11Years 9-11年 ○12 years and above 12年及以上	√			
8	Your education: 您的学历： ○High school (Including secondary school) 高中 (含中专） ○Bachelor's Degree and College 本科及大专 ○Master's Degree or above 硕士及以上	√			

Index of Item-Objective Congruence (IOC)

Part II Importance of the four secondary dimensions in relation to network capacity

第二部分 四个二级维度相对于网络能力的重要程度

The expert is kindly requested to examine each item of the research instrument for its content validity.		Expert's Review			
NO.	Questionnaire for Participants (Single choice question) **Items**	**Agree**	**Not Sure**	**Disagree**	**Comment**
		+1	**0**	**-1**	
1	Network planning capacity 网络规划能力	√			
2	Network relationship capacity 网络关系能力	√			

3	Network occupying capacity 网络占位能力		√		
4	Network utilization capacity 网络利用能力	√			

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Part III Importance of the two secondary variables relative to knowledge sharing
第三部分　两个二级变量相对于知识共享的重要程度

The expert is kindly requested to examine each item of the research instrument for its content validity.		Expert's Review			
NO.	Questionnaire for Participants (Single choice question) **Items**	**Agree** **+1**	**Not Sure** **0**	**Disagree** **-1**	**Comment**
1	Explicit knowledge sharing 显性知识共享	√			
2	Tacit knowledge sharing 隐性知识共享	√			

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Part IV The Importance of the Four Issues Relative to Network Planning Capabilities
第四部分　四个问题相对于网络规划能力的重要程度

The expert is kindly requested to examine each item of the research instrument for its content validity.		Expert's Review			
NO.	Questionnaire for Participants (Single choice question) **Items**	**Agree** **+1**	**Not Sure** **0**	**Disagree** **-1**	**Comment**
1	We are good at analyzing how well our development strategy matches our network resources 我们善于分析自身发展战略与网络资源的匹配程度	√			
2	We are keen to recognize partnership opportunities in development	√			

	我们在开发中能敏锐识别合作机会				
3	We have clear goals and action guidelines for cooperation 我们有清晰的合作目标和行动准则	√			
4	We are well aware of the strategies to build long-term relationships with potential partners 我们很清楚以何种策略与潜在合作伙伴建立长期关系	√			

Index of Item-Objective Congruence (IOC)

Part V. Importance of the Four Issues Relative to Network Relationship Capacity

第五部分　四个问题相对于网络关系能力的重要程度

The expert is kindly requested to examine each item of the research instrument for its content validity.		Expert's Review			
NO.	Questionnaire for Participants (Single choice question) **Items**	**Agree** **+1**	**Not Sure** **0**	**Disagree** **-1**	**Comment**
1	We emphasize that cooperation is based on trust 我们强调合作基于信任	√			
2	We know how to build relationships with potential partners. 我们清楚以何种策略与潜在合作伙伴建立关系		√		
3	We have more partners of various types than our peers, including universities, research institutes, key suppliers and customers in the industry. 与同行相比，本企业拥有更多的各种类型的合作伙伴，包括大学、研究所、行业内重要的供应商和客户等		√		
4	We are able to deal with differences and conflicts in our partner network 我们能够妥善处理合作网络中的分歧和冲突问题	√			

Index of Item-Objective Congruence (IOC)

Part VI The Importance of the Four Issues Relative to Network Occupancy Capacity
第六部分　四个问题相对于网络占位能力的重要程度

The expert is kindly requested to examine each item of the research instrument for its content validity.		Expert's Review			
NO.	Questionnaire for Participants (Single choice question) **Items**	**Agree** **+1**	**Not Sure** **0**	**Disagree** **-1**	**Comment**
1	We have a strong ability to be at the center of a network of partnerships. 我们具有很强的占据合作关系网络中心位置的能力	√			
2	We often act as a bridge between other partners 我们经常成为其他合作伙伴间的沟通桥梁	√			
3	We are always able to communicate very quickly with all partners without having to rely on third parties to pass on information. 我们总是能非常快地与所有合作伙伴沟通而不用依赖第三方来传递信息	√			
4	We are able to take center stage and gain access to more resources. 我们能够占据中心位置从而获得更多的资源	√			

Index of Item-Objective Congruence (IOC)

Part VII. Importance of the four issues relative to the ability to utilize the network
第七部分　四个问题相对于网络利用能力的重要程度

The expert is kindly requested to examine each item of the research instrument for its content validity.	Expert's Review

NO.	Questionnaire for Participants (Single choice question) **Items**	**Agree** **+1**	**Not Sure** **0**	**Disagree** **-1**	**Comment**
1	We are able to think about the development of the relationship from the partner's point of view. 我们能从合作伙伴的角度来思考如何发展双方关系	√			
2	We have a strong ability to develop mutual trust and mutual benefit with our partners. 我们具有很强发展与合作伙伴之间相互信任、互惠互利的能力	√			
3	Within the company, departments often exchange information and resources to accomplish tasks together (reverse problem) The company always uses a third party when communicating with its partners. 企业内，部门之间经常交换信息和资源共同完成任务(反向问题）企业在与合作方沟通时总是需要借助第三方	√			
4	Our partners rarely discontinue their relationships with us. 已联系的合作方很少主动中断与本企业的合作关系		√		

Index of Item-Objective Congruence (IOC)

Part VIII The Importance of the Four Questions in Relation to Explicit Knowledge Sharing

第八部分　四个问题相对于显性知识共享的重要程度

The expert is kindly requested to examine each item of the research instrument for its content validity.		Expert's Review			
NO.	Questionnaire for Participants (Single choice question) **Items**	**Agree** **+1**	**Not Sure** **0**	**Disagree** **-1**	**Comment**
1	Regular sharing with partners: information on technology	√			

	development/service, project progress reports, etc. 与合作伙伴经常共享：技术研发/服务、项目进度报告等信息资料				
2	Regularly share with partners: information on quality control of technology/services 与合作伙伴经常共享：技术/服务质量控制方面的信息资料	√			
3	Frequently shared with partners: information on technical components/service details 与合作伙伴经常共享：技术构成/服务细节方面的信息资料	√			
4	Frequently share with partners: information on market and customer needs. 与合作伙伴经常共享：市场和客户需求方面的信息资料	√			

Index of Item-Objective Congruence (IOC)

Part IX The Importance of the Four Questions Relative to Tacit Knowledge Sharing
第九部分　四个问题相对于隐性知识共享的重要程度

The expert is kindly requested to examine each item of the research instrument for its content validity.		Expert's Review			
NO.	Questionnaire for Participants (Single choice question) **Items**	**Agree** **+1**	**Not Sure** **0**	**Disagree** **-1**	**Comment**
1	Often shared with partners: know-how behind technology/service implementation 与合作伙伴经常共享：技术/服务实施背后的经验诀窍	√			
2	Often shared with partners: know-how to solve technical/service problems or unexpected technical/service problems.	√			

	与合作伙伴经常共享：解决技术/服务问题或意外技术/服务问题 经验诀窍				
3	Often shared with partners: know-how to break through technical/service problems/technical/service limitations 与合作伙伴经常共享：突破技术/服务难题/技术/服务局限的经验诀窍	√			
4	Often shared with partners: Experience in understanding and judging market and customer needs. 与合作伙伴经常共享：对市场和客户需求的理解和判断经验	√			

Index of Item-Objective Congruence (IOC) Part X. Importance of the eight issues relative to innovation performance 第十部分 八个问题相对于创新绩效的重要程度					
The expert is kindly requested to examine each item of the research instrument for its content validity.		Expert's Review			
NO.	Questionnaire for Participants (Single choice question) **Items**	**Agree** **+1**	**Not Sure** **0**	**Disagree** **-1**	**Comment**
1	The company's customers have high requirements for products and technology 公司的客户对产品和技术有很高的要求	√			
2	Customers are very satisfied with the company's products and technology 客户对公司的产品和技术非常满意	√			
3	Our company's market share continues to grow 我们公司市场份额持续增长	√			
4	Our company's profitability increases every year	√			

	我们公司的利润率逐年提高				
5	We can learn to come up with original solutions to problems 我们可以通过学习提出一些独创性的问题解决方案	√			
6	We proactively support innovative ideas 我们会主动支持具有创新性的思想	√			
7	We are able to translate innovative ideas into practical applications 我们能够把创新性的想法转化成实际应用	√			
8	Shorter time to market for similar products due to the development of product innovations 由于产品创新的发展，类似产品上市的时间缩短	√			

Index of Item-Objective Congruence (IOC)

Part XI. Importance of the sixteen issues in relation to network capacity

第十一部分　十六个问题相对于网络能力的重要程度

	The expert is kindly requested to examine each item of the research instrument for its content validity.	Expert's Review			
NO.	Questionnaire for Participants (Single choice question) **Items**	**Agree** **+1**	**Not Sure** **0**	**Disagree** **-1**	**Comment**
1	We are good at analyzing how well our development strategy matches our network resources 我们善于分析自身发展战略与网络资源的匹配程度	√			
2	We are keen to recognize partnership opportunities in development 我们在开发中能敏锐识别合作机会	√			
3	We have clear goals and action guidelines for cooperation 我们有清晰的合作目标和行动准则	√			

4	We are well aware of the strategies to build long-term relationships with potential partners 我们很清楚以何种策略与潜在合作伙伴建立长期关系	√			
5	We emphasize that cooperation is based on trust 我们强调合作基于信任	√			
6	We know how to build relationships with potential partners. 我们清楚以何种策略与潜在合作伙伴建立关系		√		
7	We have more partners of various types than our peers, including universities, research institutes, key suppliers and customers in the industry. 与同行相比，本企业拥有更多的各种类型的合作伙伴，包括大学、研究所、行业内重要的供应商和客户等	√			
8	We are able to deal with differences and conflicts in our partner network 我们能够妥善处理合作网络中的分歧和冲突问题	√			
9	We have a strong ability to be at the center of a network of partnerships. 我们具有很强的占据合作关系网络中心位置的能力	√			
10	We often act as a bridge between other partners 我们经常成为其他合作伙伴间的沟通桥梁	√			
11	We are always able to communicate very quickly with all partners without having to rely on third parties to pass on information. 我们总是能非常快地与所有合作伙伴沟通而不用依赖第三方来传递信息	√			
12	We are able to take center stage and gain access to more resources. 我们能够占据中心位置从而获得更多的资源	√			

13	We are able to think about the development of the relationship from the partner's point of view. 我们能从合作伙伴的角度来思考如何发展双方关系	√			
14	We have a strong ability to develop mutual trust and mutual benefit with our partners. 我们具有很强发展与合作伙伴之间相互信任、互惠互利的能力		√		
15	Within the company, departments often exchange information and resources to accomplish tasks together (reverse problem) The company always uses a third party when communicating with its partners. 企业内，部门之间经常交换信息和资源共同完成任务(反向问题）企业在与合作方沟通时总是需要借助第三方	√			
16	Our partners rarely discontinue their relationships with us. 已联系的合作方很少主动中断与本企业的合作关系	√			

Index of Item-Objective Congruence (IOC)

Part XII. Importance of the eight issues in relation to knowledge-sharing

第十二部分 八个问题相对于知识共享的重要程度

The expert is kindly requested to examine each item of the research instrument for its content validity.		Expert's Review			
NO.	Questionnaire for Participants (Single choice question) **Items**	**Agree** **+1**	**Not Sure** **0**	**Disagree** **-1**	**Comment**
1	Regular sharing with partners: information on technology development/service, project progress reports, etc. 与合作伙伴经常共享：技术研发/服务、项目进度报告等信息资料	√			
2	Regularly share with partners: information on quality	√			

	control of technology/services 与合作伙伴经常共享：技术/服务质量控制方面的信息资料				
3	Frequently shared with partners: information on technical components/service details 与合作伙伴经常共享：技术构成/服务细节方面的信息资料	√			
4	Frequently share with partners: information on market and customer needs. 与合作伙伴经常共享：市场和客户需求方面的信息资料	√			
5	Often shared with partners: know-how behind technology/service implementation 与合作伙伴经常共享：技术/服务实施背后的经验诀窍	√			
6	Often shared with partners: know-how to solve technical/service problems or unexpected technical/service problems. 与合作伙伴经常共享：解决技术/服务问题或意外技术/服务问题 经验诀窍		√		
7	Often shared with partners: know-how to break through technical/service problems/technical/service limitations 与合作伙伴经常共享：突破技术/服务难题/技术/服务局限的经验诀窍	√			
8	Often shared with partners: Experience in understanding and judging market and customer needs. 与合作伙伴经常共享：对市场和客户需求的理解和判断经验	√			

The influence of network capability and knowledge sharing on innovation performance of Hi-tech SMEs

（For Expert 3）

By

YAN ZHANG

Hi-tech SMEs have become the backbone of China's independent innovation capability, and the network capability and resources possessed by Hi-tech SMEs are more limited, and the network capability has become one of the important channels for Hi-tech SMEs to solve the problem of insufficient information and resources. In the competitive environment, how Hi-tech SMEs can own the network capability and obtain the competitiveness of sustainable development in the industrial chain is an important issue for the future development of Hi-tech SMEs.

This study aims to achieve three objectives: 1) To study the impact of network capability on innovation performance of small and medium-sized technology 2) To study the relationship between network capability (NC) and knowledge sharing .3) To study the influence of knowledge sharing on innovation performance of small and medium-sized technology-based enterprises. on innovation performance of small and medium-sized technology -based enterprises. This paper adopts a quantitative research method, the instruments for data collection are the instruments for data collection are questionnaires. The data are mainly from Hi-tech SMEs in East China, because these regions have active economies and high levels of innovation. The survey respondents are mainly managers of Hi-tech SMEs (Small and Medium-sized Enterprises). Strict confidentiality is maintained for the interviewees, and filling out the questionnaires will not have any negative impact on them, which ensures the authenticity and reliability of the data.

The following table consists of twelve parts: the first part of the basic information, the second part of the four dimensions of network capability, the third

part of the two dimensions of knowledge sharing, the fourth part of the four dimensions of network planning capability, and the fifth part is

four dimensions of network relationship capability, part 6 four dimensions of network occupancy capability, part 7 four dimensions of network utilization capability, part 8 four dimensions of explicit knowledge sharing, part 9 four dimensions of tacit knowledge sharing, part 10 eight dimensions of innovation performance, part 11 sixteen dimensions of network capability, and part 12 eight dimensions of knowledge sharing.

I hope you can spare your valuable time to participate in this study.

Thank you very much.

Yan Zhang

Researcher

Index of Item-Objective Congruence (IOC) Part I. Basic Information 第一部分　基本信息					
The expert is kindly requested to examine each item of the research instrument for its content validity.		Expert's Review			
NO.	Questionnaire for Participants (Single choice question) **Items**	**Agree** **+1**	**Not Sure** **0**	**Disagree** **-1**	**Comment**
1	How many years has your company been established? 您所在企业成立了几年： ○3 years or less 3年及以内 ○3-5 years 3-5年 ○5 years and above 5年及以上	√			
2	The size of your company 您所在企业的规模：	√			

	○49 employees or less 49人及以内 ○50- 100 employees 50-100人 ○50- 100 employees 101人及以上				
3	Your company's industry areas are: 贵公司的行业领域为: ○Electronic Information 电子信息 ○Biological medicine 生物医药 ○New materials 新材料 ○opto-mechatronics 光机电一体化 ○New energy and high efficiency and energy saving 新能源与高效节能 ○High-tech services 高技术服务 ○Resources and Environment 资源与环境 ○Agriculture and rural areas 农业与农村 ○Ation and Aerospace 航空与航天 ○Other 其他	√			
4	Nature of your company: 贵公司的性质: ○State-owned Enterprises 国有企业 ○Private enterprises 合资企业 ○Joint Ventures 民营企业 ○Others 其他	√			
5	Your position in your company: 您在贵公司担任的职务 ○Chairman or General Manager 董事长或总经理 ○Intelligent Department manager 关键技术人员 ○Key Technical Personnel 智能部门经理 ○Others 其他	√			

6	Your position level: 您的职位级别： ○Junior Managers 基层管理者 ○Middle managers 中层管理者 ○Senior Management 高层管理者	√			
7	Your current working years in the company: 目前您在该企业的工作年限: ○Less than 3 years 3年以下 ○3-5 years 3-5年 ○6-8 years 6-8年 ○9- 11Years 9-11年 ○12 years and above 12年及以上	√			
8	Your education: 您的学历： ○High school (Including secondary school) 高中 (含中专） ○Bachelor's Degree and College 本科及大专 ○Master's Degree or above 硕士及以上	√			

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Part II Importance of the four secondary dimensions in relation to network capacity

第二部分 四个二级维度相对于网络能力的重要程度

The expert is kindly requested to examine each item of the research instrument for its content validity.		Expert's Review			
NO.	Questionnaire for Participants (Single choice question) **Items**	**Agree** **+1**	**Not Sure** **0**	**Disagree** **-1**	**Comment**
1	Network planning capacity 网络规划能力	√			
2	Network relationship capacity 网络关系能力		√		

3	Network occupying capacity 网络占位能力	√			
4	Network utilization capacity 网络利用能力	√			

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Part III Importance of the two secondary variables relative to knowledge sharing
第三部分　两个二级变量相对于知识共享的重要程度

The expert is kindly requested to examine each item of the research instrument for its content validity.		Expert's Review			
NO.	Questionnaire for Participants (Single choice question) **Items**	**Agree**	**Not Sure**	**Disagree**	**Comment**
		+1	**0**	**-1**	
1	Explicit knowledge sharing 显性知识共享	√			
2	Tacit knowledge sharing 隐性知识共享	√			

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Part IV The Importance of the Four Issues Relative to Network Planning Capabilities
第四部分　四个问题相对于网络规划能力的重要程度

The expert is kindly requested to examine each item of the research instrument for its content validity.		Expert's Review			
NO.	Questionnaire for Participants (Single choice question) **Items**	**Agree**	**Not Sure**	**Disagree**	**Comment**
		+1	**0**	**-1**	
1	We are good at analyzing how well our development strategy matches our network resources 我们善于分析自身发展战略与网络资源的匹配程度	√			
2	We are keen to recognize partnership opportunities in development	√			

	我们在开发中能敏锐识别合作机会				
3	We have clear goals and action guidelines for cooperation 我们有清晰的合作目标和行动准则	√			
4	We are well aware of the strategies to build long-term relationships with potential partners 我们很清楚以何种策略与潜在合作伙伴建立长期关系	√			

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Part V. Importance of the Four Issues Relative to Network Relationship Capacity

第五部分　四个问题相对于网络关系能力的重要程度

The expert is kindly requested to examine each item of the research instrument for its content validity.		Expert's Review			
NO.	Questionnaire for Participants (Single choice question) **Items**	**Agree** **+1**	**Not Sure** **0**	**Disagree** **-1**	**Comment**
1	We emphasize that cooperation is based on trust 我们强调合作基于信任	√			
2	We know how to build relationships with potential partners. 我们清楚以何种策略与潜在合作伙伴建立关系	√			
3	We have more partners of various types than our peers, including universities, research institutes, key suppliers and customers in the industry. 与同行相比，本企业拥有更多的各种类型的合作伙伴，包括大学、研究所、行业内重要的供应商和客户等	√			
4	We are able to deal with differences and conflicts in our partner network 我们能够妥善处理合作网络中的分歧和冲突问题	√			

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Part VI The Importance of the Four Issues Relative to Network Occupancy Capacity
第六部分　四个问题相对于网络占位能力的重要程度

The expert is kindly requested to examine each item of the research instrument for its content validity.		Expert's Review			
NO.	Questionnaire for Participants (Single choice question) **Items**	**Agree** **+1**	**Not Sure** **0**	**Disagree** **-1**	**Comment**
1	We have a strong ability to be at the center of a network of partnerships. 我们具有很强的占据合作关系网络中心位置的能力		√		
2	We often act as a bridge between other partners 我们经常成为其他合作伙伴间的沟通桥梁	√			
3	We are always able to communicate very quickly with all partners without having to rely on third parties to pass on information. 我们总是能非常快地与所有合作伙伴沟通而不用依赖第三方来传递信息	√			
4	We are able to take center stage and gain access to more resources. 我们能够占据中心位置从而获得更多的资源	√			

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Part VII. Importance of the four issues relative to the ability to utilize the network
第七部分　四个问题相对于网络利用能力的重要程度

The expert is kindly requested to examine each item of the research instrument for its content validity.	Expert's Review

NO.	Questionnaire for Participants (Single choice question) **Items**	**Agree** **+1**	**Not Sure** **0**	**Disagree** **-1**	**Comment**
1	We are able to think about the development of the relationship from the partner's point of view. 我们能从合作伙伴的角度来思考如何发展双方关系		√		
2	We have a strong ability to develop mutual trust and mutual benefit with our partners. 我们具有很强发展与合作伙伴之间相互信任、互惠互利的能力	√			
3	Within the company, departments often exchange information and resources to accomplish tasks together (reverse problem) The company always uses a third party when communicating with its partners. 企业内，部门之间经常交换信息和资源共同完成任务(反向问题）企业在与合作方沟通时总是需要借助第三方	√			
4	Our partners rarely discontinue their relationships with us. 已联系的合作方很少主动中断与本企业的合作关系	√			

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Part VIII The Importance of the Four Questions in Relation to Explicit Knowledge Sharing

第八部分　四个问题相对于显性知识共享的重要程度

The expert is kindly requested to examine each item of the research instrument for its content validity.		Expert's Review			
NO.	Questionnaire for Participants (Single choice question) **Items**	**Agree** **+1**	**Not Sure** **0**	**Disagree** **-1**	**Comment**
1	Regular sharing with partners: information on technology	√			

	development/service, project progress reports, etc. 与合作伙伴经常共享：技术研发/服务、项目进度报告等信息资料				
2	Regularly share with partners: information on quality control of technology/services 与合作伙伴经常共享：技术/服务质量控制方面的信息资料		√		
3	Frequently shared with partners: information on technical components/service details 与合作伙伴经常共享：技术构成/服务细节方面的信息资料		√		
4	Frequently share with partners: information on market and customer needs. 与合作伙伴经常共享：市场和客户需求方面的信息资料	√			

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Part IX The Importance of the Four Questions Relative to Tacit Knowledge Sharing
第九部分　四个问题相对于隐性知识共享的重要程度

The expert is kindly requested to examine each item of the research instrument for its content validity.		Expert's Review			
NO.	Questionnaire for Participants (Single choice question) **Items**	**Agree** **+1**	**Not Sure** **0**	**Disagree** **-1**	**Comment**
1	Often shared with partners: know-how behind technology/service implementation 与合作伙伴经常共享：技术/服务实施背后的经验诀窍	√			
2	Often shared with partners: know-how to solve technical/service problems or unexpected technical/service problems.	√			

	与合作伙伴经常共享：解决技术/服务问题或意外技术/服务问题 经验诀窍				
3	Often shared with partners: know-how to break through technical/service problems/technical/service limitations 与合作伙伴经常共享：突破技术/服务难题/技术/服务局限的经验诀窍	√			
4	Often shared with partners: Experience in understanding and judging market and customer needs. 与合作伙伴经常共享：对市场和客户需求的理解和判断经验	√			

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Part X. Importance of the eight issues relative to innovation performance

第十部分　八个问题相对于创新绩效的重要程度

The expert is kindly requested to examine each item of the research instrument for its content validity.		Expert's Review			
NO.	Questionnaire for Participants (Single choice question) **Items**	**Agree** **+1**	**Not Sure** **0**	**Disagree** **-1**	**Comment**
1	The company's customers have high requirements for products and technology 公司的客户对产品和技术有很高的要求		√		
2	Customers are very satisfied with the company's products and technology 客户对公司的产品和技术非常满意	√			
3	Our company's market share continues to grow 我们公司市场份额持续增长	√			
4	Our company's profitability increases every year	√			

	我们公司的利润率逐年提高				
5	We can learn to come up with original solutions to problems 我们可以通过学习提出一些独创性的问题解决方案	√			
6	We proactively support innovative ideas 我们会主动支持具有创新性的思想	√			
7	We are able to translate innovative ideas into practical applications 我们能够把创新性的想法转化成实际应用	√			
8	Shorter time to market for similar products due to the development of product innovations 由于产品创新的发展，类似产品上市的时间缩短	√			

Index of Item-Objective Congruence (IOC) Part XI. Importance of the sixteen issues in relation to network capacity 第十一部分　十六个问题相对于网络能力的重要程度					
The expert is kindly requested to examine each item of the research instrument for its content validity.		Expert's Review			
NO.	Questionnaire for Participants (Single choice question) **Items**	**Agree** **+1**	**Not Sure** **0**	**Disagree** **-1**	**Comment**
1	We are good at analyzing how well our development strategy matches our network resources 我们善于分析自身发展战略与网络资源的匹配程度	√			
2	We are keen to recognize partnership opportunities in development 我们在开发中能敏锐识别合作机会	√			
3	We have clear goals and action guidelines for cooperation 我们有清晰的合作目标和行动准则	√			

4	We are well aware of the strategies to build long-term relationships with potential partners 我们很清楚以何种策略与潜在合作伙伴建立长期关系	√			
5	We emphasize that cooperation is based on trust 我们强调合作基于信任	√			
6	We know how to build relationships with potential partners. 我们清楚以何种策略与潜在合作伙伴建立关系	√			
7	We have more partners of various types than our peers, including universities, research institutes, key suppliers and customers in the industry. 与同行相比，本企业拥有更多的各种类型的合作伙伴，包括大学、研究所、行业内重要的供应商和客户等		√		
8	We are able to deal with differences and conflicts in our partner network 我们能够妥善处理合作网络中的分歧和冲突问题	√			
9	We have a strong ability to be at the center of a network of partnerships. 我们具有很强的占据合作关系网络中心位置的能力	√			
10	We often act as a bridge between other partners 我们经常成为其他合作伙伴间的沟通桥梁	√			
11	We are always able to communicate very quickly with all partners without having to rely on third parties to pass on information. 我们总是能非常快地与所有合作伙伴沟通而不用依赖第三方来传递信息	√			
12	We are able to take center stage and gain access to more resources. 我们能够占据中心位置从而获得更多的资源	√			

13	We are able to think about the development of the relationship from the partner's point of view. 我们能从合作伙伴的角度来思考如何发展双方关系	√			
14	We have a strong ability to develop mutual trust and mutual benefit with our partners. 我们具有很强发展与合作伙伴之间相互信任、互惠互利的能力	√			
15	Within the company, departments often exchange information and resources to accomplish tasks together (reverse problem) The company always uses a third party when communicating with its partners. 企业内，部门之间经常交换信息和资源共同完成任务(反向问题）企业在与合作方沟通时总是需要借助第三方	√			
16	Our partners rarely discontinue their relationships with us. 已联系的合作方很少主动中断与本企业的合作关系	√			

Index of Item-Objective Congruence (IOC) Part XII. Importance of the eight issues in relation to knowledge-sharing 第十二部分 八个问题相对于知识共享的重要程度					
The expert is kindly requested to examine each item of the research instrument for its content validity.		Expert's Review			
NO.	Questionnaire for Participants (Single choice question) **Items**	**Agree** **+1**	**Not Sure** **0**	**Disagree** **-1**	**Comment**
1	Regular sharing with partners: information on technology development/service, project progress reports, etc. 与合作伙伴经常共享：技术研发/服务、项目进度报告等信息资料	√			
2	Regularly share with partners: information on quality	√			

	control of technology/services 与合作伙伴经常共享：技术/服务质量控制方面的信息资料				
3	Frequently shared with partners: information on technical components/service details 与合作伙伴经常共享：技术构成/服务细节方面的信息资料	√			
4	Frequently share with partners: information on market and customer needs. 与合作伙伴经常共享：市场和客户需求方面的信息资料	√			
5	Often shared with partners: know-how behind technology/service implementation 与合作伙伴经常共享：技术/服务实施背后的经验诀窍	√			
6	Often shared with partners: know-how to solve technical/service problems or unexpected technical/service problems. 与合作伙伴经常共享：解决技术/服务问题或意外技术/服务问题 经验诀窍	√			
7	Often shared with partners: know-how to break through technical/service problems/technical/service limitations 与合作伙伴经常共享：突破技术/服务难题/技术/服务局限的经验诀窍	√			
8	Often shared with partners: Experience in understanding and judging market and customer needs. 与合作伙伴经常共享：对市场和客户需求的理解和判断经验	√			

The influence of network capability and knowledge sharing on innovation performance of Hi-tech SMEs

（For Expert 4）

By

YAN ZHANG

Hi-tech SMEs have become the backbone of China's independent innovation capability, and the network capability and resources possessed by Hi-tech SMEs are more limited, and the network capability has become one of the important channels for Hi-tech SMEs to solve the problem of insufficient information and resources. In the competitive environment, how Hi-tech SMEs can own the network capability and obtain the competitiveness of sustainable development in the industrial chain is an important issue for the future development of Hi-tech SMEs.

This study aims to achieve three objectives: 1) To study the impact of network capability on innovation performance of small and medium-sized technology 2) To study the relationship between network capability (NC) and knowledge sharing .3) To study the influence of knowledge sharing on innovation performance of small and medium-sized technology-based enterprises. on innovation performance of small and medium-sized technology -based enterprises. This paper adopts a quantitative research method, the instruments for data collection are the instruments for data collection are questionnaires. The data are mainly from Hi-tech SMEs in East China, because these regions have active economies and high levels of innovation. The survey respondents are mainly managers of Hi-tech SMEs (Small and Medium-sized Enterprises). Strict confidentiality is maintained for the interviewees, and filling out the questionnaires will not have any negative impact on them, which ensures the authenticity and reliability of the data.

The following table consists of twelve parts: the first part of the basic information, the second part of the four dimensions of network capability, the third

part of the two dimensions of knowledge sharing, the fourth part of the four dimensions of network planning capability, and the fifth part is

four dimensions of network relationship capability, part 6 four dimensions of network occupancy capability, part 7 four dimensions of network utilization capability, part 8 four dimensions of explicit knowledge sharing, part 9 four dimensions of tacit knowledge sharing, part 10 eight dimensions of innovation performance, part 11 sixteen dimensions of network capability, and part 12 eight dimensions of knowledge sharing.

I hope you can spare your valuable time to participate in this study.

Thank you very much.

Yan Zhang

Researcher

Index of Item-Objective Congruence (IOC) Part I. Basic Information 第一部分　基本信息					
The expert is kindly requested to examine each item of the research instrument for its content validity.		Expert's Review			
NO.	Questionnaire for Participants (Single choice question) **Items**	**Agree** **+1**	**Not Sure** **0**	**Disagree** **-1**	**Comment**
1	How many years has your company been established? 您所在企业成立了几年： ○3 years or less 3年及以内 ○3-5 years 3-5年 ○5 years and above 5年及以上	√			
2	The size of your company 您所在企业的规模：	√			

	○49 employees or less 49人及以内 ○50- 100 employees 50-100人 ○50- 100 employees 101人及以上				
3	Your company's industry areas are: 贵公司的行业领域为: ○Electronic Information 电子信息 ○Biological medicine 生物医药 ○New materials 新材料 ○opto-mechatronics 光机电一体化 ○New energy and high efficiency and energy saving新能源与高效节能 ○High-tech services 高技术服务 ○Resources and Environment 资源与环境 ○Agriculture and rural areas 农业与农村 ○Ation and Aerospace 航空与航天 ○Other其他	√			
4	Nature of your company: 贵公司的性质: ○State-owned Enterprises 国有企业 ○Private enterprises 合资企业 ○Joint Ventures 民营企业 ○Others 其他	√			
5	Your position in your company: 您在贵公司担任的职务 ○Chairman or General Manager 董事长或总经理 ○Intelligent Department manager 关键技术人员 ○Key Technical Personnel 智能部门经理 ○Others 其他	√			

6	Your position level: 您的职位级别： ○Junior Managers 基层管理者 ○Middle managers 中层管理者 ○Senior Management 高层管理者	√			
7	Your current working years in the company: 目前您在该企业的工作年限: ○Less than 3 years 3年以下 ○3-5 years 3-5年 ○6-8 years 6-8年 ○9- 11Years 9-11年 ○12 years and above 12年及以上	√			
8	Your education: 您的学历： ○High school (Including secondary school) 高中（含中专） ○Bachelor's Degree and College 本科及大专 ○Master's Degree or above 硕士及以上	√			

Index of Item-Objective Congruence (IOC)

Part II Importance of the four secondary dimensions in relation to network capacity

第二部分 四个二级维度相对于网络能力的重要程度

The expert is kindly requested to examine each item of the research instrument for its content validity.		Expert's Review			
NO.	Questionnaire for Participants (Single choice question) **Items**	**Agree** **+1**	**Not Sure** **0**	**Disagree** **-1**	**Comment**
1	Network planning capacity 网络规划能力	√			
2	Network relationship capacity 网络关系能力	√			

3	Network occupying capacity 网络占位能力	√			
4	Network utilization capacity 网络利用能力	√			

Index of Item-Objective Congruence (IOC) Part III Importance of the two secondary variables relative to knowledge sharing 第三部分　两个二级变量相对于知识共享的重要程度					
The expert is kindly requested to examine each item of the research instrument for its content validity.		Expert's Review			
NO.	Questionnaire for Participants (Single choice question) **Items**	**Agree** **+1**	**Not Sure** **0**	**Disagree** **-1**	**Comment**
1	Explicit knowledge sharing 显性知识共享	√			
2	Tacit knowledge sharing 隐性知识共享	√			

Index of Item-Objective Congruence (IOC) Part IV The Importance of the Four Issues Relative to Network Planning Capabilities 第四部分　四个问题相对于网络规划能力的重要程度					
The expert is kindly requested to examine each item of the research instrument for its content validity.		Expert's Review			
NO.	Questionnaire for Participants (Single choice question) **Items**	**Agree** **+1**	**Not Sure** **0**	**Disagree** **-1**	**Comment**
1	We are good at analyzing how well our development strategy matches our network resources 我们善于分析自身发展战略与网络资源的匹配程度	√			
2	We are keen to recognize partnership opportunities in development	√			

	我们在开发中能敏锐识别合作机会				
3	We have clear goals and action guidelines for cooperation 我们有清晰的合作目标和行动准则		√		
4	We are well aware of the strategies to build long-term relationships with potential partners 我们很清楚以何种策略与潜在合作伙伴建立长期关系	√			

Index of Item-Objective Congruence (IOC) Part V. Importance of the Four Issues Relative to Network Relationship Capacity 第五部分 四个问题相对于网络关系能力的重要程度					
The expert is kindly requested to examine each item of the research instrument for its content validity.		Expert's Review			
NO.	Questionnaire for Participants (Single choice question) **Items**	**Agree** **+1**	**Not Sure** **0**	**Disagree** **-1**	**Comment**
1	We emphasize that cooperation is based on trust 我们强调合作基于信任		√		
2	We know how to build relationships with potential partners. 我们清楚以何种策略与潜在合作伙伴建立关系	√			
3	We have more partners of various types than our peers, including universities, research institutes, key suppliers and customers in the industry. 与同行相比，本企业拥有更多的各种类型的合作伙伴，包括大学、研究所、行业内重要的供应商和客户等	√			
4	We are able to deal with differences and conflicts in our partner network 我们能够妥善处理合作网络中的分歧和冲突问题	√			

Index of Item-Objective Congruence (IOC)

Part VI The Importance of the Four Issues Relative to Network Occupancy Capacity
第六部分　四个问题相对于网络占位能力的重要程度

The expert is kindly requested to examine each item of the research instrument for its content validity.		Expert's Review			
NO.	Questionnaire for Participants (Single choice question) **Items**	**Agree** **+1**	**Not Sure** **0**	**Disagree** **-1**	**Comment**
1	We have a strong ability to be at the center of a network of partnerships. 我们具有很强的占据合作关系网络中心位置的能力	√			
2	We often act as a bridge between other partners 我们经常成为其他合作伙伴间的沟通桥梁	√			
3	We are always able to communicate very quickly with all partners without having to rely on third parties to pass on information. 我们总是能非常快地与所有合作伙伴沟通而不用依赖第三方来传递信息	√			
4	We are able to take center stage and gain access to more resources. 我们能够占据中心位置从而获得更多的资源	√			

Index of Item-Objective Congruence (IOC)

Part VII. Importance of the four issues relative to the ability to utilize the network
第七部分　四个问题相对于网络利用能力的重要程度

The expert is kindly requested to examine each item of the research instrument for its content validity.	Expert's Review

NO.	Questionnaire for Participants (Single choice question) **Items**	**Agree** **+1**	**Not Sure** **0**	**Disagree** **-1**	**Comment**
1	We are able to think about the development of the relationship from the partner's point of view. 我们能从合作伙伴的角度来思考如何发展双方关系	√			
2	We have a strong ability to develop mutual trust and mutual benefit with our partners. 我们具有很强发展与合作伙伴之间相互信任、互惠互利的能力	√			
3	Within the company, departments often exchange information and resources to accomplish tasks together (reverse problem) The company always uses a third party when communicating with its partners. 企业内，部门之间经常交换信息和资源共同完成任务(反向问题）企业在与合作方沟通时总是需要借助第三方	√			
4	Our partners rarely discontinue their relationships with us. 已联系的合作方很少主动中断与本企业的合作关系	√			

Index of Item-Objective Congruence (IOC)

Part VIII The Importance of the Four Questions in Relation to Explicit Knowledge Sharing

第八部分　四个问题相对于显性知识共享的重要程度

The expert is kindly requested to examine each item of the research instrument for its content validity.		Expert's Review			
NO.	Questionnaire for Participants (Single choice question) **Items**	**Agree** **+1**	**Not Sure** **0**	**Disagree** **-1**	**Comment**
1	Regular sharing with partners: information on technology		√		

	development/service, project progress reports, etc. 与合作伙伴经常共享：技术研发/服务、项目进度报告等信息资料				
2	Regularly share with partners: information on quality control of technology/services 与合作伙伴经常共享：技术/服务质量控制方面的信息资料	√			
3	Frequently shared with partners: information on technical components/service details 与合作伙伴经常共享：技术构成/服务细节方面的信息资料	√			
4	Frequently share with partners: information on market and customer needs. 与合作伙伴经常共享：市场和客户需求方面的信息资料	√			

Index of Item-Objective Congruence (IOC)

Part IX The Importance of the Four Questions Relative to Tacit Knowledge Sharing
第九部分　四个问题相对于隐性知识共享的重要程度

The expert is kindly requested to examine each item of the research instrument for its content validity.		Expert's Review			
NO.	Questionnaire for Participants (Single choice question) **Items**	**Agree** **+1**	**Not Sure** **0**	**Disagree** **-1**	**Comment**
1	Often shared with partners: know-how behind technology/service implementation 与合作伙伴经常共享：技术/服务实施背后的经验诀窍	√			
2	Often shared with partners: know-how to solve technical/service problems or unexpected technical/service problems.	√			

	与合作伙伴经常共享：解决技术/服务问题或意外技术/服务问题 经验诀窍				
3	Often shared with partners: know-how to break through technical/service problems/technical/service limitations 与合作伙伴经常共享：突破技术/服务难题/技术/服务局限的经验诀窍	√			
4	Often shared with partners: Experience in understanding and judging market and customer needs. 与合作伙伴经常共享：对市场和客户需求的理解和判断经验	√			

Index of Item-Objective Congruence (IOC)

Part X. Importance of the eight issues relative to innovation performance

第十部分　八个问题相对于创新绩效的重要程度

The expert is kindly requested to examine each item of the research instrument for its content validity.		Expert's Review			
NO.	Questionnaire for Participants (Single choice question) **Items**	**Agree** **+1**	**Not Sure** **0**	**Disagree** **-1**	**Comment**
1	The company's customers have high requirements for products and technology 公司的客户对产品和技术有很高的要求	√			
2	Customers are very satisfied with the company's products and technology 客户对公司的产品和技术非常满意	√			
3	Our company's market share continues to grow 我们公司市场份额持续增长	√			
4	Our company's profitability increases every year	√			

	我们公司的利润率逐年提高				
5	We can learn to come up with original solutions to problems 我们可以通过学习提出一些独创性的问题解决方案		√		
6	We proactively support innovative ideas 我们会主动支持具有创新性的思想	√			
7	We are able to translate innovative ideas into practical applications 我们能够把创新性的想法转化成实际应用	√			
8	Shorter time to market for similar products due to the development of product innovations 由于产品创新的发展，类似产品上市的时间缩短	√			

Index of Item-Objective Congruence (IOC) Part XI. Importance of the sixteen issues in relation to network capacity 第十一部分　十六个问题相对于网络能力的重要程度					
The expert is kindly requested to examine each item of the research instrument for its content validity.		Expert's Review			
NO.	Questionnaire for Participants (Single choice question) **Items**	**Agree** **+1**	**Not Sure** **0**	**Disagree** **-1**	**Comment**
1	We are good at analyzing how well our development strategy matches our network resources 我们善于分析自身发展战略与网络资源的匹配程度	√			
2	We are keen to recognize partnership opportunities in development 我们在开发中能敏锐识别合作机会	√			
3	We have clear goals and action guidelines for cooperation 我们有清晰的合作目标和行动准则	√			

4	We are well aware of the strategies to build long-term relationships with potential partners 我们很清楚以何种策略与潜在合作伙伴建立长期关系	√			
5	We emphasize that cooperation is based on trust 我们强调合作基于信任	√			
6	We know how to build relationships with potential partners. 我们清楚以何种策略与潜在合作伙伴建立关系	√			
7	We have more partners of various types than our peers, including universities, research institutes, key suppliers and customers in the industry. 与同行相比，本企业拥有更多的各种类型的合作伙伴，包括大学、研究所、行业内重要的供应商和客户等	√			
8	We are able to deal with differences and conflicts in our partner network 我们能够妥善处理合作网络中的分歧和冲突问题		√		
9	We have a strong ability to be at the center of a network of partnerships. 我们具有很强的占据合作关系网络中心位置的能力	√			
10	We often act as a bridge between other partners 我们经常成为其他合作伙伴间的沟通桥梁	√			
11	We are always able to communicate very quickly with all partners without having to rely on third parties to pass on information. 我们总是能非常快地与所有合作伙伴沟通而不用依赖第三方来传递信息	√			
12	We are able to take center stage and gain access to more resources. 我们能够占据中心位置从而获得更多的资源	√			

13	We are able to think about the development of the relationship from the partner's point of view. 我们能从合作伙伴的角度来思考如何发展双方关系	√			
14	We have a strong ability to develop mutual trust and mutual benefit with our partners. 我们具有很强发展与合作伙伴之间相互信任、互惠互利的能力	√			
15	Within the company, departments often exchange information and resources to accomplish tasks together (reverse problem) The company always uses a third party when communicating with its partners. 企业内，部门之间经常交换信息和资源共同完成任务(反向问题）企业在与合作方沟通时总是需要借助第三方		√		
16	Our partners rarely discontinue their relationships with us. 已联系的合作方很少主动中断与本企业的合作关系		√		

Index of Item-Objective Congruence (IOC)

Part XII. Importance of the eight issues in relation to knowledge-sharing

第十二部分 八个问题相对于知识共享的重要程度

The expert is kindly requested to examine each item of the research instrument for its content validity.		Expert's Review			
NO.	Questionnaire for Participants (Single choice question) **Items**	**Agree** **+1**	**Not Sure** **0**	**Disagree** **-1**	**Comment**
1	Regular sharing with partners: information on technology development/service, project progress reports, etc. 与合作伙伴经常共享：技术研发/服务、项目进度报告等信息资料	√			
2	Regularly share with partners: information on quality	√			

	control of technology/services 与合作伙伴经常共享：技术/服务质量控制方面的信息资料				
3	Frequently shared with partners: information on technical components/service details 与合作伙伴经常共享：技术构成/服务细节方面的信息资料	√			
4	Frequently share with partners: information on market and customer needs. 与合作伙伴经常共享：市场和客户需求方面的信息资料	√			
5	Often shared with partners: know-how behind technology/service implementation 与合作伙伴经常共享：技术/服务实施背后的经验诀窍	√			
6	Often shared with partners: know-how to solve technical/service problems or unexpected technical/service problems. 与合作伙伴经常共享：解决技术/服务问题或意外技术/服务问题 经验诀窍	√			
7	Often shared with partners: know-how to break through technical/service problems/technical/service limitations 与合作伙伴经常共享：突破技术/服务难题/技术/服务局限的经验诀窍	√			
8	Often shared with partners: Experience in understanding and judging market and customer needs. 与合作伙伴经常共享：对市场和客户需求的理解和判断经验	√			

The influence of network capability and knowledge sharing on innovation performance of Hi-tech SMEs

（For Expert 5）

By

YAN ZHANG

Hi-tech SMEs have become the backbone of China's independent innovation capability, and the network capability and resources possessed by Hi-tech SMEs are more limited, and the network capability has become one of the important channels for Hi-tech SMEs to solve the problem of insufficient information and resources. In the competitive environment, how Hi-tech SMEs can own the network capability and obtain the competitiveness of sustainable development in the industrial chain is an important issue for the future development of Hi-tech SMEs.

This study aims to achieve three objectives: 1) To study the impact of network capability on innovation performance of small and medium-sized technology 2) To study the relationship between network capability (NC) and knowledge sharing .3) To study the influence of knowledge sharing on innovation performance of small and medium-sized technology-based enterprises. on innovation performance of small and medium-sized technology -based enterprises. This paper adopts a quantitative research method, the instruments for data collection are the instruments for data collection are questionnaires. The data are mainly from Hi-tech SMEs in East China, because these regions have active economies and high levels of innovation. The survey respondents are mainly managers of Hi-tech SMEs (Small and Medium-sized Enterprises).Strict confidentiality is maintained for the interviewees, and filling out the questionnaires will not have any negative impact on them, which ensures the authenticity and reliability of the data.

The following table consists of twelve parts: the first part of the basic information, the second part of the four dimensions of network capability, the third

part of the two dimensions of knowledge sharing, the fourth part of the four dimensions of network planning capability, and the fifth part is

four dimensions of network relationship capability, part 6 four dimensions of network occupancy capability, part 7 four dimensions of network utilization capability, part 8 four dimensions of explicit knowledge sharing, part 9 four dimensions of tacit knowledge sharing, part 10 eight dimensions of innovation performance, part 11 sixteen dimensions of network capability, and part 12 eight dimensions of knowledge sharing.

I hope you can spare your valuable time to participate in this study.

Thank you very much.

Yan Zhang

Researcher

Index of Item-Objective Congruence (IOC) Part I. Basic Information 第一部分　基本信息					
The expert is kindly requested to examine each item of the research instrument for its content validity.		Expert's Review			
NO.	Questionnaire for Participants (Single choice question) **Items**	**Agree** **+1**	**Not Sure** **0**	**Disagree** **-1**	**Comment**
1	How many years has your company been established? 您所在企业成立了几年： ○3 years or less 3年及以内 ○3-5 years 3-5年 ○5 years and above 5年及以上	√			
2	The size of your company 您所在企业的规模：	√			

	○49 employees or less 49人及以内 ○50- 100 employees 50-100人 ○50- 100 employees 101人及以上				
3	Your company's industry areas are: 贵公司的行业领域为: ○Electronic Information 电子信息 ○Biological medicine 生物医药 ○New materials 新材料 ○opto-mechatronics 光机电一体化 ○New energy and high efficiency and energy saving 新能源与高效节能 ○High-tech services 高技术服务 ○Resources and Environment 资源与环境 ○Agriculture and rural areas 农业与农村 ○Ation and Aerospace 航空与航天 ○Other其他	√			
4	Nature of your company: 贵公司的性质: ○State-owned Enterprises 国有企业 ○Private enterprises 合资企业 ○Joint Ventures 民营企业 ○Others 其他	√			
5	Your position in your company: 您在贵公司担任的职务 ○Chairman or General Manager 董事长或总经理 ○Intelligent Department manager 关键技术人员 ○Key Technical Personnel 智能部门经理 ○Others 其他	√			

6	Your position level: 您的职位级别： ○Junior Managers 基层管理者 ○Middle managers 中层管理者 ○Senior Management 高层管理者	√			
7	Your current working years in the company: 目前您在该企业的工作年限: ○Less than 3 years 3年以下 ○3-5 years 3-5年 ○6-8 years 6-8年 ○9- 11Years 9-11年 ○12 years and above 12年及以上	√			
8	Your education: 您的学历： ○High school (Including secondary school) 高中(含中专） ○Bachelor's Degree and College 本科及大专 ○Master's Degree or above 硕士及以上	√			

Index of Item-Objective Congruence (IOC)

Part II Importance of the four secondary dimensions in relation to network capacity

第二部分 四个二级维度相对于网络能力的重要程度

	The expert is kindly requested to examine each item of the research instrument for its content validity.	Expert's Review			
NO.	Questionnaire for Participants (Single choice question) **Items**	**Agree** **+1**	**Not Sure** **0**	**Disagree** **-1**	**Comment**
1	Network planning capacity 网络规划能力	√			
2	Network relationship capacity 网络关系能力	√			

3	Network occupying capacity 网络占位能力	√			
4	Network utilization capacity 网络利用能力	√			

Index of Item-Objective Congruence (IOC)

Part III Importance of the two secondary variables relative to knowledge sharing
第三部分　两个二级变量相对于知识共享的重要程度

The expert is kindly requested to examine each item ofthe research instrument for its content validity.		Expert's Review			
NO.	Questionnaire for Participants (Single choice question) **Items**	**Agree**	**Not Sure**	**Disagree**	**Comment**
		+1	**0**	**-1**	
1	Explicit knowledge sharing 显性知识共享		√		
2	Tacit knowledge sharing 隐性知识共享	√			

Index of Item-Objective Congruence (IOC)

Part IV The Importance of the Four Issues Relative to Network Planning Capabilities
第四部分　四个问题相对于网络规划能力的重要程度

The expert is kindly requested to examine each item ofthe research instrument for its content validity.		Expert's Review			
NO.	Questionnaire for Participants (Single choice question) **Items**	**Agree**	**Not Sure**	**Disagree**	**Comment**
		+1	**0**	**-1**	
1	We are good at analyzing how well our development strategy matches our network resources 我们善于分析自身发展战略与网络资源的匹配程度	√			
2	We are keen to recognize partnership opportunities in development	√			

	我们在开发中能敏锐识别合作机会				
3	We have clear goals and action guidelines for cooperation 我们有清晰的合作目标和行动准则	√			
4	We are well aware of the strategies to build long-term relationships with potential partners 我们很清楚以何种策略与潜在合作伙伴建立长期关系	√			

Index of Item-Objective Congruence (IOC)

Part V. Importance of the Four Issues Relative to Network Relationship Capacity

第五部分　四个问题相对于网络关系能力的重要程度

The expert is kindly requested to examine each item of the research instrument for its content validity.		Expert's Review			
NO.	Questionnaire for Participants (Single choice question) **Items**	**Agree** **+1**	**Not Sure** **0**	**Disagree** **-1**	**Comment**
1	We emphasize that cooperation is based on trust 我们强调合作基于信任	√			
2	We know how to build relationships with potential partners. 我们清楚以何种策略与潜在合作伙伴建立关系	√			
3	We have more partners of various types than our peers, including universities, research institutes, key suppliers and customers in the industry. 与同行相比，本企业拥有更多的各种类型的合作伙伴，包括大学、研究所、行业内重要的供应商和客户等	√			
4	We are able to deal with differences and conflicts in our partner network 我们能够妥善处理合作网络中的分歧和冲突问题	√			

Index of Item-Objective Congruence (IOC)

Part VI The Importance of the Four Issues Relative to Network Occupancy Capacity

第六部分　四个问题相对于网络占位能力的重要程度

The expert is kindly requested to examine each item ofthe research instrument for its content validity.		Expert's Review			
NO.	Questionnaire for Participants (Single choice question) **Items**	**Agree** **+1**	**Not Sure** **0**	**Disagree** **-1**	**Comment**
1	We have a strong ability to be at the center of a network of partnerships. 我们具有很强的占据合作关系网络中心位置的能力	√			
2	We often act as a bridge between other partners 我们经常成为其他合作伙伴间的沟通桥梁	√			
3	We are always able to communicate very quickly with all partners without having to rely on third parties to pass on information. 我们总是能非常快地与所有合作伙伴沟通而不用依赖第三方来传递信息	√			
4	We are able to take center stage and gain access to more resources. 我们能够占据中心位置从而获得更多的资源	√			

Index of Item-Objective Congruence (IOC)

Part VII. Importance of the four issues relative to the ability to utilize the network

第七部分　四个问题相对于网络利用能力的重要程度

The expert is kindly requested to examine each item of the research instrument for its content validity.	Expert's Review

NO.	Questionnaire for Participants (Single choice question) **Items**	**Agree** **+1**	**Not Sure** **0**	**Disagree** **-1**	**Comment**
1	We are able to think about the development of the relationship from the partner's point of view. 我们能从合作伙伴的角度来思考如何发展双方关系	√			
2	We have a strong ability to develop mutual trust and mutual benefit with our partners. 我们具有很强发展与合作伙伴之间相互信任、互惠互利的能力	√			
3	Within the company, departments often exchange information and resources to accomplish tasks together (reverse problem) The company always uses a third party when communicating with its partners. 企业内，部门之间经常交换信息和资源共同完成任务(反向问题）企业在与合作方沟通时总是需要借助第三方	√			
4	Our partners rarely discontinue their relationships with us. 已联系的合作方很少主动中断与本企业的合作关系	√			

Index of Item-Objective Congruence (IOC)

Part VIII The Importance of the Four Questions in Relation to Explicit Knowledge Sharing

第八部分　四个问题相对于显性知识共享的重要程度

The expert is kindly requested to examine each item of the research instrument for its content validity.		Expert's Review			
NO.	Questionnaire for Participants (Single choice question) **Items**	**Agree** **+1**	**Not Sure** **0**	**Disagree** **-1**	**Comment**

1	Regular sharing with partners: information on technology development/service, project progress reports, etc. 与合作伙伴经常共享：技术研发/服务、项目进度报告等信息资料	√			
2	Regularly share with partners: information on quality control of technology/services 与合作伙伴经常共享：技术/服务质量控制方面的信息资料	√			
3	Frequently shared with partners: information on technical components/service details 与合作伙伴经常共享：技术构成/服务细节方面的信息资料	√			
4	Frequently share with partners: information on market and customer needs. 与合作伙伴经常共享：市场和客户需求方面的信息资料	√			

Index of Item-Objective Congruence (IOC)

Part IX The Importance of the Four Questions Relative to Tacit Knowledge Sharing

第九部分　四个问题相对于隐性知识共享的重要程度

The expert is kindly requested to examine each item of the research instrument for its content validity.		Expert's Review			
NO.	Questionnaire for Participants (Single choice question) **Items**	**Agree** **+1**	**Not Sure** **0**	**Disagree** **-1**	**Comment**
1	Often shared with partners: know-how behind technology/service implementation 与合作伙伴经常共享：技术/服务实施背后的经验诀窍		√		
2	Often shared with partners: know-how to solve technical/service problems or unexpected technical/service	√			

	problems. 与合作伙伴经常共享：解决技术/服务问题或意外技术/服务问题 经验诀窍				
3	Often shared with partners: know-how to break through technical/service problems/technical/service limitations 与合作伙伴经常共享：突破技术/服务难题/技术/服务局限的经验诀窍	√			
4	Often shared with partners: Experience in understanding and judging market and customer needs. 与合作伙伴经常共享：对市场和客户需求的理解和判断经验		√		

Index of Item-Objective Congruence (IOC) Part X. Importance of the eight issues relative to innovation performance 第十部分　八个问题相对于创新绩效的重要程度					
The expert is kindly requested to examine each item of the research instrument for its content validity.		Expert's Review			
NO.	Questionnaire for Participants (Single choice question) **Items**	**Agree** **+1**	**Not Sure** **0**	**Disagree** **-1**	**Comment**
1	The company's customers have high requirements for products and technology 公司的客户对产品和技术有很高的要求	√			
2	Customers are very satisfied with the company's products and technology 客户对公司的产品和技术非常满意		√		
3	Our company's market share continues to grow 我们公司市场份额持续增长	√			

4	Our company's profitability increases every year 我们公司的利润率逐年提高	√			
5	We can learn to come up with original solutions to problems 我们可以通过学习提出一些独创性的问题解决方案	√			
6	We proactively support innovative ideas 我们会主动支持具有创新性的思想	√			
7	We are able to translate innovative ideas into practical applications 我们能够把创新性的想法转化成实际应用	√			
8	Shorter time to market for similar products due to the development of product innovations 由于产品创新的发展，类似产品上市的时间缩短	√			

Index of Item-Objective Congruence (IOC) Part XI. Importance of the sixteen issues in relation to network capacity 第十一部分　十六个问题相对于网络能力的重要程度					
The expert is kindly requested to examine each item of the research instrument for its content validity.		Expert's Review			
NO.	Questionnaire for Participants (Single choice question) **Items**	**Agree** **+1**	**Not Sure** **0**	**Disagree** **-1**	**Comment**
1	We are good at analyzing how well our development strategy matches our network resources 我们善于分析自身发展战略与网络资源的匹配程度		√		
2	We are keen to recognize partnership opportunities in development 我们在开发中能敏锐识别合作机会	√			
3	We have clear goals and action guidelines for cooperation	√			

	我们有清晰的合作目标和行动准则				
4	We are well aware of the strategies to build long-term relationships with potential partners 我们很清楚以何种策略与潜在合作伙伴建立长期关系		√		
5	We emphasize that cooperation is based on trust 我们强调合作基于信任	√			
6	We know how to build relationships with potential partners. 我们清楚以何种策略与潜在合作伙伴建立关系	√			
7	We have more partners of various types than our peers, including universities, research institutes, key suppliers and customers in the industry. 与同行相比，本企业拥有更多的各种类型的合作伙伴，包括大学、研究所、行业内重要的供应商和客户等	√			
8	We are able to deal with differences and conflicts in our partner network 我们能够妥善处理合作网络中的分歧和冲突问题		√		
9	We have a strong ability to be at the center of a network of partnerships. 我们具有很强的占据合作关系网络中心位置的能力	√			
10	We often act as a bridge between other partners 我们经常成为其他合作伙伴间的沟通桥梁	√			
11	We are always able to communicate very quickly with all partners without having to rely on third parties to pass on information. 我们总是能非常快地与所有合作伙伴沟通而不用依赖第三方来传递信息	√			
12	We are able to take center stage and gain access to more resources.	√			

	我们能够占据中心位置从而获得更多的资源				
13	We are able to think about the development of the relationship from the partner's point of view. 我们能从合作伙伴的角度来思考如何发展双方关系	√			
14	We have a strong ability to develop mutual trust and mutual benefit with our partners. 我们具有很强发展与合作伙伴之间相互信任、互惠互利的能力	√			
15	Within the company, departments often exchange information and resources to accomplish tasks together (reverse problem) The company always uses a third party when communicating with its partners. 企业内，部门之间经常交换信息和资源共同完成任务(反向问题）企业在与合作方沟通时总是需要借助第三方	√			
16	Our partners rarely discontinue their relationships with us. 已联系的合作方很少主动中断与本企业的合作关系	√			

Index of Item-Objective Congruence (IOC)

Part XII. Importance of the eight issues in relation to knowledge-sharing

第十二部分　八个问题相对于知识共享的重要程度

The expert is kindly requested to examine each item of the research instrument for its content validity.		Expert's Review			
NO.	Questionnaire for Participants (Single choice question) **Items**	**Agree** **+1**	**Not Sure** **0**	**Disagree** **-1**	**Comment**
1	Regular sharing with partners: information on technology development/service, project progress reports, etc. 与合作伙伴经常共享：技术研发/服务、项目进度报告等信息资料		√		

2	Regularly share with partners: information on quality control of technology/services 与合作伙伴经常共享：技术/服务质量控制方面的信息资料	√			
3	Frequently shared with partners: information on technical components/service details 与合作伙伴经常共享：技术构成/服务细节方面的信息资料	√			
4	Frequently share with partners: information on market and customer needs. 与合作伙伴经常共享：市场和客户需求方面的信息资料		√		
5	Often shared with partners: know-how behind technology/service implementation 与合作伙伴经常共享：技术/服务实施背后的经验诀窍	√			
6	Often shared with partners: know-how to solve technical/service problems or unexpected technical/service problems. 与合作伙伴经常共享：解决技术/服务问题或意外技术/服务问题 经验诀窍	√			
7	Often shared with partners: know-how to break through technical/service problems/technical/service limitations 与合作伙伴经常共享：突破技术/服务难题/技术/服务局限的经验诀窍	√			
8	Often shared with partners: Experience in understanding and judging market and customer needs. 与合作伙伴经常共享：对市场和客户需求的理解和判断经验	√			

Appendix C

IOC Evaluation Results

AppendixC1 Importance of the four secondary indicators relative to network capacity

Item Expert Score	Expert 1	Expert 2	Expert3	Expert 4	Expert 5	IOC
NPC1-NPC4	1	1	1	1	1	1
NRC1-NRC4	1	1	0	1	1	0.8
NOC1-NOC4	1	0	1	1	1	0.8
NUC1-NUC4	1	1	1	1	1	1

AppendixC2 Importance of two secondary indicators relative to knowledge sharing

Item Expert Score	Expert 1	Expert 2	Expert3	Expert 4	Expert 5	IOC
EKS1-EKS4	1	1	1	1	0	0.8
TKS1-TKS4	1	1	1	1	1	1

AppendixC3 Importance of eight secondary indicators relative to innovation performance

Item Expert Score	Expert 1	Expert 2	Expert3	Expert 4	Expert 5	IOC
IP1	1	1	0	1	1	0.8
IP2	1	1	1	1	0	0.8
IP3	1	1	1	1	1	1
IP4	1	1	1	1	1	1
IP5	1	1	1	0	1	0.8
IP6	1	1	1	1	1	1

Item Expert Score	Expert 1	Expert 2	Expert3	Expert 4	Expert 5	IOC
IP7	0	1	1	1	1	0.8
IP8	1	1	1	1	1	1

AppendixC4 Importance of the four tertiary indicators relative to network planning capability

Item Expert Score	Expert 1	Expert 2	Expert3	Expert 4	Expert 5	IOC
NPC1	1	1	1	1	1	1
NPC2	0	1	1	1	1	0.8
NPC3	1	1	1	0	1	0.8
NPC4	1	1	1	1	1	1

AppendixC5 Importance of the four tertiary indicators in relation to network relations capacity

Item Expert Score	Expert 1	Expert 2	Expert3	Expert 4	Expert 5	IOC
NRC1	1	1	1	0	1	0.8
NRC2	1	0	1	1	1	0.8
NRC3	1	0	1	1	1	0.8
NRC4	1	1	1	1	1	1

AppendixC6 Importance of the four tertiary indicators relative to network occupancy ability

Item Expert Score	Expert 1	Expert 2	Expert3	Expert 4	Expert 5	IOC
NOC1	1	1	0	1	1	0.8
NOC2	1	1	1	1	1	0.8
NOC3	1	1	1	1	1	1
NOC4	0	1	1	1	1	0.8

AppendixC7 Importance of the four tertiary indicators relative to web utilization ability

Item Expert Score	Expert 1	Expert 2	Expert3	Expert 4	Expert 5	IOC
NUC1	1	1	0	1	1	0.8
NUC2	0	1	1	1	1	0.8
NUC3	1	1	1	1	1	1
NUC4	1	0	1	1	1	0.8

AppendixC8 Importance of the four tertiary indicators relative to explicit knowledge sharing

Item Expert Score	Expert 1	Expert 2	Expert3	Expert 4	Expert 5	IOC
EKS1	1	1	1	0	1	0.8

EKS2	1	1	0	1	1	0.8
EKS3	1	1	0	1	1	0.8
EKS4	0	1	1	1	1	0.8

AppendixC9 Importance of the four tertiary indicators relative to tacit knowledge sharing

Item Expert Score	Expert 1	Expert 2	Expert3	Expert 4	Expert 5	IOC
TKS1	1	1	1	1	0	0.8
TKS2	0	1	1	1	1	0.8
TKS3	1	1	1	1	1	1
TKS4	1	1	1	1	0	0.8

AppendixC10 Importance of the sixteen tertiary indicators relative to network capacity

Item Expert Score	Expert 1	Expert 2	Expert3	Expert 4	Expert 5	IOC
NPC1	1	1	1	1	0	0.8
NPC2	0	1	1	1	1	0.8
NPC3	1	1	1	1	1	1
NPC4	1	1	1	1	0	0.8
NRC1	1	1	1	1	1	1
NRC2	1	0	1	1	1	0.8
NRC3	1	1	0	1	1	0.8
NRC4	1	1	1	1	0	0.8

Item Expert Score	Expert 1	Expert 2	Expert3	Expert 4	Expert 5	IOC
NOC1	1	1	1	0	1	0.8
NOC2	1	1	1	1	1	1
NOC3	1	1	1	1	1	1
NOC4	1	1	1	1	1	1
NUC1	0	1	1	1	1	0.8
NUC2	1	0	1	1	1	0.8
NUC3	1	1	1	0	1	0.8
NUC4	1	1	1	0	1	0.8

AppendixC11 Importance of the eight tertiary indicators relative to knowledge sharing

Item Expert Score	Expert 1	Expert 2	Expert3	Expert 4	Expert 5	IOC
EKS1	1	1	1	1	0	0.8
EKS2	0	1	1	1	1	0.8
EKS3	1	1	1	1	1	1
EKS4	1	1	1	1	0	0.8
TKS1	1	1	1	1	1	1
TKS2	1	0	1	1	1	0.8
TKS3	1	1	1	1	1	1
TKS4	1	1	1	1	1	1

Appendix D

Certificate of Approval

COA. No. RSUERB2024-079

Certificate of Approval
By
Ethics Review Board of Rangsit University

COA. No.	COA. No. RSUERB2024-079
Protocol Title	The influence of network capability and knowledge sharing on innovation performance of Technology-based SMEs
Principle Investigator	Yan Zhang
Co-Investigator	Dr.Chen Jiakui
Affiliation	Faculty of Business Administration, Rangsit University
How to review	Expedited Review
Approval includes	1. Project proposal 2. Information sheet 3. Informed consent form 4. Data collection form/Program or Activity plan
Date of Approval:	10 May 2024
Date of Expiration:	10 May 2026

The prior mentioned documents have been reviewed and approved by Ethics Review Board of Rangsit University based Declaration of Helsinki, The Belmont Report, ~~CIOMS~~ Guideline and International Conference on Harmonization in Good Clinical Practice or ICH-GCP.

RSU-ERB 10 MAY 2024

Signature.....

(Associate Professor Dr. Panan Kanchanaphum)
Chairman, Ethics Review Board for Human Research

Ethics Review Board of Rangsit University, 5th floor, Arthit Ourairat Building (Bldg.1) Rangsit University
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