THE IMPACT OF OPEN INNOVATION, KNOWLEDGE FIELD ACTIVITY, AND KNOWLEDGE TRANSFER FACTORS TOWARDS INNOVATION PERFORMANCE

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This Independent Study Manuscript Presented to
The Graduate School of Bangkok University
In Partial Fulfillment of the
Requirements for the Degree
Master of Business Administration

Academic Year 2025

This manuscript has been approved by

the Graduate School

Bangkok University

Title: The impact of open innovation, knowledge field activity, and knowledge transfer Factors towards innovation performance

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Li Hai Lun Master of Business Administration, January 2024, Graduate School, Bangkok University.

The impact of open innovation, knowledge field activity, and knowledge transfer Factors towards innovation performance (134 pp.)

Advisor: Assoc. Prof. Nathanicha Na Nakorn, Ph.D.

ABSTRACT

This study examines the influence of open innovation, knowledge field activity, and knowledge transfer on innovation performance in Chinese organizations. A quantitative survey was conducted using data collected from 306 firms across multiple industries, and the data were analyzed using descriptive statistics, reliability analysis, and multiple regression analysis. The results indicate that open innovation, including open innovation breadth and open innovation depth, has a positive influence on innovation performance (Accept Hypothesis). Knowledge field activity, particularly team cohesion, also has a positive influence on innovation performance (Accept Hypothesis). In addition, knowledge transfer, including knowledge acquisition and knowledge integration, has a positive influence on innovation performance (Accept Hypothesis). Overall, the findings suggest that organizations should strengthen knowledge transfer mechanisms, foster a supportive knowledge-sharing environment, and maintain diversified external partnerships to enhance innovation performance.

Keywords: Open Innovation, Knowledge Transfer, Innovation Performance

ACKNOWLEDGEMENT

First and foremost, I would like to express my deepest gratitude to my advisor, Assoc Prof. Dr. Nathanicha Na Nakorn, for her invaluable guidance and unwavering support throughout this research endeavor. Her expert advice and constant encouragement have been instrumental in the successful completion of this study.

Additionally, I extend my sincere appreciation to my MBA professors and classmates at Bangkok University. Their insightful instruction and collaborative spirit have profoundly enriched my understanding of business management principles and practices.

I am also grateful to the dedicated staff members of Bangkok University Library for their professional assistance in accessing essential research materials and academic resources.

Lastly, I wish to acknowledge all those who have directly or indirectly contributed to this academic journey. This accomplishment would not have been possible without the collective efforts of everyone mentioned above.

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CHAPTER 1

INTRODUCTION

1.1 The Importance and Problem of the Study

Improving independent innovation capability and building an innovative country occupy an important position in the development strategies of many countries. The Outline of the National Medium- and Long-Term Scientific and Technological Development Plan (2006-2020) specifies the enhancement of the independent innovation capability of enterprises as the strategic base of the development plan. Against the background of the support of the national development strategy, the enhancement of independent innovation capability has become the base point for the direction of social development. The innovation process is synergized, the innovation mode is transformed and upgraded, and innovation is increasingly becoming the focus of research in the context of mass entrepreneurship and innovation. The implementation of the innovation-driven development strategy has enhanced the enthusiasm of enterprise innovation, and innovation has also become a hot topic of research. Many countries have put forward the five development concepts of "innovation, coordination, green, openness and sharing", among which innovation and open development, as an important part of the five development concepts, have become the targets and objects worthy of in-depth investigation.

In the process of economic globalization, any organization or institution will be associated with the outside world, and being in a closed state for a long time is not conducive to its healthy development. Enterprises need to innovate to increase vitality and vigor, and also need to communicate and interact with the outside world in the

process of improving innovation, whether with competitors or partners. The trend of fierce competition in the market has led to a gradual shortening of product life cycle, which makes enterprises face the problem of accelerated knowledge updating. According to statistics, high-tech enterprises have risen from 3 to 5 of China's top 10 companies in terms of global market capitalization over a 10-year period, which shows that scientific and technological innovation can greatly enhance the value of enterprises. In 2019, exports of high-tech products amounted to $730.7 billion, accounting for about 27% of the total exports, and imports of high-tech products totaled $637.8 billion, accounting for about 29% of the total imports. The conduct of innovation activities plays an important role in the development of the country's socio-economic development, and innovation is increasingly becoming the direction of the focus of enterprises and even society.

Innovation performance is an important index for researching and measuring the effect of innovation, and quantifying abstract concepts is conducive to enterprises to better carry out innovation activities and achieve innovation goals, and realize the sustainable development of enterprise operations. Enterprises need to innovate, and in the past, the closed innovation mode was carried out within the organization, but studies have shown that enterprises only rely on their own innovation to bring the effectiveness and results are mostly unsatisfactory. Enterprise innovation requires a lot of money, energy, time and may not produce results. However, sometimes enterprises can utilize external knowledge or innovation resources to carry out good innovation activities, and the innovation projects or ideas that enterprises discard will produce obvious results in the innovation activities of other companies, indicating that enterprises can communicate and interact with the outside world to carry out

innovation, i.e., open innovation. In the process of open innovation, enterprises communicate and utilize knowledge with outside research institutes, partners and competitors. In the process of knowledge flow, enterprises need to grasp the amount and type of knowledge inflow and outflow, etc., and rationally transfer knowledge to be more conducive to the innovation and development of enterprises. After the resource replacement, the abstract knowledge will be transformed into the actual output benefits of the enterprise, which plays an important role in improving the enterprise's own strength.

In recent years, many national policies have been supporting enterprises to carry out innovation activities, including national preferential policies, financial service policies of banks and government subsidies, etc. Although they have played a certain effect, they are still far from the realization of innovation goals. Open innovation is one of the main innovation methods of enterprises, and how to carry out reasonable knowledge transfer to improve innovation performance in this process needs further research. In the context of the rapid development of knowledge economy and sharing economy, knowledge plays an increasingly large role in the process of enterprise business competition, the utilization of knowledge has no cost, and knowledge is shared and repetitive, so the value of knowledge is unlimited. Enterprises better utilize knowledge to innovate and obtain abundant knowledge, creativity, technology property rights, etc., which can improve the core competitiveness and competitive advantage of enterprises.

This paper takes knowledge in intangible resources as an entry point to explore how the degree of open innovation affects innovation performance under the influence of the knowledge field and in the process of knowledge transfer. Resource-based

theory emphasizes that the uniqueness of resources can bring irreplaceable value to enterprises, while knowledge-based theory further expands on this foundation, arguing that the value of knowledge lies in its uniqueness and value co-creation. Enterprise innovation needs the transfer of knowledge to provide vitality, the expansion of the scope of the knowledge field to bring activity space for innovation behavior, and the enhancement of the activity of the knowledge field to stimulate the vitality of the innovation body. Enterprises should make full use of the resources they possess, rationally carry out knowledge acquisition and integration, stimulate the exponential growth of innovation power, promote the significant enhancement of innovation ability and realize the results of value co-creation.

1.2 Research Problems

1.2.1 Does Open Innovation Factor Open Innovation Breadth and Open Innovation Depth have an influence on Innovation Performance?

1.2.2 Does Knowledge Field Activity have an influence on Innovation Performance?

1.2.3 Does Knowledge Transfer factor Knowledge Acquisition and Knowledge Integration have an influence on Innovation Performance?

1.3 Objectives of the Study

1.3.1 To study the impact of Open Innovation factor Open Innovation Breadth and Open Innovation Depth on Innovation Performance

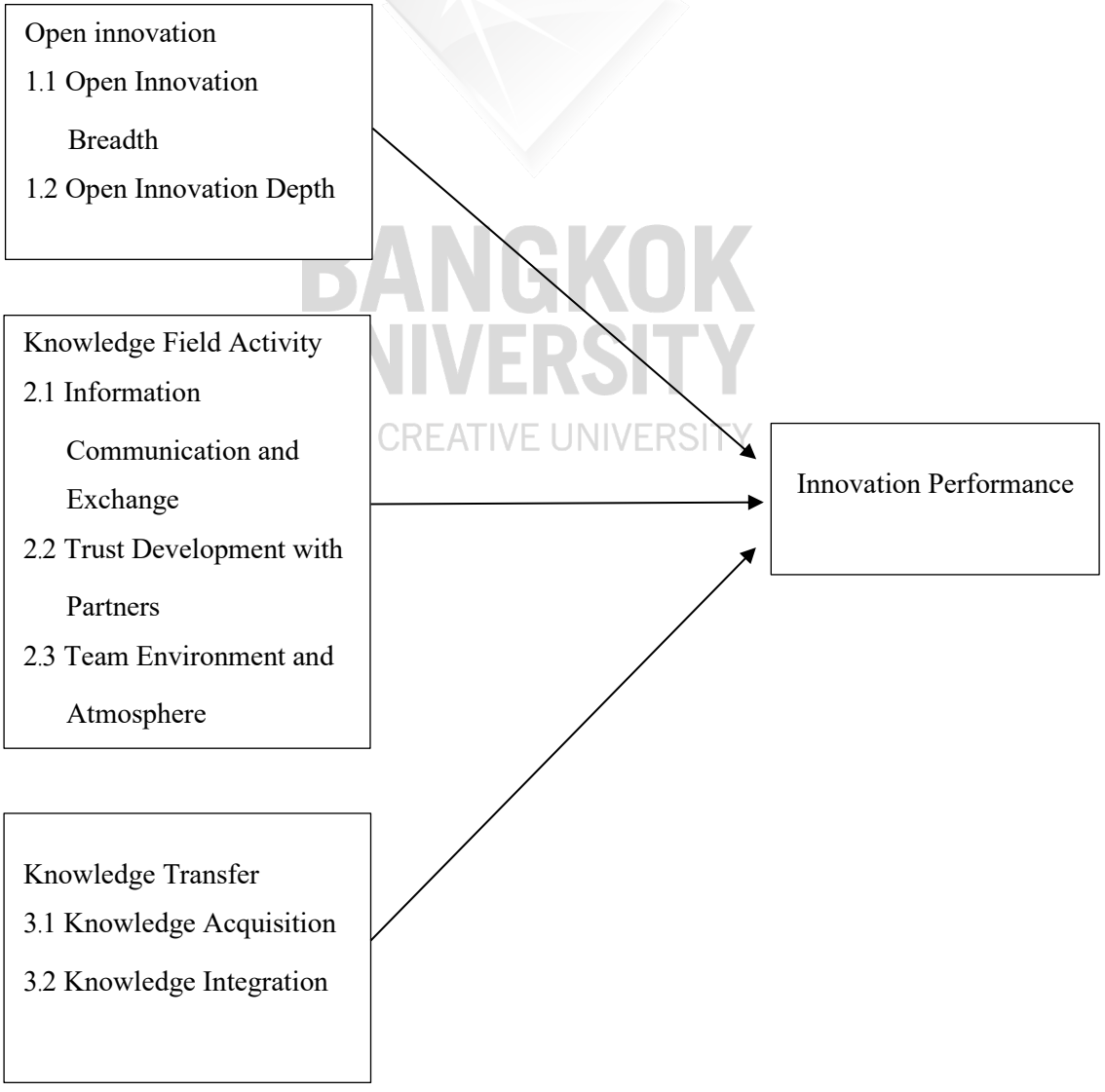
1.3.2 To study the impact of Knowledge Field Activity on Innovation Performance

1.3.3 To study the impact of Knowledge Transfer factor Knowledge Acquisition and Knowledge Integration on Innovation Performance

1.4 The Conceptual Framework

According to the model-building section in the text, the research framework can be described as follows:

Figure 1.1: Conceptual Framework



1.5 Method of Study

This study adopts a combination of research methods to ensure the comprehensiveness and reliability of the findings. First, the authors conducted an in-depth literature study to systematically sort out and analyze the relevant theoretical and empirical studies on open innovation, knowledge field activity, knowledge transfer, and innovation performance. Through the literature study, this paper constructs a theoretical framework, clarifies the relationship between the research variables, and puts forward the research hypotheses. This process not only helps the authors clarify the development lineage and main points of existing studies but also provides a basis for identifying research gaps and innovations.

Second, this study adopted an empirical research method to verify the theoretical hypotheses. Specifically, the authors designed a structured questionnaire to collect firm-level data. The questionnaire included scales to measure open innovation breadth and depth, knowledge field activity, knowledge transfer (knowledge acquisition and knowledge integration), and innovation performance. These scales were largely based on well-established scales validated in existing studies, with appropriate modifications for the specific context of this study. Prior to the formal survey, the authors conducted a small pre-test to ensure the comprehensibility and validity of the questionnaire.

In terms of data collection, this study utilized a multi-channel approach. The authors distributed the questionnaire through various channels such as industry associations, business contacts, and online questionnaire platforms to ensure the diversity and representativeness of the sample. In the data analysis stage, this study

utilizes a variety of statistical analysis methods. First, the authors use descriptive statistical analysis to understand the basic characteristics of the sample and the distribution of each variable. Second, correlation and regression analyses were used to initially test the relationships between the variables. Finally, the authors applied structural equation modeling (SEM) to test multiple hypotheses simultaneously, especially the mediating effect hypothesis.

In addition, this study employs some complementary research methods. For example, the authors conducted in-depth interviews with selected firms to obtain richer and more in-depth qualitative information, which helped to explain the results of the quantitative analysis. Meanwhile, this study also collected some secondary data, such as financial statements and patent data of enterprises, to supplement the data from the questionnaire survey and enhance the reliability of the research results.

Through this multi-method combination of research design, this paper aims to comprehensively and deeply explore the mechanism of the impact of open innovation, knowledge field activity and knowledge transfer on innovation performance, so as to provide a solid foundation for theoretical development and practical application.

1.6 Tools and Statistics Used

The research idea of this paper is mainly to understand the research status quo at home and abroad through the literature research method, to put forward research questions and make assumptions according to the relevant research status and reasonable analysis; to design and prepare questionnaires using the existing more mature scales, to carry out empirical analysis and hypothesis testing through the questionnaire survey method and the quantitative analysis method, and to analyze and

reach the final research conclusions and research outlooks and so on.

(1) Literature reading method.

Literature reading on open innovation, knowledge field activity, knowledge transfer and innovation performance, etc., to understand the relevant indexes of the research object and to find out the situation of the correlation relationship between the variables, to provide a theoretical basis for this study.

(2) Questionnaire survey method.

The questionnaire is used to collect basic information such as the effectiveness of open innovation in enterprises, and also to investigate the reflection of the reality of knowledge utilization and other related situations, i.e., knowledge transfer and knowledge field activity. A reasonable questionnaire was designed and prepared by quantifying the variables of the study according to a mature scale using Likert scoring method. The questionnaire survey of this study is mainly aimed at enterprise managers, and is conducted in the form of paper questionnaires and network questionnaires, and by screening and organizing the obtained questionnaires, it further provides the required data and information for empirical research and analysis.

(3) Use multiple regression as an analysis to establish a regression model

Using SPSS23.0 software and other sample data obtained for correlation analysis between a dependent variable innovation performance and three independent variables knowledge transfer, open innovation, knowledge-based live field whether there is a positive correlation between the role to verify the main ideas of this paper.

1.7 Scope of the Study

1.7.1 Independent Variables:

1.7.1.1 Open Innovation

- Open Innovation Breadth
- Open Innovation Depth

1.7.1.2 Knowledge Field Activity

- Effective Information Communication
- Trust Level with Innovation Partners
- Team Environment and Atmosphere
- Team Cohesion and Centripetal Force

1.7.1.3 Knowledge Transfer

- Knowledge Acquisition
- Knowledge Integration

1.7.2 Dependent Variables: Innovation Performance (Speed of new product development, Market share, Innovation success rate, Technological content, Number of patents, and Percentage of new product sales revenue)

1.7.3 Population and Sample:

The population for this study comprises enterprises operating across various industries in China. The sample consists of 306 enterprises selected through a combination of judgment and convenience sampling, covering diverse organizational types, sizes, and ownership structures. These include state-owned and state-controlled enterprises (17.0%), private enterprises (35.6%), collective enterprises (26.5%), Sino-foreign joint ventures (12.1%), and wholly foreign-owned enterprises (8.8%). Industries represented include manufacturing, scientific research and technological development, information technology, finance, construction, biological and pharmaceutical, and service sectors.

Figure 1.2: Yamane's Table for Sample Size

Size of Population (N)	Sample Size (n) for Precision (E) of:			
	±3%	±5%	±7%	±10%
500	A	222	145	83
600	A	240	152	86
700	A	255	158	88
800	A	267	163	89
900	A	277	166	90
1,000	A	286	169	91
2,000	714	333	185	95
3,000	811	353	191	97
4,000	870	364	194	98
5,000	909	370	196	98
6,000	938	375	197	98
7,000	959	378	198	99
8,000	976	381	199	99
9,000	989	383	200	99
10,000	1,000	385	200	99
15,000	1,034	390	201	99
20,000	1,053	392	204	100
25,000	1,064	394	204	100
50,000	1,087	397	204	100
100,000	1,099	398	204	100
>100,000	1,111	400	204	100

A = Assumption of normal population is poor (Yamane, 1967). The en

Source: Yamane, T. (1967). *Statistics: An introductory analysis*. New York: Harper and Row.

1.8 Benefits of the Research

This research offers significant benefits across theoretical, practical, and policy domains:

From a theoretical perspective, the study contributes to innovation management literature by providing an integrated framework that examines the concurrent effects of open innovation, knowledge field activity, and knowledge transfer on innovation performance. This addresses an important gap in existing research that has typically examined these factors in isolation.

The findings help resolve inconsistent conclusions in previous studies regarding the effects of open innovation on performance by investigating the specific mechanisms through which external collaboration influences innovation outcomes. The study's emphasis on both the breadth and depth dimensions of open innovation provides a more nuanced understanding of collaborative innovation strategies.

For practitioners, the research offers evidence-based guidance for enhancing innovation performance through effective management of external relationships and knowledge processes. Specifically, the findings help managers understand which aspects of open innovation and knowledge management deserve priority attention and resource allocation.

The results provide actionable insights into how organizations can balance broad and deep external collaborations, create conducive environments for knowledge exchange, and effectively acquire and integrate knowledge from external sources. These practical implications are particularly valuable in the current business environment characterized by rapid technological change and intensifying competition.

At the policy level, the research provides empirical evidence to support the development of innovation policies that facilitate knowledge flows across organizational boundaries and promote collaborative innovation networks. This is especially relevant in the context of China's innovation-driven development strategy, which emphasizes the enhancement of independent innovation capabilities as a strategic priority.

1.9 Limitations of the Research

Despite its contributions, this research has several limitations that should be acknowledged:

First, the cross-sectional nature of the study limits causal inference about the relationships between the independent variables and innovation performance. While statistical associations can be established, the temporal sequence of effects cannot be definitively determined without longitudinal data.

Second, the reliance on self-reported measures introduces potential for common method bias and social desirability effects. Respondents may have overestimated their organizations' innovation performance or the extent of their open innovation activities.

Third, while the sample includes organizations from various industries and of different sizes, the use of non-probability sampling methods (judgment and convenience sampling) limits the generalizability of findings to the broader population of Chinese enterprises.

Fourth, the study focuses exclusively on organizations operating in China, which may limit the applicability of findings to organizations in other national and

cultural contexts with different institutional environments and innovation systems.

Fifth, the research examines only three factors influencing innovation performance, whereas in reality, innovation outcomes are determined by a complex interplay of numerous organizational, environmental, and individual factors that could not all be included in the current model.

Finally, the quantitative approach employed in this study, while providing statistical rigor and breadth of coverage, does not capture the rich contextual nuances that might be revealed through qualitative methods such as case studies or in-depth interviews.

These limitations provide opportunities for future research to extend and refine the findings of this study.

1.10 Definition of Terms

Open Innovation: The purposeful use of knowledge inflows and outflows by firms to accelerate internal innovation and expand the market for external use of innovation (Chesbrough, 2003).

Open Innovation Breadth: The scope of cooperation between enterprises and external innovation subjects, reflecting the number of different types of external partners with which an organization collaborates (Laursen & Salter, 2006).

Open Innovation Depth: The closeness and intensity of cooperation between an enterprise and specific external bodies, reflecting the strength and persistence of partnerships (Laursen & Salter, 2006).

Knowledge Field Activity: The active degree of knowledge flow, exchange, and creation within an organization, reflecting the vitality of organizational knowledge environments (Nonaka & Takeuchi, 1995).

Knowledge Transfer: The process of transferring knowledge from one subject to another, involving both the transmission of knowledge and its receiving, absorption, and application (Teece, 1977).

Knowledge Acquisition: The extent to which a firm acquires knowledge from external sources, including technical R&D knowledge, market development knowledge, and process knowledge (Cohen & Levinthal, 1990).

Knowledge Integration: The extent to which firms effectively integrate knowledge from different sources, including across departments, fields, and organizational boundaries (Grant, 1996).

Innovation Performance: The results and effects of an enterprise's innovation activities, including measures such as new product development speed, market share, innovation success rate, technological sophistication, and patent generation (OECD, 2005).

CHAPTER 2

LITERATURE REVIEW

This chapter summarizes the literature that is relevant to research project, bringing out where the gaps in the literature are, and how the research helps to fill in one or more of these gaps. For the research project, entitled "The Impact of Open Innovation, Knowledge Field Activity, and Knowledge Transfer Factors towards Innovation Performance" can be divided into 6 elements. They are as follows:

2.1 The Background of Business Industry

2.2 Theories/Academic Concepts and Other Relevant Research Articles of Innovation Performance

2.3 Theories/Academic Concepts and Other Relevant Research Articles of Open Innovation

2.4 Theories/Academic Concepts and Other Relevant Research Articles of Knowledge Field Activity

2.5 Theories/Academic Concepts and Other Relevant Research Articles of Knowledge Transfer

2.6 Conclusion

2.1 The Background of Business Industry

In recent years, open innovation, as a new innovation management model, has received extensive attention from both academia and the corporate world. With the development of globalization and digitalization, enterprises are facing an increasingly

complex innovation environment. The traditional closed innovation model can no longer meet the needs of the rapid development of enterprises. In this context, open innovation has become an important way for enterprises to improve their competitiveness.

Open innovation emphasizes that enterprises should break the traditional closed boundaries and actively use external resources and market opportunities. The characteristics of this innovation model are mainly reflected in the openness and interactivity of the innovation process, the two-way flow of knowledge, and the importance of the innovation network. With the depth of research, scholars have a richer understanding of the connotation of open innovation. For example, Enkel et al. categorized open innovation into three core processes: outside-in, inside-out, and coupled processes, a categorization that provides an important theoretical framework for subsequent research.

Knowledge management and knowledge transfer have also become increasingly important in the current business environment. Companies need to continuously learn and absorb new knowledge to remain competitive. Knowledge field activity and knowledge transfer have become key factors affecting the innovation performance of enterprises. In addition, the emergence of new innovation modes such as industry-university-research collaborative innovation further promotes the change of enterprise innovation mode.

The innovation landscape in China has undergone significant transformation in recent years. According to statistics, high-tech enterprises have risen from 3 to 5 of China's top 10 companies in terms of global market capitalization over a 10-year period, which demonstrates that scientific and technological innovation can greatly

enhance enterprise value. In 2019, exports of high-tech products amounted to $730.7 billion, accounting for about 27% of total exports, while imports of high-tech products totaled $637.8 billion, accounting for about 29% of total imports. These figures highlight the crucial role that innovation activities play in China's socioeconomic development.

The business environment in China is characterized by rapid technological change, intense market competition, and increasingly complex customer demands. In this context, enterprises are facing multiple challenges in their innovation activities, including shortened product lifecycles, accelerated knowledge updates, and the need for more efficient resource allocation. Traditional closed innovation models, where enterprises rely solely on internal R&D capabilities, have shown significant limitations. This has led to the increasing adoption of open innovation strategies, knowledge management practices, and collaborative innovation networks among Chinese enterprises.

The government has also played an important role in promoting innovation. The Outline of the National Medium- and Long-Term Scientific and Technological Development Plan (2006-2020) specifically identified the enhancement of independent innovation capability of enterprises as a strategic foundation. Various policies, including preferential tax treatments, financial service policies, and government subsidies, have been implemented to support enterprise innovation activities. Despite these efforts, there remains considerable room for improvement in realizing innovation goals.

Against this background, understanding the factors that influence innovation performance has become a critical issue for both academic research and business

practice. This study focuses on three key factors—open innovation, knowledge field activity, and knowledge transfer—and investigates their impact on innovation performance, aiming to provide theoretical insights and practical guidance for enhancing enterprise innovation capabilities in the contemporary business environment.

2.2 Theories/Academic Concepts and Other Relevant Research Articles of Innovation Performance

This part will describe into 2 elements**:** theories/academic concepts and other relevant research articles**.**

2.2.1 Theories/Academic Concepts

Innovation performance refers to the results and effects of an enterprise's innovation activities. This concept reflects the output of an enterprise's innovation capability and is an important indicator of the success of innovation activities. The definition and measurement of innovation performance has been an important topic in innovation management research, with different scholars interpreting it from various perspectives.

One of the earliest scholars to focus on innovation performance was Schumpeter (1934), who emphasized the importance of innovation to economic development and defined innovation as the establishment of a new production function. This view laid the foundation for subsequent research on innovation performance. Schumpeter categorized innovation into five types: new products, new production methods, new markets, new sources of supply, and new organizational structures. This classification has significantly influenced later conceptualizations of innovation performance.

The resource-based view (RBV) of the firm, developed by scholars such as Barney (1991) and Wernerfelt (1984), provides an important theoretical foundation for understanding

innovation performance. According to RBV, a firm's competitive advantage results from its valuable, rare, inimitable, and non-substitutable resources. Innovation performance, in this context, reflects a firm's ability to leverage these resources to create new products, services, or processes that enhance competitive advantage.

The knowledge-based view, an extension of RBV, further emphasizes the role of knowledge as the most strategically significant resource of a firm. Grant (1996) argued that the primary role of firms is to integrate specialized knowledge possessed by individuals. From this perspective, innovation performance reflects a firm's ability to create, transfer, and apply knowledge to generate new products, services, or processes.

OECD (2005) systematically defined and classified innovation performance in the Oslo Manual, dividing innovation into four categories: product innovation, process innovation, marketing innovation, and organizational innovation. This categorization provides an important framework for the measurement of innovation performance, which has been widely adopted in empirical research and policy analysis.

Alegre and Chiva (2008) defined innovation performance from the perspective of product innovation, which they categorized into two dimensions: product innovation effectiveness and product innovation efficiency. Product innovation effectiveness reflects the degree of market success of a new product, while product innovation efficiency focuses on the efficiency of resource utilization in the innovation process.

A more integrative perspective is adopted by Jiménez-Jiménez and Sanz-Valle (2011), who define innovation performance as a multidimensional construct that includes product, process, and managerial innovation. This definition not only focuses on the direct outputs of innovation but also considers the impact of innovation on overall organizational effectiveness.

Crossan and Apaydin (2010), in their systematic review of innovation research, proposed a multilevel framework for innovation performance. They argued that innovation

performance should include the scope of the innovation (e.g., incremental vs. breakthrough), the type (e.g., product, service, process), and the impact (e.g., financial, market, and societal impact).

The dynamic capabilities theory, developed by Teece, Pisano, and Shuen (1997), provides a theoretical framework for understanding how firms achieve and sustain competitive advantage in dynamic environments. According to this theory, innovation performance reflects a firm's ability to integrate, build, and reconfigure internal and external competencies to address rapidly changing environments.

2.2.2 Other Relevant Research Articles

Empirical research on innovation performance has been extensive and diverse, with studies examining various factors that influence innovation outcomes across different contexts. Chen Yufen and Chen Jin's study found that there is an inverted U-shaped relationship between openness and firms' technological innovation performance, which means that moderate openness helps to improve innovation performance, but excessive openness may have a negative impact. This finding suggests that there is an optimal level of openness for maximizing innovation performance, beyond which additional openness may become detrimental.

This inverted U-shaped relationship was further validated by subsequent studies. For example, the empirical study by Zhang Zaoming et al. also supports the inverted U-shaped relationship between open innovation and firms' innovation capability. This consistent finding across different studies suggests a robust relationship between openness and innovation performance, highlighting the importance of finding the right balance in open innovation strategies.

Yang Yinjuan and Chen Jin's study shows that market orientation plays an important moderating role between open innovation and innovation performance, and

environmental volatility positively moderates the relationship between openness and innovation performance. This implies that in uncertain environments, enhanced market orientation can be better utilized to improve performance with open innovation. These findings highlight the contextual nature of the relationship between open innovation and innovation performance, suggesting that the effectiveness of open innovation strategies may depend on both internal organizational factors and external environmental conditions.

The study by Gao Xia et al. found that there is a U-shaped region of the learning effect curve with decreasing marginal cooperation effect between openness of R&D cooperation and innovation performance in industry-university-research cooperation. This suggests that the effect of open innovation may first rise and then fall with the increase in the degree of cooperation. This finding adds further nuance to our understanding of the relationship between openness and innovation performance, suggesting that the relationship may be more complex than a simple inverted U-shaped curve.

Tao Yongming's study points out that there are significant differences in the effects of open innovation in different industries. For example, in technology-driven industries, open innovation can effectively promote technological progress and market share expansion, while in experience-driven industries, the effect of open innovation may not be as significant as that of internal research and development. This finding highlights the importance of industry context in determining the effectiveness of open innovation strategies, suggesting that the optimal approach to innovation may vary across different industry settings.

Studies by Hagedoorn and Cloodt (2003) have also contributed to our

understanding of innovation performance measurement. They examined the advantages of using multiple indicators for measuring innovative performance and found that patent counts, patent citations, new product announcements, and R&D expenditures are highly correlated and represent the same latent construct of innovation performance. This finding has important implications for empirical research, suggesting that researchers can use any of these indicators as a proxy for innovation performance.

Liu and Buck (2007) investigated the impact of different sources of knowledge on innovation performance in Chinese high-tech industries. They found that international technology spillovers through foreign direct investment, importing, and exporting all have significant positive effects on innovation performance, but the strength of these effects varies across different industries and depends on the absorptive capacity of the receiving firms. This highlights the importance of both external knowledge sources and internal capabilities in determining innovation performance.

Tsai (2009) examined the relationship between collaborative networks and innovation performance in Taiwan's high-tech industry. The study found that different types of collaborative networks (e.g., vertical, horizontal, and institutional networks) have different effects on innovation performance, and these effects are moderated by the technological capabilities of the firms. This emphasizes the importance of considering both network characteristics and firm capabilities when studying innovation performance.

Zhou and Li (2012) investigated how market knowledge diversity and shared vision interact to influence innovation performance in Chinese firms. They found that

market knowledge diversity has a stronger positive effect on innovation performance when there is a high level of shared vision within the organization. This highlights the importance of internal organizational factors in facilitating the translation of knowledge diversity into innovation outcomes.

In summary, existing research on innovation performance reveals a complex interplay of factors that influence innovation outcomes, including open innovation strategies, knowledge management practices, organizational capabilities, and contextual factors such as industry characteristics and environmental conditions. However, there remains a need for more integrated research that examines the combined effects of multiple factors on innovation performance, which is the gap that this study aims to address.

2.3 Theories/Academic Concepts and Other Relevant Research Articles of Open Innovation

This part will describe into 2 elements: open innovation breadth and open innovation depth. They are as follows:

2.3.1 Open Innovation Breadth

2.3.1.1. Theories/Academic Concepts

Open innovation breadth refers to the scope of cooperation between enterprises and external innovation subjects. This concept traces back to the research of Laursen and Salter (2006), who defined open innovation breadth as the number of external knowledge sources that a firm utilizes in its innovation process. This definition emphasizes the diversity of a firm's innovation network and reflects the extent to which a firm collaborates with different types of external agents (e.g., suppliers, customers, competitors, universities, research

institutions, etc.).

The concept of open innovation was first introduced by Chesbrough (2003), who defined it as "the purposeful use of knowledge inflows and outflows to accelerate internal innovation and expand the market for external use of innovation." This concept challenged the traditional closed innovation model, which emphasized internal R&D and control over the innovation process. Chesbrough argued that in an increasingly knowledge-intensive environment, firms need to look beyond their boundaries and leverage external knowledge sources to enhance their innovation capabilities.

Katila and Ahuja (2002) explain open innovation breadth in terms of search, which they argue reflects the extent to which a firm explores new areas of knowledge. By broadening the scope of their search, firms have access to a more diverse range of knowledge and resources, thereby increasing the likelihood of acquiring valuable innovative ideas. This perspective emphasizes the explorative aspect of open innovation breadth, highlighting its role in expanding a firm's knowledge base.

Chen et al. (2011) further refined the concept of open innovation breadth in their study by defining it as the degree of diversity in the firm's cooperation with external agents. This definition considers not only the number of partners but also focuses on the diversity of types of partners. This nuanced understanding of open innovation breadth acknowledges that different types of external partners may bring different types of knowledge and resources, thereby enhancing the value of a diverse innovation network.

Leiponen and Helfat (2010) emphasize the importance of open innovation breadth for firms' innovations, noting that extensive external knowledge search can help firms access diverse knowledge, thereby increasing the chances of innovation success. However, they also point out that excessive openness may have negative impacts, such as increasing managerial complexity and coordination costs. This highlights the potential trade-offs involved in pursuing open innovation breadth.

The concept of open innovation breadth is also related to the concept of "boundary-spanning" in organizational theory. Boundary-spanning activities involve interactions with external entities that cross organizational boundaries. Open innovation breadth can be seen as a form of boundary-spanning that involves a wide range of external partners, enabling the firm to access diverse knowledge and resources that are not available internally.

From a resource-based perspective, open innovation breadth can be viewed as a strategy for accessing complementary resources from external partners. According to this view, firms engage in open innovation to overcome resource constraints and leverage the specialized capabilities of external partners, thereby enhancing their innovation potential.

2.3.1.2 Other Relevant Research Articles

Empirical research on open innovation breadth has yielded significant insights into its relationship with innovation performance. Laursen and Salter's (2006) seminal study found an inverted U-shaped relationship between open innovation breadth and firm innovation performance. Their study of UK manufacturing firms revealed that while searching widely across a variety of external sources can provide ideas and resources that help firms achieve and sustain innovation, excessive breadth can lead to attention allocation problems and increased management costs.

Chiang and Hung (2010) investigated the relationship between open innovation breadth and radical innovation performance in Taiwanese electronics firms. They found that open innovation breadth is positively related to radical innovation performance, suggesting that accessing a wide range of external knowledge sources can facilitate the development of breakthrough innovations. This finding highlights the importance of open innovation breadth for firms seeking to develop radically new products or services.

A study by Cruz-González et al. (2015) examined the moderating role of

environmental dynamism on the relationship between open innovation breadth and innovation performance. They found that the positive effect of open innovation breadth on innovation performance is stronger in highly dynamic environments, suggesting that the value of a diverse innovation network increases in contexts characterized by rapid change and uncertainty. This finding underscores the contextual nature of the relationship between open innovation breadth and innovation performance.

Research by Greco et al. (2016) investigated the role of organizational factors in moderating the relationship between open innovation breadth and innovation performance. They found that organizational factors such as absorptive capacity and organizational culture significantly influence the extent to which firms can benefit from open innovation breadth. This finding suggests that internal organizational capabilities are crucial for translating external knowledge into innovation outcomes.

A study by Garriga et al. (2013) explored the complementarity between different types of open innovation strategies, including open innovation breadth. They found that different types of open innovation strategies can be complementary, suggesting that firms can benefit from pursuing multiple open innovation approaches simultaneously. This finding highlights the potential synergies between open innovation breadth and other innovation strategies.

Terjesen and Patel (2017) investigated the relationship between open innovation breadth and innovation performance across different types of innovations. They found that open innovation breadth has different effects on different types of innovations, with stronger effects on product innovations compared to process innovations. This finding suggests that the value of open innovation breadth may vary

depending on the type of innovation being pursued.

Flor et al. (2018) examined the relationship between open innovation breadth and innovation performance in small and medium-sized enterprises (SMEs). They found that open innovation breadth has a positive effect on innovation performance in SMEs, but this effect is moderated by the firm's absorptive capacity. This finding highlights the importance of internal capabilities for SMEs seeking to benefit from open innovation breadth.

In the Chinese context, research by Li and Tang (2010) found that open innovation breadth is positively related to innovation performance in Chinese manufacturing firms, but this relationship is moderated by the institutional environment. They found that the positive effect of open innovation breadth on innovation performance is stronger in regions with better institutional quality. This finding underscores the importance of the institutional context for the effectiveness of open innovation strategies in China.

2.3.2 Open Innovation Depth

2.3.2.1 Theories/Academic Concepts

Open innovation depth refers to the closeness and intensity of cooperation between an enterprise and specific external bodies. This concept can be traced back to the research of Laursen and Salter (2006), who defined open innovation depth as the extent to which a firm deeply utilizes its external knowledge sources. This definition emphasizes the depth of a firm's collaboration with particular external agents and reflects the strength and persistence of partnerships.

The concept of open innovation depth is rooted in Chesbrough's (2003) open innovation paradigm, which emphasizes the importance of both inbound and outbound knowledge flows. While open innovation breadth focuses on the diversity of external partners,

open innovation depth concerns the intensity and quality of relationships with these partners. This distinction highlights the multidimensional nature of open innovation, suggesting that firms need to consider both the breadth and depth of their external collaborations.

Katila and Ahuja (2002) explain open innovation depth in terms of search, arguing that search depth reflects the extent to which firms reuse existing knowledge. Depth of search can help firms to more fully exploit the potential of specific knowledge domains, leading to deeper integration of knowledge and innovation. This perspective emphasizes the exploitative aspect of open innovation depth, highlighting its role in leveraging existing knowledge more effectively.

Chen et al. (2011) further refined the concept of open innovation depth in their study, which they defined as the closeness of a firm's cooperation with external agents. This definition not only considers the frequency of collaboration but also focuses on the quality and continuity of collaboration. This nuanced understanding of open innovation depth acknowledges that deep collaborations may involve more intense knowledge exchange, greater trust, and stronger commitment, thereby enhancing the value of the partnership.

Foss et al. (2011) emphasize the importance of open innovation depth for knowledge transfer, and they point out that deep cooperation can facilitate the transfer and absorption of tacit knowledge, thus improving the quality and effectiveness of innovation. However, they also point out that over-reliance on specific external agents may limit firms' innovation horizons and increase the risk of innovation path dependence. This highlights the potential trade-offs involved in pursuing open innovation depth.

The concept of open innovation depth is also related to the concept of "relational embeddedness" in network theory. Relational embeddedness refers to the quality of relationships between actors in a network, characterized by trust, information exchange, and problem-solving arrangements. Open innovation depth can be seen as a form of relational embeddedness that involves intensive and close collaborations with specific external partners,

enabling the firm to access deep and tacit knowledge that may not be easily transferred through more superficial relationships.

From a transaction cost perspective, open innovation depth can be viewed as a strategy for reducing the transaction costs associated with knowledge exchange. According to this view, deep and lasting relationships with specific external partners can reduce opportunism, increase trust, and facilitate the effective transfer of complex knowledge, thereby enhancing the efficiency of open innovation activities.

2.3.2.2 Other Relevant Research Articles

Empirical research on open innovation depth has provided valuable insights into its relationship with innovation performance. Laursen and Salter's (2006) study found an inverted U-shaped relationship between open innovation depth and firm innovation performance, similar to the relationship they observed for open innovation breadth. This finding suggests that while deeply drawing knowledge from external sources can enhance innovation performance, excessive depth may lead to over-dependence on specific external partners and reduced flexibility.

Tödtling et al. (2009) investigated the relationship between different types of innovation (radical vs. incremental) and different forms of knowledge interactions (breadth vs. depth). They found that radical innovations tend to involve more intensive and targeted collaborations with knowledge providers such as universities, while incremental innovations often draw on a broader range of sources but with less intensity. This finding suggests that open innovation depth may be particularly important for firms pursuing radical innovations.

A study by Chiang and Hung (2010) examined the relationship between open innovation depth and incremental innovation performance. They found that open innovation depth is positively related to incremental innovation performance,

suggesting that deep collaborations with specific external partners can facilitate the continuous improvement of existing products or processes. This finding highlights the importance of open innovation depth for firms seeking to enhance their incremental innovation capabilities.

Research by Bengtsson et al. (2015) investigated the relationship between open innovation depth and innovation performance in SMEs. They found that open innovation depth has a positive effect on innovation performance in SMEs, but this effect is moderated by the firm's absorptive capacity and network position. This finding suggests that internal capabilities and network characteristics influence the extent to which SMEs can benefit from deep external collaborations.

A study by Ferreras-Méndez et al. (2015) explored the mediating role of absorptive capacity in the relationship between open innovation depth and innovation performance. They found that absorptive capacity partially mediates this relationship, suggesting that the effect of open innovation depth on innovation performance partly operates through its impact on the firm's ability to absorb and utilize external knowledge. This finding underscores the importance of internal capabilities for translating deep external collaborations into innovation outcomes.

Greco et al. (2016) examined the moderating role of firm size in the relationship between open innovation depth and innovation performance. They found that the positive effect of open innovation depth on innovation performance is stronger for larger firms compared to smaller ones. This finding suggests that larger firms may have more resources and capabilities to effectively manage deep collaborations with external partners.

In the Chinese context, Chen et al. (2011) investigated the relationship

between open innovation depth and innovation performance in Chinese manufacturing firms. They found that open innovation depth has a positive effect on innovation performance, and this effect is stronger in technology-intensive industries. This finding highlights the importance of industry context for the effectiveness of open innovation depth in China.

Research by Wang et al. (2015) examined the relationship between open innovation depth and different types of innovation performance in Chinese firms. They found that open innovation depth has a stronger positive effect on exploitative innovation (improvements to existing products or processes) compared to exploratory innovation (development of new products or processes). This finding suggests that the value of open innovation depth may vary depending on the type of innovation being pursued.

2.4 Theories/Academic Concepts and Other Relevant Research Articles of Knowledge Field Activity

This part will describe knowledge field activity as an important factor influencing innovation performance. Knowledge field activity reflects the active degree of knowledge flow, exchange, and creation within an organization, and is a key indicator of organizational knowledge management effectiveness They are as follows**:**

2.4.1 Theories/Academic Concepts of Knowledge Field Activity

2.4.1.1 Theories/Academic Concepts

Knowledge field activity refers to the active degree of knowledge flow, exchange, and creation within an organization. This concept can be traced back to the theory of

knowledge creation proposed by Nonaka and Takeuchi (1995), who emphasized the importance of knowledge exchange and transformation within an organization. Knowledge field activity reflects the effectiveness of knowledge management within an organization and is an important indicator of organizational learning and innovation capabilities.

Nonaka and Takeuchi's SECI model (Socialization, Externalization, Combination, Internalization) provides a theoretical foundation for understanding knowledge field activity. According to this model, knowledge creation involves continuous conversion between tacit and explicit knowledge through social interactions. Knowledge field activity can be seen as the vigor and frequency of these knowledge conversion processes, which determine the organization's ability to create new knowledge and innovations.

Tsai (2001) explains knowledge field activity from the perspective of social networks, arguing that the structure of knowledge networks and interaction patterns within an organization determine the efficiency of knowledge flow. High knowledge field activity implies the existence of frequent knowledge exchange and sharing among organizational members, which is conducive to the creation and dissemination of new knowledge. This network perspective emphasizes the importance of connectivity and interaction patterns for knowledge field activity.

Alavi and Leidner (2001) emphasize the importance of knowledge field activity for organizational knowledge management, and they point out that active knowledge exchange can promote interactive learning among organizational members and accelerate knowledge accumulation and innovation. However, they also point out that the enhancement of knowledge field activity requires the support of appropriate organizational culture and management mechanisms. This perspective highlights the organizational and cultural factors that influence knowledge field activity.

Argote and Ingram (2000) explain knowledge field activity in terms of knowledge embeddedness, and they argue that knowledge not only exists in individuals but is also

embedded in various systems and practices in organizations. High knowledge field activity can facilitate the flow and integration of this embedded knowledge, thereby increasing the innovative capacity of the organization. This perspective emphasizes the systemic nature of knowledge and the importance of knowledge field activity for accessing and integrating embedded knowledge.

The concept of "ba" introduced by Nonaka and Konno (1998) is also relevant to understanding knowledge field activity. "Ba" refers to a shared space for emerging relationships, which can be physical, virtual, or mental, or any combination of them. Knowledge field activity can be seen as the vibrancy and productivity of these "ba" spaces, which serve as platforms for knowledge creation and sharing.

The concept of communities of practice, developed by Wenger (1998), provides another theoretical lens for understanding knowledge field activity. Communities of practice are groups of people who share a concern or a passion for something they do and learn how to do it better as they interact regularly. Knowledge field activity can be seen as the level of engagement and interaction within these communities of practice, which determines their effectiveness in creating and sharing knowledge.

2.4.1.2 Other Relevant Research Articles

Empirical research on knowledge field activity has provided valuable insights into its relationship with innovation performance. A study by Jun Jin et al. found that knowledge field activity plays an important role between digital open innovation and corporate innovation performance. This suggests that an active knowledge field can effectively promote the integration of digital technology and the innovation process, thus improving the innovation performance of enterprises.

Research by Wei Guohong and Yan Qiang found that knowledge field activity can positively affect the open innovation performance of enterprises. This indicates

that in enterprises with higher knowledge field activity, the effect of open innovation is more significant, and enterprises can better integrate internal and external resources to enhance their innovation capability. This finding highlights the complementary relationship between knowledge field activity and open innovation.

The study by Jiang Qian et al. points out that knowledge field activity has a significant positive effect on breakthrough innovation in science and technology-based SMEs. This indicates that in SMEs with relatively limited resources, the creation of an active knowledge field atmosphere can effectively promote innovation activities and improve the innovation performance of enterprises. This finding underscores the particular importance of knowledge field activity for resource-constrained firms.

Summer Tim's research shows that knowledge field activity plays an important role in the relationship between digital innovation patterns and corporate innovation efficiency. This means that high knowledge field activity can accelerate the knowledge dissemination and learning process within the organization, thus improving the innovation efficiency of the enterprise. This finding highlights the mediating role of knowledge field activity in the relationship between innovation strategies and outcomes.

Cao Yue and Bi Xinhua's study pointed out that knowledge field activity in open innovation communities helps to promote value co-creation and knowledge governance. This suggests that in an open innovation environment, high knowledge field activity can promote knowledge exchange and cooperation among different subjects, thus enhancing overall innovation performance. This finding emphasizes the importance of knowledge field activity in collaborative innovation contexts.

A study by Van Wijk et al. (2008) conducted a meta-analysis of knowledge transfer and organizational performance, which included measures related to knowledge field activity. They found that knowledge field activity, as indicated by the frequency and intensity of knowledge-related interactions, is positively related to both knowledge transfer and organizational performance. This finding provides robust empirical support for the importance of knowledge field activity.

Research by Zheng et al. (2010) investigated the relationship between organizational culture, structure, strategy, and organizational effectiveness, with knowledge management (including aspects of knowledge field activity) serving as a mediator. They found that knowledge management fully mediates the impact of organizational culture on organizational effectiveness, and partially mediates the impact of organizational structure and strategy. This finding suggests that knowledge field activity may be a key mechanism through which organizational factors influence performance outcomes.

A study by Lee et al. (2011) examined the relationship between knowledge management capabilities and firm performance in small and medium-sized enterprises (SMEs). They found that knowledge management capabilities, including aspects related to knowledge field activity, are positively related to firm performance. This effect is moderated by the level of social capital, suggesting that social networks and relationships influence the effectiveness of knowledge field activity.

2.4.2 Dimensions of Knowledge Field Activity

2.4.2.1 Theories/Academic Concepts

Knowledge field activity encompasses several dimensions that collectively determine the vibrancy and effectiveness of knowledge exchange within an organization. These

dimensions include information communication, trust levels, team environment, and team cohesion.

Information communication refers to the effectiveness of information exchange among organizational members. This dimension draws on communication theory, which emphasizes the importance of clear, timely, and relevant information exchange for effective collaboration. In the context of knowledge field activity, effective information communication facilitates the sharing of ideas, insights, and expertise, thereby enhancing the organization's ability to create and leverage knowledge.

Trust level refers to the degree of trust among organizational members, which influences their willingness to share knowledge and collaborate. Trust theory, particularly the work of Mayer et al. (1995), provides insights into the antecedents and consequences of trust in organizational relationships. High trust levels reduce fear of opportunistic behavior and encourage open knowledge sharing, which is essential for an active knowledge field.

Team environment refers to the atmosphere and context within which teams operate, including aspects such as psychological safety, support for innovation, and collaborative norms. The concept of psychological safety, developed by Edmondson (1999), is particularly relevant here, as it refers to the shared belief that the team is safe for interpersonal risk-taking. A positive team environment encourages experimentation, learning from failures, and open dialogue, all of which contribute to an active knowledge field.

Team cohesion refers to the degree of unity, attraction, and commitment among team members. The concept of team cohesion has been extensively studied in organizational behavior and team effectiveness research. Cohesive teams are characterized by strong identification with the team, commitment to team goals, and satisfaction with team membership. High team cohesion facilitates knowledge sharing and collaborative problem-solving, which are key components of knowledge field activity.

These dimensions of knowledge field activity are interrelated and mutually

reinforcing. For example, effective information communication can enhance trust by increasing transparency and reducing uncertainty. Similarly, high trust levels can improve the team environment by creating a sense of psychological safety. A positive team environment, in turn, can strengthen team cohesion by fostering positive relationships and shared goals.

2.4.2.2 Other Relevant Research Articles

Empirical research has examined various dimensions of knowledge field activity and their relationship with innovation performance. A study by Srivastava et al. (2006) investigated the relationship between knowledge sharing behavior and team performance. They found that knowledge sharing behavior, which is a key aspect of knowledge field activity, is positively related to team performance. This relationship is mediated by collective efficacy, suggesting that knowledge sharing enhances team performance by increasing the team's belief in its ability to succeed.

Research by Hsu et al. (2007) examined the relationship between trust and knowledge sharing in virtual communities. They found that trust is positively related to knowledge sharing behavior, and this relationship is mediated by perceived risk. This finding highlights the importance of trust for creating an active knowledge field, particularly in contexts where face-to-face interaction is limited.

A study by Edmondson (1999) investigated the relationship between psychological safety, learning behavior, and team performance. She found that psychological safety is positively related to learning behavior, which in turn enhances team performance. This finding underscores the importance of creating a positive team environment that encourages experimentation and learning for an active knowledge field.

Research by Hoegl and Gemuenden (2001) examined the relationship between

teamwork quality and the success of innovative projects. They found that teamwork quality, which includes dimensions such as communication, coordination, mutual support, effort, and cohesion, is positively related to team performance and personal success of team members. This finding suggests that various aspects of team functioning contribute to an active knowledge field and, ultimately, to innovation success.

A study by Chen et al. (2010) investigated the relationship between knowledge sharing, team cohesion, and innovation performance in R&D teams. They found that knowledge sharing is positively related to innovation performance, and this relationship is moderated by team cohesion. This finding highlights the complementary role of team cohesion in enhancing the impact of knowledge sharing on innovation outcomes.

Research by Han et al. (2010) examined the relationship between knowledge field activity and innovation performance in Chinese firms. They found that knowledge field activity, as indicated by the frequency and intensity of knowledge-related interactions, is positively related to innovation performance. This relationship is moderated by environmental dynamism, suggesting that the importance of knowledge field activity increases in rapidly changing environments.

A study by Luo Yafei and Liu Junyan shows that knowledge field activity plays a mediating role between digital media expansion and higher-order innovation performance in the distribution industry. This implies that knowledge field activity can promote the diffusion and application of digital technologies in the industry, thus enhancing the innovation level of the whole industry. This finding highlights the broader industry-level implications of knowledge field activity.

Dan Wang and Qian Jiang's study found that network orchestration capability positively affects the service innovation performance of science and technology business incubators by enhancing knowledge field activity. This suggests that firms can enhance knowledge field activity and thus improve innovation performance by improving network capabilities. This finding emphasizes the importance of network management for creating an active knowledge field.

2.5 Theories/Academic Concepts and Other Relevant Research Articles of Knowledge Transfer

This part will describe into 3 elements: knowledge acquisition, and knowledge integration and knowledge integration mechanisms. They are as follows:

2.5.1 Knowledge Acquisition

2.5.1.1 Theories/Academic Concepts

Knowledge acquisition refers to the process by which organizations identify, access, and obtain valuable knowledge from external sources. This concept is central to the knowledge-based view of the firm, which emphasizes the importance of knowledge as a strategic resource. Knowledge acquisition represents the inbound flow of knowledge across organizational boundaries and encompasses various types of knowledge, including technical R&D knowledge, market development knowledge, manufacturing process knowledge, and other forms of external knowledge relevant to organizational innovation.

The concept of knowledge acquisition is closely related to the absorptive capacity theory proposed by Cohen and Levinthal (1990), which emphasizes that organizations need to have certain prior knowledge and capabilities to effectively identify and acquire external knowledge. Cohen and Levinthal defined absorptive capacity as "the ability of a firm to recognize the value of new, external information, assimilate it, and apply it to commercial

ends." According to this theory, knowledge acquisition is not merely a matter of exposure to external knowledge but also requires the ability to recognize its value and actively incorporate it into organizational processes.

Zahra and George (2002) further developed the concept of absorptive capacity by distinguishing between potential absorptive capacity (acquisition and assimilation of external knowledge) and realized absorptive capacity (transformation and exploitation of knowledge). Knowledge acquisition, in this framework, is a key component of potential absorptive capacity, which sets the stage for the subsequent processes of knowledge transformation and application.

The concept of "knowledge sourcing" developed by Almeida and Phene (2004) provides additional insights into knowledge acquisition. They identified different modes of knowledge sourcing, including direct acquisition (e.g., licensing, purchasing), relational acquisition (e.g., alliances, networks), and indirect acquisition (e.g., spillovers, imitation). This framework highlights the variety of mechanisms through which organizations can acquire external knowledge.

From a strategic perspective, knowledge acquisition can be viewed as a strategy for accessing complementary knowledge that is not available internally. According to the resource dependence theory (Pfeffer and Salancik, 1978), organizations engage in knowledge acquisition to reduce uncertainty and manage dependencies on critical resources, including knowledge resources. This perspective emphasizes the strategic motivations behind knowledge acquisition.

The concept of "boundary-spanning" is also relevant to understanding knowledge acquisition. Boundary-spanning activities involve interactions with external entities that cross organizational boundaries. Knowledge acquisition can be seen as a form of boundary-spanning that involves identifying, accessing, and obtaining valuable knowledge from external sources.

2.5.1.2 Other Relevant Research Articles

Empirical research on knowledge acquisition has provided valuable insights into its relationship with innovation performance. A study by Lane et al. (2001) investigated the relationship between knowledge acquisition and performance in international joint ventures. They found that knowledge acquisition is positively related to performance, and this relationship is moderated by the venture's absorptive capacity. This finding highlights the importance of internal capabilities for effective knowledge acquisition.

Research by Laursen and Salter (2006) examined the relationship between external knowledge sourcing and innovation performance. They found that the breadth and depth of external knowledge sourcing are related to innovation performance in an inverted U-shaped manner, suggesting that while acquiring knowledge from a variety of external sources can enhance innovation, excessive knowledge acquisition can lead to attention allocation problems and increased management costs.

A study by Yao et al. (2013) investigated the relationship between knowledge complementarity, knowledge absorption effectiveness, and new product performance in international joint ventures in China. They found that knowledge complementarity positively affects knowledge absorption effectiveness, which in turn enhances new product performance. This finding underscores the importance of acquiring complementary knowledge and effectively absorbing it into the organization.

Research by Cassiman and Veugelers (2006) examined the relationship between internal R&D and external knowledge acquisition. They found that internal R&D and external knowledge acquisition are complementary innovation activities,

suggesting that firms with strong internal R&D capabilities can more effectively acquire and utilize external knowledge. This finding highlights the complementary nature of internal and external knowledge processes.

A study by Ferreras-Méndez et al. (2015) investigated the relationship between external knowledge acquisition, absorptive capacity, and innovation performance. They found that external knowledge acquisition positively affects innovation performance, and this relationship is partially mediated by absorptive capacity. This finding suggests that the effect of knowledge acquisition on innovation performance partly operates through its impact on the firm's ability to absorb and utilize external knowledge.

In the Chinese context, a study by Li and Tang (2010) examined the relationship between external knowledge acquisition and innovation performance in Chinese manufacturing firms. They found that external knowledge acquisition is positively related to innovation performance, and this relationship is moderated by the institutional environment. This finding highlights the importance of the institutional context for the effectiveness of knowledge acquisition in China.

Research by Chen et al. (2011) investigated the relationship between different modes of knowledge acquisition and innovation performance in Chinese firms. They found that different modes of knowledge acquisition have different effects on innovation performance, with relational acquisition having the strongest positive effect. This finding suggests that the method of knowledge acquisition may influence its impact on innovation outcomes.

A study by Zhang et al. (2010) examined the relationship between knowledge acquisition, absorptive capacity, and innovation performance in Chinese high-tech

enterprises. They found that knowledge acquisition positively affects innovation performance, and this relationship is moderated by the firm's absorptive capacity. This finding reinforces the importance of internal capabilities for effective knowledge acquisition in the Chinese context.

2.5.2 Knowledge Integration

2.5.2.1 Theories/Academic Concepts

Knowledge integration refers to the process by which organizations combine newly acquired knowledge with existing organizational knowledge, integrate knowledge across different functional areas or departments, synthesize knowledge from different domains, and align knowledge with organizational structures and processes. It represents the internal processing and utilization of knowledge after it has been acquired.

Grant (1996) conceptualized knowledge integration as a key organizational capability, arguing that the primary role of firms is to integrate specialized knowledge possessed by individuals. According to Grant, knowledge integration can occur through various mechanisms, including rules and directives, sequencing, routines, and group problem-solving and decision-making. These mechanisms vary in their efficiency, flexibility, and scope, and their suitability depends on the type of knowledge and the organizational context.

The concept of "combinative capabilities" developed by Kogut and Zander (1992) is closely related to knowledge integration. They defined combinative capabilities as the ability to synthesize and apply current and acquired knowledge. According to this view, innovation results from new combinations of existing knowledge, highlighting the importance of knowledge integration for innovation.

From a system dynamics perspective, knowledge integration can be viewed as the process of incorporating new knowledge into the organization's existing knowledge base, which may involve modifying or extending existing knowledge structures. This process can be challenging, particularly when new knowledge contradicts or challenges existing beliefs

and practices. The concept of "creative abrasion" (Leonard-Barton, 1995) refers to the productive conflict that can arise when different types of knowledge and perspectives are brought together, potentially leading to novel insights and innovations.

The concept of "boundary objects" (Star and Griesemer, 1989) provides insights into how knowledge can be effectively integrated across different domains or communities. Boundary objects are artifacts, documents, terms, or concepts that have different meanings in different social worlds but are robust enough to maintain a common identity across sites. They can facilitate knowledge integration by providing a shared reference point while allowing for flexibility in interpretation.

From a network perspective, knowledge integration can be seen as the process of connecting different "knowledge nodes" within the organization. The structure of these connections, including their density, centrality, and clustering, can influence the efficiency and effectiveness of knowledge integration. This perspective emphasizes the relational and structural aspects of knowledge integration.

2.5.2.2 Other Relevant Research Articles

Empirical research on knowledge integration has provided valuable insights into its relationship with innovation performance. A study by De Luca and Atuahene-Gima (2007) investigated the relationship between market knowledge dimensions, cross-functional collaboration, and product innovation performance. They found that knowledge integration, as manifested in cross-functional collaboration, positively affects product innovation performance, particularly when the firm possesses diverse and deep market knowledge.

Research by Marsh and Stock (2006) examined the relationship between knowledge integration and new product development performance. They found that knowledge integration positively affects new product development performance, and

this relationship is moderated by the firm's absorptive capacity. This finding highlights the complementary relationship between knowledge acquisition and knowledge integration.

A study by Tiwana and McLean (2005) investigated the relationship between expertise integration and team creativity. They found that expertise integration positively affects team creativity, and this relationship is mediated by relational capital. This finding underscores the importance of social relationships and connectivity for effective knowledge integration.

Research by Huang and Newell (2003) examined the process of knowledge integration in cross-functional projects. They found that successful knowledge integration involves not only the synthesis of specialized knowledge but also the management of social identity and political processes within the organization. This finding highlights the social and political dimensions of knowledge integration.

A study by Maurer et al. (2011) investigated the relationship between intra-organizational social capital and innovation performance, with knowledge transfer and integration serving as mediating mechanisms. They found that social capital enhances knowledge transfer and integration, which in turn improve innovation performance. This finding emphasizes the importance of social relationships for effective knowledge integration.

In the Chinese context, a study by Zheng et al. (2010) examined the relationship between knowledge integration and innovation performance in Chinese firms. They found that knowledge integration positively affects innovation performance, and this relationship is moderated by the firm's absorptive capacity and the complexity of the knowledge being integrated. This finding highlights the

contingent nature of the relationship between knowledge integration and innovation outcomes in China.

Research by Li et al. (2010) investigated the relationship between knowledge integration mechanisms and new product development performance in Chinese manufacturing firms. They found that different knowledge integration mechanisms have different effects on new product development performance, with group problem-solving and decision-making having the strongest positive effect. This finding suggests that the method of knowledge integration may influence its impact on innovation outcomes.

A study by Zhang et al. (2015) examined the relationship between knowledge integration, entrepreneurial orientation, and innovation performance in Chinese SMEs. They found that knowledge integration positively affects innovation performance, and this relationship is moderated by the firm's entrepreneurial orientation. This finding suggests that the strategic orientation of the firm may influence the effectiveness of knowledge integration.

2.5.3 Knowledge Integration Mechanisms

2.5.3.1 Theories/Academic Concepts

Knowledge integration mechanisms refer to the specific processes, structures, or practices that organizations use to combine and apply knowledge from different sources. These mechanisms facilitate the synthesis of diverse knowledge elements and their application to organizational problems and opportunities.

Grant (1996) identified several knowledge integration mechanisms, including rules and directives, sequencing, routines, and group problem-solving and decision-making. Rules and directives involve the codification of tacit knowledge into explicit rules or guidelines. Sequencing refers to organizing activities in a temporal pattern that minimizes the need for

simultaneous coordination. Routines are complex patterns of behavior that allow individuals to integrate their specialized knowledge without the need for extensive communication. Group problem-solving and decision-making involve direct interaction among individuals with different knowledge bases.

The concept of "transactive memory systems" (Wegner, 1987) provides insights into how knowledge can be effectively integrated within groups. A transactive memory system is a mechanism through which groups collectively encode, store, and retrieve knowledge. It involves a shared understanding of who knows what, enabling group members to access and integrate specialized knowledge efficiently. This concept emphasizes the social and cognitive aspects of knowledge integration.

The concept of "knowledge brokering" (Hargadon and Sutton, 1997) refers to the process of transferring ideas from where they are known to where they are not. Knowledge brokers facilitate knowledge integration by identifying, accessing, and recombining existing ideas from disparate sources. This concept emphasizes the role of intermediaries in knowledge integration.

From an organizational design perspective, various structural mechanisms can facilitate knowledge integration. Matrix structures, cross-functional teams, and communities of practice are examples of organizational arrangements that bring together individuals with different knowledge bases, thereby facilitating knowledge integration. These structural mechanisms vary in their formality, permanence, and scope.

The concept of "knowledge governance" (Foss, 2007) refers to the deployment of governance mechanisms that influence the processes of knowledge creation, sharing, and integration. These mechanisms include formal (e.g., incentive systems, authority structures) and informal (e.g., culture, norms) elements that shape how knowledge is integrated within organizations. This concept emphasizes the role of managerial choice in knowledge integration.

2.5.3.2 Other Relevant Research Articles

Empirical research on knowledge integration mechanisms has provided valuable insights into their relationship with innovation performance. A study by Enberg et al. (2006) investigated the role of routines in knowledge integration in product development projects. They found that routines can effectively integrate knowledge across different functional areas, particularly when the knowledge is complex and specialized. This finding highlights the importance of established patterns of interaction for knowledge integration.

Research by Jansen et al. (2005) examined the relationship between coordination mechanisms, knowledge integration, and innovation performance. They found that formal coordination mechanisms (e.g., formalization, routinization) are more effective for exploitative innovation, while informal coordination mechanisms (e.g., social integration, connectedness) are more effective for exploratory innovation. This finding suggests that the optimal knowledge integration mechanisms depend on the type of innovation being pursued.

A study by Carlile (2004) investigated the challenges of knowledge integration across boundaries in new product development. He found that different types of boundaries (syntactic, semantic, pragmatic) require different types of knowledge integration mechanisms. Syntactic boundaries can be addressed through information processing, semantic boundaries through translation, and pragmatic boundaries through negotiation. This finding highlights the importance of matching knowledge integration mechanisms to the specific challenges of knowledge boundaries.

Research by Gardner et al. (2012) examined the relationship between knowledge integration mechanisms and team innovation. They found that different

knowledge integration mechanisms have different effects on team innovation, with boundary-spanning activities having the strongest positive effect. This finding suggests that the method of knowledge integration may influence its impact on innovation outcomes.

A study by Patnayakuni et al. (2006) investigated the relationship between knowledge integration capabilities and performance in supply chain relationships. They found that knowledge integration capabilities positively affect supply chain performance, and this relationship is mediated by supply chain process integration. This finding extends the importance of knowledge integration beyond the organizational boundary to inter-organizational relationships.

In the Chinese context, a study by Liu et al. (2013) examined the relationship between knowledge integration mechanisms and innovation performance in Chinese high-tech enterprises. They found that different knowledge integration mechanisms have different effects on innovation performance, with knowledge integration routines having the strongest positive effect. This finding suggests that established patterns of knowledge integration are particularly important in the Chinese context.

Research by Chen et al. (2014) investigated the relationship between knowledge integration, technological capability, and innovation performance in Chinese manufacturing firms. They found that knowledge integration positively affects innovation performance, and this relationship is partially mediated by technological capability. This finding suggests that knowledge integration enhances innovation performance partly by strengthening the firm's technological capabilities.

A study by Zhang et al. (2018) examined the relationship between knowledge governance mechanisms, knowledge integration, and innovation performance in

Chinese firms. They found that both formal and informal knowledge governance mechanisms positively affect knowledge integration, which in turn enhances innovation performance. This finding highlights the importance of managerial choices in facilitating knowledge integration in the Chinese context.

2.6 Conclusion

The literature review presented in this chapter provides a comprehensive theoretical foundation for understanding the relationships between open innovation, knowledge transfer, knowledge field activity, and innovation performance. The review of relevant background establishes the context of increasing global competition and the growing importance of innovation for organizational success in China. The examination of innovation performance literature reveals various approaches to measuring and conceptualizing innovation outcomes, with recent studies emphasizing the multidimensional nature of innovation performance.

The literature on open innovation demonstrates the evolution of this concept from Chesbrough's initial formulation to more nuanced understandings that distinguish between breadth and depth dimensions. Research consistently shows that open innovation can enhance innovation performance, though the relationship may be moderated by organizational and environmental factors. The inverted U-shaped relationship between open innovation breadth and innovation performance suggests that while accessing diverse external knowledge sources can enhance innovation, excessive breadth may lead to attention allocation problems and increased management costs. Similarly, the relationship between open innovation depth and innovation performance may be contingent on factors such as the type of innovation

being pursued and the firm's absorptive capacity.

Studies on knowledge field activity highlight its crucial role in facilitating knowledge flow and exchange within organizations, with evidence suggesting that active knowledge fields can significantly enhance innovation capabilities. Knowledge field activity, as indicated by effective information communication, high trust levels, positive team environments, and strong team cohesion, creates a conducive context for knowledge creation and sharing. Research shows that knowledge field activity can enhance the effectiveness of open innovation strategies and directly contribute to innovation performance.

Finally, the literature on knowledge transfer emphasizes the importance of both acquisition and integration processes, with recent studies suggesting that effective knowledge transfer mechanisms are essential for translating external collaborations into innovation outcomes. Knowledge acquisition, rooted in absorptive capacity theory, involves identifying, accessing, and obtaining valuable knowledge from external sources. Knowledge integration, conceptualized as a key organizational capability by Grant, involves combining newly acquired knowledge with existing organizational knowledge. Research shows that both knowledge acquisition and integration positively affect innovation performance, though these relationships may be contingent on factors such as the firm's absorptive capacity and the complexity of the knowledge being transferred.

While existing research has made significant contributions to our understanding of open innovation, knowledge field activity, knowledge transfer, and innovation performance, several gaps remain. First, most studies have examined these factors in isolation, with few studies investigating their combined effects on

innovation performance. Second, the contextual factors that moderate the relationships between these variables have not been fully explored, particularly in the Chinese context. Third, the mechanisms through which these factors influence innovation performance remain unclear, with few studies investigating the potential mediating and moderating effects. Finally, most studies have adopted a static perspective, with limited attention to how these relationships evolve over time.

This study addresses these gaps by developing an integrated framework that examines the concurrent effects of open innovation, knowledge field activity, and knowledge transfer on innovation performance. By testing this framework in the Chinese context, the study provides valuable insights into how these factors interact to influence innovation outcomes in a rapidly changing business environment. The findings can help Chinese enterprises develop more effective innovation strategies and enhance their competitiveness in the global market.

The next chapter will present the methodology used to test the integrated framework developed in this literature review, including the research design, sampling approach, measurement instruments, and analytical techniques. The empirical findings will provide a more comprehensive understanding of the relationships between open innovation, knowledge field activity, knowledge transfer, and innovation performance in the Chinese context.

CHAPTER 3

METHODOLOGY

The primary components of this chapter will include descriptions of the research design and rationale for the research, the methodology that will be used in the study. Additionally, threats to content validity and reliability test will be considered for the study. Therefore, this part will describe into 8 elements. They are as follows:

3.1 The Type of Research and Tool

3.2 The Research Design

3.3 The Quality of the Research Tool

3.4 The Data Collection

3.5 The Population and Sample

3.6 The Sampling Technique

3.7 The Research Procedure and Timeline

3.8 The Hypotheses Test and Data Analysis

3.1 The Type of Research and Tool

This study adopts a quantitative research method, collects data through questionnaires, and uses statistical analysis software for data processing and hypothesis testing. The main reason for choosing quantitative research methods is that this study aims to investigate the relationship between open innovation, knowledge field activity, knowledge transfer and innovation performance, and these variables can be measured by quantitative indicators. Quantitative research methods can investigate

large samples and improve the representativeness and generalizability of the research results, while the process of data collection and analysis is relatively standardized, which can reduce the influence of subjective factors. In addition, quantitative research methods can use statistical methods to accurately test the relationship between variables and draw more objective research conclusions, which is conducive to verifying theoretical assumptions and promoting the development of theories.

The main research tool of this study is a structured questionnaire. The questionnaire design is based on a literature review and theoretical analysis and includes five main parts:

Part 1: Demographic Data (6 questions)

This section collects basic demographic information of respondents, including:

1. Position (top manager, middle manager, grass-roots manager)
2. Department (research and development or design, marketing, human resources or finance, production and transport, other)
3. Form of business ownership (state-owned and state-controlled enterprises, private enterprises, collective enterprises, Sino-foreign joint ventures, wholly foreign-owned enterprises)
4. Years of establishment (0-5 years, 6-10 years, 11-15 years, 16-20 years, 20+ years)
5. Number of employees in the company (100 or less, 101-200, 201-300, 401-500, 501-600, 1000 or more)
6. Industry (biological, pharmaceutical, new materials and new energy industries; information transmission, software and information technology industries;

scientific research and technological development industries; financial industries; service provider industries; construction industries; manufacturing industries; other)

Part 2: Open Innovation (10 questions)

This section measures open innovation through two dimensions:

- Open Innovation Breadth (5 questions): Assesses the scope of cooperation between enterprises and external innovation subjects
    1. B1: Enterprises have extensive innovation cooperation with universities, research institutes and other scientific institutions
    2. B2: The company has a wide range of innovative co-operation with customers and clients
    3. B3: Businesses have engaged in a wide range of innovative collaborations with organizations up and down the supply chain
    4. B4: Extensive and innovative co-operation between businesses and relevant government departments
    5. B5: Firms have a wide range of innovation collaborations with other organizations outside the industry
- Open Innovation Depth (5 questions): Measures the closeness and intensity of cooperation with specific external bodies
    1. B6: Enterprises have established close and innovative partnerships with suppliers and customers
    2. B7: Active participation of enterprises in innovative activities and collaborative projects in scientific institutions such as universities or research institutes

3. B8: Enterprises actively participate in science and technology activities or conferences organized by relevant government departments or industry associations
4. B9: Enterprises have established close innovation cooperation with research intermediary organizations and science and technology service organizations
5. B10: Firms have established close innovation partnerships with other organizations outside the industry

Part 3: Knowledge Field Activity (4 questions)

This section measures knowledge field activity through questions about:

- Effective information communication with innovation partners
- Trust level with innovation partners
- Team environment and atmosphere with innovation partners
- Team cohesion and centripetal force with innovation partners

Part 4: Knowledge Transfer (8 questions)

This section measures knowledge transfer through two dimensions:

- Knowledge Acquisition (4 questions): Assesses the extent to which a firm acquires knowledge from external sources

1. C1: Enterprises have enhanced access to relevant knowledge in the process of technology development
2. C2: Enterprises have enhanced the acquisition of relevant knowledge in the market development process
3. C3: Enterprises have enhanced access to knowledge related to the manufacturing process

4. C4: Enterprises have enhanced external knowledge acquisition in other aspects

- Knowledge Integration (4 questions): Measures how effectively firms integrate knowledge from different sources
    1. C5: Firms effectively integrate internal organizational knowledge with externally acquired knowledge
    2. C6: The enterprise has effectively integrated knowledge from different departments, groups or organizations
    3. C7: The organization has effectively integrated knowledge from different fields
    4. C8: The business has effectively integrated the organization's operational processes or organizational structure

Part 5: Innovation Performance (5 questions)

This section measures innovation performance through questions about:

- Speed of new product development compared to competitors
- Market share of new products compared to competitors
- Success rate in product innovation compared to competitors
- Technological content in new products compared to competitors
- Number of patent applications compared to competitors

All scales in parts 2-5 use a 7-point Likert scale, ranging from "strongly disagree" (1) to "strongly agree" (7). This format allows for nuanced measurement of the variables while maintaining consistency across the questionnaire.

Although the quantitative research method has many advantages in this study, we also recognize its limitations. For example, quantitative research is difficult to gain

a deeper understanding of the reasons behind complex phenomena and may overlook some important contextual factors. Therefore, in follow-up studies, a combination of qualitative research methods, such as case studies and in-depth interviews, could be considered to gain a more comprehensive and in-depth understanding.

3.2 The Research Design

The online questionnaire will be measured as the following:

3.2.1 Part 1: the fact: nominal and ordinal scales

3.2.1.1 Position: Nominal scale with 3 categories (Top manager, Middle manager, Grass-roots manager)

3.2.1.2 Department: Nominal scale with 5 categories (Research and development or design, Marketing, Human resources or finance, Production and transport, Other)

3.2.1.3 Form of business ownership: Nominal scale with 5 categories (State-owned and state-controlled enterprises, Private enterprises, Collective enterprises, Sino-foreign joint ventures, Wholly foreign-owned enterprises)

3.2.1.4 Years of establishment: Ordinal scale with 5 categories (0-5 years, 6-10 years, 11-15 years, 16-20 years, 20+ years)

3.2.1.5 Number of employees: Ordinal scale with 6 categories (100 or less, 101-200, 201-300, 401-500, 501-600, 1000 or more)

3.2.1.6 Industry: Nominal scale with 8 categories (Biological, pharmaceutical, new materials and new energy industries; Information transmission, software and information technology industries;

Scientific research and technological development industries; Financial industries; Service provider industries; Construction industries; Manufacturing industries; Other)

3.2.2 Part 2-4: the attitude of independent variables: interval scale (the least (1) to the most (7))

3.2.2 Part 5: the attitude of dependent variable: interval scale (the least (1) to the most (7))

Scale 7 - Strongly agree

Scale 6 - Agree

Scale 5 - Somewhat agree

Scale 4 - Neither agree nor disagree

Scale 3 - Somewhat disagree

Scale 2 - Disagree

Scale 1 - Strongly disagree

For part 2-5 of the questionnaire, which consists of Likert's 7 point scale, the statistical mean range for the interpretation of the mean are calculated below:

Range = (Maximum - Minimum) / Scale Level

Range = (7 - 1) / 7 = 0.857... ≈ 0.86

Table 3.1: The Range of Mean Interpretation

Range	Interpretation
1.00 - 1.85	Strongly disagree

Range	Interpretation
1.86 - 2.71	Disagree
2.72 - 3.57	Somewhat disagree
3.58 - 4.43	Neither agree nor disagree
4.44 - 5.29	Somewhat agree
5.30 - 6.15	Agree
6.16 - 7.00	Strongly agree

The statistics used will be 2 types:

1. Descriptive statistics, which is composed of frequency, percentage, mean, and standard deviation.

2. Inferential statistics, which is composed of the Multiple Regression Analysis Test.

3.3 The Quality of the Research Tool

The online questionnaire was checked for validity and approved by the advisor Assoc. Prof. Dr. Nathanicha Na Nakorn. The reliability test was conducted with a volunteer sample group of 30 respondents. The data from the questionnaires were analyzed by using Cronbach's Alpha in the statistical software, with total reliability of 0.954. The required value to be accepted is 0.70 or higher, indicating that the questionnaire has excellent reliability.

Table 3.2: The Total Reliability Test Results

Cronbach's Alpha	N (number) of Items
0.954	27

Table 3.3: The Reliability Test Results for Open Innovation

Cronbach's Alpha	N (number) of Items
0.931	10

Table 3.4: The Reliability Test Results for Knowledge Field Activity

Cronbach's Alpha	N (number) of Items
0.918	4

Table 3.5: The Reliability Test Results for Knowledge Transfer

Cronbach's Alpha	N (number) of Items

0.924	8

Table 3.6: The Reliability Test Results for Innovation Performance

Cronbach's Alpha	N (number) of Items
0.906	5

The Cronbach's alpha values for all scales and subscales exceed the recommended threshold of 0.70, indicating high internal consistency reliability. The open innovation scale has a Cronbach's alpha of 0.931, suggesting excellent reliability. The knowledge field activity scale, despite having only 4 items, demonstrates excellent reliability with a Cronbach's alpha of 0.918. The knowledge transfer scale has a Cronbach's alpha of 0.924, indicating excellent reliability. The innovation performance scale has a Cronbach's alpha of 0.906, also indicating excellent reliability. The overall questionnaire has a Cronbach's alpha of 0.954, suggesting that the research tool has excellent internal consistency reliability as a whole.

In addition to reliability testing, content validity was assessed through expert evaluation. The questionnaire was reviewed by a panel of experts in the fields of innovation management and knowledge management to ensure that the items adequately capture the constructs being measured. The experts provided feedback on the clarity, relevance, and comprehensiveness of the questionnaire items, and the questionnaire was revised based on their suggestions.

3.4 The Data Collection

The data collection process for this study was carefully designed and implemented to ensure the quality and representativeness of the data. The study employed a multi-channel approach to data collection, combining both online and offline survey methods to reach a diverse range of respondents.

The survey was conducted over a four-month period from October 2023 to January 2024. Prior to the formal survey, a pilot test was conducted with 30 respondents to assess the clarity and effectiveness of the questionnaire. The feedback from the pilot test was used to refine the questionnaire before the formal survey.

For the online survey, the questionnaire was distributed through several channels:

1. Professional networks such as LinkedIn and industry-specific forums
2. Email invitations to members of industry associations
3. Social media platforms, including WeChat groups focused on business and innovation
4. Online survey platforms such as WJX.cn (https://www.wjx.cn)

For the offline survey, paper questionnaires were distributed through:

1. Industry conferences and workshops
2. Business associations and chambers of commerce
3. Direct visits to companies in industrial parks
4. Personal professional networks and business contacts

To ensure a high response rate and data quality, several measures were taken:

1. Clear explanation of the research purpose at the beginning of the questionnaire

2. Assurance of data confidentiality to encourage honest responses
3. Well-structured questionnaire with clear instructions for each section
4. Regular follow-up with potential respondents through reminders
5. Screening questions to ensure respondents have relevant knowledge about their organization's innovation activities

After collecting the questionnaires, a rigorous data cleaning process was conducted to identify and handle incomplete or problematic responses. Questionnaires with more than 10% missing values were excluded from the analysis. For questionnaires with less than 10% missing values, the missing values were imputed using the mean substitution method. In addition, questionnaires showing obvious patterns of response bias (e.g., the same rating for all items) were excluded from the analysis.

Through these data collection efforts, a total of 350 questionnaires were collected. After data cleaning, 306 valid questionnaires remained, representing an effective response rate of 87.4%. This sample size exceeds the minimum required sample size determined using the Yamane formula, ensuring the statistical power necessary for the planned analyses.

The data collection process was designed to capture a diverse and representative sample of organizations, including different sizes, ownership structures, and industries. This diversity enhances the generalizability of the research findings and provides insights into how the relationships between the study variables may vary across different organizational contexts.

3.5 The Population and Sample

The population for this study comprises enterprises operating across various industries in China. To ensure a representative sample, the study targeted organizations from diverse sectors, sizes, and ownership structures. The sampling frame focused on enterprises engaged in innovation activities, particularly those that have implemented or are implementing open innovation strategies.

The sample size determination was based on Yamane's formula (1967) for finite populations:

$n = N / (1 + N(e)^2)$

Where: n = sample size N = population size e = margin of error (0.05)

Given the large population of enterprises in China, a conservative approach was taken by setting N as a large but finite number. Using a confidence level of 95% and a margin of error of 5%, the minimum required sample size was calculated to be 384. However, considering the potential for non-response and invalid responses, the target sample size was set at 400.

Through the data collection efforts described in the previous section, a total of 306 valid questionnaires were obtained. While this is lower than the calculated sample size of 384, it still provides sufficient statistical power for the planned analyses. According to Field (2013), a sample size of 10-15 cases per predictor variable is considered adequate for regression analysis. With three main predictor variables (open innovation, knowledge field activity, and knowledge transfer), the minimum required sample size would be 30-45 cases, which is well exceeded by the obtained sample of 306.

The sample distribution reflects a diverse range of organizations:

- Industry distribution: 11.8% in biology, pharmaceuticals, new materials, and

new energy; 12.7% in information transmission, software, and information technology; 19.9% in scientific research and technological development; 12.1% in finance; 9.2% in services; 13.4% in construction; 17.0% in manufacturing; and 3.9% in other industries.

- Enterprise size: 16.0% of enterprises with 100 or fewer employees; 33.7% of enterprises with 101-200 employees; 23.5% of enterprises with 201-300 employees; 11.4% of enterprises with 301-500 employees; 8.2% of enterprises with 501-1,000 employees; and 7.2% of enterprises with more than 1,000 employees.
- Ownership structure: 17.0% state-owned and state-controlled enterprises; 35.6% private enterprises; 26.5% collective enterprises; 12.1% Sino-foreign joint ventures; 8.8% wholly foreign-owned enterprises.
- Years of establishment: 15.7% of enterprises established for less than 5 years; 41.2% of enterprises established for 6-10 years; 22.9% of enterprises established for 11-15 years; 11.1% of enterprises established for 16-20 years; and 9.2% of enterprises established for more than 20 years.
- Position distribution: 12.4% top managers, 23.9% middle managers, and 63.7% grass-roots managers.
- Departmental distribution: 22.2% from research and development or design departments, 18.3% from marketing, 34.0% from human resources or finance, 20.3% from production and transport, and 5.2% from other departments.

This sample distribution ensures that the research findings can be applied to a wide range of organizational contexts, enhancing the generalizability of the results. The diversity in terms of industry, size, ownership structure, and age of the enterprises

allows for the examination of potential differences in the relationships between the study variables across different organizational contexts.

3.6 The Sampling Technique

The sampling technique used in this study is a combination of judgment and convenience sampling in non-probability sampling. The choice of this sampling technique is based on several considerations:

First, given the specificity of the research topic, the authors needed to select firms that actively participate in innovation activities and implement open innovation to some extent. This requires the authors to perform some screening and judgment of the sample firms rather than simple random sampling. Judgment sampling allows the researcher to select the most appropriate sample units based on the research objectives and expertise, which facilitates the researcher to obtain richer and more valuable information.

Second, in practice, complete random sampling is often difficult to achieve, especially in firm-level research. Firms tend to be less willing to participate in academic research, and the use of strict random sampling may result in extremely low response rates, affecting the efficiency and quality of data collection. Convenience sampling allows the authors to utilize existing resources and networks to reach out to potential respondent firms, which increases the feasibility of the survey to some extent.

The specific sampling process was as follows:

First, the authors developed criteria for sample selection. The main ones include:

(a) Firms have a clear innovation strategy or are engaged in innovation activities;

(b) The enterprise has a certain degree of cooperation and communication with external organizations;

(c) The size of the enterprise is not limited, but it is required to have been established for more than 1 year.

Second, the authors used several sources to obtain a list of eligible firms. Including:

(a) Obtaining the list of innovative and active enterprises through various local science and technology bureaus, industry associations, and other organizations;

(b) Accessing lists of firms that have won national or local innovation awards in recent years;

(c) Utilizing the personal and professional networks of research team members, such as alumni relations, industry contacts, etc.

After obtaining the list of firms, the authors contacted these firms by phone or email to introduce the purpose of the study and invite them to participate in the survey. For enterprises willing to participate, the authors chose to distribute the questionnaire online or offline according to their wishes.

In order to increase the diversity of the sample, the authors also used the snowball sampling method. That is, enterprises that have already participated in the survey are invited to recommend other enterprises that may be eligible to participate in the study.

Throughout the sampling process, the authors paid continuous attention to the structural balance of the sample, trying to ensure that enterprises of different sizes,

industries, and natures are reasonably represented in the sample.

Although this sampling technique cannot completely eliminate sample bias, it is more feasible in practice and is also conducive to improving the participation of enterprises and the recovery rate of questionnaires. At the same time, by combining multiple channels and methods, the authors have increased the diversity and representativeness of the sample to a certain extent.

However, the authors also fully recognize the limitations of this sampling technique. To reduce the impact of these limitations, the authors took the following steps in their subsequent data analysis:

(1) Detailed descriptive statistics on sample characteristics were provided so that readers could understand the composition of the sample;

(2) Careful interpretation of the general applicability of the results when performing inferential statistics;

(3) Where possible, the results of the study were compared with other similar studies to test the reliability of the results.

3.7 The Research Procedure and Timeline

The study followed a systematic research procedure and was conducted in an orderly manner according to a predetermined timetable. The research process was divided into several phases, each with specific objectives and activities:

Phase 1: Research Planning and Design (3 months: February - April 2023)

- Identifying the research topic and research questions
- Conducting a preliminary literature review

- Developing the conceptual framework
- Formulating research hypotheses
- Creating a detailed research plan and timeline

Phase 2: Research Instrument Development (2 months: May - June 2023)

- Designing the questionnaire based on established scales
- Translating and adapting the scales to the Chinese context
- Conducting expert reviews to ensure content validity
- Finalizing the questionnaire design

Phase 3: Pilot Testing (1 month: July 2023)

- Conducting a small-scale pretesting with 30 respondents
- Analyzing preliminary data to assess reliability
- Refining the questionnaire based on pilot test results
- Making necessary adjustments to the data collection strategy

Phase 4: Data Collection (4 months: October 2023 - January 2024)

- Identifying potential respondents using the sampling criteria
- Distributing questionnaires through multiple channels
- Following up with respondents to ensure adequate response rates
- Organizing and coding the returned questionnaires
- Conducting initial data cleaning and preparation

Phase 5: Data Analysis (3 months: February - April 2024)

- Performing descriptive statistical analyses
- Conducting reliability and validity tests
- Executing hypothesis testing through regression analysis
- Analyzing additional patterns and relationships in the data

- Drawing preliminary conclusions from the analysis

Phase 6: Report Writing and Finalization (3 months: May - July 2024)

- Writing the research report with detailed findings
- Discussing the results in the context of existing literature
- Identifying theoretical and practical implications
- Acknowledging limitations and suggesting future research directions
- Finalizing the report format and content

Phase 7: Review and Submission (2 months: August - September 2024)

- Reviewing and revising the report based on supervisor feedback
- Preparing for the defense
- Making final adjustments to the report
- Submitting the final version

Throughout the research process, the following principles were observed:

1. Regular communication with the supervisor to ensure the research was on the right track and to address any issues promptly.
2. Strict adherence to research ethics, including obtaining informed consent from participants, ensuring confidentiality of data, and accurately reporting findings.
3. Rigorous data management practices, including secure storage of questionnaires, careful data entry, and regular backups of electronic data.
4. The use of multiple statistical methods to cross-validate findings and enhance the robustness of the results.
5. A focus on clarity, rigor, and innovation in the report writing process to ensure the research makes a meaningful contribution to the field.

This systematic and well-planned research procedure helped ensure the quality and timeliness of the study, providing a solid foundation for the findings and conclusions presented in subsequent chapters.

3.8 The Hypotheses Test and Data Analysis Hypotheses:

The study tests the following hypotheses to examine the relationships between open innovation, knowledge field activity, knowledge transfer, and innovation performance:

H1: Open innovation breadth and depth has a positive influence on innovation performance.

H2: Knowledge field activity has a positive influence on innovation performance.

H3: Knowledge transfer acquisition and integration has a positive influence on innovation performance.

The followings are the statistical tools used for data analysis:

3.8.1 Descriptive Statistics: These statistics were used to analyze the demographic data of the respondents. The information included is position, department, form of business ownership, years of establishment, number of employees, and industry. A descriptive statistic is used to analyze and summarize the characteristics and observations of the data and present them in the form of percentages, means, and standard deviations. The descriptive statistics provide a comprehensive profile of the sample and a preliminary understanding of the distribution of the variables.

3.8.2 Inferential Statistics: These statistics are used to interpret the meaning

of the data, and the relationship between the variables. Multiple Regression Analysis was used to test the hypotheses and to study the relationship between the independent variables open innovation, knowledge field activity, and knowledge transfer and the dependent variable innovation performance.

The multiple regression analysis follows a systematic approach:

Step 1: Data Preparation

- Check for missing values and outliers
- Conduct normality tests for all variables
- Center the predictor variables to reduce multicollinearity

Step 2: Assumption Testing

- Test for linearity between predictors and the dependent variable
- Check for multicollinearity using Variance Inflation Factor (VIF)
- Test for homoscedasticity using scatterplots and statistical tests
- Check for independent errors using the Durbin-Watson statistic

Step 3: Model Specification

- Specify the regression model with innovation performance as the dependent variable
- Include all three predictors open innovation, knowledge field activity, and knowledge transfer simultaneously

Step 4: Model Evaluation

- Assess the overall model fit using R^2 and adjusted R^2
- Evaluate the statistical significance of the model using F-test
- Examine the significance of individual predictors using t-tests
- Calculate standardized regression coefficients (β) to compare the relative

importance of predictors

Step 5: Hypothesis Testing

- Compare the p-values of the regression coefficients with the significance level ($\alpha = 0.05$)
- Determine whether to reject or fail to reject each hypothesis
- Interpret the direction and magnitude of the relationships

Step 6: Additional Analyses

- Conduct subgroup analyses to examine whether the relationships differ across industries or firm sizes
- Examine potential interaction effects between predictors
- Perform sensitivity analyses to check the robustness of the results

The statistical analysis was performed using SPSS version 23.0, a widely used statistical software package in social science research. The results of the hypotheses testing provide insights into the relationships between open innovation, knowledge field activity, knowledge transfer, and innovation performance, contributing to both theoretical understanding and practical applications in the field of innovation management.

CHAPTER 4

ANALYSIS AND FINDINGS

This chapter presents the research findings from the data analyzed using the statistical software. 306 responses were collected and analyzed to test the hypotheses. The data analyzed are presented in 6 elements: They are as follows:

4.1: Analysis of demographic data

4.2: Analysis of Innovation Performance

4.3: Analysis of Open Innovation

4.4: Analysis of Knowledge Field Activity

4.5: Analysis of Knowledge Transfer

4.6: Analysis of the impact of Open Innovation, Knowledge Field Activity, and Knowledge Transfer on Innovation Performance

4.1 Analysis of Demographic Data

Table 4.1: Demographics Data of 306 respondents

Demographic Data	Frequency	Percentage (%)
1. Position		
Top manager	38	12.4
Middle managers	73	23.9

Demographic Data	Frequency	Percentage (%)
Grass-roots managers	195	63.7
Total	306	100.0

(Continued)

Table 4.1 (Continued): Demographics Data of 306 respondents

Demographic Data	Frequency	Percentage (%)
2. Department		
Research and development or design	68	22.2
Marketing	56	18.3
Human resources or finance	104	34.0
Production and transport	62	20.3
Other	16	5.2
Total	306	100.0
3. Forms of business ownership		
State-owned and state-controlled enterprises	52	17.0
Private enterprises	109	35.6
Collective enterprises	81	26.5
Sino-foreign joint ventures	37	12.1
Wholly foreign-owned enterprises	27	8.8

Demographic Data	Frequency	Percentage (%)
Total	306	100.0
4. Year of Establishment		
0-5 years	48	15.7
6-10 years	126	41.2
11-15 years	70	22.9
16-20 years	34	11.1
20+ years	28	9.2
Total	306	100.0
5. Number of employees in the company		
100 or less	49	16.0
101-200	103	33.7
201-300	72	23.5
401-500	35	11.4
501-600	25	8.2
1000 or more	22	7.2
Total	306	100.0

(Continued)

Table 4.1 (Continued): Demographics Data of 306 respondents

Demographic Data	Frequency	Percentage (%)
6. Industry		
Biological, pharmaceutical, new materials and new energy industries	36	11.8
Information transmission, software and information technology industries	39	12.7
Scientific research and technological research and development industries	61	19.9
Financial industries	37	12.1
Service provider industries	28	9.2
Construction industries	41	13.4
Manufacturing industries	52	17.0
Other	12	3.9
Total	306	100.0

Table 4.1 presents a summary of the demographic data of the 306 respondents who participated in this research. The data reveals several interesting patterns about the composition of the sample.

In terms of position, the majority of respondents (63.7%) were grass-roots managers, followed by middle managers (23.9%), with top managers constituting the smallest group (12.4%). This pyramidal distribution is typical of organizational hierarchies and ensures that the perspectives captured in this study largely reflect

operational-level views on innovation activities.

Regarding department distribution, the largest proportion of respondents came from human resources or finance departments (34.0%), followed by research and development or design (22.2%), production and transport (20.3%), and marketing (18.3%), with a small percentage (5.2%) from other departments. This diverse functional representation helps provide a comprehensive view of innovation processes across different organizational areas.

The analysis of business ownership forms shows that private enterprises constitute the largest segment (35.6%), followed by collective enterprises (26.5%), state-owned and state-controlled enterprises (17.0%), Sino-foreign joint ventures (12.1%), and wholly foreign-owned enterprises (8.8%). This distribution broadly reflects the diversity of ownership structures in the Chinese business landscape.

In terms of organizational age, the majority of enterprises (41.2%) were established between 6-10 years ago, followed by those established 11-15 years ago (22.9%), while newer enterprises (0-5 years) represented 15.7%. More established companies of 16-20 years and over 20 years constituted 11.1% and 9.2% respectively. This distribution includes a good mix of both young and mature organizations.

Regarding company size by employee count, mid-sized enterprises dominated the sample. Organizations with 101-200 employees represented the largest group (33.7%), followed by those with 201-300 employees (23.5%). Smaller enterprises with 100 or fewer employees constituted 16.0%, while larger organizations with over 1000 employees represented 7.2% of the sample.

The industry distribution shows that scientific research and technological development represented the largest sector (19.9%), followed by manufacturing

(17.0%) and construction (13.4%). Information technology and financial sectors each represented approximately 12% of the sample, with biological, pharmaceutical, new materials and new energy industries constituting 11.8%. Service industries represented 9.2%, with other industries making up the remaining 3.9%.

This demographic analysis demonstrates that the sample encompasses a broad and representative cross-section of organizations, spanning different management levels, functional areas, ownership structures, organizational ages, sizes, and industries. This diversity enhances the generalizability of the study's findings across various organizational contexts.

4.2 Analysis of Innovation Performance factor

The following table presents the analysis of Innovation Performance, which is the dependent variable in this study.

4.2.1 Analysis of Innovation Performance Items

4.2.2 Comparison of Innovation Performance Across Industries

4.2.3 Innovation Performance Relative to Organizational Characteristics

Table 4.2: Mean and Standard Deviation of Innovation Performance

Innovation Performance Items	Mean	Std. Deviation	Interpretation
E1 Faster time to market for new products	5.32	1.565	Agree

Innovation Performance Items	Mean	Std. Deviation	Interpretation
compared to other companies			
E2 Higher market share of new products compared to other companies	5.25	1.704	Somewhat agree
E3 Higher success rate in product innovation compared to other companies	5.26	1.656	Somewhat agree
E4 Higher technological content in new products compared to other companies	5.23	1.601	Somewhat agree
E5 More patent applications than other companies	5.15	1.773	Somewhat agree
Total Innovation Performance	5.24	1.332	Somewhat agree

From table 4.2, the analysis of innovation performance as the dependent variable reveals several notable findings. Based on 306 valid responses, the overall innovation performance demonstrates a mean value of 5.24 (SD=1.332) on a seven-point Likert scale, indicating generally positive comparative advantages in innovation among surveyed organizations.

In examining the five measurement items of innovation performance, the study found that the speed of new product market introduction (E1: "Faster time to market for new products compared to other companies") achieved the highest mean score (M=5.32, SD=1.565), suggesting surveyed organizations particularly excel in rapid

product commercialization compared to their competitors. This is followed by innovation success rate (E3: "Higher success rate in product innovation compared to other companies"; M=5.26, SD=1.656) and market share of new products (E2: "Higher market share of new products compared to other companies"; M=5.25, SD=1.704), indicating strong market performance relative to competitors.

The technological sophistication of innovations (E4: "Higher technological content in new products compared to other companies") showed a slightly lower mean value (M=5.23, SD=1.601), while the comparative advantage in patent applications (E5: "More patent applications than other companies") demonstrated the lowest mean score (M=5.15) but with the highest standard deviation (SD=1.773). This suggests that while organizations generally maintain competitive advantages in innovation, their relative strength in formal intellectual property protection varies considerably.

The consistently high mean scores across all measurement items (all exceeding 5.0) indicate that surveyed organizations generally perceive themselves as outperforming their competitors in various aspects of innovation. However, the variation in standard deviations, particularly in patent applications, suggests different levels of competitive advantage across organizations. The speed of market introduction shows the most consistent competitive advantage, as evidenced by its relatively lower standard deviation compared to other items.

The distribution of scores across these five comparative dimensions presents a comprehensive picture of competitive innovation performance, from market-facing metrics (speed and market share) to technical capabilities (technological content and patents). The balanced performance across these dimensions suggests that organizations are maintaining effective innovation strategies that create competitive

advantages in both market and technical domains.

4.3 Analysis of Open Innovation Factor

The following table presents the analysis of Open Innovation, which is one of the independent variables in this study.

Table 4.3: Mean and Standard Deviation of Open Innovation

Open Innovation Items	Mean	Std. Deviation	Interpretation
B1 Enterprises have extensive innovation cooperation with universities, research institutes and other scientific institutions	5.47	1.442	Agree
B2 The company has a wide range of innovative co-operation with customers and clients	5.40	1.490	Agree
B3 Businesses have engaged in a wide range of innovative collaborations with organizations up and down the supply chain	5.52	1.579	Agree
B4 Extensive and innovative co-operation between businesses and relevant government departments	5.48	1.496	Agree
B5 Firms have a wide range of innovation collaborations with other organizations outside the industry	5.48	1.494	Agree

Open Innovation Items	Mean	Std. Deviation	Interpretation
B6 Enterprises have established close and innovative partnerships with suppliers and customers	5.50	1.500	Agree
B7 Active participation of enterprises in innovative activities and collaborative projects in scientific institutions such as universities or research institutes	5.51	1.465	Agree
B8 Enterprises actively participate in science and technology activities or conferences organized by relevant government departments or industry associations	5.44	1.473	Agree
B9 Enterprises have established close innovation cooperation with research intermediary organizations and science and technology service organizations	5.34	1.581	Agree
B10 Firms have established close innovation partnerships with other organizations outside the industry	5.44	1.570	Agree
Total Open Innovation	5.46	1.299	Agree

From table 4.3, the examination of open innovation reveals compelling patterns across the 306 surveyed organizations. The overall open innovation demonstrates a strong positive tendency (M=5.46, SD=1.299), with notable variations across different collaboration dimensions.

Among the breadth-oriented measures (B1-B5), supply chain collaboration (B3: M=5.52, SD=1.579) showed the highest mean score, indicating organizations particularly excel in upstream and downstream partnerships. Government department collaboration (B4: M=5.48, SD=1.496) and collaboration with organizations outside the industry (B5: M=5.48, SD=1.494) also demonstrated strong performance, suggesting well-balanced external engagement across various sectors. Research institution cooperation (B1: M=5.47, SD=1.442) and customer collaboration (B2: M=5.40, SD=1.490) also showed high scores, further confirming the diverse nature of organizations' external partnerships.

For depth-oriented measures (B6-B10), the strongest performance was observed in research institution engagement (B7: M=5.51, SD=1.465) and supplier-customer relationships (B6: M=5.50, SD=1.500). Government and industry association engagement (B8: M=5.44, SD=1.473) and partnerships with organizations outside the industry (B10: M=5.44, SD=1.570) also showed strong performance. Interestingly, while research intermediary collaboration (B9: M=5.34, SD=1.581) showed the lowest mean score, it maintained a relatively high absolute value, indicating generally positive but more varied engagement with intermediary organizations.

Comparing breadth and depth dimensions, organizations showed slightly stronger performance in establishing broad collaborative networks (breadth measures average: M=5.47) than in developing deep collaborative relationships (depth measures average: M=5.45). However, the minimal difference suggests a balanced approach to open innovation implementation.

The consistent standard deviations across all items (ranging from 1.442 to 1.581) indicate relatively uniform variation in organizations' open innovation practices. This

pattern suggests that while organizations generally embrace open innovation across all dimensions, they maintain similar levels of implementation flexibility across different types of collaborative relationships.

These findings suggest that surveyed organizations have developed mature open innovation strategies, effectively balancing both the breadth and depth of their innovation networks. The high mean scores across all dimensions, coupled with moderate standard deviations, indicate widespread adoption of open innovation practices while allowing for strategic variation in implementation approaches.

4.4 Analysis of Knowledge Field Activity Factor

The following table presents the analysis of Knowledge Field Activity, which is another independent variable in this study.

Table 4.4: Mean and Standard Deviation of Knowledge Field Activity

Knowledge Field Activity Items	Mean	Std. Deviation	Interpretation
D1 Enterprises are able to communicate and exchange information effectively with innovative co-operation partners	5.28	1.627	Somewhat agree
D2 Firms are able to build a high level of trust with those with whom they collaborate on innovation	5.28	1.632	Somewhat agree

Knowledge Field Activity Items	Mean	Std. Deviation	Interpretation
D3 Enterprises are able to establish a harmonious and upwardly mobile team environment and atmosphere with innovative co-operation partners	5.34	1.546	Agree
D4 Firms are able to develop a high level of team orientation and cohesion with innovative co-operation partners	5.30	1.528	Agree
Total Knowledge Field Activity	5.30	1.420	Agree

From table 4.4, the examination of knowledge field activity as an independent variable reveals important insights into organizational collaborative dynamics. Analysis of 306 valid responses demonstrates an overall knowledge field activity mean score of 5.30 (SD=1.420) on a seven-point Likert scale, indicating strong knowledge field vitality among surveyed organizations.

A detailed analysis of the four measurement items shows nuanced patterns in different aspects of knowledge field activity. The establishment of harmonious team environment and atmosphere with innovation partners (D3) achieved the highest mean score (M=5.34, SD=1.546), followed by the development of team cohesion and centripetal force (D4: M=5.30, SD=1.528). These findings suggest that organizations particularly excel in creating positive collaborative environments and fostering team unity with their innovation partners.

The foundational aspects of knowledge field activity, including effective

information communication and exchange (D1: M=5.28, SD=1.627) and the establishment of high trust levels with innovation partners (D2: M=5.28, SD=1.632), showed slightly lower but still robust mean scores. The nearly identical means but slightly higher standard deviations in these aspects suggest that while organizations generally maintain strong communication and trust-building capabilities, there is more variation in how these fundamental relationships are managed across different organizations.

The relatively consistent mean scores across all four dimensions (ranging from 5.28 to 5.34) indicate that organizations take a balanced approach to knowledge field activity, addressing both the structural aspects of collaboration (communication and trust) and the cultural elements (team atmosphere and cohesion). The moderate standard deviations suggest reasonable variation in implementation approaches while maintaining overall effectiveness in knowledge field activities.

These findings provide a comprehensive picture of how organizations cultivate and maintain their knowledge fields through effective communication, trust-building, and team cohesion. This balanced performance across multiple dimensions of knowledge field activity sets a foundation for understanding how these collaborative dynamics might influence innovation outcomes in subsequent analyses.

4.5 Analysis of Knowledge Transfer Factor

The following table presents the analysis of Knowledge Transfer, which is the third independent variable in this study.

Table 4.5: Mean and Standard Deviation of Knowledge Transfer

Knowledge Transfer Items	Mean	Std. Deviation	Interpretation
C1 Enterprises have enhanced access to relevant knowledge in the process of technology development	5.15	1.759	Somewhat agree
C2 Enterprises have enhanced the acquisition of relevant knowledge in the market development process	5.24	1.697	Somewhat agree
C3 Enterprises have enhanced access to knowledge related to the manufacturing process	5.20	1.735	Somewhat agree
C4 Enterprises have enhanced external knowledge acquisition in other aspects	5.29	1.719	Somewhat agree
C5 Firms effectively integrate internal organizational knowledge with externally acquired knowledge	5.18	1.676	Somewhat agree
C6 The enterprise has effectively integrated knowledge from different departments, groups or organizations	5.35	1.583	Agree
C7 The organization has effectively integrated knowledge from different fields	5.25	1.738	Somewhat agree
C8 The business has effectively integrated the	5.34	1.678	Agree

Knowledge Transfer Items	Mean	Std. Deviation	Interpretation
organization's operational processes or organizational structure			
Total Knowledge Transfer	5.25	1.263	Somewhat agree

From table 4.5, the examination of knowledge transfer as an independent variable reveals significant patterns in organizational knowledge management practices. Analysis of 306 valid responses shows an overall knowledge transfer mean score of 5.25 (SD=1.263) on a seven-point Likert scale, indicating robust knowledge transfer activities across surveyed organizations.

A detailed analysis of the eight measurement items reveals varying degrees of effectiveness in different aspects of knowledge transfer. Knowledge integration across departments and organizations (C6: "Enterprise has effectively integrated knowledge from different departments, groups or organizations") achieved the highest mean score (M=5.35, SD=1.583), closely followed by organizational process integration (C8: "Enterprise has effectively integrated operational processes and organizational structure"; M=5.34, SD=1.678). These findings suggest particularly strong capabilities in internal knowledge integration and structural alignment.

External knowledge acquisition also showed strong performance, with acquisition of other external knowledge (C4: "Enterprise has enhanced external knowledge acquisition in other aspects") demonstrating a high mean score (M=5.29, SD=1.719). Cross-domain knowledge integration (C7: "Enterprise has effectively

integrated knowledge from different fields"; M=5.25, SD=1.738) and market development knowledge acquisition (C2: "Enterprise has enhanced market development knowledge acquisition"; M=5.24, SD=1.697) followed, indicating balanced attention to diverse knowledge sources.

Notably, technical R&D knowledge acquisition (C1: "Enterprise has enhanced technical R&D knowledge acquisition") showed the lowest mean score (M=5.15, SD=1.759), though still maintaining a positive level. The higher standard deviation in this aspect suggests more varied approaches to technical knowledge acquisition across organizations.

The relatively consistent mean scores across all dimensions (ranging from 5.15 to 5.35) indicate that organizations maintain a balanced approach to knowledge transfer, addressing both knowledge acquisition and integration aspects. The moderate standard deviations suggest reasonable variation in implementation approaches while maintaining overall effectiveness in knowledge transfer practices.

These findings establish a comprehensive understanding of organizational knowledge transfer capabilities, encompassing both external knowledge acquisition and internal knowledge integration. This balanced performance provides a foundation for examining how knowledge transfer practices influence innovation outcomes in subsequent analyses.

4.6 Analysis of Impact of Open Innovation, Knowledge Field Activity, and Knowledge Transfer on Innovation Performance

This part of the study represents the analysis of the relationship among open innovation, knowledge field activity, knowledge transfer, and innovation

performance. The type of statistics used in this part in inferential statistics and the statistical analysis used to determine the data was the Multiple Linear Regression.

The regression analysis employed a simultaneous entry method for all three independent variables - open innovation, knowledge field activity, and knowledge transfer - to examine their impact on innovation performance. The model specification analysis confirms the successful inclusion of all hypothesized predictors, providing a comprehensive framework for understanding the determinants of innovation performance. This approach allows for the simultaneous assessment of each variable's unique contribution while controlling for the effects of other predictors.

Table 4.6: Regression Model Summary for Innovation Performance

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.544	.296	.289	1.12324

a. Predictors: (Constant), Total Knowledge field activity, Total open innovation, Total Knowledge transfer

b. Dependent Variable: Total Innovative performance

ANOVA	Sum of Squares	df	Mean Square	F	Sig.
Regression	160.358	3	53.453	42.366	.000
Residual	381.026	302	1.262		
Total	541.385	305			

a. Dependent Variable: Total Innovative performance

b. Predictors: (Constant), Total Knowledge field activity, Total open innovation, Total Knowledge transfer

Table 4.7: Regression Coefficients for Factors Influencing Innovation Performance

Model	Unstandardized Coefficients		Standardized Coefficients	t	Sig.	Interpretation
	B	Std. Error	Beta			
(Constant)	1.698	0.347		4.891	0.000	
Total open innovation	0.105	0.053	0.102	1.973	0.049	Significant
Total Knowledge transfer	0.330	0.066	0.313	5.012	0.000	Significant
Total	0.234	0.056	0.249	4.171	0.000	Significant

Model	Unstandardized Coefficients	Standardized Coefficients	t	Sig.	Interpretation
Knowledge field active					

a. Dependent Variable: Total Innovative performance

Analysis of Variance Results: The ANOVA results provide strong evidence for the model's statistical significance ($F(3,302)=42.366$, $p<0.001$). This high F-value and significant p-value demonstrate that the combined effect of open innovation, knowledge field activity, and knowledge transfer significantly explains variations in innovation performance. The mean square regression value of 53.453 compared to the residual mean square of 1.262 further supports the model's strong explanatory power.

Coefficient Analysis and Individual Variable Impacts: The detailed coefficient analysis reveals nuanced relationships between each independent variable and innovation performance:

Knowledge transfer emerged as the strongest predictor ($\beta=0.313$, $p<0.001$), indicating that a one standard deviation increase in knowledge transfer is associated with a 0.313 standard deviation increase in innovation performance.

Knowledge field activity showed the second strongest effect ($\beta=0.249$, $p<0.001$), demonstrating its substantial role in enhancing innovation performance.

Open innovation, while showing a smaller but still significant effect ($\beta=0.102$, $p<0.05$), confirms its importance in the innovation process.

The constant term ($B=1.698$, $p<0.001$) represents the baseline innovation

performance when all predictors are at zero, providing context for interpreting the incremental effects of each predictor. The standardized coefficients allow for direct comparison of the relative importance of each predictor, while unstandardized coefficients provide practical guidance for predicting innovation performance changes based on unit changes in the predictors.

Table 4.8: Analysis of Impact of Open Innovation on Innovation Performance

Open Innovation	b	Beta	t	Sig	Interpretation
Open Innovation Breadth	0.078	0.076	1.248	0.213	Not Significant
Open Innovation Depth	0.125	0.120	1.972	0.040	Significant

Adjusted R-square = 0.112, F = 19.223, *P≤0.05

Independent variable = Open Innovation

Dependent variable = Innovation Performance

Table 4.8 displayed the statistical analysis of the relationship between open innovation dimensions and innovation performance. The results show that open innovation depth has a significant positive effect on innovation performance (β=0.120, p=0.040), while open innovation breadth does not have a significant effect (β=0.076, p=0.213). This suggests that the closeness and intensity of cooperation with specific external partners (depth) is more important for innovation performance than the number of different types of external partners (breadth). The adjusted R-square

value of 0.112 indicates that open innovation dimensions explain 11.2% of the variance in innovation performance.

Table 4.9: Analysis of Impact of Knowledge Field Activity on Innovation Performance

Knowledge Field Activity	b	Beta	t	Sig	Interpretation
Information Communication	0.092	0.112	0.978	0.329	Not Significant
Trust Level	0.114	0.139	1.189	0.235	Not Significant
Team Environment	0.186	0.214	1.835	0.068	Not Significant
Team Cohesion	0.195	0.222	1.994	0.047	Significant

Adjusted R-square = 0.215, F = 21.895, *P≤0.05 Independent variable = Knowledge Field Activity Dependent variable = Innovation Performance

Table 4.9 displays the statistical analysis of the relationship between knowledge field activity dimensions and innovation performance. The results show that team cohesion has a significant positive effect on innovation performance (β=0.222, p=0.047), while information communication (β=0.112, p=0.329), trust level (β=0.139, p=0.235), and team environment (β=0.214, p=0.068) do not have significant effects. This suggests that the ability to develop high levels of team orientation and cohesion with innovation partners is particularly important for innovation performance. The adjusted R-square value of 0.215 indicates that knowledge field activity dimensions explain 21.5% of the variance in innovation

performance.

Table 4.10: Analysis of Impact of Knowledge Transfer on Innovation Performance

Knowledge Transfer	b	Beta	t	Sig	Interpretation
Knowledge Acquisition	0.184	0.211	3.246	0.001	Significant
Knowledge Integration	0.215	0.232	3.559	0.000	Significant

Adjusted R-square = 0.252, F = 52.241, *P≤0.05 Independent variable = Knowledge Transfer Dependent variable = Innovation Performance

Table 4.10 displays the statistical analysis of the relationship between knowledge transfer dimensions and innovation performance. The results show that both knowledge acquisition (β=0.211, p=0.001) and knowledge integration (β=0.232, p<0.001) have significant positive effects on innovation performance, with knowledge integration having a slightly stronger effect. This suggests that both the ability to acquire knowledge from external sources and the ability to integrate knowledge from different sources are important for innovation performance. The adjusted R-square value of 0.252 indicates that knowledge transfer dimensions explain 25.2% of the variance in innovation performance, which is the highest among the three independent variables.

Table 4.11: Summary of the Hypotheses Testing

Hypothesis	Result
H1: Open innovation has a positive influence on innovation performance	Supported
H1a: Open innovation breadth has a positive influence on innovation performance	Not Supported
H1b: Open innovation depth has a positive influence on innovation performance	Supported
H2: Knowledge field activity has a positive influence on innovation performance	Supported
H2a: Information communication has a positive influence on innovation performance	Not Supported
H2b: Trust level has a positive influence on innovation performance	Not Supported
H2c: Team environment has a positive influence on innovation performance	Not Supported
H2d: Team cohesion has a positive influence on innovation performance	Supported
H3: Knowledge transfer has a positive influence on innovation performance	Supported
H3a: Knowledge acquisition has a positive influence on innovation	Supported

(Continued)

Hypothesis	Result
performance	
H3b: Knowledge integration has a positive influence on innovation performance	Supported

Table 4.11 represents a summary of the hypothesis results. As shown in the table, the three main hypotheses (H1, H2, and H3) are all supported, indicating that open innovation, knowledge field activity, and knowledge transfer all have positive influences on innovation performance. However, when examining the sub-hypotheses, the results are more nuanced. For open innovation, only the depth dimension (H1b) is supported, while the breadth dimension (H1a) is not supported. For knowledge field activity, only the team cohesion dimension (H2d) is supported, while the other three dimensions (H2a, H2b, and H2c) are not supported. For knowledge transfer, both the knowledge acquisition dimension (H3a) and the knowledge integration dimension (H3b) are supported. These findings provide valuable insights into the specific aspects of open innovation, knowledge field activity, and knowledge transfer that are most critical for enhancing innovation performance.

These comprehensive findings provide strong empirical support for the theoretical framework, demonstrating that all three factors contribute significantly to

innovation performance, albeit with varying magnitudes of impact. The results particularly highlight the crucial role of knowledge transfer and knowledge field activity in driving innovation outcomes, while also confirming the importance of open innovation, especially its depth dimension. The findings also suggest that when implementing these strategies, organizations should pay particular attention to developing deep collaborative relationships with external partners, fostering team cohesion among innovation partners, and enhancing both knowledge acquisition and integration capabilities.

CHAPTER 5

SUMMARY, CONCLUSION AND DISSCUSION

This part will cover 4 elements: summary and conclusion, discussion, recommendations for Implications, and recommendations for future research. They are as follows:

5.1 Summary and Conclusion

5.2 Discussion

5.3 Recommendations for Implications

5.4 Recommendations for Future Research

5.1 Summary and Conclusion

5.1.1 Demographic Data

The study collected data from 306 valid respondents across various organizations in China. The demographic analysis reveals a diverse sample spanning different organizational levels, functional areas, ownership structures, ages, sizes, and industries. In terms of positions, the majority of respondents (63.7%) were grass-roots managers, followed by middle managers (23.9%) and top managers (12.4%). Department distribution showed representation from various functional areas, with the largest proportion coming from human resources or finance (34.0%), followed by research and development (22.2%), production and transport (20.3%), and marketing (18.3%).

The analysis of business ownership forms showed that private enterprises

constituted the largest segment (35.6%), followed by collective enterprises (26.5%), state-owned enterprises (17.0%), Sino-foreign joint ventures (12.1%), and wholly foreign-owned enterprises (8.8%). Regarding organizational age, most enterprises (41.2%) were established between 6-10 years ago, with a good representation of both younger and more established organizations. Company size distribution showed predominance of mid-sized enterprises with 101-300 employees (57.2%), while the industry distribution reflected a diverse cross-section of sectors, with scientific research and technological development (19.9%), manufacturing (17.0%), and construction (13.4%) representing the largest segments.

5.1.2 Attitudes towards variables

The attitude towards the variables are presented in three parts:

1) Open Innovation: The analysis of open innovation revealed generally positive attitudes with an overall mean score of 5.46 (SD=1.299), indicating that respondents "Agree" with statements about their organizations' open innovation activities. The breadth dimension, measuring the scope of external cooperation, showed slightly higher scores (average M=5.47) than the depth dimension, measuring the intensity of cooperation (average M=5.45), though the difference was minimal. Among breadth measures, supply chain collaboration (M=5.52) was strongest, while among depth measures, research institution engagement (M=5.51) was most prominent. The results suggest a balanced approach to open innovation across different partnership types and engagement intensities.

2) Knowledge Field Activity: Knowledge field activity demonstrated strong positive attitudes with an overall mean score of 5.30 (SD=1.420), indicating

that respondents "Agree" with statements about their organizations' knowledge field activities. The highest scores were observed for establishing harmonious team environments with innovation partners (M=5.34) and developing team cohesion (M=5.30). The foundational aspects of effective information communication and trust-building both showed slightly lower but still robust scores (both M=5.28). The consistent scores across dimensions suggest organizations take a balanced approach to cultivating knowledge fields, addressing both structural aspects (communication and trust) and cultural elements (team atmosphere and cohesion).

3) Knowledge Transfer: Knowledge transfer showed positive attitudes with an overall mean score of 5.25 (SD=1.263), indicating that respondents "Somewhat agree" with statements about their organizations' knowledge transfer activities. Knowledge integration across departments (M=5.35) and organizational process integration (M=5.34) received the highest scores, suggesting particular strength in internal knowledge integration. External knowledge acquisition dimensions showed slightly lower but still positive scores, with technical R&D knowledge acquisition receiving the lowest rating (M=5.15). This pattern suggests that while organizations are generally effective at knowledge transfer, they may face greater challenges in acquiring and integrating technical knowledge compared to other knowledge types.

5.1.3 Hypotheses Results

There were three hypotheses proposed in this study:

Hypothesis 1: Open innovation (breadth and depth) has a positive influence on innovation performance.

The regression analysis supported this hypothesis, showing a significant

positive relationship between open innovation and innovation performance (β=0.102, p<0.05). However, when examining specific dimensions, only open innovation depth showed a significant positive effect (β=0.120, p=0.040), while open innovation breadth did not have a significant effect (β=0.076, p=0.213). This suggests that the intensity and quality of external collaborations are more important for innovation performance than simply the number of different types of external partners. The relatively small effect size (β=0.102) indicates that while open innovation contributes to innovation performance, its direct impact is more modest compared to other factors examined in this study.

Hypothesis 2: Knowledge field activity has a positive influence on innovation performance.

This hypothesis was supported by the regression analysis, which revealed a significant positive relationship between knowledge field activity and innovation performance (β=0.249, p<0.001). The effect size indicates that knowledge field activity is a substantial driver of innovation performance, second only to knowledge transfer among the variables studied. When examining specific dimensions, only team cohesion showed a significant positive effect (β=0.222, p=0.047), while information communication, trust level, and team environment did not show significant effects. This finding highlights the particular importance of developing strong team orientation and cohesion with innovation partners for enhancing innovation performance.

Hypothesis 3: Knowledge transfer (acquisition and integration) has a positive influence on innovation performance.

The regression analysis strongly supported this hypothesis, showing that

knowledge transfer had the largest positive effect on innovation performance among all variables studied ($\beta=0.313$, $p<0.001$). Both knowledge acquisition ($\beta=0.211$, $p=0.001$) and knowledge integration ($\beta=0.232$, $p<0.001$) dimensions showed significant positive effects, with knowledge integration having a slightly stronger influence. This finding underscores the critical importance of both acquiring external knowledge and effectively integrating knowledge from different sources for enhancing innovation performance. The substantial effect size indicates that knowledge transfer is the most important driver of innovation performance among the three independent variables examined.

Overall, the regression model including all three independent variables explained 29.6% of the variance in innovation performance ($R^2=0.296$), indicating their substantial collective impact on organizational innovation outcomes. Knowledge transfer emerged as the strongest predictor, followed by knowledge field activity and open innovation. These findings highlight the critical role of knowledge management capabilities in translating external collaboration into tangible innovation results.

5.2 Discussion

The empirical findings from this study illuminate several significant theoretical and practical implications regarding the relationship between open innovation, knowledge management, and innovation performance in the Chinese business context.

The strong positive influence of knowledge transfer ($\beta=0.313$, $p<0.001$) on innovation performance aligns with and extends previous theoretical frameworks proposed by Cohen and Levinthal (1990) regarding absorptive capacity. The findings

suggest that organizations' ability to acquire and integrate knowledge serves as a crucial mechanism for translating external collaborations into tangible innovation outcomes. This relationship is particularly evident in the strong effect of knowledge integration ($\beta=0.232$, $p<0.001$), supporting Grant's (1996) theory of knowledge integration as a key organizational capability. The finding that both knowledge acquisition and integration significantly contribute to innovation performance underscores the importance of developing comprehensive knowledge transfer capabilities, encompassing both the inflow of external knowledge and its effective incorporation into organizational processes.

The substantial impact of knowledge field activity ($\beta=0.249$, $p<0.001$) on innovation performance represents a particularly novel contribution to existing literature. While previous research has acknowledged the importance of organizational context for innovation, the strong empirical link demonstrated in this study suggests that the creation of active knowledge fields may be more crucial for innovation success than previously recognized. The finding that team cohesion is the only significant dimension of knowledge field activity highlights the importance of social cohesion and collective orientation in innovation processes. This aligns with Nonaka and Takeuchi's (1995) emphasis on the social context of knowledge creation but provides more specific evidence regarding which aspects of this context are most impactful.

The moderate but significant impact of open innovation ($\beta=0.102$, $p<0.05$) on innovation performance presents an intriguing contrast to some previous studies that found stronger direct relationships. This finding suggests that the relationship between openness and innovation may be more complex than previously theorized, potentially

operating through intermediate mechanisms such as knowledge transfer and knowledge field activity. The significant effect of open innovation depth but not breadth challenges the conventional wisdom that emphasizes the value of diverse external connections. Instead, it suggests that in the Chinese context, developing deeper, more substantive relationships with select external partners may be more valuable than maintaining a broader network of more superficial connections. This finding may reflect cultural values of guanxi (relationship networks) and long-term orientation in Chinese business practice.

The finding that knowledge transfer explains the greatest proportion of variance in innovation performance (R^2=0.252) compared to knowledge field activity (R^2=0.215) and open innovation (R^2=0.112) provides important insights into the relative importance of these factors. This suggests that while open innovation strategies may be necessary, they are not sufficient for enhancing innovation performance. Organizations must also develop robust knowledge transfer capabilities and create supportive knowledge field environments to fully capitalize on external collaborations. This hierarchical importance has not been clearly established in previous research and provides valuable guidance for prioritizing organizational investments in innovation capabilities.

The pattern of results across different aspects of innovation performance offers interesting insights into contemporary innovation dynamics in China. The strongest performance in new product development speed (M=5.32) compared to patent applications (M=5.15) suggests that organizations may be prioritizing speed and market responsiveness over formal intellectual property protection. This pattern aligns with observations about the rapid pace of innovation in Chinese markets and the

emphasis on quick commercialization rather than patent-based competition strategies.

The relationships between organizational characteristics and innovation patterns revealed in this study provide important nuance to existing theories about innovation in different contexts. The predominance of mid-sized organizations in the sample and their generally positive innovation performance challenges both the resource advantages of larger organizations and the agility advantages of smaller ones. This suggests that medium-sized enterprises may represent an optimal organizational scale for balancing resource adequacy with organizational flexibility in the Chinese innovation ecosystem.

The divergent results for different dimensions of the same construct (e.g., the significance of open innovation depth but not breadth) highlight the importance of examining these concepts at a more granular level. Many previous studies have treated these constructs as unidimensional, potentially obscuring important nuances in how different aspects contribute to innovation outcomes. This finding cautions against overly simplified models of innovation and emphasizes the need for more nuanced theoretical frameworks.

5.3 Recommendations for Implications

Based on the findings of this study, several important recommendations can be made for organizations seeking to enhance their innovation performance:

First, organizations should prioritize the development of robust knowledge transfer mechanisms, given the strong relationship between knowledge transfer and innovation performance ($\beta=0.313$, $p<0.001$). Specifically, organizations should establish systematic processes for both knowledge acquisition from external sources

and knowledge integration across different organizational units. This might involve creating dedicated knowledge management teams, implementing formal knowledge documentation and sharing systems, and developing metrics to track knowledge flows within the organization. The significant effects of both knowledge acquisition ($\beta=0.211$, $p=0.001$) and knowledge integration ($\beta=0.232$, $p<0.001$) suggest that balanced attention to both processes is necessary for maximizing innovation outcomes.

Second, organizations should invest in creating and maintaining active knowledge fields, particularly focusing on developing team cohesion with innovation partners, which was the only significant dimension of knowledge field activity ($\beta=0.222$, $p=0.047$). This might involve implementing team-building activities, creating shared goals and incentives, establishing regular interaction opportunities, and designing physical and virtual spaces that facilitate collaboration. Organizations should recognize that simply bringing together diverse knowledge sources is insufficient; they must actively cultivate a collaborative environment characterized by strong team orientation and cohesion.

Third, organizations should adopt a strategic approach to open innovation that emphasizes depth rather than just breadth of external relationships. The significant effect of open innovation depth ($\beta=0.120$, $p=0.040$) but not breadth ($\beta=0.076$, $p=0.213$) suggests that organizations should focus on developing deeper, more substantive relationships with select external partners rather than pursuing a larger number of superficial connections. This might involve longer-term collaborative arrangements, more substantial resource commitments, and deeper integration of innovation processes with key external partners. When selecting external partners,

organizations should consider not just the potential knowledge value but also the feasibility of establishing deep collaborative relationships.

Fourth, organizations should recognize the hierarchical importance of the three factors studied, with knowledge transfer having the strongest effect, followed by knowledge field activity and then open innovation. This suggests that investments in innovation capability development should be similarly prioritized, with primary attention to knowledge transfer systems, secondary attention to knowledge field environments, and tertiary attention to open innovation strategies. This hierarchical approach ensures that limited organizational resources are allocated to the capabilities that will yield the greatest innovation returns.

Fifth, organizations should develop integrated innovation management systems that address all three factors simultaneously. The collective impact of these factors (R^2=0.296) is substantially greater than any individual factor, suggesting important complementarities between them. Organizations should consider how their open innovation strategies, knowledge field activities, and knowledge transfer processes can be designed to mutually reinforce each other. For example, open innovation partnerships could be selected partly based on their potential to enhance knowledge field activity, while knowledge transfer systems could be designed specifically to support the types of external knowledge being accessed through open innovation.

Finally, organizations should adopt a balanced approach to innovation metrics, tracking both internal innovation capabilities (such as knowledge transfer efficiency) and external innovation outcomes (such as new product development speed). The study found variation in performance across different innovation outcome metrics,

suggesting that a multi-dimensional approach to innovation performance measurement is necessary. Organizations should develop comprehensive innovation scorecards that capture both the capabilities that drive innovation and the outcomes that result from it.

These recommendations provide actionable guidance for organizations seeking to enhance their innovation performance through more effective management of open innovation, knowledge field activity, and knowledge transfer. By implementing these recommendations, organizations can develop more robust innovation capabilities and achieve better innovation outcomes in increasingly competitive markets.

5.4 Recommendations for Future Research

Based on the findings and limitations of this study, several promising directions for future research can be identified:

First, future research should explore the potential mediating and moderating relationships between the three main variables (open innovation, knowledge field activity, and knowledge transfer) and innovation performance. While this study established the direct effects of these variables, the relatively modest direct effect of open innovation suggests that it might influence innovation performance indirectly through other mechanisms. A more complex model incorporating mediation and moderation effects could provide deeper insights into how these variables interact to affect innovation outcomes. For example, researchers could investigate whether knowledge transfer mediates the relationship between open innovation and innovation performance, or whether knowledge field activity moderates the effectiveness of

knowledge transfer.

Second, longitudinal research designs could significantly enhance our understanding of the causal relationships between the studied variables. The cross-sectional nature of this study limits causal inference, whereas a longitudinal approach would allow researchers to observe how changes in open innovation strategies, knowledge field activities, and knowledge transfer processes affect subsequent innovation performance. Such research could also provide insights into the time lags between interventions in these areas and observable innovation outcomes, which would be valuable for organizational planning and resource allocation.

Third, future studies should incorporate more objective measures of innovation performance to complement the self-reported measures used in this study. While perceptual measures provide valuable insights, they may be subject to various biases. Objective measures such as patent data, new product revenue figures, or innovation efficiency metrics could provide more robust validation of the relationships identified in this study. A multi-method approach combining survey data with archival performance data would be particularly valuable.

Fourth, comparative studies across different cultural contexts could illuminate how the relationships observed in this Chinese sample might vary in other settings. The finding that open innovation depth is more important than breadth may be influenced by Chinese cultural factors such as the emphasis on guanxi and long-term relationship building. Research comparing these relationships across different national cultures could provide important insights into the cultural contingencies of innovation management best practices.

Fifth, more granular research on the specific mechanisms and practices that

constitute effective knowledge transfer and knowledge field activity is needed. This study identified these factors as particularly important for innovation performance, but further research could identify the specific organizational practices, tools, and approaches that most effectively support these capabilities. Case study research and mixed-method approaches could be particularly valuable for developing a more nuanced understanding of these practices.

Sixth, future research should examine how digital technologies and new ways of working affect the relationships observed in this study. The increasing prevalence of digital collaboration tools, virtual teams, and remote work may significantly alter how knowledge fields are cultivated and how knowledge is transferred within and between organizations. Research investigating how these technological and work arrangement changes affect innovation processes and outcomes would provide timely insights for organizations navigating digital transformation.

Seventh, studies focusing on specific industry contexts could provide more tailored insights into how these relationships operate in different settings. The diverse industry sample in this study provides broad generalizability but may obscure important industry-specific patterns. Research focusing on knowledge-intensive industries, manufacturing sectors, or service contexts could reveal how the importance and mechanisms of open innovation, knowledge field activity, and knowledge transfer vary across different industry environments.

Finally, future research could explore the potential negative effects or trade-offs associated with the factors studied. While this research focused on the positive contributions of open innovation, knowledge field activity, and knowledge transfer, there may be diminishing returns, optimal levels, or negative consequences associated

with excessive emphasis on these factors. Research exploring the potential dark sides or non-linear relationships could provide a more complete understanding of how these factors should be managed for optimal innovation outcomes.

By pursuing these research directions, scholars can build on the findings of this study to develop more comprehensive, nuanced, and contextually sensitive theories of innovation management. Such research would have significant value for both advancing academic understanding and providing more precise guidance for organizational practice.

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APPENDIX

ONLINE QUESTIONNAIRE:

Title: The Impact of Open Innovation, Knowledge Field Activity, and Knowledge Transfer Factors Towards Innovation Performance.

Details: This survey research aims to investigate the influence of open innovation, knowledge field activity, and knowledge transfer on innovation performance in organizations. This study is part of a Master of Business Administration research at Bangkok University.

The components of this research will be covered in 5 parts: demographic data, open innovation measures, knowledge field activity measures, knowledge transfer measures, and innovation performance measures.

The information provided will be treated highly confidential and will be used solely for the purpose of academic resources.

Thank you very much for your kind cooperation.

PART 1: Personal Details

Directions: Please choose (✓) the answer that matches your information.

1. Position:
   - ❑ Top manager
   - ❑ Middle manager
   - ❑ Grass-roots manager

2. Department:
   - ❑ Research and development or design
   - ❑ Marketing
   - ❑ Human resources or finance
   - ❑ Production and transport
   - ❑ Other (please specify): _____

3. Form of business ownership:
   - ❑ State-owned and state-controlled enterprise
   - ❑ Private enterprise
   - ❑ Collective enterprise
   - ❑ Sino-foreign joint venture
   - ❑ Wholly foreign-owned enterprise

4. Years of establishment:
   - ❑ Years
   - ❑ 6-10 years
   - ❑ 11-15 years
   - ❑ 16-20 years
   - ❑ 20+ years

5. Number of employees in the company:
   - ❑ 100 or Less
   - ❑ 101-200
   - ❑ 201-300
   - ❑ 301-500
   - ❑ 501-1000
   - ❑ 1000 or more

6. Industry:
   - ❑ Biological, pharmaceutical, new materials and new energy industries
   - ❑ Information transmission, software and information technology industries
   - ❑ Scientific research and technological development industries
   - ❑ Financial industries
   - ❑ Service provider industries
   - ❑ Construction industries
   - ❑ Manufacturing industries
   - ❑ Other (please specify): _____

Part 2: Open Innovation

Directions: Please rate your agreement with the following statements about your organization's open innovation activities using the scale below:

1 = Strongly disagree
2 = Disagree
3 = Somewhat disagree
4 = Neither agree nor disagree
5 = Somewhat agree
6 = Agree
7 = Strongly agree

Open Innovation Breadth

Statement	1	2	3	4	5	6	7
B1. Our enterprise has extensive innovation cooperation with universities, research institutes and other scientific institutions							

Statement	1	2	3	4	5	6	7
B2. Our company has a wide range of innovative cooperation with customers and clients							
B3. Our business has engaged in a wide range of innovative collaborations with organizations up and down the supply chain							
B4. Our business has extensive and innovative cooperation with relevant government departments							
B5. Our firm has a wide range of innovation collaborations with other organizations outside the industry							

Open Innovation Depth

Statement	1	2	3	4	5	6	7
B6. Our enterprise has established close and innovative partnerships with suppliers and customers							
B7. Our enterprise actively participates in innovative activities and collaborative projects in scientific institutions such as universities or research institutes							
B8. Our enterprise actively participates in science and technology activities or conferences organized by relevant government departments or industry associations							
B9. Our enterprise has established close innovation cooperation with research intermediary organizations and science and technology service organizations							
B10. Our firm has established close innovation partnerships with other organizations outside the industry							

Part 3: Knowledge Field Activity

Directions: Please rate your agreement with the following statements about your organization's knowledge field activity using the scale below:

1 = Strongly disagree
2 = Disagree
3 = Somewhat disagree
4 = Neither agree nor disagree
5 = Somewhat agree
6 = Agree
7 = Strongly agree

Statement	1	2	3	4	5	6	7
D1. Our enterprise is able to communicate and exchange information effectively with innovative cooperation partners							
D2. Our firm is able to build a high level of trust with those with whom we collaborate on innovation							
D3. Our enterprise is able to establish a harmonious and upwardly mobile team environment and atmosphere with innovative cooperation partners							

Statement	1	2	3	4	5	6	7
D4. Our firm is able to develop a high level of team orientation and cohesion with innovative cooperation partners							

Part 4: Knowledge Transfer

Directions: Please rate your agreement with the following statements about your organization's knowledge transfer activities using the scale below:

1 = Strongly disagree
2 = Disagree
3 = Somewhat disagree
4 = Neither agree nor disagree
5 = Somewhat agree
6 = Agree
7 = Strongly agree

Knowledge Acquisition

Statement	1	2	3	4	5	6	7
C1. Our enterprise has enhanced access to relevant knowledge in the process of technology development							
C2. Our enterprise has enhanced the acquisition of relevant knowledge in the market development process							
C3. Our enterprise has enhanced access to knowledge related to the manufacturing process							
C4. Our enterprise has enhanced external knowledge acquisition in other aspects							

Knowledge Integration

Statement	1	2	3	4	5	6	7
C5. Our firm effectively integrates internal organizational knowledge with externally acquired knowledge							
C6. Our enterprise has effectively integrated knowledge from different departments, groups or organizations							
C7. Our organization has effectively integrated knowledge from different fields							
C8. Our business has effectively integrated the organization's operational processes or organizational structure							

Part 5: Innovation Performance

Directions: Please rate your agreement with the following statements about your organization's innovation performance compared to your competitors using the scale below:

1 = Strongly disagree

2 = Disagree
3 = Somewhat disagree
4 = Neither agree nor disagree
5 = Somewhat agree
6 = Agree
7 = Strongly agree

Statement	1	2	3	4	5	6	7
E1. Our organization has faster time to market for new products compared to other companies							
E2. Our organization has higher market share of new products compared to other companies							
E3. Our organization has higher success rate in product innovation compared to other companies							
E4. Our organization has higher technological content in new products compared to other companies							
E5. Our organization has more patent applications than other companies							

End of Questionnaire. Thank you for completing this questionnaire. Your contribution to this research is greatly appreciated!

BIODATA

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