Volume: 27, Issue: 1
Page: 16-34
2023

International Journal of Science and Business

Journal homepage: ijsab.com/ijsb

The Relationship between Innovation Network Resource Integration, Dual Innovation, and Innovation Performance: A Case Study of Intelligent Manufacturing Enterprises in the Yangtze River Delta Region of China

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Abstract

The prerequisite for enterprises to carry out innovative activities is to effectively integrate various resources and play the role of different resources. According to the theory of resource dependence, an enterprise's own innovation resources are relatively single, and it is difficult to carry out technological innovation with its own resources and capabilities. Currently, the innovation network is an important source for manufacturing enterprises to obtain complementary resources. In recent years, intelligent manufacturing enterprises in the Yangtze River Delta region have achieved increasingly remarkable results in terms of economic benefits, development scale, innovation achievements, and international competitiveness. But at the same time, there are still shortcomings in the quality of development, and it is necessary to continuously strengthen innovation leadership, improve innovation performance, and drive development with innovation. Based on relevant theories such as innovation network, resource integration, ambidexterity innovation, and the intermediary role of environmental dynamism, this paper objective and is to close the above mentioned gap/s of study and the research design is by surveying relevant data on the innovation and upgrading of intelligent manufacturing enterprises in the Yangtze River Delta region, and uses AMOS and SPSS software to empirically test the hypothetical model. The findings and conclusions and innovations of this paper are as follows: The situational factors that affect the innovation practice of intelligent manufacturing enterprises are revealed. This paper studies the mediating effect of environmental dynamism change factors on corporate innovation activities (exploratory innovation and exploitative innovation) and innovation performance.

IJSB
Accepted 15 June 2023
Published 17 June 2023
DOI: 10.58970/IJSB.2162

ISSN: 2520-4750 (Online) 2521-3040 (Print)

Keywords: *Innovation Network, Resource Integration, Dual Innovation, and Innovation Performance.*

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Introduction

In 2020, my country's GDP is 1000 trillion yuan, of which the output value of intelligent manufacturing enterprises accounts for about 8.8% of GDP. The overall scale of intelligent manufacturing has been greatly improved. In recent years, my country has developed many key scientific and technological innovations in the high-tech field. From manufacturing to creativity. On the one hand, thanks to the Chinese government's proposal to build an independent innovation-oriented country, focusing on increasing integrated innovation, original innovation, and introduction of re-innovation, a collaborative innovation system with intelligent manufacturing enterprises as the main body and market-oriented has been formed; On the other hand, thanks to the dual advantages of institutional innovation and technological innovation of intelligent manufacturing enterprises (Yang 2023; Wu 2021). Practice has shown that high-tech intelligent manufacturing enterprises with technical knowledge as strategic resource elements have possessed certain innovation capabilities and can manufacture and produce high-tech products that are internationally competitive. Today's high-tech is changing with each passing day, competition is becoming increasingly fierce, and innovative products and innovative achievements are constantly emerging. Under this realistic background, the key to realizing the fundamental transformation of my country's social and economic development mode is technological innovation. The transformation and upgrading of the intelligent manufacturing industry should also be an important way to change innovation-driven development. However, the strategic choices presented by the industrial structure and industrial system and the strategic trend of the industrial system are only changes in the overall characteristics. Chesbrough (2003) pointed out that enterprises can enhance their own innovation capabilities by integrating, utilizing, and re-innovating various resources of external entities. Many studies have also confirmed that the success of an enterprise's innovation depends on whether it can select and absorb the extensive degree of external knowledge. Therefore, enterprises need to integrate the innovation resources contained in each subject in the external innovation network, so as to promote the technological innovation process of manufacturing enterprises. Fu et al, 2015 believe that enterprise technological innovation is more likely to exist in the interactive relationship between stakeholders. Practice shows that domestic and foreign enterprises have begun to pay attention to cooperation and communication with stakeholders. In addition, Granovetter (2005) believes that the economic activities of enterprises should be considered in the context of interpersonal relationships. However, from the perspective of the creator of the innovation network—the trust at the individual level of the person in charge of the enterprise, the sharing of innovative knowledge and the relationship network, and how the person in charge of the enterprise, as the protagonist of the enterprise, how to promote the interest coordination mechanism of the technological innovation of the enterprise is one of the key issues that need to be resolved urgently in enterprise innovation .In short, the innovation network has gradually become an organizational form that drives enterprise innovation. It is more realistic and urgent for enterprises to make better use of external resources and incorporate network relationship capital into the scope of enterprise innovation capability improvement. Under the premise of considering the characteristics of high-tech intelligent manufacturing enterprises, this research will focus on how the intelligent manufacturing enterprises in the Yangtze River Delta region in the transformation and upgrading of high-tech industries can use the resources in the innovation network to achieve the improvement of enterprise technology innovation performance through organizational ambidexterity innovation , to explore the relationship between resource integration , ambidextrous (exploratory and exploitative) innovation and innovation performance in manufacturing enterprises under dynamic environmental changes. This is a new attempt, and it is also a realistic problem that manufacturing enterprises need to solve urgently. (Li & Xiang 2008; Granovetter 2005; Jones et al. 2001)

Problem Statement

The research contents on resource integration mainly focuses on the relationship between resource integration and dynamic capabilities, the intermediary role of resource integration between enterprise development orientation and innovation performance, etc. These studies analyze research on enterprise resource integration and innovation performance. However, for intelligent manufacturing enterprises, it is also necessary to continuously integrate and utilize innovative resources to achieve continuous innovation and development, and the relationship between resource integration and innovation performance still needs to be further explored. Based on the resource theory, the tangible and intangible resources of an enterprise are transformed into unique capabilities, which are the basis of an enterprise's sustainable competitive advantage. Through a series of integration activities of network resources, enterprises can not only explore, combine, and utilize existing resources, but also promote the development of new technologies and new products. Therefore, network resource integration can promote exploratory and exploitative innovation, and then improve the innovation performance of intelligent manufacturing enterprises. From this perspective, the relationship between resource integration, ambidexterity innovation and the innovation performance of smart manufacturing enterprises is worth exploring. However, at present, the integration of innovative network resources to promote the innovation of intelligent manufacturing enterprises and help China's intelligent manufacturing enterprises to catch up and climb to the top of the value chain remains to be studied. Secondly, the theory of ambidexterity innovation has attracted the attention of many scholars in the field of management in recent years. The concept of ambidexterity was first born in the field of strategic management. At the end of the 1970s, Ducan first proposed the concept of the dual structure of the enterprise. Later, some scholars gradually paid attention to and began to study the duality of the organization. The representative one is March. He continued Duncan’s definition of the duality, learning from the organization 's perspective distinguishes between exploration and exploitation. Exploration is expressed as search, flexibility, exploration, and creation of new products; utilization is expressed as selection, production, execution, etc. The dual concept with innovation management for the first time and divided it into exploratory innovation and exploitative innovation according to the knowledge base and degree of innovation. Subsequently, many scholars conducted further research and extensive discussions on the cause and effect of ambidexterity innovation. However, it is not difficult to find that the current research on ambidexterity innovation pays more attention to the independent innovation behavior and innovation ability within the enterprise, and there are relatively few studies on the internal innovation of enterprises integrating external resources from the perspective of open innovation. In addition, there are relatively few studies on the causes and consequences of ambidexterity innovation in combination with the macro environment, especially under dynamic environmental changes. Therefore, this article will use empirical research methods to explore the relationship between integration of innovative network resources and ambidexterity innovation under the realistic background of dynamic changes in the technical environment and market environment.

Research objectives

The core goal of this paper is to study the concepts of integration of innovative network resources and ambidexterity innovation from the perspective of resource-based theory and open innovation, clarify their connotations and characteristics, improve the corresponding measurement scales, and explore integration of innovative network resources, the connection between ambidexterity innovation, environmental dynamism, and innovation performance. Thus, the research objectives are established as: 1. To explore the integration of innovative network resources affect innovation performance. 2. To explore how does integration of

innovative network resources affects ambidexterity innovation. 3. To evaluate what impact does ambidexterity innovation has on innovation performance. 4. To evaluate how does ambidexterity innovation plays a mediating role between integration of innovative network resources and innovation performance. 5. To evaluate how does environmental dynamism plays a moderating role.

Research questions

Based on the above problem statement, the specific questions of this research are as follows :1. How does integration of innovative network resources affect innovation performance? 2. How does integration of innovative network resources affect ambidexterity innovation? 3. What impact does ambidexterity innovation have on innovation performance? 4. Does ambidexterity innovation play a mediating role between integration of innovative network resources and innovation performance? 5. Does environmental dynamism play a moderating role?

Scope of study

This study takes China's manufacturing industry as the research object. Combining resource-based theory, resource-dependence theory and ambidexterity innovation theory, it explores the innovation and development of intelligent manufacturing enterprises, in order to provide reference and reference for intelligent manufacturing enterprises to explore new development momentum. At the same time, based on the development status of China's manufacturing industry and enterprise management practice, combined with resource-based view, resource dependence theory, environmental theory, ambidexterity innovation and other related theories, this study explores how manufacturing enterprises can integrate through the integration of innovative network resources in the process of innovation. It promote enterprises to carry out exploratory and exploitative innovation, and then improve innovation performance, explore the path for manufacturing enterprises to improve innovation performance, and explore the mediating role of environmental uncertainty. While expanding the theoretical research on resource integration and manufacturing innovation, it provides a reference for exploring new kinetic energy for manufacturing and improving the position of China's manufacturing industry in the global value chain.

Literature review

Integration of Innovative Network Resources

As early as 1996, some scholars discovered that the network is an institutional arrangement with innovative characteristics formed by the interaction and interconnection of various participating elements in the region. It can make innovations occur in multiple layers and links. It provides enterprises with broader learning opportunities and is a regional governance structure that is conducive to innovation. The network is a new innovative organizational form outside the hierarchical organization and the market, between the hierarchical form and the market form. It is more stable than the market and more flexible than hierarchical organization. The innovation network can activate resources and information, increase flexibility, reduce uncertainty, and enhance enterprise innovation capabilities. In the current complex and changeable regional economic development environment, the innovation network has become a new combination and operation method adopted by various actors. The regional innovation system of the network organization, that is, the regional innovation network, as a new form of regional adaptation to the characteristics of the knowledge economy, will undoubtedly become the organizational structure form for the development of the regional innovation system. The concept of network first appeared in sociological research. In sociological research, a social network is a network composed of nodes connected by a group of special types of social relations. Later, economists drew on the concept of social network, replaced social relations

with inter-firm relations, and replaced individuals in nodes with enterprises, and proposed the concept of enterprise network. The innovation participants are connected through various channels to form different networks. The innovation network is the networking behavior of innovation participants through interconnection in the innovation process. The innovation network will affect innovation activities. " Innovation Network " originates from the research collection on "Innovator Network" in the important journal "Research Policy" in the field of “innovation research network", " innovation network " and other concepts, and compared the networking behavior of enterprises in the innovation process to "innovation networking". Freeman (1991) quoted and accepted Imai and Baba's definition of innovation network and believed that innovation network is a basic institutional arrangement to deal with systematic innovation. Innovation network types are joint ventures and research companies, cooperative research and development agreements, technology exchange agreements, direct investment, license agreements, subcontracting, division of production and supplier networks, research associations, government-funded joint research projects, etc. The the innovation network is an inter-organizational network. In many cases, although an organization with diversified industries may internalize an inter-industry network, an inter-industrial network necessarily means an inter-organizational network. These inter-organizational networks include technological cooperation, joint venture, strategic alliance, consortium, etc. Wu (2021) analyzed the structural characteristics and performance driving mechanism of the regional industry-university-research collaboration innovation network based on the perspective of industry-university-research collaboration innovation under the RIS framework. A new organizational form for collaborative innovation of various heterogeneous knowledge subjects such as the government. Yang (2023) believes that the enterprise innovation network is the carrier of enterprise innovation activities, that is, the overall structure of various formal and informal cooperative relations formed around the enterprise in the process of technological innovation. He believes that the innovation network is a "hybrid" organizational form, a special cooperative relationship, and the sum of all innovative cooperative relationships of an enterprise, which is different from cooperation and alliances.

Innovation Performance

Innovation performance is a research direction focused on in the fields of management and economics. It is an evaluation of the innovation efficiency and effect of an organization or an individual and consists of two parts: process performance and output performance. Yang (2023) research point of view on innovation is that innovation is the recombination of production factors by enterprise decision makers to realize enterprise benefits. Scholars' initial innovation theory was the use of new ideas, new methods, or major perception changes. Innovation performance evaluation are to help enterprise decision-makers understand the status quo of enterprise innovation, make reasonable innovation decisions, improve the level of enterprise innovation, and reduce the risks caused by enterprise innovation. Enterprise innovation is a very complicated and lengthy process, and there is no unified standard system for performance evaluation at home and abroad. There are also several methods of performance measurement: From the perspective of innovation process, scholars such as Yang (2023) based on the generation, promotion, and completion of ideas From the perspective of innovation input, scholars believe that R&D input, total innovation expenditure, patents Not only that, but also the final performance can be measured from the number of patents owned by the company and the number of new products produced; from the perspective of innovation output, Yang (2023) believes that it can be used Enterprise performance is measured by four indicators: value-added of new product production, value-added of patent quantity, value-added of R&D investment and value-added of return on investment.

Ambidexterity Innovation

Scholars have divided technological innovation based on different perspectives. Robert Duncan first used the term "Ambidexterty" to describe organizational capabilities in the field of management. Later, Benner & Tushman introduced ambidexterty into innovation activities, and ambidexterity innovation was born. He believes that exploratory innovation is a transformational innovation. It is an innovative way for enterprises to continuously learn and explore new knowledge, new technologies and new products to enhance their competitiveness, and to continuously adapt to new needs in the future. Exploratory innovation is a slow innovation to continuously improve and innovate existing products, services, and technologies to meet the needs of existing customers or already developed markets. It is an innovative way that can improve the operating efficiency of enterprises. From the perspective of participants, it can be divided into independent innovation and cooperative innovation. From the perspective of knowledge acquisition methods, it can be divided into open innovation and closed innovation. Judging from the degree of impact on the existing market, it can be divided into continuous innovation and destructive innovation. From the perspective of the extent of innovation, it can be divided into breakthrough innovation and incremental innovation. From the perspective of organizational strategy initiative, it can be divided into exploratory innovation and exploitative innovation Wu (2021) .

Environmental Dynamism

Enterprises do not operate, survive, compete, or be eliminated in an independent and static environment at any time. Changes in the external environment affect the development of enterprises all the time. There are many environmental factors that will affect the development of intelligent manufacturing enterprises. Enterprises must face this reality and deal with changes in environmental dynamism to maintain their high efficiency. Uncertainty means that decisions must be made without obtaining sufficient information about environmental factors, and it is difficult for decision makers to estimate changes in the external environment. Changes in environmental dynamism increase the risk of various strategic failures of enterprises, making it difficult for enterprises to calculate the costs and probabilities related to various strategic options. Domestic scholars Li and Xiang (2008) compared the impact mechanism of environmental dynamism on company performance to the model analysis of atmospheric disturbances on aircraft flight, and concluded that environmental dynamism has a positive impact on company entrepreneurial performance. Therefore, in recent years, environmental dynamism has also become management science Enterprise research is an important research variable in the literature. Searching for the keyword environmental dynamism from platforms such as CNKI also reveals that from 2017 to 2020, the related research on environmental dynamism is obviously increasing year by year. From the above research, scholars It is generally recognized that the change of environmental dynamism is a multidimensional construct, and a very comprehensive and in-depth discussion has been made on the division of the dimensions of environmental dynamism change from different perspectives.

Methodology

Research Design

This research will strive to achieve the combination of normative research and empirical research, qualitative research and quantitative research, and the combination of literature review and survey interviews. It generally follows the methods of literature review and theoretical deduction—qualitative research—hypopaper— —questionnaire survey—empirical analysis—formation of conclusion" research ideas are gradually deepened. The specific research methods are as follows:

1. Literature review and theoretical deduction

In order to explore the mechanism of integration of innovative network resources, ambidexterity innovation network and key network dimensional features on technology innovation performance , and the intermediary role of environmental dynamism , it is first necessary to systematically collect and read previous research related to this research topic analyze. The author has extensively consulted domestic and foreign literature such as technological innovation theory, high-tech enterprise growth theory, resource concept theory, social network and social capital theory, stakeholder theory, and ambidexterity innovation research. The intermediary role of ambidexterity innovation and environmental dynamism is systematically sorted out, and the mathematical expression, various measurement roles, attributes and status of innovation network resources are basically summarized. Combining the subject of this research with the actual background, collect domestic and foreign literature on the relationship between integration of innovative network resources , ambidexterity innovation, innovation performance , and environmental dynamism , and analyze the internal influence of innovation network resources on technology innovation performance through ambidexterity innovation mechanism, the intermediary mechanism of environmental dynamism , lays a literature foundation for the study of integration of innovative network resources , ambidexterity innovation and innovation performance , and the mechanism of environmental dynamism affecting the technological innovation performance of intelligent manufacturing enterprises .

2. Quantitative empirical research

Based on literature research and exploratory research, the types and characteristics of related variables are defined, and the relationship between variables is deduced by combining normative analysis and exploratory research results, and the conceptual model and hypopaper of this study are proposed. The rationality and applicable conditions of propositional assumptions are tested by means of large sample questionnaire survey and statistical analysis. Based on the distribution and collection of questionnaires, relevant statistical analysis and hypopaper testing were carried out by using SPSS22.0 software.

Data collection

In terms of the selection of the distribution area, the questionnaires in this study are distributed to smart manufacturing enterprises in the Yangtze River Delta. The reason is determined by the availability of the questionnaires and the research objects. In terms of the selection of distribution objects, the distribution objects of the research questionnaire are mainly employees who have been employed for more than 5 years, because information such as the development of enterprise innovation activities and innovation performance involves the level of enterprise operation and management, and it is difficult for new employees to make accurate judgments and opinions. Older employees can clearly know the production and operation of the enterprise, so it is more reasonable to use them as the object of questionnaire distribution. In terms of distribution channels for questionnaires, three methods are mainly used for distribution and collection of questionnaires: on-site distribution, network distribution and entrusted agency distribution. Among them, ① On-site distribution is mainly through the MBA class, DBA class, and units with business contacts of Asia Metropolitan University. The paper version of the questionnaire is distributed in spare time and collected on the spot. A total of 220 questionnaires were distributed and 201 valid questionnaires were recovered. share. ②Online distribution mainly distributes to relatives and friends who hold management positions in manufacturing enterprises to further increase the number of questionnaires recovered. A total of 220 questionnaires were distributed and 200 valid questionnaires were recovered. ③ The entrusted institution distributes through the government department that cooperates with my research team to contact some manufacturing companies to distribute. A total of 180 questionnaires were distributed and 180

valid questionnaires were recovered. The questionnaire is mainly distributed to employees who have worked in manufacturing enterprises for more than 5 years to enhance the reliability of the data. In the end, 620 questionnaires were distributed, and 581 questionnaires were returned. After excluding missing and wrongly filled questionnaires, a total of 535 valid questionnaires were recovered, and the questionnaire recovery rate was 86.29%. According to the statistics of 535 valid questionnaires, the information shown in Table 3-6 is obtained. This study explores the mechanism of action among factors such as integration of innovative network resources, ambidexterity innovation , and innovation performance at the enterprise level . The middle and high-level managers and technical managers have a relatively full understanding of it, so choosing this type of respondent is in line with Research requirements.

Target population

The term "target population" refers to a certain group of people that the researchers would like to focus their attention on while carrying out the study. Wu (2021). There are many distinct target groups that may be found in various types of research; therefore, we need to choose which target population will provide us with the best opportunities to collect data and information for our study. The employees of intelligent manufacturing enterprises in the Yangtze River Delta region of China are the population that will serve as the focal point of this investigation. In terms of the selection of distribution objects, the distribution objects of the research questionnaire are mainly employees who have been employed for more than 5 years, because information such as the development of enterprise innovation activities and innovation performance involves the level of enterprise operation and management, and it is difficult for new employees to make accurate judgments and opinions.

Sampling frame and sampling location

The Yangtze River Delta region of China were the focus of this research. The sampling frame consisted of all employees of intelligent manufacturing enterprises in the Yangtze River Delta region of China that participated in this study. The Yangtze River Delta region of China were chosen as the locations for the sample collection for this study.

Sampling size

The size of the sample that is collected from the whole population is known as the sampling size. The size of the sample should be large enough to eliminate the possibility of sampling errors and biases. Full population research will be impractical and prohibitively expensive to carry out; instead, establishing a sampling size will be the most effective way to cut down on the time and money required to carry out a study. For the purpose of our study, 620 questionnaires were distributed, and 581 questionnaires were returned. After excluding missing and wrongly filled questionnaires, a total of 535 valid questionnaires were recovered, and the questionnaire recovery rate was 86.29%.

Questionnaire design and instrumentation

The variables involved in this study are all constructs, and it is necessary to use questionnaires for research data collection. The items included in the questionnaire have a decisive impact on the reliability and validity of the research results, so the quality of the questionnaire design will be crucial to this study. This questionnaire consists of two parts:

(1) The basic information of the company and the basic situation of its employees, mainly including the industry to which the company belongs, the number of employees, the company's revenue, the type of ownership, the position and age of the respondents (middle and high-level managers), etc.

(2) Specific variables involved in the research, such as integration of innovative network resources, ambidexterity innovation, environmental dynamism, and innovation performance, and list specific measurement items. At the same time, since the integration of innovative network resources, ambidexterity innovation, innovation performance, environmental dynamism and other variables involved in this study are relatively complex, multi-item measurement should be carried out on the premise of ensuring the internal consistency of the measurement items during empirical analysis. When redesigning the questionnaire, the respondents did not understand the concept of variables, could not understand the content of the measurement items, could not answer according to the actual situation, and were unwilling to answer the four reasons, which made the final measurement results produce irreversible errors. Therefore, it is necessary to reduce the corresponding errors through certain measurement methods and research measures.

Measurement of Integration of Innovative Network Resources

Many scholars have conducted research and attempted to measure innovation networks and resource integration. This paper divides the integration of innovative network resources into two dimensions: vertical network integration and horizontal network integration. Among them, vertical network integration refers to the ability of core enterprises to integrate innovation resources such as suppliers, distributors, and customers, and horizontal network integration refers to the ability of core enterprises to integrate innovation resources of government, universities, scientific research institutes, financial institutions, and other institutions. After repeated discussions by the research group, the measurement scale and items for integration of innovative network resources were preliminarily determined , specifically including: the company can obtain technical information and technical knowledge from suppliers, the company can obtain market dynamic information provided by distributors, the company can obtain the actual needs of users and information feedback, the company obtains relevant government policy information and policy support, the company can recruit knowledge talents from universities and colleges, the company can obtain and absorb and transform resources such as knowledge and patented technologies of scientific research institutes, the company can obtain financial information from financial institutions and obtain financial resource support, the company can effectively absorb technical information from technical intermediary service agencies, and the company can obtain technical information support from relevant industry associations. The measurement scale of integration of innovative network resources is shown in Table 3-1.

Table3- 1Integration of Innovative Network Resources Measurement Scale

Measurement of Ambidexterity Innovation

item	two dimensions	serial number	content	in accordance with
innovation network resource integration	Vertical Innovation Network Network resource integration	1	The company has access to technical information and technical knowledge from suppliers	Eisenhardt & Martin (2000); Cui Yonghua (2011); Fu Binghai (2015)
		2	The company can obtain market dynamic information provided by dealers	
		3	The company can obtain the actual needs and information feedback of users	
	Horizontal Innovation Network Network resource integration	4	The company obtains relevant government policy information and obtains policy support	
		5	The company can recruit knowledge talents from universities and colleges	
		6	The company can obtain and absorb and transform resources such as knowledge and	

			patented technologies of scientific research institutes	
		7	The company can obtain financial information from financial institutions and obtain financial resource support	
		8	The company can effectively absorb technical information from technical intermediary service agencies	
		9	The company can obtain technical information support from relevant industry associations	

Based on the degree of innovation carried out by the organization and its knowledge base, ambidexterity innovation can be divided into exploratory innovation and exploitative innovation. Among them, exploratory innovation refers to the innovative mode in which enterprises develop new markets and meet new demands based on new knowledge and technologies. Exploitative innovation is an innovative model in which enterprises refine market and customer needs based on their original knowledge. The measure exploratory innovation and exploitative innovation, each containing 4 items. Among them, exploratory innovation mainly involves: the company continues to launch a new generation of products, the company develops a variety of products, and the company seeks new and promising new technologies; exploitative innovation measures: based on the previous technology, the company's products .There are 7 items to improve, improve the performance of existing products, improve existing production processes and processes, improve product quality, and continuously improve product production efficiency through technological improvement. See Table 3-2 for the ambidexterity innovation measurement scale.

Table3- 2Ambidexterity Innovation Measurement Scale

item	two dimensions	serial number	content	in accordance with
ambidexterity innovation	exploratory innovation	1	The company continues to launch a new generation of products	March (1991); Lavie et al. (2010); Kam Ching Xian (2017)
		2	The company has developed a variety of products	
		3	The company seeks new and promising new technologies	
	exploitative innovation	4	Improve the company's products based on previous technologies	
		5	Improve the performance of existing products	
		6	Improve the existing production process and flow, improve product quality	
		7	Continuously improve the production efficiency of products through technological improvement	

Measurement of Environmental Dynamism

Regarding environmental uncertainty, many scholars have attempted variable measurement. In this paper, reviewing previous literature on the definition of environmental uncertainty, refer to Wu (2021). The scholar's measurement scale uses 6 items to measure changes in environmental dynamism. Including: the technological innovation of the industry changes rapidly, the market demand for products changes rapidly, it is difficult to predict market demand, the marketing strategy of competitors is difficult to predict, the cycle of new technology application in the industry is relatively short, and the competition of products in the market very intense. The measurement scale of environmental dynamism is shown in Table 3-3.

Table3- 3Environmental Dynamism Measurement Scale

item	serial number	content	in accordance with
environmental dynamics	1	Technological innovations in the industry change rapidly	Milliken (1987); Peng Wei (2015); Xie Yongping (2017)
	2	Market demand for products changes rapidly	
	3	Difficult to predict market demand	
	4	Competitors' marketing strategies are difficult to predict	
	5	The cycle of new technology application in the industry is relatively short	
	6	Products are highly competitive in the market	

Measurement of Innovation Performance

Measures the innovation performance of enterprises through 5 measurement items. 5 items include: Our products contain first-class advanced technology and technology, our new product development success rate is relatively high, the number of our patent applications continues to increase, our innovative products have a good response in the market, and our ability to compete with industry competitors launch new products faster. The innovation performance measurement scale is shown in Table 3-4.

Table3- 4Innovation Performance Measurement Scale

item	serial number	content	in accordance with
innovation performance	1	Our products contain first-class advanced technology and craftsmanship	Laurs en et al (2010); Guo Jingjing and others (2017)
	2	Our new product development success rate is relatively high	
	3	Our number of patent applications is constantly increasing	
	4	Our innovative products are well received in the market	
	5	We can launch new products faster than industry competitors	

Findings

Demographic Profile

Table 4-1 conducts a descriptive statistical analysis of the samples in terms of enterprise type, industry distribution, enterprise size and revenue status.

Table4- 1Questionnaire Survey Statistics

Category	Item name	Frequency	Proportion (%)
gender	male	365	68.22
	female	170	31.78
age	25 and under	35	6.54
	26～35	338	63.18
	36～45	118	22.06
	46 years and over	44	8.22
academic qualifications	PhD	10	1.87
	master	91	17
	undergraduate	298	55.7
	College and below	136	25.4
Position	top management	13	2.43
	middle manager	34	6.36
	technical manager	46	8.6
	other	442	82.61
type of enterprise	State-owned enterprises	33	6.17
	Private Enterprise	430	80.37
	Foreign companies	32	5.98
	other	40	7.48

industry name	Pharmaceutical and Medical Manufacturing	104	19.44
	Aerospace Equipment Manufacturing	30	5.61
	chemical manufacturing	33	6.17
	Office Equipment Manufacturing	134	25.05
	Instrumentation Manufacturing	72	13.46
	Electronic Communication Equipment Manufacturing	155	28.97
	other	7	1.31
Developers as a percentage of total company headcount	<5%	122	22.8
	5%～10%	326	60.93
	11%～20%	54	10.09
	More than 20%	33	6.168
Number of employees	50～300	18	3.36
	301～800	300	56.07
	801～1500	165	30.84
	More than 1500	52	9.72
operating income	10 million to 200 million	59	11.03
	200 million to 1 billion	197	36.82
	1 billion to 5 billion	234	43.74
	More than 5 billion	45	8.41

Reliability and Validity

Reliability test

Reliability, also known as reliability, refers to the degree of consistency of the results obtained when the same method is used to repeatedly measure the same object, that is, the degree of reliability of the measurement data. For the same question in the same questionnaire, if the same respondent repeatedly answers the question for 3 consecutive days, and the answers are inconsistent every day, it means that the reliability of the survey results for this question is low. If you choose the same answer or an answer with small differences for 3 days, it means that the reliability of the survey results is high under the condition of excluding systematic errors. Reliability indicators are mostly represented by correlation coefficients, that is, the correlation coefficients of two sets of data obtained from the same tested sample are used as indicators for measuring consistency, which are called reliability coefficients. In the reliability test of data, the reliability test is a very critical test link. The reliability test uses the same method to measure and survey the same object to test the consistency and stability of the questionnaire results, that is, whether the measurement scale can measure the target variable stably, so the reliability test can also be a reliability test. Reliability testing can generally be achieved through the internal consistency of the scale. This study mainly uses Cronbach's alpha as the criterion to test the internal consistency of the scale. Cronbach's alpha or Cronbach's α is a statistic , which refers to the average value of the half-half reliability coefficients obtained by all possible item division methods of the scale , and is the most commonly used reliability measurement method . It was first named by American educator Lee Cronbach in 1951. The Cronbach α reliability coefficient is currently the most commonly used reliability coefficient, and the calculation formula is shown in formula (1).

$$\alpha = \frac{K}{\mathrm{K}-1}\left(1 - \frac{?_{\mathrm{i}=1}^{K} \mathrm{S}_{\mathrm{i}}^{2}}{\mathrm{S}_{X}^{2}}\right) \quad (1)$$

In formula (1), K — the sample size of the questionnaire; S_{X}^{2} — the variance of the total sample, that is, the variance of the total score of each respondent on each topic of a questionnaire; $\mathrm{S}_{\mathrm{i}}^{2}$ — the variance of the current observation sample, that is, the variance of each survey The variance of the ratings for a particular item. Usually the value of Cronbach's alpha coefficient is between

0 and 1. If the α coefficient does not exceed 0.6, it is generally considered that the internal consistency reliability_is insufficient. When it reaches 0.7-0.8, it means that the scale has considerable reliability, and when it reaches 0.8-0.9, it means that the reliability of the scale is very good. Some scholars believe that the Cronbach's alpha coefficient should be at least 0.8 in basic research, and the Cronbach's alpha coefficient should be at least 0.7 in exploratory research. Refer to Table 3.6 for the range of coefficient values.

Table3- 5Coefficient value reference table

Cronbach α	Reliability
α ≤ 0.6	Very poor, the scale needs to redesign the items
0.6 ≤ α < 0.7	Very low, the scale should be revised, but still loses its value
0.7 ≤ α < 0.8	mediocre but acceptable
0.8 ≤ α < 0.9	have considerable reliability

The reliability scale has two parameters: the corrected total correlation (CITC), and the alpha coefficient with the term removed. Corrected Total Correlation (CITC) The Pearson correlation coefficient between a specified term and the remaining terms, reflecting the degree of correlation between the term and the remaining terms. See formula (2) for the expression.

$$CITC = \rho(X, Sum) = \rho(X, Y + Z + \cdots) \quad (2)$$

The α coefficient of the deleted item specifies the α coefficient between the remaining items after the item is deleted and reflects the influence of the removal of the item on the reliability of the remaining items. It can be seen from the formula of α that the number of items involved in the analysis of the reliability coefficient cannot be less than 2, otherwise it cannot be calculated. Generally, when the number of items is too large, the α reliability coefficient will be too large, so as many samples as possible should be arranged to participate in the reliability test. Before the official survey, the CITC and the α coefficients with items deleted can be used to test the reliability of the pre-investigation, and generally around 100 surveys can be conducted. In this stage, when CITC<0.4 or the α coefficient of the deleted item is significantly higher than that of other items, the deleted α coefficient can be selected. The reliability coefficient Cronbach α belongs to the internal consistency coefficient, which only analyzes the reliability of the data on the mathematical level and has reference significance. If there are reverse questions in the sample, that is, the degree direction of the questions in the question setting is opposite to that of most of them, the value direction of this item should be reversed before participating in the calculation. This study conducted a reliability test on the scale, and the results are shown in Table 5-2. It can be found that the coefficients of the integration of innovative network resources, ambidexterity innovation, environmental dynamism and innovation performance scales are 0.915, 0.812, 0.848 and 0.889 respectively, all of which are above 0.8, indicating that the scale used in this study has a good level of reliability. In addition, this paper also conducted a reliability test on the total scale, and the Cronbach's alpha coefficient reached 0.925 (greater than the Cronbach's alpha coefficients of all subscales), indicating that both the total scale and the subscales have passed the reliability test.

Table3- 6 Reliability test of each variable

item	content	CITC	Term Deleted Coefficient Cronbach-α	Cronbach-α coefficient
Integration of innovative network resources	The company has access to technical information and technical knowledge from suppliers	0.761	0.885	0.915
	The company can obtain market dynamic information provided by dealers	0.749	0.911	
	The company can obtain the actual needs and information feedback of users	0.718	0.909	

	The company obtains relevant government policy information and obtains policy support	0.729	0.987	
	The company can recruit knowledge talents from universities and colleges	0.747	0.912	
	The company can obtain and absorb and transform resources such as knowledge and patented technologies of scientific research institutes	0.756	0.912	
	The company can obtain financial information from financial institutions and obtain financial resource support	0.643	0.909	
	The company can effectively absorb technical information from technical intermediary service agencies	0.629	0.908	
	The company can obtain technical information support from relevant industry associations	0.687	0.907	
Ambidexterity innovation	The company continues to launch a new generation of products	0.862	0.747	0.812
	The company has developed a variety of products	0.602	0.989	
	The company seeks new and promising new technologies	0.889	0.729	
	Improve the company's products based on previous technologies	0.681	0.811	
	Improve the performance of existing products	0.712	0.788	
	Improve the existing production process and flow, improve product quality	0.677	0.812	
	Continuously improve the production efficiency of products through technological improvement	0.658	0.811	
Environmental dynamics	Technological innovations in the industry change rapidly	0.762	0.839	0.848
	Market demand for products changes rapidly	0.671	0.859	
	Difficult to predict market demand	0.742	0.838	
	Competitors' marketing strategies are difficult to predict	0.751	0.839	
	The cycle of new technology application in the industry is relatively short	0.564	0.865	
	Products are highly competitive in the market	0.712	0.847	
Innovation performance	Our products contain first-class advanced technology and craftsmanship	0.773	0.853	0.859
	Our new product development success rate is relatively high	0.601	0.887	
	Our number of patent applications is constantly increasing	0.789	0.848	
	Our innovative products are well received in the market	0.728	0.857	
	We can launch new products faster than industry competitors	0.769	0.849	
Total scale Cronbach-α alpha coefficient				0.925

Validity test

Validity analysis refers to the analysis of scale measurement expression to the accuracy of measurement indicators. There are many methods of validity analysis, among which item analysis , independent criterion measure validity analysis and factor analysis are often used in communication research . Item analysis is mainly to measure the difficulty and discrimination of various items in the scale, and the scale with moderate difficulty and high discrimination is selected as the effective scale. The independent criterion measurement analysis method mainly uses a certain independent validity as the criterion and basis of validity analysis, and each item of the scale is correlated with this independent criterion for analysis . Items that do not reach a significant level are invalid items, while those that reach a significant level are valid scales. Factor analysis is the most ideal method of validity analysis. Because only it can measure the validity analysis process and its effective items to explain the percentage of the entire scale variation . Factor analysis is essentially a mathematical model that uses a group of variables as independent variables and dependent variables, and its calculation process is a simplified process of a complex variable linear model. Due to the different purposes of application, factor

analysis has the following characteristics: First, it can use small common factors to explain the relationship between multiple variables. The second is to be able to discover undiscovered causal factors from the relationship among a group of variables, and it has the significance of putting forward hypotheses. The third is that factor analysis can not only put forward hypotheses, but also further prove the hypotheses. In questionnaire research, analyzing the validity of questionnaire is always one of the unavoidable links, especially the validity analysis process. This paper conducts a comprehensive review from the perspective of analytical thinking and has a deeper understanding of validity analysis. The validity test is to test the validity of the questionnaire, which is to determine whether the designed items are reasonable and whether they can effectively correspond to the research expectations of the researchers. Validity can be divided into three categories: content validity, criterion validity, and construct validity. Content validity is to test whether the content of the questionnaire meets the purpose and requirements of the research. Criterion validity refers to the degree of correlation between the questionnaire measurement results and the criterion. Structural validity refers to the degree to which the results of the measurement items can reflect the expected factors (dimensions). The validity classification is shown in Figure 3-1.

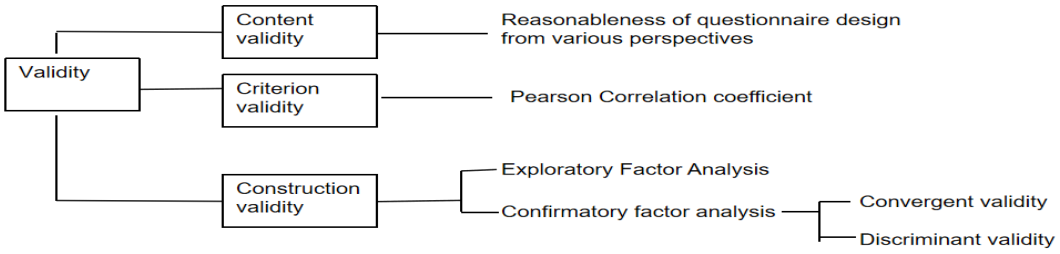

Figure3- 1 Validity Classification Chart

1. Content validity, a commonly used method to test validity, mainly describes the validity of the scale through words.
Use words to describe the questionnaire design process, including how to maintain consistency between question design and thinking; use words to describe the reference basis for questionnaire design, such as referring to certain literature to design questionnaires, etc.; use words to describe the process of questionnaire design, such as whether pre-testing has been carried out , what modifications have been made to the questionnaire, the reasons for the revision, etc.; use words to describe the approval of experts or peers, for example, the design of the questionnaire has been approved by a supervisor or teacher, or it has been carried out by related professionals (such as seniors and classmates, etc.) communication modification, etc.
2. Criterion validity. Criterion validity takes the measurement results of the classical scale as the "gold standard" and conducts correlation analysis with the results obtained from the current data. If the correlation coefficient value is high, it means that the criterion validity is good. Pearson correlation analysis was used to examine the correlation between the measured scores and the criterion scores of the two groups of data. The larger the analytical correlation coefficient, the higher the correlation and the higher the validity.
3. Structural validity, there are two commonly used methods to analyze the structural validity of questionnaires: exploratory factor analysis and confirmatory factor analysis. Under normal circumstances, for the validity analysis of scale data, it is necessary to use exploratory factor analysis to verify the validity and explain it comprehensively with the content validity.

Exploratory factor analysis uses SPSSAU validity or factors and puts them into scale questions for analysis. Judgment criteria for validity analysis: KMO value should be greater than 0.6, the factor loading coefficient on the corresponding factor should be greater than 0.4, there should be no serious deviation in the correspondence between items and factors, the degree of commonality should be greater than 0.4, and the cumulative variance explanation rate should be greater than 50%. Validity analysis generally needs to go through multiple analyzes. If the final results can meet the above criteria, it means that the division of dimensions is more reasonable and has good structural validity. Confirmatory factor analysis can be used to verify convergent validity and discriminant validity. All items under the same factor need to be put into the same analysis box, and so on. If there are several dimensions, put them into several analysis boxes. Criteria for confirmatory factor analysis: AVE and CR are common indicators of convergent validity. Usually, AVE greater than 0.5 and CR value greater than 0.7 indicate high convergent validity. By comparing the square root of AVE and the correlation value, if the square root of AVE is greater than the value of the correlation coefficient, it means that the discriminant validity is good. In this paper, standardized exploratory factor loadings are used to test the structural validity, that is, it is judged by calculating whether the factor loadings in each dimension of the variable are greater than 0.5. Before conducting exploratory factor analysis, this study tested the feasibility of factor analysis by means of KMO and Bartlett test. The KMO coefficient refers to the sampling appropriateness quantity. Table 5-3 shows the KMO and Bartlett test results of each variable. It can be found that the KMO values of all variables are above 0.7, indicating that it is suitable for exploratory factor analysis.

Table3- 7variables KMO and Bartlett

variable	KMO value	Approximate chi-square	degrees of freedom	significant
integration of innovative network resources	0.842	1056.218	27	0.000
ambidexterity innovation	0.785	1079.371	twenty-four	0.000
environmental dynamics	0.867	568.629	15	0.000
innovation performance	0.846	578.479	13	0.000

(1) Integration of Innovative Network Resources Exploratory Factor Analysis
Table 3-9 shows the integration of innovative network resources. It can be seen from the table that this variable contains two common factors, and the cumulative explained variance of the two factors reached 71.298%, which has strong explanatory power. In addition, under each common factor, the factor loadings of items are greater than 0.5, indicating that the two-dimensional structure formed by exploratory factor analysis has good reliability.

Table3- 8Integration of Innovative Network Resources Exploratory Factor Analysis

item	common factor	
	1	2
The company has access to technical information and technical knowledge from suppliers	0.749	0.419
The company can obtain market dynamic information provided by dealers	0.912	0.287
The company can obtain the actual needs and information feedback of users	0.917	0.278
The company obtains relevant government policy information and obtains policy support	0.409	0.709
The company can recruit knowledge talents from universities and colleges	0.428	0.682
The company can obtain and absorb and transform resources such as knowledge and patented technologies of scientific research institutes	0.357	0.719
The company can obtain financial information from financial institutions and obtain financial resource support	0.169	0.789

The company can effectively absorb technical information from technical intermediary service agencies	0.288	0.668
The company can obtain technical information support from relevant industry associations	0.229	0.801
Cumulative explained variance variation (%)	71.298%	

Note: The factor loading value is taken after the maximum variance rotation

(2) Ambidexterity Innovation Exploratory Factor Analysis

Table 3-10 is the exploratory factor analysis of ambidexterity innovation. It can be found that ambidexterity innovation contains two common factors, and the cumulative explained variance of the factors reaches 73.688%, which has strong explanatory power. In addition, under each common factor, the factor loadings of items are greater than 0.5, indicating that the reliability of the two dimensions (exploratory innovation and exploitative innovation) formed by exploratory factor analysis is high.

Table3- 9Ambidexterity Innovation Exploratory Factor Analysis

item	common factor	
	1	2
The company continues to launch a new generation of products	0.939	0.221
The company has developed a variety of products	0.708	0.279
The company seeks new and promising new technologies	0.948	0.211
Improve the company's products based on previous technologies	0.109	0.826
Improve the performance of existing products	0.258	0.812
Improve the existing production process and flow, improve product quality	0.241	0.791
Continuously improve the production efficiency of products through technological improvement	0.291	0.761
Cumulative explained variance variation (%)	73.688%	

Note: The factor loading value is taken after the maximum variance rotation

(3) Environmental Dynamism Exploration Factor Analysis

Table 3-11 is the exploratory factor analysis of environmental dynamism. It can be found that environmental dynamism contains a common factor, and the cumulative explained variance of the factor reaches 61.898%, and the factor loading of each item is greater than 0.5. It shows that exploratory factor analysis has good explanatory power.

Table3- 10Environmental Dynamism Exploratory Factor Analysis

item	common factor
	1
Technological innovations in the industry change rapidly	0.838
Market demand for products changes rapidly	0.751
Difficult to predict market demand	0.819
Competitors' marketing strategies are difficult to predict	0.838
The cycle of new technology application in the industry is relatively short	0.701
Products are highly competitive in the market	0.789
Cumulative explained variance variation (%)	61.898%

Note: The factor loading value is obtained after principal component analysis

(4) Innovation Performance Exploration Factor Analysis

Table 3-12 is the exploratory factor analysis of innovation performance. It can be found that innovation performance has only one common factor, and the cumulative explained variance of the factor reaches 67.897%. In addition, the factor loading of each item is greater than 0.5, indicating that the exploratory factor Analytical reliability is high.

Table3- 11Innovation Performance Exploratory Factor Analysis

item	common factor
	1
Our products contain first-class advanced technology and craftsmanship	0.859
Our new product development success rate is relatively high	0.868
Our number of patent applications is constantly increasing	0.715
Our innovative products are well received in the market	0.858
We can launch new products faster than industry competitors	0.809
Cumulative explained variance variation (%)	67.897%

Note: The factor loading value is obtained after principal component analysis

Conclusion

(1) Integration of innovative network resources can stimulate ambidexterity innovation. For enterprises, the smooth development of innovation activities and the improvement of innovation force depend on diversified resources, which come not only from within the enterprise, but also from diversified subjects such as suppliers, dealers, and customers in the innovation network. Acquisition and utilization of important resources in the innovation network can not only promote the optimization and improvement of existing knowledge, but also stimulate and give rise to new knowledge, products and technologies. Therefore, in manufacturing and experience management, manufacturing enterprises must pay attention to active communication and interaction with various entities in the innovation network (suppliers, distributors, customers, competitors, etc.), identify and obtain technical information that is beneficial to their own innovation, market information, demand and feedback information, etc.

(2) Exploratory and exploitative innovation will have a significant positive impact on the innovation performance of manufacturing enterprises , and the degree of positive impact of exploratory innovation on innovation performance is stronger than that of exploitative innovation on innovation performance , which is further verified Wu (2021) and other scholars' research shows that for manufacturing enterprises, to occupy the market and gain competitive advantages, they can continuously improve and optimize existing products or services to Professionalism, focus on consolidating and expanding the competitive advantage of the enterprise. At the same time, based on existing production, manufacturing and operation management, manufacturing enterprises can also pay more attention to resource investment in exploratory innovation, and continuously develop new technologies and products to open up new markets, seek new business models, and move toward high-tech industries, Transformation of technology product or service. This is in line with the current situation of the overall development of my country's manufacturing industry and is also the need for the innovation and development of China's manufacturing industry in the future.

(3) The study also found that ambidexterity innovation (exploratory innovation and exploitative innovation) plays a regulating role between the resource integration and innovation performance of the innovation network, indicating that the resource integration of the innovation network can promote exploratory innovation and exploitative innovation , and finally act on innovation performance . This discovery uncovers the black box of how the innovation network resource integration can promote the innovation performance of manufacturing enterprises and deepens the connection between the three. This helps Chinese manufacturing enterprises realize that the integration of innovative network resources can not only bring new product R&D performance, but also further enhance the sustainable competitive advantage of enterprises by promoting the smooth development of enterprise innovation activities.

(4) This study also found that changes in environmental dynamism positively regulate the relationship between integration of innovative network resources, exploratory innovation and innovation performance, but there is no significant effect between integration of innovative network resources, exploitative innovation and innovation performance regulatory effect. It can be seen that the stronger the environmental dynamism and the degree of unpredictability, the more enterprises need to carry out exploratory innovation activities by integrating various resources in the innovation network. In addition, according to the contingency theory, whether innovation is effective depends not only on the innovation practice itself, but also whether the external environment matches is also an important factor. Therefore, enterprises should pay attention to changes in the external environment and adjust their innovation strategies in a timely manner. But it is worth noting that despite the dynamic changes in the external environment and the unpredictable changes in technology and market demand, the inherent high risks and uncertainties of exploratory innovation make exploitative innovation necessary. Exploratory innovation is important, but companies still need to survive, and need to follow the original technology track, improve and upgrade existing products or services to meet the needs of original customers, so as to maintain their own development.

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Cite this article:

Li Wu Li (2023). The Relationship between Innovation Network Resource Integration, Dual Innovation, and Innovation Performance: A Case Study of Intelligent Manufacturing Enterprises in the Yangtze River Delta Region of China. *International Journal of Science and Business, 27*(1), 16-34. doi: https://doi.org/10.58970/IJSB.2162

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