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A Study of Intellectual Capital and Innovation Performance of Small and Medium-Sized Technological Enterprises in Guangdong Province

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Abstract

This study focuses on the basic question of "how intellectual capital affects innovation performance", integrates resource-based theory, dynamic capability theory, and knowledge-based theory, and explores the influence of intellectual capital on the innovation performance of small and medium-sized technological enterprises through a multi-level research method including literature review, theoretical derivation, and statistical analysis. The corresponding generalization and analysis are conducted for each variable, and finally an integrated model is constructed and the corresponding hypotheses in the model are derived under the guidance of theory. In the data collection stage, the relevant data of the small and medium-sized technological enterprises are obtained through the questionnaire survey method, and the sample collection is mainly aimed at the small and medium-sized technological enterprises in Guangdong Province. The respondents are mainly senior and middle managers of small and medium-sized technological enterprises in Guangdong Province. The reliability and validity of the data obtained from the survey are tested and statistically analyzed. The hypotheses in the model are verified, and the following conclusions are drawn: the intellectual capital of small and medium-sized technological enterprises in Guangdong Province has a significant role in promoting innovation performance; dynamic capabilities of small and medium-sized technological enterprises, such as proactive behavior and external knowledge acquisition are conducive to the growth of innovation performance of enterprises. Proactive behavior and external knowledge acquisition play a mediating role between intellectual capital and innovation performance.

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Introduction

With the increasingly obvious development trend of the integration of economy and technology in the world today, technological innovation is on the one hand an important driving force of economic growth and technological level development, on the other hand, technological innovation is also the vitality of enterprises to obtain competitive advantages for sustainable development (Xiao 2021; Xu et al. 2021). Enterprises are the main body of technological innovation, and small and medium-sized enterprises are the most active group of technological innovation. Practice shows that the focus of power to promote the economic development of various countries has gradually shifted from large enterprises with monopoly advantages to science and technology enterprises with intensive innovation activities, especially the advantages of small and medium-sized science and technology enterprises without scale advantages are more and more prominent. Small and medium-sized technological enterprise have become an important force in the development of the national economy and society, and play a pivotal role in the process of building an innovative country in China (Ma 2020). With their unique technological advantages, flexible operation mechanism, and keen market grasping ability, small and medium-sized technology enterprises have achieved fruitful innovation achievements (Chen et al. 2019). The report of the "18th National Congress" put forward the innovation-driven development strategy and pointed out that scientific and technological innovation is the strategic support for improving social productive forces and overall national strength, which must be placed at the core of China's overall development. Small and medium-sized technological enterprise have 65% of the country's patents, 74% of technological innovations, and 80% of new product development. At the forefront of reform and opening up, Guangdong has become the "leader" of China's economic development relying on its strong economic strength. In 2021, with Dongguan becoming a city with a GDP exceeding one trillion yuan, the "Guangdong elder" has owned four trillion-dollar cities of Shenzhen, Guangzhou, Foshan, and Dongguan. In 2022, despite the severe impact of the over-expected domestic epidemic, the economic operation of Guangdong Province still rose steadily. The Guangdong Provincial Bureau of Statistics (2022) released the unified accounting results of the regional GDP. In the first half of 2022, the GDP of Guangdong was 5,951.84 billion yuan, a year-on-year increase of 2.0%. Among them, the added value of the primary industry was 216.601 billion yuan, an increase of 5.9%; the added value of the secondary industry was 2,418.337 billion yuan, an increase of 2.9%; the added value of the tertiary industry was 3,316.902 billion yuan, an increase of 1.1%. Statistics from the Department of Science and Technology of Guangdong Province show that in 2021, the total number of high-tech enterprises in Guangdong Province has exceeded 60,000, and the number of small and medium-sized technological enterprises that have entered into the database has reached 57,000. The group of science and technology enterprises has become an important force to create a new development pattern in Guangdong. At present, Guangdong's scientific and technological innovation shows a development trend such as obvious performance, strong overall competitiveness, strong support from industrial systems and development entities, high investment intensity, and a good basic environment. Promoting technological innovation not only helps to promote the high-quality development of Guangdong, but also has great significance in promoting regional development through the realization of urban synergy, the demonstration effect of technological innovation on other regions, and the implementation of national development strategies. Guangdong's small and medium-sized science and technology enterprises have distinct characteristics. First, they are active in entrepreneurship and innovation. According to the latest data released by the Guangdong Provincial Market Supervision Bureau, the number of small and medium-sized enterprises with patents in Guangdong Province ranks first in China. Among them, the number of SMEs with patents is 200,000, accounting for 19.8% of the total number of SMEs with patents in Chia. The second is

the large scale of SMEs. The small and medium-sized enterprises in Guangdong Province are mainly manufacturing enterprises. The large number of small and medium-sized enterprises of various types support the brilliant manufacturing industry in Guangdong Province. Among the 41 major industrial sectors included in the national statistics, Guangdong Province has 40, while 25 are among the top three in the country in terms of sales and output value. The province has formed seven industrial clusters with an output value exceeding one trillion yuan, including a new generation of electronic information, green petrochemicals, smart home appliances, advanced materials, modern light industry and textiles, software and information services, and modern agriculture and food. The scale of the 5G industry and digital economy ranks first in China. At last, the brand awareness is strong and the influence is wide. The number of well-known brands and their influence is wide. From the perspective of industrial distribution, the brand awareness and influence of Guangdong enterprises not only take the lead in traditional fields, such as home appliances, automobiles, medicine, etc. but also at the forefront of the country in emerging fields. Guangzhou is a well-known headquarters city, gathering the headquarters of many brands, such as GAC, Evergrande, Poly, etc.; Shenzhen is a young city famous for technological innovation, attracting Huawei, Vanke, Ping An, and other companies; while the second- and third-tier cities such as Zhongshan and Foshan have obvious advantages in the manufacturing industry, with well-known brands such as Hisense, Kelon, Opple, and Huadi; Jiangmen has developed rapidly in agriculture, with well-known brands such as Xinhui tangerine peel. However, affected by the Covid-19 epidemic, the macro economy has revealed an "epidemic mode", which has a greater impact on small and medium-sized enterprises (Xu et al. 2021).

Problem Statement

Humanity entered the era of knowledge economy at the end of the twentieth century. This is an era with knowledge as the core element and an era with volatility, uncertainty, complexity, and ambiguity. The business environment faced by enterprises is increasingly complex and turbulent (Xu et al. 2021; Ma 2020). With the continuous expansion of market globalization, the original competition logic of enterprises based on material resources is facing revolutionary changes, and the original law of business competition has been completely broken. The challenge faced by enterprises is not only the recombination of production factors, but more importantly, the internal logic of the business itself and changes in the content of assets (Pawlowsky, 2001). When the industrial society is transitioning to a knowledge-based economy, knowledge as a new factor of production has made an important contribution to economic growth, and intellectual capital, as a new type of strategic resource, has been expanding its role in enterprises (Drucker, 1993). In the era of knowledge economy, science and technology have undergone revolutionary changes, the importance of material resources is decreasing day by day, the knowledge intensity of enterprises is increasing, and intangible resources with intellectual capital as the core are playing an increasingly important role in corporate performance and maintaining competitive advantages. A large amount of old and new knowledge recombination and development promotes innovation activities, and the generation of innovation results, in turn, makes enterprises pay more attention to knowledge enhancement, and enterprises competing in the era of knowledge economy must pay attention to the changes brought by intangible assets to enterprise management. Intellectual capital is the multifaceted reflection of the human, structural and relational aspects of corporate knowledge in an organization (Quinn, 1992). Companies in the knowledge economy environment need to make efforts to change the organization type into a learning organization and make continuous investments in intellectual capital. Enterprises that still use tangible assets or material resources as their main strategic resources will not be able to survive in the fiercely competitive environment. Today's international competition is a contest between

comprehensive national strengths, but its strategic focus is reflected in technological innovation. On the one hand, technological innovation is an important driving force of economic growth and technological level development, on the other hand, technological innovation is also the vitality of enterprises to obtain competitive advantages for sustainable development. In 2019, The McKinsey Global Institute pointed out in a survey of 5,750 business giants around the world that a company's level of intangible assets is closely related to its competitive advantage. Facts have also proved that most of the companies with the highest market capitalization in the United States today are occupied by technology companies (Ma, 2020).

Research question

Based on the problem statement, this study raises the key issues of the impact of intellectual capital on innovation performance and the mediating role of external resource acquisition and proactive behavior in small and medium-sized technological enterprises of Guangdong. To address the salient issues, this paper proposes the research question as below: Is there a significant relationship between intellectual capital and corporate innovation performance?

Objective of the research

The objective is as below: To explore the significant relationship between intellectual capital and corporate innovation performance.

Research scope

The purpose of this study is to explore the relationship between intellectual capital, acquisition of external resources, proactive behavior, and innovation performance of Guangdong SMEs. Therefore, the evaluation of small and medium-sized technological enterprises is limited to the following aspects: intellectual capital, acquisition of external resources, proactive behavior, and innovation performance. This study was conducted in the context of small and medium-sized technological enterprises in Guangdong Province. This is because, in the process of innovation of small and medium-sized technological enterprises, intellectual capital can be said to be at the core and is the main driving force for the realization of a series of other innovations.

Literature Review

The innovation performance of an enterprise is a result-oriented innovation concept, which refers to the positive results achieved by an enterprise through the innovation process, and is a method and indicator for measuring enterprise innovation. However, the different research angles also lead to the lack of consensus on the specific connotation of innovation performance. In a narrow sense, when a new product or a product produced by a new technology enters the market, it is the innovation performance of a firm (Hagedoorn, & Cloodt, 2003). In the broad sense, enterprise innovation performance can be all the results in the innovation process (Ernst, 2001). A company's success in the market does not depend only on low prices to gain more customers, but is influenced by numerous factors, such as product and service quality, product performance and design, product appearance, diversified suppliers, the establishment of a network of external relationships and sensitivity to changes in customer needs. Therefore, although innovation is an inevitable choice for enterprises in the increasingly fierce competition, innovation is not always good. Only when the results of innovation are accepted by the market and customers, can meet the emerging demand, and the profit obtained through innovation is higher than the original cost, then it is a beneficial innovation. Innovation performance is the most important indicator to measure innovation achievements.

Previous research on innovation performance

Schumpeter (1942) pointed out the important impetus of an entrepreneur's personal characteristics in enterprise innovation activities, and established an early innovation model.

Process innovation performance refers to the degree of change in product production and processing technology, production management mode, and production operations (He, & Wong, 2004; Utterback, 1975). Technological innovation performance refers to the use of knowledge to generate new production technologies, thereby obtaining better products or generating certain commercial economic value through the technology itself (Daft, 1978). Organizational innovation performance refers to the improvement of organizational structure, such as institution, authority-responsibility relationship, corporate culture, etc., to produce an organizational structure that adapts to social development and changes (Damanpour, 1984). Abernathy and Clark (1985) believe that incremental innovation is the strengthening and development of existing organizational knowledge and making improvements, while breakthrough innovation is the use of existing knowledge to make mainstream technology obsolete and old knowledge into "new products or technologies". Dewar and Dutton (1986) divided innovation performance into two types: incremental innovation performance and breakthrough innovation performance. Chaganti and Damanpour (1991) divided innovation performance into product innovation performance, technological innovation performance, organizational innovation performance, and process and process innovation performance. Incremental innovation performance complements existing products, services, or technologies and enhances the potential of established product-service designs and technologies (Ettlie, 1993). Product innovation performance, as its name suggests, refers to the development of new products that meet new market demands or potential demands through knowledge (intellectual capital) (Gopalakrishman, & Damanpour, 1997).

Research on intellectual capital

First of all, it should be noted that although scholars have conducted a lot of research on intellectual capital for decades, due to different research angles and focuses, there is still no unified and accepted definition of intellectual capital until today. Senior (1836) first proposed the term intellectual capital, but at that time intellectual capital has the same meaning as human capital, and is interpreted as "knowledge and skills mastered by individuals", and has no other rich meanings. On this basis, John Kenneth Galbraith (1969) separated intellectual capital from the concept of human capital for the first time. He believes that intellectual capital not only includes knowledge and ability under static conditions, but also a process of effectively using knowledge to achieve individual or organizational goals. Subsequently, Galbraith (1988) emphasized that in addition to its "intangible" characteristics, intellectual capital can also create certain value for an organization.

Previous research on intellectual capital

The connotation and characteristics of intellectual capital scholars from different backgrounds and fields have conducted extensive research on intellectual capital since the 1990s. Because of different fields, different definitions and interpretations of intellectual capital have also been formed. Galbraith (1968) believes that intellectual capital not only includes static knowledge and ability but a process of using knowledge effectively to achieve personal or organizational goals. Kang, Snell, & Swart (2012) proposed that intellectual capital is a type of knowledge that originates from individuals, society, and is embedded in organizational rules, processes, and systems, which is an input process for organizational learning. It can be seen that the definition of intellectual capital from the perspective of knowledge management, first of all, emphasizes the synthesis of the potential knowledge and ability of the organization, which is a kind of ability to aggregate knowledge carriers. Second, it itself includes the utilization process of converting knowledge into value. This perspective provides a transparency analysis of capital value creation and analyzes its cause and effect. However, because knowledge itself is a complex system, which is scattered and difficult to integrate, related research often falls into the trap of "measurement". Taking the resource-based view as the theoretical basis, defining intellectual

capital from the perspective of strategic resources is the combination of strategic management and intellectual capital research, and is also the foothold of the research framework of this paper. This perspective emphasizes the inimitability, high value and strategic nature of intellectual capital, which is the most important strategic resource of an organization (Barney,1999). Klein,& Prusak(1994) and Lynn(1998) proposed that intellectual capital is a kind of intellectual raw material (resource) for the production of high-value assets. This intellectual raw material can be mastered in a standardized way and generate higher value, that is, when these intangible assets exist in a way that can be mastered and developed, they become a resource. Dzinkowski (2000) proposed that intellectual capital is regarded as the total stock of capital owned by an organization or a knowledge-based resource. Hoss et al. (2009) emphasized that intellectual capital is a source of sustainable competitive advantage for organizations. Chinese scholars' research collections on intellectual capital and corporate performance have also gradually increased. Ren (2014) used the structural equation model to test the positive correlation between intellectual capital and the enterprise value of listed companies on China's GEM, and found that intellectual capital has a significant effect on enterprise value, especially long-term value. Nan (2014) analyzed the value creation behavior of intellectual capital and its various elements from the perspective of intellectual capital investment and capital accumulation, and found that intellectual capital is the core element in enterprise value creation. Chinese scholar Fu (2016) deeply studied the relationship between corporate governance level and intellectual capital value creation, and pointed out that in a company with a higher governance level, the higher the value creation efficiency of intellectual capital, the better the role it can play. Guo, Zhang, & Le (2016) proposed that in the era of knowledge economy, intellectual capital is gradually replacing physical capital such as land, capital, and machine workshops in the traditional economy, becoming the most important factor of production. Intellectual capital itself is an intangible resource that can be invested in innovation, and can indirectly affect corporate performance through innovation input. Li, Shao, & Chen (2017) proposed that intellectual capital is a key resource that affects organizational performance, and in the process of industry-academia collaboration, there are behaviors such as knowledge transfer, knowledge creation, talent exchange and cultivation, and social relationship network linkage, which are all important factors that form or influence the intellectual capital of enterprises. Pei, He, & Gao (2017) pointed out that intellectual capital has a significant positive impact on the innovation performance of high-tech enterprises, which is a necessary factor for high-tech enterprises to improve their survival probability and maintain their competitive advantages.

Methodology

The theoretical induction and deduction through literature review is the starting point of this research. Based on the top management and economics journals at home and abroad, this paper organizes and analyzes a large number of current researches on intellectual capital, innovation performance, and the concepts involved in this paper, and finds the combination of realistic backgrounds from the literature. There is a wealth of results on the impact of corporate intangible assets on corporate performance or innovation from resource-based theory, which provides a solid foundation for the study in this paper. After summarizing the literature related to intellectual capital and innovation, this paper finds that past research tends to look at the relationship between corporate intangible assets and innovation from a static and isolated perspective. Although these studies have well answered the question of why an enterprise's intellectual capital is the core resource for enterprise innovation and maintaining competitiveness, they cannot explain how intellectual capital completes internal development, and It is rather thin to explain the process of "resource–performance" only by relying on the resource-based theory. Therefore, on the basis of reviewing and summarizing relevant

literature, this study firstly defines the connotation and dimension division of concepts of intellectual capital and innovation in the context of small and medium-sized enterprises and incorporates the dynamic capabilities of enterprises into the analysis framework. Through the integration of resource-based theory, firm dynamic capability theory, and knowledge-based theory, the mediating effect of external knowledge acquisition and proactive behavior is expounded theoretically, and the research framework is constructed.

Questionnaire survey method

The sample of the formal survey data for this study comes from the small and medium-sized technological enterprises in Guangdong Province, which are widely distributed and have strong representation. The author's research has received strong support from the Guangdong Association of Small and Medium-sized Science and Technology Enterprises. After obtaining the consent of the person in charge of the Guangdong Association of Small and Medium-sized Science and Technology Enterprises, the company's contact information was obtained, and then the small and medium-sized enterprise managers were contacted by telephone and e-mail. After a detailed explanation of the purpose of the visit and the study, the questionnaires were distributed and collected mainly through Wenquanxing on WeChat. A total of 347 valid questionnaires were obtained from 107 small and medium-sized technological enterprises in Guangdong Province in this survey. Since the scale on intellectual capital was adjusted in terms of the question items according to the Chinese scenario and the characteristics of the sample of small and medium-sized technological enterprises, to ensure the quality of the survey data, a pre-research work of the questionnaire was conducted for this variable, and the pre-test sample was selected from 10 small and medium-sized technological enterprises in Guangzhou, Foshan and Dongguan cities nearby.

Data Analysis Method

In this study, reliability and validity tests, SPSS 24.0, Bootstrap analysis method, and regression analysis were performed for the collected data. The variables measured in this study have been extensively studied in the field of management, and different variables have one or more mature scales to choose from in empirical research. By summarizing the existing literature, we find that different scholars choose variable definitions close to their own concerns according to their research content and focus. According to the particularity of the research sample and the connotation of the four variables to be discussed, this study refers to mature scales developed by famous scholars in related fields and used many times in domestic and foreign journals. According to the characteristics of the research sample (small and medium-sized technological enterprises), the definition and corresponding items suitable for this study in each variable were selected and considered.

Table 3-1 Related items of intellectual capital

HC1: Members of the company are highly skilled in their respective positions.
HC2: Members of the company have strong expertise and are experts in relevant fields.
HC3: Members of the company have extensive work experience in related industries.
HC4: The company supports employees to receive more education and participate in various types of training.
HC5: Members of the company generally have a strong sense of responsibility.
HC6: The company focuses on employee career development plans and aligns them with corporate goals.
HC7: Members of the company can adapt quickly to changes in the environment.
HC8: Members of the company have the flexibility to use the Internet or other tools to fulfill job requirements.
HC9: The company's top management understands the company's positioning and formulates corresponding short-term or long-term strategic plans.
OC10: When an employee leaves the company, the important knowledge and information they have can remain in the company.
OC11: In the company, relevant workplace policies and procedures can be quickly found through relevant manuals or corporate materials to guide the work in a timely manner.
OC12: The company provides adequate incentives for employees to finish their jobs.

OC13: Members of the company have sufficient authority to handle customer or production line problems.
OC14: The company uses information technology and network technologies (such as databases, intranets, or other software) to facilitate the exchange of information.
OC15: The company has an open and compatible working atmosphere.
OC16: The company has clear measures to prevent internal knowledge and information from being plagiarized.
OC17: The company has a rapid response mechanism to emergencies.
OC18: The company encourages employees to collaborate across job functions.
RC19: The company understands the needs of customers very well.
RC20: The company has established long-term trusting relationships with key customers.
RC21: The company has established long-term trusting relationships with key suppliers.
RC22: The company communicates efficiently with suppliers.
RC23: The company has joined an enterprise strategic alliance.
RC24: The company maintains close ties with R&D or scientific research institutions.
RC25: The company establishes and maintains strong relationships with government departments.
RC26: There is a strong relationship between the company and the bank (or financial institution).
RC27: Members of the company identify with the company's culture and actively promote the unity of values.
RC28: Members of the company are very easy to get along with and respect each other.

Note: HC means "Human capital item"; OC means "Organizational capital item"; RC means "Relational capital item"

Schumpeter (1912) believes that the essence of enterprise innovation is the effective recombination of production factors, and proposed five innovation types. Because Schumpeter's definition is closest to the practice and theoretical research of enterprises, it has been widely used. In the field of management, Drucker (1954) defined innovation as an important function of an organization in his book "The Practice of Management". He believes that the essence of innovation in the commercial field is to create new business opportunities, and it is a way to constantly explore the market demand and produce according to the demand, to meet the demand of consumers and obtain excess profits. When the activity cannot create such business value, it is not an innovative activity. Therefore, the focus should be on the results of innovation rather than the occurrence of innovative behavior (Evily, & Chakravarthy, 2002). This study uses innovation performance as an indicator to judge the effectiveness of organizational innovation. In the past, the measurement of innovation performance can be roughly divided into two categories: subjective and objective. Some studies analyze innovation results through objective data, which is more intuitive and convenient for people to compare, but it is impossible to observe the internal changes brought about by innovation results for enterprises. Moreover, for enterprises, only innovations that can be recognized by the market and bring value beyond the cost of innovation are successful innovations. Therefore, this study emphasizes innovation performance, rather than innovation behavior or innovation results. If objective data such as patents are used, there is a big difference with the research direction. At the same time, because the research objects are small and medium-sized technological enterprises, their innovation direction is often product innovation, content innovation, management innovation, and service innovation, while technological innovation and production process innovation are more easily produced by large enterprises, which can not be well described by using objective data. Therefore, based on the questionnaire designed by Subramaniam & Youndt (2005), this study adopts the subjective measurement method, and the following 7 items are used to examine the innovation performance from two aspects: incremental innovation performance and breakthrough innovation performance. A five-point Likert scale is also used (from "1" indicating Strongly disagree to "5" indicating Strongly agree, with "3" indicating Neither disagree nor agree and the degree of agreement increases in turn). This part of the scale is the second part of the first questionnaire, and the specific content is shown in Table 3-2 below:

Table 3-2 Innovation performance items

IP1: The company's innovation improves an existing product or service line.
IP2: The company's innovation strengthens the company's technological capabilities.
IP3: The company's innovation enhances the company's existing competitiveness.
IP4: The company's innovation makes the original product or service obsolete.
IP5: The company's innovation makes old knowledge and skills obsolete.
IP6: The company's innovative product or service completely replaces the original product or service.
IP7: The company's innovation has a good market response.

Note: IP means "Innovation performance item".

Questionnaire design

A questionnaire survey method is used in this study, and the survey object samples are small and medium-sized technological enterprises in Guangdong Province. This paper firstly conducts an extensive literature search for each variable of the study, selects appropriate scales and items through screening and comparison, improves the expression of items and supplements content according to the particularity of the research samples and the Chinese context, and forms a formal investigation questionnaire. The variable-related measurement scales involved in the theoretical model of this research are all derived from mature scales developed by famous foreign scholars. These scales have been used by empirical research in related fields at home and abroad, and are reliable evaluation tools for these variables. Since the paths of value creation are different, the core variable of this study, intellectual capital, needs to be revised in the Chinese scenario. Finally, this research invited senior professors from Sun Yat-sen University to review the questionnaire and further improved the language and content description of the questionnaire to make the questionnaire more suitable for Chinese respondents to answer.

Findings and Discussion

Through the analysis and test of the data obtained from the formal scale in the third chapter, the data obtained in this survey have high reliability and validity, and we have obtained the support of the data test results under the rigorous research design. In this chapter, firstly, each hypothesis of the research model is tested; secondly, the mean values of each variable and the correlation coefficients between them are reported to initially verify the reasonableness of the model hypotheses in this paper; thirdly, the mechanism of action between each variable is analyzed and verified according to the hypotheses proposed in the theoretical model; finally, the overall model is tested.

Summary of Respondents

The formal data sample of this study comes from the survey sample of small and medium-sized technological enterprises in Guangdong Province. Small and medium-sized technological enterprises are a group of SMEs engaged in the research and development, production and service of high-tech products, and have become an important force for cultivating and developing new kinetic energy and promoting high-level scientific and technological self-reliance. Guangdong Province attaches great importance to the cultivation and innovative development of small and medium-sized technological enterprises, and the number of small and medium-sized technological enterprises ranks first in the China. In 2021, Guangdong's regional innovation comprehensive capacity ranked first in the country for five consecutive years, and the province's R&D expenditure increased from 234.4 billion yuan in 2017 to more than 380 billion yuan in 2021, accounting for 2.61% to 3.14% of regional GDP; the province's R&D personnel exceeded 1.1 million; the effective amount of invention patents, PCT international patent applications, and other indicators ranked first in China. In an interview with the Yangcheng Evening News, Gong (2022), director of the Department of Science and

Technology of Guangdong Province, emphasized that the active innovation consciousness and strong innovation ability of enterprises are the characteristics and advantages of Guangdong's economic development. In recent years, Guangdong Province has established an echelon cultivation mechanism for start-up technological enterprises, small and medium-sized technological enterprises, high-tech enterprises, and technology-leading enterprises, and formed a more complete incubation and cultivation system with the whole chain of "mass innovation spaces, incubators, accelerators and university science and technology parks" in cultivating and expanding the scale of technology-based enterprises. Guangdong Province ranks first in the country in the number of incubators and mass innovation spaces and has become a cradle for the cultivation and growth of science and technology enterprises. In 2021, the total number of high-tech enterprises in Guangdong Province exceeded 60,000, ranking first in China for six consecutive years. The number of small and medium-sized technological enterprises that have entered into the database has reached 57,000, and the group of science and technology enterprises has become an important force to create a new development pattern in Guangdong. As of August 2022, there are 29,041 companies that are consistent with the policy of the Department of Science and Technology of Guangdong Province for entering into the database of small and medium-sized technological enterprises, as shown in Table 3.11. These enterprises all meet the following characteristics: (1) The total number of employees does not exceed 500, the annual sales income does not exceed 200 million yuan, and the total assets do not exceed 200 million yuan. (2) Scientific and technological personnel, R&D investment, and scientific and technological achievements reaching a comprehensive score of 60 and above. That is to say, technology companies must have technology products with key core technologies, more than 60% of scientific and technological personnel, more than 5 scientific and technological achievements represented by high-value intellectual property rights, and R&D investment intensity higher than 6%. (3) The industries are distributed in scientific research and technical services, manufacturing, information transmission, software and information technology services, wholesale and retail, leasing and business services, construction, culture, sports and entertainment, resident services, repair, and other services, etc.

Table 4-3 Statistics table of the small and medium-sized technological enterprises that have entered into the database in Guangdong Province as of August 2022

Batch	Time	Number of companies
1	April 20	4166
2	May 19	6616
3	June 14	6395
4	July 19	8033
5	August 16	3831
Total		29041

Data source: Public data from the official website of the Department of Science and Technology of Guangdong Province

This questionnaire was distributed to 107 companies, and each company has 4 questionnaires, a total of 428 questionnaires were distributed, and 379 questionnaires were collected. On the other hand, due to the limitation of objective reasons, a small number of questionnaire items were not filled out completely. After communicating with the surveyed companies, some samples were eliminated. Finally, a total of 347 valid questionnaires were collected, and the response rate was 81.07%, while the completion rate was 91.56%, it can be said that better results have been achieved. The demographic characteristics of the respondents in the formal test sample (N=347) are as follows:

Correlation analysis of variables

Before verifying the model, the correlation analysis between variables is to judge the degree of interdependence between different variables and to preliminarily judge the rationality of this research model through the correlation coefficient and significance. The standardized correlation coefficient is generally [-1, 1]. The closer the absolute value is to 0, the smaller the correlation. However, when the correlation coefficient is greater than 0.7, it is necessary to consider the possible multicollinearity of the variables in the model. Of course, correlation is only a preliminary judgment on the influence relationship between two variables, and it is impossible to distinguish a causal relationship, but only after a certain degree of correlation is reached, it is necessary to carry out hypothesis verification in follow-up research. The correlation statistical test for the main sample data of the formal survey is shown in Table 4-3 below:

Table 4-4 Correlation analysis of research model variables

	1	2	3	4	5	6	7	8
1. Intellectual capital	0.19**	0.04	0.13	0.15	-			
2. Proactive behavior	0.05	0.07	0.12	0.06	0.22**	-		
3. External knowledge	0.16*	-0.13	0.07	0.12	0.48**	0.43**	-	
4. Innovation performance	0.08	0.02	0.11	0.18**	0.38**	0.19**	0.43**	-
Mean	2.52	2.89	2.10	0.23	3.59	3.90	3.16	3.50
Standard deviation	1.19	0.50	0.58	2.52	0.49	0.50	0.51	0.54

Note: Sample N=137**, p<0.01*, p<0.05 (two-tailed).

The results of the correlation analysis in Table 4-1 show that there are different degrees of positive correlations between intellectual capital, proactive behavior, external knowledge acquisition, and innovation performance, and each variable has a more obvious correlation with the other. At the same time, since the correlation coefficients do not exceed 0.7, it proves that there is no serious problem of multicollinearity among the variables.

Research Objective: Examination of the relationship between intellectual capital, external knowledge acquisition, and innovation performance

Hayes (2004) proposed the Bootstrap method to verify the relevant mediating effect, i.e., the sample is repeatedly sampled and the significance of the product of the regression coefficient of the independent variable on the mediating variable and the regression coefficient of the mediating variable on the dependent variable is tested, and if it is significant, it indicates that there is a mediating effect, and if not, it indicates that there is no mediating effect. The advantage of this method is that there is no need to test for main effects, and there is no need to consider whether the statistics are normally distributed, which has a better validation effect and is more operational. The bootstrap method has been widely used in psychology, organizational behavior, and other fields in recent years, and has gained more and more attention. Therefore, this study also uses this method to verify related hypotheses. This study used the SPSS plug-in Process developed by Hayes in 2012 to test the mediation effect. First, the relationship between intellectual capital, external knowledge acquisition, and innovation performance was tested and the results are shown in Table 4-4.

From the below data results, it can be concluded that intellectual capital has a significant positive impact on external knowledge acquisition, and the correlation coefficient β=.52, P-value<.001; external knowledge acquisition has a significant positive impact on innovation performance, and the correlation coefficient β= .32, P-value<.001; intellectual capital has a significant positive impact on corporate innovation performance, and the correlation coefficient is β=.25, P-value<.01.

Table 4-5 Test of the mediating effect of external knowledge acquisition on intellectual capital and innovation performance

	External Knowledge Acquisition	Innovation Performance
Intellectual Capital	.52*** (.07)	.25** (.07)
External Knowledge Acquisition	-	.32*** (.06)
Direct effect (X on Y)	.25	
95% confidence interval	[.11,.40]	
Indirect effect (1-1-1model)	.17	
95% confidence interval	[.10,.25]	
R^2	.25***	. 29***

Note: ***p<0.001, **p<0.01, *p<0.05, the standard deviation is in brackets, X represents intellectual capital, and Y represents innovation performance.

Also, by putting external knowledge acquisition in the model with innovation performance as the dependent variable, the results of the test of mediating effect in the table above show that the interval of the test result of mediating effect of external knowledge acquisition between intellectual capital and innovation performance does not contain 0 at 95% confidence interval (a×b=.17, 95% CI [.10, .25]), proving a significant mediating effect of external knowledge acquisition between intellectual capital and innovation performance. Further, the interval of the test result of the direct effect of intellectual capital on external knowledge acquisition also does not contain 0 (c'=.25, 95% CI [.11,.40]), indicating that there is a significant direct effect. Based on the above results, it can be shown that external knowledge acquisition of small and medium-sized technological enterprises has played a partial mediating role in the effect of intellectual capital on innovation performance. For small and medium-sized technological enterprises, external knowledge acquisition is a very important dynamic capability and innovation path in the innovation process. It avoids the material foundation that small and medium-sized enterprises lack in innovation to the greatest extent, and connects the intellectual capital resources and innovation performance of enterprises well. External knowledge acquisition is the embodiment of dynamic ability in the process of intellectual capital transformation.

Conclusion

Intellectual capital and innovation performance:Firms create core values through their core products and work programs, which are ultimately reflected in their performance, and the creation of these core products and work programs often has various linkages with the firm's intellectual capital. These linkages are not necessarily a direct effect of intellectual capital but may be an indirect effect or a synergistic effect with physical capital on the performance of firms (Dong 2022). The direct effect of intellectual capital on enterprise innovation performance refers to the fact that the increase of intellectual capital can directly promote the increase in enterprise innovation performance. The two have a relatively significant correlation, and this effect does not need to be transmitted through some medium. The reason is that with the increase of intellectual capital, the number of high-quality customers and sales profit can be effectively increased, while the cost of sales and operating costs can be significantly reduced. The use of intellectual capital directly contributes to the appreciation of the value of the company, and this contribution is created directly by the intellectual capital itself and is not dependent on other capital. Because the increase of intellectual capital investment can greatly increase the number of customers of the enterprise, promote the growth of sales revenue, and at the same time can reduce the production cost and operating cost of the enterprise, thus increasing the main business profits of enterprises, and finally achieving the goal of increasing the innovation performance of enterprises. As one of the components of intellectual capital, human capital is usually considered to be the driving force

behind the creation of the core value of an enterprise. Especially in the era of knowledge economy, the importance of human capital is self-evident. It can be said that human capital has become the core driving force for the sustainable development of today's social enterprises. There is a direct and significant positive relationship between human capital and innovation performance (Guo et al. 2022). The level of enterprise management personnel directly affects the decision-making of the enterprise and affects the performance of the enterprise in a general direction, while the skills of ordinary employees directly affect the level of enterprise productivity, and has a direct effect on the quality of the enterprise's products. As an important carrier of corporate human capital, structural capital also has a crucial impact on corporate performance. Structural capital often directly affects the internal capital operation of the entire enterprise. Enterprises with high structural capital often show a good corporate culture. The influence of this corporate culture on corporate performance may not be short-term, but it usually influences the play of various capital functions in the enterprise subtly, and affects the value creation of the enterprise together with human capital, thereby enhancing the long-term sustainable development ability of the enterprise (Chen et al. 2018). Compared with traditional industries, the high-tech content of high-tech industries determines the characteristics of intensive investment of intellectual capital. The role of intellectual capital is often greater and more significant, especially in the era of knowledge economy, which often directly affects the success or failure of high-tech enterprises. For enterprises in the high-tech industry, because they tend to light assets and attach importance to technology and innovation, intellectual capital plays a greater role in innovation performance in high-tech enterprises than in general industries. Therefore, compared with traditional industries, enterprises in the high-tech industry should pay more attention to a large amount of investment in intellectual capital. Intellectual capital is another product in the era of knowledge economy. Because of its characteristics of being difficult to imitate, valuable, scarce, and irreplaceable, intellectual capital is regarded as the most important strategic resource of contemporary enterprises, and also an important source of enterprise innovation ability (McEvily, & Chakravarthy, 2002). Based on the resource-based theory, the heterogeneous strategic resources of enterprises are the main reason for the differences in innovation performance. For small and medium-sized enterprises, physical resources are inherently scarce, and intellectual capital is needed to overcome the innovation constraints caused by the lack of physical resources. Intellectual capital, as an intangible strategic resource, is the basis for innovation activities in SMEs and is a necessary element for successful innovation (Hoss et al., 2009; Meso & Smith, 2000).

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