



# Enterprise Innovation Performance: Bibliometric Review and Future Research Trends

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## Abstract

By using CiteSpace visual analysis software and taking 1232 enterprise innovation performance research documents in the Chinese Social Science Citation Index database from 2000 to 2021 as the analysis object, this paper deeply discusses the research hotspots, research objects and influencing factors in the research field of enterprise innovation performance in China. The results show that: the research on China's enterprise innovation performance follows the relevant policies of innovation support, and the research attention is rising; the influencing factors of enterprise innovation performance include not only the internal factors of technology, capital, personnel and organization management, but also the external factors of enterprises such as innovation network, tax system and innovation environment; however, the evaluation system of enterprise innovation performance has not formed in China, and a large-scale cooperative research network of enterprise innovation performance has not formed; the impact of R & D investment, financing constraints, the nature of property rights and tax incentives on enterprise innovation performance will be hot topics of research at present and in the future.

## Subject Areas

Entrepreneurship, Innovation Management

## Keywords

Enterprise, Innovation Performance, CiteSpace, Innovation Performance Evaluation, Cooccurrence Analysis

## 1. Introduction

China's economy has changed from a high-speed growth stage to a high-quality development stage. To achieve high-quality development, we must achieve con-

notative growth driven by innovation. Enterprises are the main body of innovation. Innovation can help enterprises obtain market competitive advantages. Without innovation, enterprises will lose their core competitiveness. Innovation is the driving force to promote the inexhaustible development of enterprises and make enterprises invincible in the tide of market competition of survival of the fittest. At present, there is no systematic definition of enterprise innovation performance. It is generally believed that enterprise innovation performance is the result or output of enterprises after innovation activities or innovation behavior [1]. The research on enterprise innovation efficiency will help to have a clearer understanding of the input and output process of enterprise innovation activities and the restrictive factors in the process. In view of this, by using the visual analysis of the knowledge map, this paper systematically combs the research trend of domestic enterprise innovation performance, the influencing factors of innovation performance and the evaluation methods of innovation performance. It puts forward the hot issues that should be paid attention to in the future research of enterprise innovation performance, in order to provide reference and inspiration for subsequent researchers.

## **2. Data Sources and Research Methods**

### **2.1. Data Source**

In order to ensure the authority and accuracy of the research samples, this paper takes CSSCI (Chinese Social Science Citation Index) as the sample data. Due to the mixed use of innovation performance and innovation efficiency in Chinese domestic literature, the retrieval is carried out with the themes of “enterprise + innovation performance” and “enterprise + innovation efficiency” respectively. The retrieval time is February 21, 2022, and the interviews and A total of 1232 research sample documents were obtained from non academic documents such as the introduction of the conference and documents unrelated to the subject of this study. The literature time span was from January 2000 to December 2021.

### **2.2. Research Method**

Bibliometric analysis is a research method to explore the knowledge structure, characteristics and laws of a subject field by using mathematical, statistical and other methods to conduct quantitative research on the literature system and bibliometric characteristics. This study mainly uses the visual bibliometric analysis software CiteSpace developed by Chinese American scholar Chen Chaomei based on Java language to sort out and count the research status, research hotspots and evolution paths of domestic enterprise innovation performance through keyword co-occurrence analysis, co-occurrence analysis of authors and research institutions, high CO citation analysis, burst analysis and other methods, and display the data in image form with the help of visual analysis software, Knowledge map analysis is one of the main research methods of scientific metrology.

### 3. Statistical Analysis of Document Volume

The number of documents can intuitively reflect scholars' attention to enterprise innovation performance. This statistics shows the number and trend of papers published on enterprise innovation performance in CSSCI (Chinese Social Science Citation Index) from 2000 to 2021. From 2000 to 2005, the number of papers on enterprise innovation performance was small and the upward trend was flat; From 2006 to 2011, the number of documents issued by enterprises' innovation performance began to rise, and the growth rate varied; Since 2012, especially since 2015, the number of documents on enterprise innovation performance has been at a high level, and is still on the rise. (Figure 1)

On the whole, the academic trends of enterprise innovation research closely follow the national policy guidance and close to the needs of enterprise innovation. In terms of the number of documents issued on innovation performance, 2006, 2012 and 2015 are three important nodes. In 1998, "The Special Plan for the Development of Science, Technology and Education in the Tenth Five Year Plan for National Economic and Social Development (Science and Technology Development Plan)" prepared by the National Development Planning Commission clearly proposed "taking enterprises as the main body of technological innovation", which began to attract domestic scholars' attention to the research field of enterprise innovation performance. With the release of "the Outline of the National Medium and Long Term Science and Technology Development Plan (2006-2020)" in February 2006, the research results on enterprise innovation performance began to increase gradually; In 2012, "the Opinions of the CPC Central Committee and the State Council on Deepening the Reform of the Scientific and Technological System and Accelerating the Construction of the National Innovation System" proposed to accelerate the establishment of a "technological innovation system with enterprises as the main body, market orientation and close integration of industry, University, research and Application, and give full play to the main role of enterprises in technological innovation decision-making, R & D investment, scientific research organization and achievement transformation". In particular, the 18th CPC National Congress

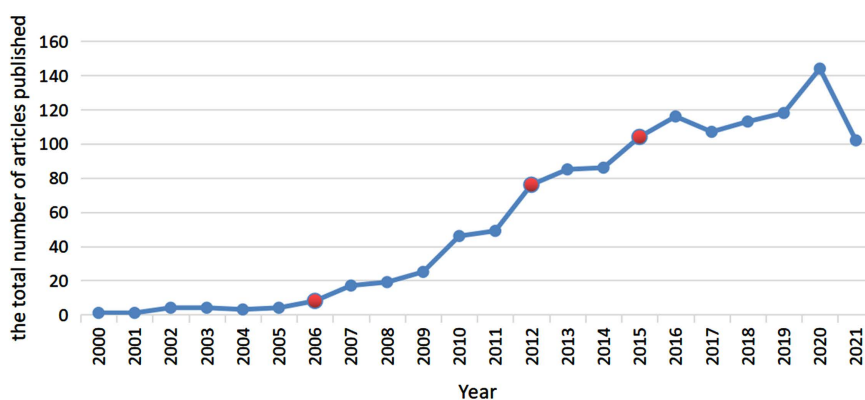


Figure 1. Statistics of enterprise innovation performance over the years.

proposed to implement the innovation driven development strategy and take innovation as the first driving force to lead development. At this time, the research results of enterprise innovation performance in China began to increase significantly. In 2015, “Made in China 2025” issued by the State Council stressed the need to “strengthen the dominant position of enterprise technological innovation” and “strengthen the research and development of key core technologies”. The innovation performance of enterprises has also become a hot issue concerned and studied by the industry and academia, and the high-level research results of domestic enterprise innovation performance have also maintained high output.

## **4. Analysis on Hot Topics of Enterprise Innovation Performance Research**

### **4.1. Research Objects of Enterprise Innovation Performance**

From the perspective of research objects, the research objects of enterprise innovation performance mainly include state-owned enterprises, private enterprises and small and medium-sized enterprises.

#### **4.1.1. Research on Innovation Performance of State-Owned Enterprises**

There are 12 literatures on the innovation performance of state-owned enterprises. Scholars once generally believed that state-owned enterprises lacked innovation power due to their enterprise nature. Through the research on the information disclosure data of 123 Manufacturing Listed Companies in 2012, Li Zheng and Lu Yinhong (2014) [2], the results showed that the innovation performance of state-owned holding enterprises was significantly higher than that of private enterprises, while the scale increasing benefits Capital and technological advantages and the innovation of state-owned assets management system all play an important role in the innovation performance of state-owned enterprises. Li Jing (2014) [3] also showed that the nature of state-owned enterprise ownership can significantly promote enterprise technological innovation. However, Li Jing and He Xiaogang (2012) [4] based on the paired panel data of listed manufacturing companies from 2004 to 2008, the results show that the innovation efficiency of family enterprises is higher than that of state-owned enterprises. Dong Xiaoqing *et al.* (2014) [5] believe that state-owned enterprises pay too much attention to rent-seeking, which leads to the loss of innovation efficiency that cannot be ignored.

#### **4.1.2. Research on Innovation Performance of Private Enterprises**

There are 14 literatures on the innovation performance of private enterprises. Yu Haiyun *et al.* (2013) [6] obtained the data of 208 private enterprises through a questionnaire survey, which shows that entrepreneurs’ confidence can weaken the negative impact of lack of resources and low technical ability on innovation performance. Therefore, entrepreneurs’ confidence in independent innovation should be strengthened. Yu Haiyun *et al.* (2015) [7] also found that when the

innovation motivation of entrepreneurs and technical employees is strong, the innovation motivation is enough to be transformed into innovation behavior, which will significantly improve the innovation performance of enterprises. The innovation incentive policy formulated by the government will significantly improve the innovation performance of private enterprises [8], and a good business environment can also significantly improve the innovation performance of private enterprises; Moreover, the marginal effect of optimizing the business environment on the innovation performance of private enterprises in inland areas is greater than that of enterprises in coastal areas [9].

#### **4.1.3. Research on Innovation Performance of Small- and Medium-Sized Enterprises**

There are 54 literatures on the innovation performance of small and medium-sized enterprises. There are significant differences in the impact of different types of collaborative innovation network models on the innovation performance of small and medium-sized enterprises, among which the effect of “enterprise-enterprise” collaborative innovation network model is the most significant [10]. The internal ability (absorptive ability, knowledge integration) and external ability (relationship learning) of science and technology-based small and medium-sized enterprises can jointly improve the innovation performance of enterprises [11]. The knowledge absorptive capacity of scientific and technological small and medium-sized enterprises, including potential absorptive capacity (knowledge acquisition, knowledge digestion capacity) and realization absorptive capacity (knowledge transformation, knowledge utilization capacity), are positively correlated with enterprise innovation performance [12]. There are significant differences in the demand of science and technology-based small and medium-sized enterprises for four different government innovation support behaviors: simplification and decentralization, environmental supervision, service supply and policy guidance. Science and technology-based small and medium-sized enterprises prefer to receive direct support from the government. In addition, the impact of government support behavior on the efficiency creation performance of different types, different life cycles and different sizes of science and technology-based small and medium-sized enterprises may also be different. [13] Chen Baojie (2015) [14] also found that women’s participation in the senior management team can significantly improve the innovation performance of small and medium-sized enterprises through the research on small and medium-sized board listed companies.

#### **4.2. Enterprise Innovation Performance Evaluation**

At present, the innovation performance of enterprises has not formed a recognized measurement index system. Some scholars believe that the number of patent authorizations (patent stock) is an important indicator for evaluating enterprise innovation activities [15]. Generally speaking, according to the patent approval system, there is a certain time lag from application to authorization of an

invention patent. The average examination cycle of invention patents in China is 19.4 months. Therefore, Wen Jun and Feng Genfu (2012) [16], Yu Haiyun *et al.* (2013) [6], Yu Maojian and sun Yuanxin (2020) [17] Zhang Zhaoguo *et al.* (2018) [18] believe that using the number of patent applications to measure the innovation performance of enterprises is more stable. However, there is uncertainty whether the patent application can be authorized, and whether the patent can be converted into visible commercial products. Considering the differences among industries, the number of patents is mostly used to measure the innovation performance of enterprises in a single industry (Park *et al.*, 2014) [19]. Li Donghong *et al.* (2020) [20] took the proportion of new product sales in the total sales of enterprises as the index to measure the innovation performance of enterprises. In view of the possible shortcomings of a single measurement index of enterprise innovation performance, build a multi index system to measure enterprise innovation performance with three indicators: the number of patents, the number of innovative products and the sales proportion of innovative products, which can better reflect the innovation achievements of enterprise R & D, manufacturing and marketing (Ma Ning, Guan Jiancheng, 2000 [21]; Zhang Fanghua, 2010 [22]). In addition, some scholars tend to obtain first-hand data through investigation. For example, Li Zhen *et al.* (2012) [9] designed a scale composed of six question items in the questionnaire, including two factors of output performance and process performance to measure the innovation performance of enterprises.

### 4.3. Influencing Factors of Enterprise Innovation Performance

The innovation performance of enterprises is affected by many factors. From the existing research results, the innovation performance is not only related to the personnel and capital investment of enterprises, but also depends on the internal technical factors and organizational management factors. In addition, it also depends on the external environment of enterprises. (Table 1)

#### 4.3.1. Technical Factors

Whether complementary technology M & A or alternative technology M & A, it will significantly affect the innovation performance of enterprises. Because technology M & A can enable enterprises to cross market barriers, obtain external knowledge and improve their technological innovation ability (Li Yu *et al.*, 2016 [23]; Qu Jing, 2019 [24]). Cooperative R & D can also effectively improve the innovation performance of enterprises. Cooperative R & D can not only make up for the lack of innovation resources of a single enterprise, reduce R & D risks and share R & D costs, but also contribute to knowledge transfer among enterprises (Wang Longwei *et al.*, 2011) [25]. Moreover, the higher the degree of cooperative R & D among enterprises, the greater the impact of their cooperative behavior on innovation performance (Fu Yu, 2018) [26]. There is a significant inverted “U” positive relationship between enterprises’ international cooperative R & D and innovation performance (Gao Qiang *et al.*, 2021) [27].

**Table 1.** Classification of innovation performance influencing variables.

Category	Influence variable
Technical factors	Cooperative R & D; Technology M & A; Knowledge transfer; Innovation ability
Personnel and capital factors	R & D investment; Senior management team; Human capital
Organization and management factors	Absorptive capacity; Organizational learning; Corporate culture; Enterprise scale (property right nature, enterprise type); Dynamic capability
External environmental factors	Innovation network (social network, network capability, network structure, network location, relationship strength); Government subsidies (subsidies, subsidies); Tax preference; Innovation environment; Institutional environment; Financing constraints

#### 4.3.2. Personnel and Capital Factors

Enterprise R & D investment mainly includes personnel investment and fund investment. Enterprise R & D investment and innovation performance should be regarded as the simplest input-output relationship. A large number of studies show that there is a significant positive correlation between enterprise R & D investment and innovation performance. Yang Lin *et al.* (2018) [28] believe that executives with overseas functional experience and overseas industry experience are more inclined to improve innovation performance by increasing R & D investment. The stability of the top management team (Wang Jia, 2020) [29] and women's participation in the top management team can significantly improve the innovation performance of enterprises (Chen Baojie, 2015) [14]. Some scholars have studied the impact of the top management team on the innovation performance of enterprises from the perspectives of the knowledge structure of the top management team, the heterogeneity of the intelligence of the top management team and the salary gap within the top management team.

#### 4.3.3. Organization and Management Factors

Corporate culture is the internal driving force of the enterprise. Establishing an innovative corporate culture atmosphere within the enterprise will help to encourage employees to dare to innovate and try, and promote the improvement of enterprise innovation performance. Scholars have different understanding of the relationship between enterprise scale and innovation performance. There is not only the understanding process from "linear relationship" to "inverted U-shaped relationship", but also the research conclusions of "U-shaped relationship" and "no impact". Government R & D funding has different effects on the innovation performance of enterprises of different sizes, and the enterprise's own R & D in-

vestment will also be affected by the enterprise scale. In addition, different types and different property rights will also have different effects on the innovation performance of enterprises. Scholars often take absorptive capacity, organizational learning capacity and dynamic capacity as intermediate variables of enterprise innovation performance. Research shows that enterprises with higher absorptive capacity often have stronger innovation capacity (Tsai, 2001) [30].

#### 4.3.4. External Environmental Factors

In addition to the internal factors, the influencing factors of enterprise innovation performance will also be affected by the external environmental factors. Existing research shows that the institutional environment will have an impact on the innovation performance of enterprises. Xu Hui *et al.* (2020) [31] and Zhang Duolei *et al.* (2021) [32] measured the institutional environment with reference to the marketization index in the marketization index report of China's provinces in 2016 and 2018 respectively, while Yang Zhenning *et al.* (2020) [33] measured the institutional environment from the two dimensions of formal system and informal system. Wang Yihui (2013) [34], Wang Suikun *et al.* (2014) [35], Sun Hui *et al.* (2017) [36], Li Xiaozhong *et al.* (2019) [37] verified the impact of government subsidies on enterprise innovation performance. Another way for the government to encourage enterprise innovation is tax preference. The research of Yan Huahong *et al.* (2019) [38] has verified that tax preference policies can improve enterprise innovation performance as government subsidies. The research also shows that on the whole, the promotion effect of tax preference policies on enterprise innovation performance is better than government subsidies, but for state-owned enterprises, Then the effect of government subsidies on the promotion of enterprise innovation performance is better than the preferential tax policies. Innovation network was first proposed by Freeman. He pointed out that innovation network is a basic institutional arrangement to deal with systematic innovation, and its main connection mechanism is the innovation cooperation relationship between enterprises [39]. Scholars have deeply studied the role of innovation network on enterprise innovation ability from the perspectives of network structure, network location and network relationship strength.

## 5. Visual Analysis of Enterprise Innovation Performance

### 5.1. Co-Occurrence Analysis of Authors and Research Institutions

The co-occurrence analysis of authors and research institutions can reflect the cooperative relationship between researchers and research institutions in a certain research field. Run the software, select author and institution for node type at the same time, and set the time from 2000 to 2021. By default, other thresholds are obtained. There are 447 nodes and 607 node connections in the co-occurrence map. The larger the node, the more papers published by the author or organization. The connection between nodes indicates the cooperative relationship between the two, and the thickness of the connection reflects the



intensity of cooperation between the two.

Scholars who have published more than 10 articles in the field of enterprise innovation performance research include Chen Jin (14 articles, Tsinghua University), Zeng Deming (13 articles, Hunan University), Zhao Yan (9 articles, Shanghai University), Zhang Yong'an (8 articles, Beijing University of Technology), Shao Yunfei (8 articles, University of Electronic Science and Technology). Through the knowledge map analysis, we can see that several small cooperation teams have been formed in the field of innovation performance research, such as Qian Li, Xiao Renqiao and Wang zongjun, Chen Jin and Wu Hang, Ren Hao, Zeng Deming and ye Jiangfeng, Miao Jianjun, Wang Wenhua and Huang Qi. These teams mainly focus on the cooperation scale of 2 - 3 people in the same institution or the same mentor, but have not yet formed a large cooperation network group. In terms of the number of articles published by research institutions, Xi'an Jiaotong University (40 articles), Zhejiang University (37 articles), Jilin University (33 articles), South China University of Technology (32 articles), Tongji University (29 articles), Zhejiang University of Technology (28 articles) and other universities rank among the top in the field of enterprise innovation performance research, and the number of articles published by the top 10 universities accounts for 24.25% of the total, It can be seen that these universities have made outstanding contributions in the field of enterprise innovation performance research, and play a certain role in promoting the research of domestic enterprise innovation performance.

## 5.2. Analysis of Co-Cited Documents

The co-cited literature is often regarded as the basic literature in this research field and the knowledge base of this research field. The documents retrieved from the Chinese Social Sciences Citation Index database are imported into CiteSpace software. The node type selects cited reference, and the time is set to 2000-2021. Other thresholds are set by default. The software operation results show that the cited network has 743 nodes, 1440 connections, and the network density is 0.0052. The node size reflects the number of times the documents are cited. The larger the node is, the more times the documents are cited. The connection between the two nodes and the thickness of the connection can reflect the strength of the two documents being cited at the same time.

Xiao Wen *et al.* (2014) used the stochastic frontier analysis method to calculate the technological innovation efficiency of 36 industrial industries. They not only explored the differences in the impact of government support and enterprise R & D management on technological innovation efficiency, but also explored the impact of industry competition, overseas R & D capital investment, foreign investment in the industry, enterprise performance and other factors on technological innovation efficiency. The research of Yuan Jianguo *et al.* (2015) verified that there is a curse effect of political resources in Chinese enterprises. Enterprise political connection will reduce the efficiency of enterprise innova-

tion, and deeply analyzed the action mechanism of political resource curse. The research found that political connection will reduce market competition, encourage excessive investment, weaken the sensitivity of technological innovation and enterprise performance, resulting in weak technological innovation and hinder independent innovation. Innovation is a process of interactive cooperation. Qian Xihong (2010) and others believe that enterprises located in the center of the network and occupying rich structural holes in the cooperative innovation network have more innovative advantages. By providing opportunities for learning, knowledge transfer and information exchange, they can help to promote the improvement of enterprise innovation performance. (Table 2)

### 5.3. Analysis of Research Hotspots and Evolution Trend

CiteSpace mutation analysis regards the professional terms with rapidly increasing frequency as mutation words. Through the sudden change of keyword frequency in different time intervals, several keywords representing the research frontier can be presented, so as to reveal the dynamic trend of the research frontier of enterprise innovation performance. Run the “bursts terms” function in CiteSpace software and set  $\gamma = 0.8$ . The knowledge map results show that there were 16 mutation terms in the research field of enterprise innovation performance from 2000 to 2021 (Figure 2). We can divide the keyword mutation into three stages according to the start time and deadline, and because the keyword mutation occurs continuously, that is, some new mutation keywords will appear in the year when some keyword mutations disappear, so the deadline and start time of the two adjacent stages will overlap.

Top 16 Keywords with the Strongest Citation Bursts

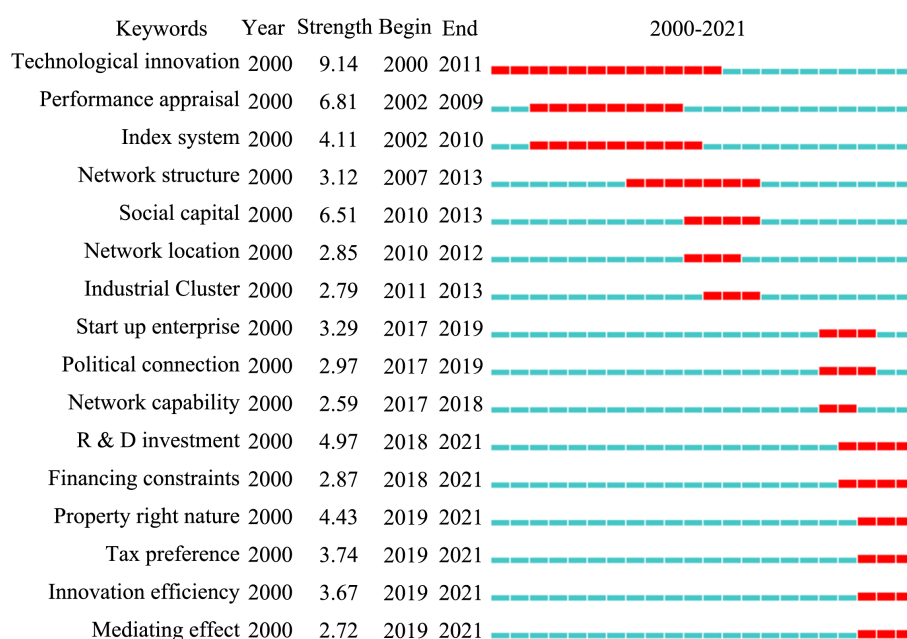


Figure 2. Knowledge map of mutation strength of keywords.

**Table 2.** Top 10 co cited literatures.

Serial number	Co citation times	First author	Time of issue	Published journal	Literature
1	25	Xiao Wen	2014	Management World	Government support, R & D management and technological innovation efficiency—An Empirical Analysis Based on China's industrial industry
2	21	Yuan Jianguo	2015	Management World	Curse effect of enterprise political resources—An investigation based on political connection and enterprise technological innovation
3	20	Qian Xihong	2010	Management World	Enterprise network location, absorptive capacity and innovation performance—An interactive effect model
4	18	Feng Zongxian	2011	The Journal of Quantitative & Technical Economics	Government Investment, Degree of Marketization and Technological Innovation Efficiency of China's Industrial Enterprises
5	16	Li Mei	2016	Management World	Whether R & D internationalization promotes enterprise innovation—A study based on the experience of Chinese information technology enterprises
6	16	Li Wenjing	2016	Economic Research Journal	Is it Substantive Innovation or Strategic Innovation?—Impact of Macroeconomic Policies on Micro-enterprises' Innovation
7	13	Zhong Changbiao	2014	Nankai Economic Studies	Study on the Impact of Emerging Economies Overseas R & D to the Innovation of the Parent Company: Based on Incremental Innovation and Subversive Innovation Perspective
8	13	Liu Xueyuan	2016	Nankai Business Review	Firm's Strength of Ties within Innovation Network, Absorptive Capacity and Innovation Performance in the Chinese Manufacturing Industries
9	12	Wu Yanbing	2012	Economic Research Journal	The Dual Efficiency Losses in Chinese State-Owned Enterprises
10	12	Zhao Shukuan	2013	Science Research Management	The innovation efficiency of hi-tech enterprises in Jilin Province based on DEA method

The first stage is from 2000 to 2010, and the research frontier of this stage is technological innovation and performance evaluation system. Domestic scholars focus on the technological innovation of enterprises and how to build the evaluation index and evaluation system of enterprise innovation performance; The second stage is from 2010 to 2018. The research frontiers in this stage are mainly network structure, network location, network capacity, social capital and industrial clusters. With the change of external environment, enterprises find it more and more difficult to innovate only by themselves, while joint innovation partners and innovation networks to cultivate joint innovation ability can promote enterprise innovation. The third stage is from 2018 to now. The effects of R & D investment, financing constraints, the nature of property rights and tax incentives on enterprise innovation performance are the research hotspots at present and in the future.

## 6. Conclusion and Prospect

Taking the literature related to enterprise innovation performance from 2000 to 2021 in the sample data of CSSCI (Chinese Social Science Citation Index) as the analysis sample, this paper first makes a statistical analysis of the number of documents on enterprise innovation performance. Then it analyzes the hot topics of enterprise innovation performance from three aspects: research object, enterprise innovation performance evaluation and influencing factors of enterprise innovation performance. By using CiteSpace software to analyze the co-occurrence of authors and research institutions, highly cited literature, research hotspots and evolution trend of enterprise innovation performance, the main conclusions are as follows: 1) The research on innovation performance of domestic enterprises is heating up and follows the relevant policies of China's innovation support; 2) The evaluation system of innovation performance of domestic enterprises has not formed. There is not only a single evaluation index such as the number of patent applications or patent authorizations, but also a comprehensive evaluation of multiple indexes, each with its advantages and disadvantages; 3) The influencing factors of enterprise innovation performance include not only the internal factors of technology, capital and personnel, organization and management, but also the external factors of innovation network, tax system, innovation environment and so on; 4) At present, the research on innovation performance of domestic enterprises has not yet formed a large-scale cooperative research network, and there are only small cooperative networks formed within several research institutions or from an academic relationship; 5) The research on the impact of R & D investment, financing constraints, the nature of property rights and tax incentives on enterprise innovation performance will be hot issues at present and in the future. The deficiency of this study is that it focuses on the research of domestic innovation performance, so it does not involve the research results of foreign enterprise innovation performance. But in fact, the domestic and foreign studies cannot be completely separated, which will also be the research direction of the next stage of this study. The comparative

analysis of domestic and foreign enterprise innovation performance research will help us better grasp the research trends and research results of enterprise innovation performance.

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## Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

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