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Literature Review on the Evaluation of Innovation Capability of Enterprise

Shibin Zhou, Xuefen Gao, Gaoxiang Chen*, Tanzhun Yu, Yuxing Ma

Wenzhou Polytechnic, Wenzhou, Zhejiang 325004, China

*Corresponding author: Gaoxiang Chen (Email: yiefanshin@163.com)

Abstract

This paper summarizes the research status of innovation capability of enterprise, reviews the importance of enhancing the capability of independent innovation as a national development strategy. In particular, the Wenzhou government attaches great importance to innovation and the promotion of "Science and Technology Innovation Index".This paper systematically combs the innovation theory, the Delphi method and other related theories, analyzes the development trend of innovation theory research, innovation capability index construction and evaluation method at home and abroad. Through literature review, this paper summarizes the multi-dimensional index system of enterprise innovation capability evaluation, including innovation input, output, research and development, environment and so on, and discusses the application of subjective and objective evaluation methods.Finally, it points out the shortcomings of the current research, and provides a theoretical basis and direction guidance for the follow-up research on the evaluation of enterprise innovation capability.

Keywords

Enterprise Management; Innovation Capability; Evaluation Research; Review Research.

1. Research Background

China has always regarded "enhancing the ability of independent innovation and building an innovative country" as the core of its national development strategy. It is regarded as the key to improving the comprehensive national strength. In 2012, the Eighteenth National Congress of the Communist Party of China put forward the "innovation-driven development strategy", which clearly defined the importance of innovation. The report of the 20th National Congress of the Communist Party of China emphasizes that "we must insist that science and technology are the first productive force, talent is the first resource, and innovation is the first driving force. We will thoroughly implement the strategy of rejuvenating the country through science and education, the strategy of strengthening the country through human resources, and the strategy of innovation-driven development, and open up new fields and new tracks for development.We should constantly shape and develop new momentum and new advantages", and "improve the system of scientific and technological innovation". At the same time, "accelerate the implementation of innovation-driven development strategy".As the main body of scientific and technological innovation, if enterprises do not have strong independent innovation and R&D capabilities, enterprises can not play a leading role in the industry, and can not achieve leapfrog and high-quality development of enterprises.

Innovation was mentioned 43 times in Wenzhou's Report on the Work of the Government in 2024. In particular, it is pointed out that one of the next key tasks is to "insist on innovation to win and project to be king. We will unswervingly take the road of "Mount Hua" for innovation and development, and focus on the project. We should accumulate the momentum of innovation, gather the ability of projects, open up a new situation with concept innovation and system

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innovation, and respond to changes with scientific and technological innovation and industrial innovation. Seize the new track, open up new space, and make every effort to achieve straight acceleration, curve overtaking and lane change. In 2023, the "Science and Technology Innovation Index" of Wenzhou City has been adopted by the China Association for Science and Technology, but the "Science and Technology Innovation Index Index System" is not perfect. In the follow-up, we should promote the construction and application of various index systems.It includes the concepts of "financial science and technology innovation index" and "industrial science and technology innovation index". So, what is the innovation ability of small and medium-sized enterprises in Wenzhou? What indicators and methods should we use to evaluate the innovation capability of enterprises? How should we guide and advise enterprises with backward innovation ability? How to enrich the index system of Wenzhou Science and Technology Innovation Index? That's what we want to know.

In order to better carry out relevant research, this paper intends to carry out a literature review of the evaluation of innovation capability of enterprise in recent years. In order to lay the foundation for the follow-up evaluation and research.

2. Review of Related Theories

2.1. Innovation Theory

Schumpeter (1912) first put forward the theory of innovation and established a theoretical model of unbalanced dynamic development with the theory of innovation as its core. Technological innovation is regarded as a new variable of production function, and a new production model is re-established. The production of new products, the development of new materials, the use of new materials, the adoption of new processes and other means will be incorporated into the new production model. After Schumpeter's innovation theory, many scholars have enriched and improved the connotation of innovation theory. Since the 1970s, whether it is the innovative evolutionary economic theory created by Winter and Nelson, or the national innovation system that Freeman and Lundvall started later, The research ideas of regional innovation system, technology system, innovation network and collaborative innovation of industry, university and research have gradually matured and developed. And has been continuously promoted and applied.

2.2. Delphi Method

Delphi method, also known as expert investigation method, was initiated and implemented by Rand Corporation of the United States in 1946, which is essentially a feedback anonymous inquiry method. Its general process is to sort out, summarize and count the problems to be predicted after obtaining the opinions of experts. Then give anonymous feedback to the experts, solicit opinions again, concentrate again, and give feedback again until a consensus is reached. In this method, a special forecasting organization is formed by enterprises, including several experts and enterprise forecasting organizers. According to the prescribed procedures, experts are consulted back to back for their opinions or judgments on the future market, and then the method of prediction is carried out.

The main characteristics of Delphi method are as follows: (1) Anonymity, Delphi method consults experts anonymously. It avoids the authority effect and group thinking that may arise from face-to-face discussion, and enables experts to express their views freely;(2) Feedback, the method makes the experts' opinions gradually consistent through repeated consultation and feedback. The accuracy and the reliability of the prediction result are improved;(3) Collective wisdom, Delphi method makes full use of the collective wisdom of experts, through synthesizing and sorting out the opinions of different experts, forming a more comprehensive prediction result;(4) Mathematical statistics method, which deals with expert opinions in

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mathematical statistics, so that qualitative investigation has quantitative explanation. The conclusion is more scientific.

The advantages of Delphi method are as follows: (1) adequate time preparation, experts have enough time to prepare for the problem, be able to think deeply and give more mature opinions;(2) Synthesizing different opinions, experts can understand different opinions in the process of repeated consultation. The views put forward are more perfect: (3) avoid the authority effect: the anonymous way is conducive to the independent thinking of experts. Avoid a few authoritative opinions influencing the overall judgment;(4) Strong scientificity, using mathematical statistics methods to collect and sort out expert opinions, so as to make the conclusions more scientific.

Disadvantages of the Delphi method: ① Strong subjectivity, the prediction results are affected by subjective factors of the experts, such as knowledge, evaluation scale, physiological state and degree of interest, etc.: ② Limitations in thinking, experts are prone to habitual thinking in a limited range, lack of global vision. ③ Lack of stability, the expert's evaluation of the problem is usually based on intuition, lack of rigorous examination, the prediction of the conclusion may be unstable; ④ Complexity of the process, the process of multi-round feedback and aggregation is more complicated and time-consuming.

3. Development Trends in Related Domestic and Overseas Research

3.1. Research and Development of Innovation Theory

The origin of innovation theory can be traced back to the beginning of the 20th century, when the Austrian-American economist Joseph Schumpeter (1912) took the lead in defining the concept of innovation and constructing its theoretical system as a means of describing the evolutionary path of capitalism. Subsequently, scholars such as Edwin Mansfield, Nancy Schwartz, Richard R. Nelson and others focused on the dimension of technological innovation, and explored in depth the intrinsic links between the diffusion of new technologies, technological innovation and market patterns, competition and monopoly dynamics, as well as the expansion of enterprise scale. In the late 20th century, British economist Christopher Freeman (1987) put forward the theory of "national innovation system" in response to the post-World War II Japanese economic miracle. In the 1990s, the theory was further expanded, with P. Patel and K. Pavitt introducing incentive mechanisms in the United Kingdom, and Bengt-Åke Lundvall of Denmark exploring the path of national innovation system to promote economic efficiency from the perspective of interactive learning between users and producers; meanwhile, Michael E. Porter analyzed in the United States how innovations can strengthens industrial clusters and enhances national competitiveness.

Since the 1990s, Chinese scholars have promoted the research on independent innovation based on the essence of international innovation theories and local practices. Chen Jin, Fu Jiaji, Chen Zhili and other pioneers have analyzed the intrinsic connection between innovation and enterprise growth, and emphasized that innovation is a key strategy for enterprises to cross the bottleneck of development, promote transformation and upgrading, and strengthen market competitiveness. Nowadays, innovation research has moved from pure conceptual definition to quantitative analysis. For example, Sun Wenhao and Zhang Jie (2021) used a panel threshold model to assess the specific impact of the scale of scientific and technological talents on corporate innovation using the "scale threshold" as a yardstick, which contributes a new perspective for quantifying innovation. Based on the data of A-share listed companies from 2007 to 2018, Shengqi Zheng (2022) reveals the inhibitory effect of deleveraging on corporate innovation through regression analysis, and further verifies it by using the mediation effect model, pointing out that deleveraging through the reduction of long-term liabilities is more helpful to stimulate the vitality of corporate innovation.

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Drawing on the research results of the predecessors, enterprise scientific and technological innovation is defined as "the process in which an enterprise aims to enhance the competitiveness of its own products or markets, and without changing the original factors of production, adopts a different business philosophy or production method, and utilizes new knowledge, methods, technologies, etc. to complete the upgrading of its products and services, and ultimately to enhance the enterprise's market value ".

3.2. Research on Innovation Capability Index

When constructing the evaluation index system of enterprise innovation ability, multi-dimensional factors need to be considered comprehensively, and scholars hold different views due to different research perspectives. Zhao Wenyan and Zeng Yueming (2013) suggest that in-depth discussions should be conducted on the dimensions of enterprise operation process, characteristics of innovative enterprises and development stage. However, if we focus on the essence of innovation, the core focus should be on innovation performance and process.

Discussions on innovation performance have extensively covered inputs, outputs and related fields. Sun Liyuan et al. (2012) systematically sorted out the current status of innovation capability research and constructed an evaluation system covering innovation inputs, outputs, activities and risk control capability, but unfortunately, the study did not involve the specific quantification of indicator weights. Sun Jihui et al. (2014), on the other hand, focused on innovation inputs and outputs, combined with innovation potentials, and tailored a financial indicator system for an enterprise in Jinzhou New District, Dalian City, using hierarchical analysis and fuzzy comprehensive evaluation method for assessment. Xu Liping et al. (2015) enriched the process-oriented evaluation practice by designing evaluation indexes from six-dimensional perspectives of inputs, outputs, research and development, and marketing through comparative analysis and empirical analysis with a sample of 20 enterprises in Shandong Province.

As for the research on innovation process, Guan et al. (2006) took the lead in constructing a comprehensive evaluation system covering learning, R&D, organizational and marketing capabilities. Ben Youhong et al. (2008) further refined it into inputs, outputs, marketing and management, and used hierarchical analysis to rank the importance of each indicator. DengShuli and Mengcheng Chen (2016) emphasized the evaluation from the levels of scientific and technological talents, innovation culture and environment for science and technology-based small and micro enterprises, and took Fengcheng City in Jiangxi Province as an example to deeply analyze the innovation status of this type of enterprises, which provided a new perspective for the evaluation within the segmented field.

To sum up, scholars have constructed different evaluation index systems of innovation capability from different perspectives and according to different research objects.These evaluation systems can be roughly divided into the following types. That is, innovation input ability, innovation output ability, innovation R&D ability, innovation environment, innovation system, management ability, marketing ability, etc. On the whole, it provides a good theoretical basis and methodological guidance for the study of this topic.

3.3. Research on the Evaluation Methods of Innovation Capability

When discussing the evaluation method of enterprise innovation capability, The academic circles mainly divide it into two camps: subjective evaluation method and objective evaluation method.Both of them have their own merits. Subjective evaluation is good at its simplicity and intuition, but there are limitations in the depth of information mining; Objective evaluation relies on data support and emphasizes positivism, but it may introduce large errors when the sample size is limited. In order to overcome the limitations of a single evaluation method, many scholars have turned to the path of interdisciplinary integration and multi-method integration.

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It aims to achieve a more accurate and comprehensive evaluation of enterprise innovation capability through multi-dimensional perspectives and mixed strategies.

Zhang Xiaoming (2014) made a pioneering attempt in this field.He skillfully combines rough theory with attribute hierarchical model (AHM), calculates index weights and puts them into practical analysis. It shows a new paradigm of integration of subjective and objective evaluation.Li Suying et al. (2017) found a new way to integrate the analytic hierarchy process (AHP) with BP neural network technology. Applied to the evaluation of innovation capability of small and medium-sized technology-based enterprises in China, it provides a new perspective for the innovation of evaluation methods.

The research of Xia Wenfei et al. (2020) further promoted this trend by comprehensively using the analytic hierarchy process and the entropy weight method. This paper constructs an evaluation model for the innovation capability of high-tech enterprises, and makes an empirical study based on the sample data of 31 provinces in China.This study not only reveals the current situation of low overall innovation efficiency of high-tech enterprises in China, it also deeply analyses the significant differences of innovation ability among regions. Especially, the high-intensity innovation capability of the southeast coastal areas is relatively weak in the northeast and the central and western regions.It provides an important reference for the formulation of regional innovation policy.

As mentioned above, both subjective and objective single-mode evaluation methods have different degrees of defects. For example, the analytic hierarchy process and fuzzy evaluation method need to quantify the indicators, which rely heavily on people's subjective judgment.Data Envelopment Analysis and Neural Network have high requirements for sample quality and algorithm model. The combination of subjective and objective weighting rules is more scientific and reasonable, which can better solve the comprehensive problem of multi-index system.

4. Summary

This paper comprehensively reviews and analyzes the background, related theories, research trends at home and abroad,Evaluation method.

First of all, from the perspective of national development strategy, the article emphasizes that China attaches great importance to enhancing the ability of independent innovation.In particular, the "innovation-driven development strategy" was clearly put forward in the reports of the Eighteenth and Twentieth National Congresses of the Communist Party of China. In particular, the article points out that as the main body of scientific and technological innovation, the innovation ability of enterprises is very important for achieving leapfrog and high-quality development.Taking Wenzhou as an example, this paper elaborates on the efforts and challenges faced by local governments in promoting innovation.For example, innovation has been mentioned many times in Wenzhou's Report on the Work of the Government, and plans to improve the "Science and Technology Innovation Index Index System".

In the part of related theory summary, the article reviews the origin and development of innovation theory, from Schumpeter's first innovation theory.Later scholars such as Winter, Nelson, Freeman and Lundvall enriched and perfected the innovation theory. The article also introduces the origin, process, characteristics, advantages and disadvantages of Delphi method (expert investigation method) and its evaluation of enterprise innovation ability in detail.Application potential in valence.Delphi method aims to improve the accuracy and reliability of prediction results through anonymous consultation with experts, multi-round feedback and aggregation.However, its shortcomings such as strong subjectivity and complex process also need attention.

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In terms of the development trend of related research at home and abroad, the article combs the transformation process of innovation theory from qualitative to quantitative.As well as the research results of domestic and foreign scholars on the evaluation index system and evaluation methods of innovation capability.The article points out that scholars have constructed a variety of evaluation index systems of innovation capability from different perspectives.It includes innovation input ability, innovation output ability, innovation R & D ability, innovation environment and so on. At the same time, the article also introduces a variety of evaluation methods, such as subjective evaluation, objective evaluation and the combination of subjective and objective evaluation methods.And their advantages and disadvantages are analyzed.

Finally, the paper summarizes the importance and future research directions of enterprise innovation capability evaluation.The article holds that with the continuous progress of science and technology and the increasingly fierce market competition, The evaluation of enterprise innovation capability will become an important support for the development of enterprises.Future research should further improve the evaluation index system and methods of innovation capability, and improve the accuracy and reliability of evaluation results; At the same time, we should also pay attention to the differences in innovation capabilities of enterprises of different industries and scales.To provide more targeted policy recommendations and practical guidance for the government and enterprises.

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