Original Research Article

Research on the performance configuration of innovation consortium achievement transformation: based on the fsQCA method

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Abstract: Based on the TOE theoretical framework and the method of fuzzy set qualitative comparative analysis, the sample data of 23 innovation consortia formed by listed enterprises as the leading companies are analyzed, and the impact configuration of innovation consortium performance is studied. The results show that no single factor is necessary to improve the performance of the innovation consortium. There are three configuration paths to improve the performance of the innovation consortium, and the corresponding innovation consortium cases are analyzed based on the three configuration paths, and countermeasures are put forward to improve the innovation consortium according to the configuration results.
Keywords: innovation consortium; TOE framework; qualitative comparative analysis of fuzzy sets; innovative development

1. Introduction

In July 2024, the "Decision of the Central Committee of China on Further Comprehensively Deepening Reform and Promoting Chinese-style Modernization" deliberated and adopted by the Third Plenary Session of the 20th Central Committee of the Communist Party of China proposed to improve the system and mechanism for the development of new quality productive forces according to local conditions, optimize the organizational mechanism of major scientific and technological innovation, strengthen the construction of national strategic scientific and technological forces, and coordinate and strengthen the research of key core technologies. Giving full play to the leading role of leading scientific and technological enterprises in scientific and technological innovation is crucial to achieving high-level scientific and technological self-reliance and accelerating the development of new quality productive forces. Since key core technologies include a large amount of tacit knowledge, high innovation barriers, and difficult to imitate and replicate, breakthroughs in key core technologies not only require long-term accumulation and precipitation of basic scientific knowledge, but also inseparable from close collaboration between multiple innovation subjects, systems, organizations, and teams.

An innovation consortium is an organization that actively integrates the scientific and technological innovation resources of colleges and universities and scientific research institutes, jointly funds in the R&D stage, or establishes an entity institution, establishes a cooperative R&D entity platform, purchases or shares R&D results through contracts or other agreed means, and competes in the production and market development stages[1]. Wu Xiaobo et al. regard the commune integrated device manufacture (CIDM) model of the semiconductor industry business division model in the Chinese context as an "innovation consortium" in the chip industry, and chip design companies, chip manufacturers, and terminal application enterprises jointly participate in project investment, and integrate multiple resources through the establishment of joint ventures to directly provide high-quality, high-quality, Efficient products, so as to achieve resource sharing, capacity collaboration, capital and risk sharing, and overcome the latecomer disadvantages of the industry.

Zhou Yan et al.[2] established an R&D game model of an innovation alliance composed of one leading enterprise and two small and medium-sized enterprises, and analyzed three cooperative R&D strategies: vertical technical benefits without collaborative decision-making, horizontal and vertical technical benefits without collaborative decision-making, and horizontal and vertical technical benefits without collaborative decision-

making. T

Guo Ju'e[3] and others believe that the organizational form of the innovation consortium is not only to break through the key core technologies such as "stuck neck" technology, but also an important carrier in the overall innovation strategic layout of core innovative enterprises, so they will rely on the innovation chain layout of core innovative enterprises to interpret and explain the cooperation mode between enterprises and between schools and enterprises such as mergers and acquisitions, strategic alliances, and industry-university-research cooperation from the perspective of innovation consortium, trying to present a more systematic panorama of technological innovation element agglomeration.

Gao Qianying [4]and others believe that innovation efficiency depends not only on the efficient operation of each actor, but also on the interconnection and cooperation between actors.

Although the existing literature has interpreted and built the research framework of innovation consortia from various aspects such as definition, formation path paradigm, operational efficiency, and industry characteristics, there are also a large number of case studies to deconstruct and analyze the development and path of innovation consortium. However, the research on the antecedents and configurations affecting the innovation efficiency of innovation consortia is still insufficient. From the perspective of TOE framework [5] this paper uses the fsQCA method to analyze the antecedents and configurations of innovation efficiency of innovation consortia from three dimensions: technology, organization and environment, explores the configuration and key factors to improve innovation efficiency, and forms a research on the innovation performance improvement path of innovation consortium.

2. Configuration analysis

The original consistency threshold is set to 0.75, the threshold of the number of cases is set to 1, and the PRI consistency threshold is set to 0.6. The configuration analysis results are shown in the table, and the corresponding complex, simple and intermediate solutions are obtained. Since the intermediate solution contains "logical remainders" and is logical, the intermediate solution is selected for analysis, and the path to improve the performance of the innovation consortium is further explored in combination with the simple solution, and the conditions that appear in both the simple solution and the intermediate solution are regarded as the core condition, and the conditions that only appear in the intermediate solution are regarded as auxiliary conditions. Through the truth table, three configurations can be identified to improve the development performance of the innovation consortium. The overall consistency was 0.81062, which was greater than the threshold of 0.8, indicating that these three configurations were sufficient conditions to improve the performance of the innovation consortium, and the overall coverage was 0.646075, which was greater than the standard of 0.5.

Table 1. Configuration analysis.

antecedent conditions	path		
	1	2	3
Resource aggregation level		⊗	○
Subject coordination level	○		⊗
Innovation ability	⊗	⊗	⊗
Technological environment	○	○	○
External environment	⊗	⊗	○
consistency	0.784587	0.786047	0.862903
raw coverage	0.394369	0.432594	0.182594
unique coverage	0.13157	0.142491	0.077645
consistency	0.81062		
coverage	0.646075		

⊗ It means that the core condition exists, ○ It means that the core conditions are missing, ⊗ VIndicates the presence of edge conditions, ○ Indicates the absence of edge conditions

Innovation consortia with high innovation ability and high external environment as necessary conditions have high output performance. This type of innovation consortium shows a high proportion of R&D investment and a high proportion of government subsidies. A high proportion of R&D investment usually means that a larger proportion of revenue or capital is spent on research and development activities, which is often part of a company's pursuit of innovation, maintaining competitive advantage, and long-term growth strategies. High R&D investment can help companies develop new products, improve existing products, increase production efficiency, or enter new markets. Government grants are an incentive for businesses to encourage specific types of investments or behaviors, such as research and development activities.

Innovation consortia with high innovation ability, high external environment as a necessary condition, and resource aggregation level as a marginal condition have high output performance. This kind of new innovation consortium is manifested in the high proportion of R&D investment of leading enterprises and large government subsidies, and at the same time, in an environment with a high concentration of resources, the development performance of innovation consortia will be significantly improved. The phenomenon of high R&D investment, high government subsidies, and high industrial linkage usually indicates that the innovation ecosystem of a country or region is relatively healthy and active. These three aspects can not only promote the growth and expansion of individual enterprises, but also promote technological progress and economic development at the regional and even national level.

Innovation consortia with high subject collaboration level and high innovation ability as necessary conditions have high output performance. This type of innovation consortium is manifested in the large number of members above the consortium size and the high proportion of enterprise R&D investment. The large number of members and high R&D investment in innovation consortia usually represent the following important characteristics and advantages: extensive cooperation network; rich knowledge and technical resources, efficient resource sharing; Stronger risk tolerance and market influence; Good policy support.

3. Conclusion

Focusing on the formation and development of innovation consortia and innovation performance, this paper analyzes the antecedents affecting the innovation and development efficiency of innovation consortia from three aspects: technology, organization and environment. Taking 23 innovation consortia in 2022 as case samples, this paper uses the fuzzy set qualitative comparative analysis method to analyze the key factors and combination conditions affecting the transformation of innovation performance of innovation consortia from the perspective of configuration. The following conclusions are drawn:

(1) The performance of the transformation of achievements of the innovation consortium is not controlled by a single variable.

(2) Through configuration analysis, it can be seen that the three paths to form the transformation performance of high-innovation achievements are "high-tech innovation", "high-tech agglomeration" and "collaborative innovation", in which the level of collaboration of the subject, innovation ability and external environment are the corresponding key factors.

(3) A single factor will not become a necessary condition for the performance development of the innovation consortium. It can be seen from the configuration analysis path that there are core conditions for innovation ability in all three paths, indicating that innovation ability is a very important sufficient and unnecessary condition for the development of innovation consortium. Organizations without innovation capabilities cannot achieve effective outcome performance.

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