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Research on Partner Selection in Enterprise Innovation Ecosystem

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Abstract: In the face of fierce market competition, enterprises must ensure the competitiveness of their products or services through technological innovation. However, the complexity of technology often surpasses the capabilities of individual enterprises, leading them to deepen cooperation with other organizations. The entities within the enterprise innovation ecosystem depend on each other, collaborate closely, and rely on core enterprises to integrate resources, thereby creating system value and enhancing competitiveness. The purpose of this paper is to explore the process of selecting appropriate ecosystem partners. It begins by providing an overview of relevant concepts, characteristics, selection factors, and methods. Subsequently, it analyzes the roles, resources, and synergy evolution of the entities within the ecosystem. An evaluation system encompassing operation, core, synergy, and development capability is then established. This system comprises 16 indicators, including organization scale and reputation, and is accompanied by a hierarchical evaluation model. Finally, the validity of the evaluation system is confirmed through empirical analysis, utilizing the Analytic Hierarchy Process (AHP) and the fuzzy comprehensive evaluation method.

Keywords: Enterprise innovation ecosystem; Partner selection; Core enterprise

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1. Introduction

In the knowledge-based economy of the twenty-first century, enterprises face challenges stemming from rapid technological development, evolving consumer demands, and intense market competition. To maintain a competitive edge, enterprises must bolster their core competitiveness, particularly through technological innovation. However, the intricate nature of technological innovation renders it challenging for enterprises to navigate alone, thus fostering a trend towards collaborative innovation that necessitates deeper and more intricate partnerships. Selecting the appropriate partner is pivotal to collaborative innovation, as it directly impacts innovation capability and success. Consequently, scholars and business practitioners are increasingly focusing on the research and practice of partner selection.

To address the challenge of selecting partners for cooperative innovation, scholars have proposed various methods and models. For instance, Liu *et al*. analyzed the influence of technical knowledge base plurality

on the selection of enterprise cooperative innovation partners using multinomial logistic regression [1]. Lo *et al*. employed the DEMATEL-AEW-FVIKOR method to evaluate decision-making in selecting partners for industry-university-research cooperative innovation [2]. Chen *et al*. utilized a method based on dynamic intuition fuzzy decision-making and field theory to explore partner selection for industry-university-research collaborative innovation [3]. Han *et al*. developed a decision-making method that combines the particle swarm algorithm with an improved TOPSIS method [4]. Zhang *et al*. proposed and validated the effectiveness of the fuzzy-QFD method in partner selection for virtual enterprises, considering customer demand [5]. Additionally, Lu and Shen introduced the PSACO algorithm, which combines the ACO algorithm for ant colony optimization with the PSO algorithm for particle swarm optimization, followed by ant colony optimization for preference [6].

While these studies offer valuable methods and models for enterprises, the business environment continues to evolve in complexity and dynamism, necessitating further refinement and enhancement of research on cooperative innovation partner selection. Recognizing the complementary nature of the Analytic Hierarchy Process (AHP) and fuzzy comprehensive evaluation method, this paper adopts a combination of these two methods as its research approach. It conducts both qualitative and quantitative evaluations to ensure comprehensive and objective results. This integrated method is expected to offer effective guidance for enterprises in selecting suitable partners.

2. Modeling of recursive hierarchies

Based on the previous analysis, this paper constructs the following evaluation index system for enterprise innovation ecosystem partner selection and divides it into three levels according to the target layer, standardized layer, and indicator layer. The details are shown in **Figure 1** below:

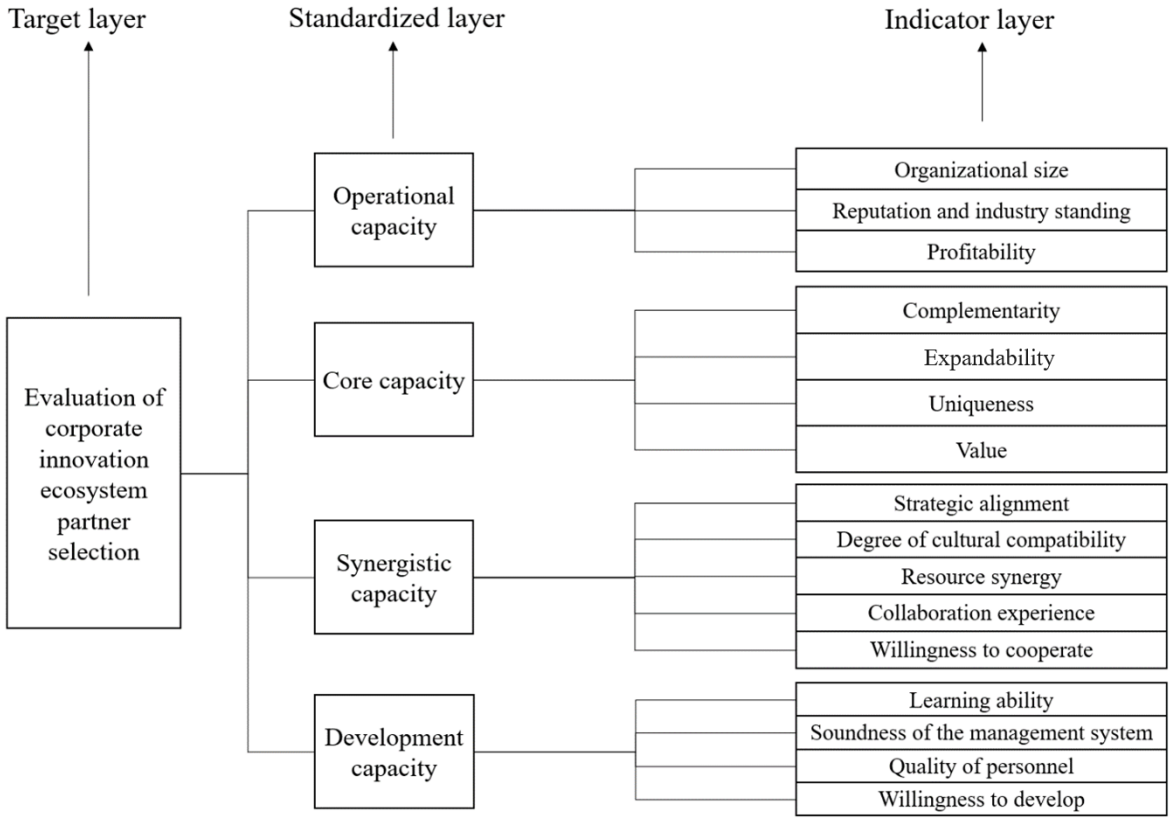

Figure 1. The recursive hierarchical structure of enterprise innovation ecosystem partner selection evaluation

3. Partner selection empirical analysis

In the subsequent section of this paper, the effectiveness of the evaluation system is tested using a real-world example of partner selection within an enterprise innovation ecosystem.

Company F, a high-tech firm, sought to expand its market share and meet heightened consumer demands for product functionality to remain competitive and dynamic in the market. In pursuit of these objectives, Company F initiated a search for new parts suppliers capable of enhancing product functionality and ensuring ample production supply. Following initial contacts and negotiations, Company F identified four potential partners: Companies A, B, C, and D. Subsequently, a decision-making group within Company F was formed to evaluate these four alternatives and assign evaluation scores based on their capabilities.

The evaluation results for Company A are presented in **Table 1** below:

Table 1. Evaluation of the affiliation of the capacity indicators of Company A

Evaluation criteria	Evaluation indicators	Very dissatisfied	Dissatisfied	Average	Satisfied	Very satisfied
Operational capacity	Organizational size	0	0	0.3	0.5	0.2
	Reputation and industry standing	0	0	0.5	0.5	0
	Profitability	0	0	0.6	0.4	0
Core capacity	Complementarity	0	0	0.2	0.5	0.3
	Expandability	0	0	0.1	0.7	0.2
	Uniqueness	0	0.1	0.6	0.3	0
	Value	0	0	0.2	0.8	0
Synergistic capacity	Strategic alignment	0	0	0.1	0.5	0.4
	Degree of cultural compatibility	0	0	0.1	0.8	0.1
	Resource synergy	0	0	0.2	0.7	0.1
	Collaboration experience	0	0	0.6	0.4	0
	Willingness to cooperate	0	0	0.1	0.6	0.3
Development capacity	Learning ability	0	0	0.2	0.5	0.3
	Soundness of the management system	0	0.1	0.4	0.5	0
	Quality of personnel	0	0	0.3	0.7	0
	Willingness to develop	0	0	0.1	0.3	0.6

The fuzzy comprehensive evaluation matrix of operational capacity is:

$$R_1 = \begin{bmatrix} 0 & 0 & 0.3 & 0.5 & 0.2 \\ 0 & 0 & 0.5 & 0.5 & 0 \\ 0 & 0 & 0.6 & 0.4 & 0 \end{bmatrix}$$

The fuzzy comprehensive evaluation matrix for core capacity is:

$$R_2 = \begin{bmatrix} 0 & 0 & 0.2 & 0.5 & 0.3 \\ 0 & 0 & 0.1 & 0.7 & 0.2 \\ 0 & 0.1 & 0.6 & 0.3 & 0 \\ 0 & 0 & 0.2 & 0.8 & 0 \end{bmatrix}$$

The fuzzy comprehensive evaluation matrix for synergistic capacity is:

$$R_3 = \begin{bmatrix} 0 & 0 & 0.1 & 0.5 & 0.4 \\ 0 & 0 & 0.1 & 0.8 & 0.1 \\ 0 & 0 & 0.2 & 0.7 & 0.1 \\ 0 & 0 & 0.6 & 0.4 & 0 \\ 0 & 0 & 0.1 & 0.6 & 0.3 \end{bmatrix}$$

The fuzzy comprehensive evaluation matrix for development capacity is:

$$R_4 = \begin{bmatrix} 0 & 0 & 0.2 & 0.5 & 0.3 \\ 0 & 0.1 & 0.4 & 0.5 & 0 \\ 0 & 0 & 0.3 & 0.7 & 0 \\ 0 & 0 & 0.1 & 0.3 & 0.6 \end{bmatrix}$$

This results in a fuzzy comprehensive evaluation matrix $R_A = (E_{A1}, E_{A2}, E_{A3}, E_{A4})^T$ for Company A, while the corresponding set of evaluation ratings is $V = (1,2,3,4,5)$. The final composite score for Company A can be obtained as:

$$U_A = W \times R_A \times V^T$$

$$= (0.1391,0.4229,0.3475,0.0904) \begin{bmatrix} 0.0000 & 0.0000 & 0.4482 & 0.4773 & 0.0745 \\ 0.0000 & 0.0097 & 0.2285 & 0.6041 & 0.1577 \\ 0.0000 & 0.0000 & 0.1521 & 0.5921 & 0.2558 \\ 0.0000 & 0.0204 & 0.2550 & 0.5285 & 0.1962 \end{bmatrix} \begin{bmatrix} 1 \\ 2 \\ 3 \\ 4 \\ 5 \end{bmatrix}$$

$$= 3.9366$$

Thus, by using the same steps, U_B, U_C, and U_D are obtained as 4.3197, 4.0446, and 3.7464, respectively.

Based on the final scoring results, it is evident that Company B should be selected as the partner. In practice, Company F has indeed chosen Company B and the cooperation has proven to be effective.

4. Conclusion

This paper integrates qualitative and quantitative partner evaluation methods through the combined use of AHP analysis and the fuzzy comprehensive evaluation method. Initially, the importance of indicators is assessed based on expert knowledge, followed by the application of mathematical techniques to mitigate subjective influences and assign weights for the fuzzy evaluation process. Subsequently, qualitative assessments made by decision-makers are quantified, and the cumulative score is determined by integrating these weights to validate the evaluation system.

Empirical findings suggest that partner selection often prioritizes short-term value creation over long-term growth considerations. This tendency may stem from the dynamic and open nature of firms' innovation ecosystems, where rapid technological iterations and challenging breakthrough innovations prevail. Consequently, core firms may emphasize current strengths and be inclined to seek new partners if existing ones fail to meet future demands. Nonetheless, it is imperative to adopt a long-term perspective, considering the costs and risks involved, and seek partners capable of sustaining collaborative efforts to maintain innovation efficiency and synergies. Moreover, core firms should maintain openness to new partnerships to enrich system dynamics and foster knowledge heterogeneity, thereby ensuring sustained innovation efficiency.

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