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A Study on the Implementation Pathways of Venture Capital-Style Spin-off Entrepreneurship in Large Enterprises

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Abstract: Leveraging the supportive role of venture capital-style spin-off entrepreneurship in large enterprises to foster and expand emerging and future industries is a key requirement for building a modern industrial system. This paper constructs an evaluation index system for the implementation pathways of venture capital-style spin-off entrepreneurship in large enterprises and further explores the suitable scenarios for different implementation pathways. The study finds that the endowments of entrepreneurial teams, the strengths of large enterprises, and external environmental factors constitute the evaluation index system for the implementation pathways of venture capital-style spin-off entrepreneurship in large enterprises; the abrupt pathway is the optimal implementation pathway for achieving venture capital-style spin-off entrepreneurship in large enterprises. Further analysis reveals that the abrupt path demonstrates significant advantages in core indicators such as team goal alignment and internal corporate synergy, making it suitable for enterprises with abundant resources and high risk tolerance; the gradual path stands out for its robustness and, leveraging industrial ecosystem advantages, is suitable for resource-constrained and risk-averse enterprises; the iterative path is balanced across all dimensions and aligns with scenarios where both resources and risk levels are moderate; the hybrid path has low suitability due to insufficient team innovation and internal synergy. This paper not only reveals the implementation pathways and suitable scenarios for venture-capital-style spin-off entrepreneurship in large enterprises but also provides empirical evidence to support the nation's efforts to refine its innovation-driven development strategy and build a modern industrial system through patient capital.

Keywords: Large enterprises; Venture-capital-style spin-off entrepreneurship; Implementation pathways; Pathway suitability

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1. Introduction

Venture-capital-style spin-off entrepreneurship within large enterprises is an innovative direction advocated and mandated by the State-owned Assets Supervision and Administration Commission (SASAC) and the national government; it is also a key pathway for fostering and expanding emerging industries, positioning future industries, and developing new-quality productive forces. Venture capital-style spin-off entrepreneurship by large enterprises facilitates the diffusion of emerging technologies, industrial restructuring, and ecosystem development. It holds significant theoretical value and practical significance for China's manufacturing sector in implementing an innovation-driven development strategy and building a modern industrial system. Scientifically selecting and optimizing implementation pathways is a critical step for large enterprises to mitigate risks and achieve effective industrial spin-offs through venture capital-style entrepreneurship. In recent years, the state has introduced a series of policies to provide strong support for venture capital-style spin-off entrepreneurship by large enterprises. In July 2024, the General Office of the State Council issued the "Several Policy Measures to Promote the High-Quality Development of Venture Capital", which called for "cultivating diversified venture capital entities" and "supporting qualified state-owned enterprises in leveraging their strengths to utilize venture capital funds to increase investment in the commercialization of scientific and technological achievements and in small and medium-sized enterprises (SMEs) across the industrial chain." The document further emphasized improving the policy environment and management systems to actively support the growth and strengthening of the venture capital sector. In May 2025, seven departments, including the Ministry of Science and Technology, jointly issued the "Several Policy Measures to Accelerate the Construction of a Science and Technology Finance System and Vigorously Support High-Level Self-Reliance in Science and Technology", which called for "improving policy mechanisms for state-owned capital investment, performance evaluation, error tolerance, and exit that align with the characteristics and development patterns of the venture capital industry, and evaluating state-owned venture capital institutions based on the entire fund lifecycle"; New regulations from the State-owned Assets Supervision and Administration Commission (SASAC) have included venture capital and the cultivation of emerging and future industries in the list of pilot initiatives exempt from liability, creating a comprehensive policy support system through institutional safeguards, deregulation, and directional guidance. From a practical perspective, large enterprises leveraging venture capital to spin off and incubate science and technology innovation entities, disseminate core technologies, and extend industrial chains can not only promote the large-scale clustering of strategic emerging industries but also facilitate the forward-looking layout of future industries and accelerate the implementation of new-quality productive forces. Based on this, this paper focuses on the selection of implementation pathways for venture capital-style spin-off entrepreneurship by large enterprises. It establishes an evaluation indicator system to identify suitable scenarios for different pathways and manage associated risks, with the aim of providing theoretical foundations and practical guidance for scientific decision-making by large enterprises.

For large corporations, venture-style spin-off entrepreneurship serves as a strategic means to overcome organizational inertia, revitalize underutilized resources, explore cutting-edge markets, and shape industrial ecosystems; however, it may also lead to dual effects such as the loss of key talent, technology leakage, and intensified internal competition [1–2]. As a form of "rooted" market entry, spin-off firms can inherit the parent company's resource endowments, technologies, and social networks, resulting in longer survival rates, stronger market competitiveness, and better financial performance compared to typical startups [3–4]. Most existing research has focused on exploring the motivations, value, influencing factors, and path classifications of spin-off entrepreneurship, as well as resource linkages between parent and spin-off firms and their competitive-cooperative relationships [5–8]. However, a unified framework for path selection and quantitative evaluation has yet to be established. Existing research either emphasizes qualitative analysis while lacking a quantifiable indicator system or treats path selection and risk management as separate issues. Few studies integrate the resource constraints and risk preferences of large Chinese enterprises to guide companies in making scientifically sound decisions regarding path selection—which is precisely the focus of this study. In light of this, this paper adopts a two-dimensional perspective of resource constraints and risk preferences to evaluate the path fit and risk performance of spin-off entrepreneurship by large enterprises across various stages. Accordingly, constructing a scientific and reasonable evaluation system holds practical significance for enterprises in accurately identifying differences in spin-off pathways and optimizing venture-capital-style spin-off decisions.

This paper makes the following three contributions. First, regarding the research topic, it combines venture-capital logic with spin-off entrepreneurship, systematically exploring implementation pathways by focusing on "venture-capital-style spin-off entrepreneurship in large enterprises" for the first time, thereby overcoming the limitations of existing literature that focuses solely on traditional spin-off entrepreneurship or corporate venture capital within a single company. Most existing research focuses on the driving mechanisms, growth performance, and resource allocation and succession of spin-off entrepreneurship, or treats spin-off models and venture capital as separate topics for independent discussion, without having formed an integrated research framework [9–10]. The paper successfully bridges this gap in the literature. Secondly, in terms of research content, this paper constructs a three-dimensional quantitative assessment model of "start-up team resources—large enterprise advantages—environmental factors" and proposes four different implementation strategies: gradual, iterative, abrupt, and mixed. This fills the gap left by previous research that only used qualitative analysis and lacked quantitative assessment tools for strategy selection. Although previous literature made preliminary classifications of spin-off entrepreneurship implementation strategies, it failed to integrate resource constraints and risk preferences into the path evaluation process, nor did it formulate a unified set of indicators and matching criteria [11]. This paper further improves the research on spin-off entrepreneurship paths. Third, in terms of implications and contributions, the paper is highly consistent with the policy direction of new-quality productive forces and innovation of state-owned enterprises. It constructs an all-round decision-making system based on path optimization, situation matching, and risk prevention and control, which offers specific practical suggestions for large enterprises to carry out spin-off entrepreneurship in a manner similar to venture capital. Almost all existing research starts from theoretical deduction and case analysis, lacking targeted transformation plans for state-owned enterprises and relevant policy recommendations [12–13]. The conclusions from this paper will not only help enterprises to choose proper paths, but also provide a theoretical basis and policy references.

This article is structured as follows: After an introduction to the policy context and practical importance of spin-off entrepreneurship via the venture capital model within large firms, Section Two begins by analyzing the literature and extracts potential evaluation criteria from three aspects: startup team resource endowment, large firm characteristics, and external environmental influences. The Delphi approach is then adopted to refine these criteria through two rounds of evaluation and selection, with the weights of each criterion at all levels determined using the Analytic Hierarchy Process (AHP). Section Three utilizes the Fuzzy Comprehensive Evaluation Model to quantitatively assess four implementation paths—progressive, iterative, abrupt, and mixed—in light of the criteria proposed in Section Two. The comprehensive scores and comparative advantages and disadvantages of each path are examined. Section Four makes decisions regarding appropriate scenarios and target entities for each path according to the results of Section Three. Section Five provides a summary of the entire article, drawing conclusions from the findings and discussing their theoretical and practical significance.

2. Development of an evaluation indicator system

2.1. Foundations and preliminary framework for indicator development

The process path of spin-off entrepreneurship in the venture capital form within large enterprises can be said to be a dynamic process of making choices between resource constraints and risk appetites based on the endowments and environment of those enterprises. It is necessary to analyze the empirical judgment process contained herein scientifically and quantitatively, thereby creating an evaluative framework to find out the optimal path. It is not a process driven by a single factor but rather one affected by several factors, including the startup team, the parent enterprise, and the external macro-environment [14]. Thus, developing an evaluative framework that includes all three sets of considerations becomes the basis for studying such processes.

From the aspect of their own endowments, spin-off entrepreneurship is able to utilize the unique properties of organizational genetics, allowing new enterprises to make use of the inherited resources and capabilities of the parent enterprises [15]. Nevertheless, it is the "people" factor that will determine whether such resources are transformed into market value. A manager's experience in an industry can affect his strategic decision-making. Moreover, collegial relations among members of the startup team, their industry knowledge, execution, and innovativeness will affect their success [16]. First of all, the team's experience in the industry is what determines the capacity to identify opportunities; technological innovation capabilities and the ability to execute determine the efficiency in translating concepts into products; and agreement within the team on objectives, values, and risk-taking attitude ensures organizational stability and cohesiveness under difficult conditions. Regarding the utilization of advantages possessed by large firms, the parent firm not only provides a base for resources but also acts as an "endorser" of the legitimacy and credibility of the venture upon entering the market. While the brand name, technology, supply chain, and marketing channels possessed by the parent firm greatly help in reducing the entry and transaction cost for the new venture. Whether the parent firm maintains an open organization structure, internal entrepreneurship, and low tolerance for failure is crucial for its capacity to support spin-off projects. Furthermore, spin-off enterprises built upon the parent company's "resource pool" experience a faster learning curve, enjoy more robust resource conditions, and face fewer entry barriers [17]. The parent company's injection of capital and implementation of various support policies in a "venture capital-like" manner are also key to the successful launch and sustained operation of spin-off ventures. From an external perspective, no entrepreneurial activity can be separated from its industrial ecosystem and macroeconomic context. The technological, market, and policy environments collectively shape the opportunities and threats for such ventures. The iterative trends in industrial technology determine the rise and fall of innovation directions; the mature application of emerging technologies often opens up disruptive blue-ocean markets, presenting the best opportunities for spin-off startups [18]. The competitive landscape, growth potential, and customer pain points of the target market are not only sources of business opportunities but also determine the development space for new enterprises. The industrial ecosystem network—comprising suppliers, partners, research institutions, industry associations, and even government policies—determines the efficiency of innovation factor flows and the costs of acquisition based on its sophistication and level of coordination [19–20]. The intensity of policy support and the level of technological maturity within a region provide indispensable safeguards and support for spin-off entrepreneurship.

Consequently, although past studies have analyzed entrepreneurial pathway choice from individual angles such as team, resource, and environment, an integrated systematic analysis model combining all three is yet to emerge. In order to address the limitations associated with qualitative analysis and obtain objective evaluation results, this paper attempts to build an evaluation model, based on the above reasoning, with three major variables—entrepreneurial team resource endowment, large company advantages, and external environment—and 18 sub-variables (as shown in **Table 1**).

Table 1. Initial indicator system for evaluating fission-based entrepreneurship pathways

Target Level	Primary Indicators	Secondary Indicators
Evaluation Indicator System for Fission-Based Entrepreneurship Pathways	Startup Team Attributes	The startup team's industry experience and background
		Innovation and Execution Capabilities of Startup Teams
		Alignment of Goals Among the Founding Team
		Stability of the startup team
		Startup Teams' Willingness to Spin Off
		Risk tolerance of startup teams
	Advantages of Large Enterprises	Brand and Resource Empowerment from Large Enterprises
		Support for internal collaboration within large enterprises
		Financial and Policy Support for Large Enterprises
		R&D intensity of large enterprises
		Market Share of Large Enterprises
		Organizational Flexibility in Large Enterprises
	External Environmental Factors	Market Competition Landscape and Opportunities
		Trends and Applications in Technological Innovation
		Completeness and Synergy of the Industrial Ecosystem
		Level of regional economic development
		Level of industry policy support
		Technology Readiness Level

2.2. Optimization and weighting of the indicator system

2.2.1. Optimization of the indicator system

Given that the assessment of venture capital–type spin-off entrepreneurship paths in big organizations consists of various aspects, which include the entrepreneur group, parent company, and external environment, and that the initial indicator system includes 18 secondary indicators, relying on literature alone to obtain evaluation indicators might easily cause problems such as redundancy and a lack of flexibility. In order to make the evaluation system more scientific, systematic, and practical, this study, based on literature analysis, further adopted the Delphi technique to screen out the evaluation indicators. The Delphi technique refers to a systematic methodology in which multiple experts participate in decision-making; by anonymously reaching consensus among experts, not only can subjective factors involved in one person's judgment be avoided, but the scientific nature and practicability of the indicators are enhanced [21].

To ensure the comprehensiveness and authority of the indicator system, this study adhered to the principle of combining representativeness with practical relevance, inviting 10 experts with extensive theoretical knowledge and practical experience in innovation and entrepreneurship management, strategic management, and industrial economics to participate in the questionnaire consultation. The expert group included professors and scholars specializing in spin-off entrepreneurship and innovation management at universities, senior managers engaged in internal incubation and strategic investment at large enterprises, and senior experts from industrial economic policy research institutions (**Table 2**). Additionally, anonymous questionnaires were used during the consultation process to prevent mutual influence among experts and to ensure the independence and objectivity of their opinions.

Table 2. Expert composition

Expert Category	Number	Percentage
University Professors	3	30%
Corporate Managers	5	50%
Entrepreneurship Policy Experts	2	20%
Total	10	100%

In the specific application of the Delphi method, this study evaluated the consultation results based on three aspects: expert engagement, authority, and consensus.

Regarding expert engagement, 10 questionnaires were distributed in each of the two rounds of consultation, and 10 valid questionnaires were ultimately returned, resulting in a 100% response rate. Notably, in the first round of consultation, several experts provided specific suggestions for revisions and additions to the preliminary indicator system in their feedback, indicating that the consulting experts not only demonstrated high levels of participation but also maintained a strong focus on the research questions.

Regarding expert authority, the experts invited for this study spanned relevant fields such as management, innovation management, and industrial economics. Based on the data in **Tables 3** and **4**, the coefficient of familiarity (Cs) for the 10 experts regarding the consultation content was 0.96, and the judgment basis score (Ca) was 0.94. Therefore, using the formula, the expert authority coefficient (Cr) was calculated as (Cs + Ca)/2 = 0.95. A mean authority coefficient Cr > 0.7 is considered statistically significant, and a higher Cr indicates greater persuasiveness of the expert panel. In this study, the expert authority coefficient Cr = 0.95, indicating a high level of expert authority for the results.

Table 3. Quantification table for expert familiarity

Level of understanding	unfamiliar	not very familiar	Generally familiar	familiar	very familiar
Number of people	0	0	0	2	8
Expert familiarity weight	0.2	0.4	0.6	0.8	1
Expert familiarity coefficient	Cs=（2*0.8+8*1）/15=0.96				

Table 4. Quantification table for expert judgment criteria

Evaluation Criteria	High		Medium		Low		Fractions
	Number of People	Weight	Number of People	Weight	Number of People	Weight	
Practical Experience	7	0.5	2	0.4	1	0.3	0.46
Theoretical Analysis	8	0.3	2	0.2	0	0.1	0.28
Domestic and International References	2	0.1	3	0.1	5	0.1	0.10
Subjective Judgment	1	0.1	3	0.1	6	0.1	0.10
Overall Score Ca=							0.94

To examine the concentration and consistency of experts' evaluations of indicators at various levels, this study utilized SPSS software for calculations and performed statistical analysis using the mean, standard deviation, and coefficient of variation. The arithmetic mean (M_j) *was used to represent the degree of concentration of expert opinions.* $M_j = \frac{1}{m_j}\sum_{i=1}^{m} C_{ij}$, where m_j represents the number of experts participating in the evaluation of the jth indicator; C_{ij} represents the score assigned by the i-th expert to the j-th indicator. A larger M_j value indicates that the j-th indicator is more important within the indicator system. Based on the results of the two rounds of expert consultation, the range of mean values for the first-level indicators is shown in **Table 5**.

Table 5. Mean and frequency range of perfect scores

Review Content	Range of Means (First Round)	Range of Means (Round 2)
Level 1 Indicator	4.1-4.8	/
Secondary indicators	2.2-4.9	3.8-5

In terms of expert agreement, calculating the coefficient of variation (V_j) and the agreement coefficient (W) can determine whether there is significant disagreement among experts regarding the evaluation of each indicator, thereby assessing the reliability of the expert scoring results for that round. $V_j = \frac{\partial_j}{M_j}$, where ∂_j is the standard deviation of the jth indicator, M_j is the arithmetic mean of the jth indicator, and V_j represents the coefficient of variation for the jth indicator—that is, the degree of agreement among experts regarding the jth indicator. A smaller value of V_j indicates a higher degree of agreement among experts on that indicator. The harmony coefficient reflects the degree of agreement among the 10 experts participating in the consultation regarding the weighting of indicators at each level. In this study, Kendall's W (W) was calculated using SPSS software, with values ranging from 0 to 1. A higher value indicates better agreement among experts, while a lower value indicates poorer agreement. If the *P*-value corresponding to the W value is less than 0.05, it can be concluded that the experts' ratings of the indicator system are consistent. Based on the results of the two rounds of expert consultation, the range of coefficients of variation and the harmony coefficients for the first-level indicators are shown in **Table 6**.

Table 6. Range of coefficients of variation and coefficients of variation from expert consultations

Number of times	Review Content	Coefficient of Variation CV	Coefficient of determination W	Chi-square value	Degrees of freedom	*P*-value
Round 1	Primary Indicators	0.0878-0.157	0.586	26.357	3	0
Round 1	Secondary Indicators	0.0645-0.6573	0.565	95.978	17	0
Round 2	Secondary Indicators	0-0.2136	0.622	49.75	8	0

As shown in the table above, compared to the data from the first round, the coefficients of variation for the first-level indicators generally decreased in the second round of evaluation; the coefficient of concordance for the second round of consultation was higher than that of the first round, indicating that experts' understanding of the rationality of the evaluation indicators was gradually converging; the *P*-values corresponding to the coefficients of concordance for both rounds were less than 0.05, indicating a good degree of agreement among experts and that the evaluation results are scientifically reliable.

Based on the above statistical test results, this paper further conducts a detailed analysis of the specific indicator scores from the two rounds of expert consultation. First, the authors analyze the results of the first round of expert consultation; **Table 7** presents the scoring results for the first-level indicators of the evaluation framework for the spin-off entrepreneurship pathway.

Table 7. Results of expert consultations on level 1 indicators

	Startup Team Attributes	Advantages of Large Enterprises	External Environmental Factors
Questionnaire 1	4	5	4
Questionnaire 2	5	4	5
Questionnaire 3	4	5	4
Questionnaire 4	4	5	4
Questionnaire 5	4	5	5
Questionnaire 6	4	5	5
Questionnaire 7	4	5	5
Questionnaire 8	3	4	3
Questionnaire 9	5	5	4
Questionnaire 10	4	5	4

The results of the analysis and calculations are shown in **Table 8**. All indicators meet the criteria of an average value greater than 3.5 and a coefficient of variation less than 0.25. As the experts have no further recommendations, all indicators will be retained, and therefore no further consultation is required.

Table 8. Results of the first round of expert consultations on level-1 indicators

Measure	Standard Deviation	Mean	Coefficient of Variation	Percentage of Perfect Scores
Startup Team Attributes	0.5676	4.1	0.1385	0.2
Advantages of Large Enterprises	0.4216	4.8	0.0878	0.8
External Environmental Factors	0.6749	4.3	0.157	0.4

The results of the expert consultation on the secondary indicators of the evaluation index system for the spin-off entrepreneurship pathway are presented in **Table 9**. Based on the screening criteria of a mean value less than 3.5 and a coefficient of variation greater than 0.25, indicators such as startup team stability, willingness to spin off, risk tolerance, R&D intensity of large enterprises, market share of large enterprises, organizational flexibility of large enterprises, regional economic development level, industry policy support, and technology maturity were excluded for failing to meet the retention criteria; Indicators such as industry experience and background of the startup team, innovation and execution capabilities of the startup team, alignment of startup team goals, brand and resource empowerment from large enterprises, internal synergy support from large enterprises, financial and policy support from large enterprises, market competition landscape and opportunities, trends and applications of technological innovation, and completeness and synergy of the industrial ecosystem were retained in the evaluation system due to their strong data performance.

Table 9. Results of the first round of expert consultations on secondary indicators

Measure	Standard Deviation	Mean	Coefficient of Variation	Percentage of Perfect Scores
The startup team's industry experience and background	0.8233	3.7	0.2225	0.2
Innovation and Execution Capabilities of Startup Teams	0.7071	4.5	0.1571	0.6
Alignment of Goals Among the Founding Team	0.483	4.7	0.1028	0.7
Stability of the startup team	1.3984	2.8	0.4994	0.1
Startup Teams' Willingness to Spin Off	1.354	2.5	0.5416	0.1
Risk tolerance of startup teams	1.5776	2.6	0.6068	0.2
Brand and Resource Empowerment from Large Enterprises	0.3162	4.9	0.0645	0.9
Support for internal collaboration within large enterprises	0.6325	3.8	0.1664	0.1
Financial and Policy Support for Large Enterprises	0.5164	4.6	0.1123	0.6
R&D intensity of large enterprises	0.7888	2.2	0.3586	0
Market Share of Large Enterprises	1.5776	2.4	0.6573	0.2
Organizational Flexibility in Large Enterprises	1.0801	2.5	0.432	0
Market Competition Landscape and Opportunities	0.3162	4.9	0.0645	0.9
Trends and Applications in Technological Innovation	0.6992	3.6	0.1942	0.1
Completeness and Synergy of the Industrial Ecosystem	0.4216	4.8	0.0878	0.8
Level of regional economic development	0.9487	2.3	0.4125	0
Level of industry policy support	1.4298	2.6	0.5499	0.1
Technology Readiness Level	1.3499	2.4	0.5625	0.1

Next, the authors analyzed the results of the second round of expert consultation. After collecting the first-round questionnaires and summarizing the results of the initial expert consultation, the authors refined the evaluation indicator system for the viral entrepreneurship pathway based on the findings and feedback and developed a second questionnaire. This second questionnaire was distributed to the experts for a second round of review. Since the data for the first-level indicators in the evaluation index system for fission entrepreneurship pathways met all requirements in the first round of expert consultation, a second round of consultation on these indicators was not necessary. The second-level indicators in the evaluation index system were refined and modified based on the data from the first round and expert feedback, reducing their number to nine. The revised indicators were then distributed to the experts for a second round of consultation, and the summarized results are shown in **Table 10**.

Table 10. Results of the second round of expert consultations on secondary indicators

Sub-indicator	Standard Deviation	Mean	Coefficient of Variation	Percentage of Perfect Scores
The startup team's industry experience and background B1	0.4216	4.8	0.0878	0.8
Innovation and Execution Capabilities of Startup Teams B2	0.7379	3.9	0.1892	0.2
Alignment of Goals Among the Founding Team B3	0.7888	3.8	0.2076	0.2
Brand and Resource Empowerment from Large Enterprises B4	0.3162	4.9	0.0645	0.9
Support for internal collaboration within large enterprises B5	0.5676	4.1	0.1385	0.2
Financial and Policy Support for Large Enterprises B6	0.6749	4.7	0.1436	0.8
Market Competition Landscape and Opportunities B7	0	5	0	1
Trends and Applications in Technological Innovation B8	0.8756	4.1	0.2136	0.4
Completeness and Synergy of the Industrial Ecosystem B9	0.7888	4.2	0.1878	0.4

Following the second round of expert consultation, the coefficients of variation and mean values for the retained secondary indicators all meet the data screening requirements, and the experts raised no further comments. In summary, the final revised evaluation framework for spin-off entrepreneurial pathways is presented in **Table 11**.

Table 11. Evaluation indicator system for spin-off entrepreneurship pathways

Target Level	Primary Indicators	Secondary Indicators
Evaluation Indicator System for Fission-Based Entrepreneurship Pathways	Startup Team Attributes	The startup team's industry experience and background
		Innovation and Execution Capabilities of Startup Teams
		Alignment of Goals Among the Founding Team
	Advantages of Large Enterprises	Brand and Resource Empowerment from Large Enterprises
		Support for internal collaboration within large enterprises
		Financial and Policy Support for Large Enterprises
	External Environmental Factors	Market Competition Landscape and Opportunities
		Trends and Applications in Technological Innovation
		Completeness and Synergy of the Industrial Ecosystem

2.2.2. Determining indicator weights

After establishing the evaluation indicator system for the fission entrepreneurship pathway, it is necessary to further determine the relative importance weights of indicators at each level to quantify the extent to which different factors influence pathway selection. This paper employs the Analytic Hierarchy Process (AHP) to determine the weights of evaluation indicators at each level. Developed by Saaty in the 1970s, this method transforms qualitative judgments into quantitative weights by hierarchically organizing complex problems and conducting pairwise comparisons among indicators at the same level. It offers the advantages of a clear structure, rigorous logic, and the ability to integrate both qualitative and quantitative factors [22–23].

First, a hierarchical structure model was constructed based on the final indicator system screened using the Delphi method. "Evaluation of the Spin-off Entrepreneurship Pathway" was designated as the goal level; "Entrepreneurial Team Attributes (A1)", "Advantages of Large Enterprises (A2)", and "External

Environmental Factors (A3)" were identified as the criterion level (first-level indicators); nine specific indicators, including "Startup Team Industry Experience and Background (B1)", were designated as the solution layer (second-level indicators), forming a complete hierarchical structure, as shown in Table 12. Second, a judgment matrix was constructed. The aforementioned experts were invited to score indicators at each level using a 1–9 quantitative rating scale (**Table 13**): if indicator A is extremely important relative to indicator B, a score of 9 is assigned; if indicator A is extremely unimportant relative to indicator B, a score of 1/9 is assigned; if indicator A is equally important relative to indicator B, a score of 1 is assigned. After multiple rounds of feedback and discussion, a consensus was reached, and judgment matrices for each level were constructed, from which the weight distribution vectors for each indicator were obtained through calculation. Finally, the weight vectors were calculated, and consistency tests were performed. Based on the judgment matrices, the eigenvalue method was used to calculate the maximum eigenvalue λ_{max} and the corresponding eigenvector; after normalization, these values became the weight values W for each indicator. To assess the internal consistency of the experts' judgment logic, the consistency ratio $CR = CI / RI$ was introduced for testing, where $CI = (\lambda_{max} - n)/(n-1)$ and RI is the average random consistency index (Table 14). When $CR < 0.1$, the judgment matrix is considered to have passed the consistency test, and the calculated weights are deemed reasonable and valid. The results of judgment matrix construction, weight calculation, and consistency testing for the first- and second-level indicators in this study are summarized below.

Table 12. Evaluation indicator system

Primary indicators	Secondary indicators
Startup Team Attributes A1	Startup Team Industry Experience and Background B1
	Startup Team Innovation and Execution Capabilities B2
	Startup Team Alignment of Goals B3
Advantages of Large Enterprises A2	Brand and Resource Empowerment from Large Enterprises B4
	Internal Synergy Support from Large Enterprises B5
	Financial and Policy Support from Large Enterprises B6
External Environmental Factors A3	Market Competitive Landscape and Opportunities B7
	Technological Innovation Trends and Applications B8
	Maturity and Synergy of the Industry Ecosystem B9

Table 13. Explanation of the rating scale

Grading scale	Assessment of Importance
1	Indicator A is equally important as Indicator B
3	Indicator A is slightly more important than Indicator B
5	Indicator A is significantly more important than Indicator B
7	Indicator A is much more important than Indicator B
9	Indicator A is extremely more important than Indicator B
2，4，6，8	The level of importance falls between the values indicated above

Table 14. Explanation of the average random consistency index (RI)

Rank of a matrix	1	2	3	4	5	6	7	8	9	10	11	12
RI	0	0	0.52	0.89	1.12	1.26	1.36	1.41	1.46	1.49	1.52	1.54

(1) Determination of weights for first-level indicators: The first-level indicator layer comprises three indicators: entrepreneurial team capabilities (A1), advantages of large enterprises (A2), and external environmental factors (A3). The judgment matrix and calculated weights are shown in **Table 15**.

Table 15. Judgment matrix and weights for first-level indicators

Indicators	A1	A2	A3	Weight
A1	1	2	5	0.568
A2	1/2	1	4	0.334
A3	1/5	1/4	1	0.098

Calculations show that for this judgment matrix, $\lambda_{max} = 3.025$, $CI = 0.012$, $RI = 0.52$, and $CR = 0.023 < 0.1$, indicating that it passes the consistency test. In terms of weight distribution, the entrepreneurial team's endowment (0.568) is the most significant factor and the primary determinant influencing the choice of the spin-off entrepreneurship path; the advantages of large enterprises (0.334) rank second, providing crucial support; external environmental factors (0.098) carry the least weight but remain indispensable.

(2) Determination of secondary indicator weights: At the secondary indicator level, judgment matrices were constructed and weights calculated for each factor under the respective primary indicators. The three secondary indicators under startup team endowment (A1) are: industry experience and background of the startup team (B1), innovation and execution capabilities of the startup team (B2), and alignment of the startup team's objectives (B3). The judgment matrices and weight calculation results are shown in **Table 16**.

Table 16. Judgment matrix and weights for the second-level indicators of entrepreneurial team attributes (A1)

	B1	B2	B3	Weight
B1	1	1/5	3	0.201
B2	5	1	6	0.707
B3	1/3	1/6	1	0.092

Calculations show that $\lambda_{max} = 3.096$, $CI = 0.048$, $RI = 0.52$, and $CR = 0.092 < 0.1$, indicating that the consistency test has been passed. The weighting results show that, among the entrepreneurial team's endowments, innovation and execution capabilities (0.707) occupy an absolutely central position, followed by industry experience and background (0.201), while the influence of goal alignment (0.092) is relatively minor.

The three second-level indicators under the advantage of large enterprises (A2) are brand and resource empowerment by large enterprises (B4), internal synergy support from large enterprises (B5), and financial and policy support from large enterprises (B6). The judgment matrix and weight calculation results are shown in **Table 17**.

Table 17. Judgment matrix and weights for the second-level indicators of the competitive advantages of large enterprises (A2)

Indicators	B4	B5	B6	Weight
B4	1	2	4	0.532
B5	1/2	1	5	0.366
B6	1/4	1/5	1	0.102

Calculations show that $\lambda_{max} = 3.095$, $CI = 0.047$, $RI = 0.52$, and $CR = 0.091 < 0.1$, indicating that the consistency test has been passed. The weighting results indicate that brand and resource empowerment (0.532) is the parent company's most critical empowerment advantage, followed by internal synergy support (0.366), while financial and policy support (0.102) has the lowest weight.

The three secondary indicators under the external environmental factors (A3) are market competition landscape and opportunities (B7), technological innovation trends and applications (B8), and the maturity and synergy of the industrial ecosystem (B9). The judgment matrix and weight calculation results are shown in **Table 18**.

Table 18. Decision matrix and weights for the sub-indicators of external environmental factors (A3)

Indicators	B7	B8	B9	Weight
B7	1	7	1/2	0.373
B8	1/7	1	1/6	0.072
B9	2	6	1	0.555

Calculations show that $\lambda_{max} = 3.081$, $CI = 0.040$, $RI = 0.52$, and $CR = 0.078 < 0.1$, indicating that the consistency test has been passed. The weighting results show that "Industrial Ecosystem Maturity and Synergy" (0.555) is the most highly prioritized factor in the external environment, followed by "Market Competition Landscape and Opportunities" (0.373), while "Technological Innovation Trends and Applications" (0.072) has the lowest weight.

(3) Summary of indicator weights and analysis of results: In summary, after calculating the weights, the consistency tests for each final judgment matrix are presented in **Table 19**. The *CR* values for all matrices are less than 0.1, indicating that they pass the consistency test. This demonstrates that experts' judgments regarding the relative importance of indicators at each level are logically consistent, and the weighting results are scientifically reliable. By aggregating the weights across all levels, the authors obtain the comprehensive weighting table for the evaluation indicator system of the venture-capital-style fission entrepreneurship path for large enterprises, as shown in **Table 20**.

Table 19. Consistency test

Indicators	Key feature	CI	RI	CR
Secondary indicatorsA1	3.096	0.048	0.520	0.092
Secondary indicatorsA2	3.095	0.047	0.520	0.091
Secondary indicatorsA3	3.081	0.040	0.520	0.078

Table 20. Summary of weights for the evaluation indicator system

Primary Indicator	Weight	Secondary Indicator	Weight	Composite Weight
Startup Team Attributes A1	0.568	The startup team's industry experience and background B1	0.201	0.114
		Innovation and Execution Capabilities of Startup TeamsB2	0.707	0.402
		Alignment of Goals Among the Founding TeamB3	0.092	0.052

Advantages of Large Enterprises A2	0.334	Brand and Resource Empowerment from Large EnterprisesB4	0.532	0.178
		Support for internal collaboration within large enterprisesB5	0.366	0.122
		Financial and Policy Support for Large EnterprisesB6	0.102	0.034
External Environmental Factors A3	0.098	Market Competition Landscape and OpportunitiesB7	0.373	0.037
		Trends and Applications in Technological Innovation B8B8	0.072	0.007
		Completeness of the Industrial Ecosystem and Synergy B9	0.555	0.054

The weighted results show that "Startup Team Attributes" (0.568) occupies a central position among the first-level indicators, with "Startup Team Innovation and Execution Capabilities" (composite weight of 0.402) being the most critical factor influencing path selection. This indicates that, regardless of the chosen path, the team's own innovation capabilities and execution capabilities serve as the decisive foundation. "Large Enterprise Advantages" (0.334) are equally important, with internal synergy support (0.122) and brand resource empowerment (0.178) providing a vital resource foundation for spin-off entrepreneurship. Relatively speaking, "External Environmental Factors" (0.098) carry a lower weight, but the sub-factor "Maturity and Synergy of the Industrial Ecosystem" (0.054) remains a scenario variable that cannot be ignored. This weight distribution provides a quantitative standard for subsequent path evaluations.

3. Evaluation of implementation pathways for venture-style spin-off entrepreneurship in large enterprises

3.1. Evaluation criteria for implementation pathways

For large firms pursuing venture-style spin-off entrepreneurship, there are two critical factors to consider: firstly, the level of resource limitation, referring to the amount of resources available, such as financial capital, personnel, and technology, which the firm can devote to the venture spin-offs; secondly, the level of risk propensity, referring to the firm's attitude toward uncertainty and boldness in its strategy. Thus, according to the fundamental principle of resource dependence theory, which states that "the availability of internal and external resources, combined with risk-bearing ability, determines strategic decisions", this study adopts the two variables to classify the implementation paths of venture-style spin-off entrepreneurship in large firms into four categories [24]. The Gradual Path (Moving Forward Step by Step): In cases where resources are scarce and risk propensity is low, the firm implements spin-offs via small-scale experimental projects, sequential investments, and expansion, focusing on a systematic and steady approach while minimizing the costs of experimentation. The Iterative Path (Moving Forward Stage by Stage): If both resources and risk tolerance are moderate, the organization follows a phased goal approach, where resource allocation takes place through trial-and-error processes quickly. The Disruptive Path (Jumping Straight to the Finish Line): If both resources and risk tolerance are high, organizations invest all their best resources at once to make a disruptive innovation breakthrough. The Hybrid Path (Combination of Multiple Paces): Within the framework of diversified conglomerates or multiple business units running concurrently, organizations take a hybrid approach combining the strategies mentioned above.

In order to achieve quantitative comparisons and evaluations of the four types of entrepreneurship, the indicator weights will first be determined through the Analytic Hierarchy Process (AHP), and afterwards, the Fuzzy Comprehensive Evaluation (FCE) will be used for evaluating the types. The method of Fuzzy Comprehensive Evaluation was developed by the American automation control specialist Zadeh in 1965. Its basic idea lies in utilizing the membership theory of fuzzy mathematics to convert qualitative evaluation, which is subjective and difficult to evaluate quantitatively, into numerical data. This method possesses the advantages of good systematicness, clear results, and widespread applications [25]. By combining AHP and FCE, it can not only make use of AHP to objectively set weighting standards of indicators for each hierarchy but also deal with the vagueness in experts' evaluations when evaluating these paths. This is because the combination of the two methods can organically integrate qualitative and quantitative approaches. The specific details are as follows:

3.1.1. Determination of the factor set

The factor set is the collection of all influencing factors of the evaluation object. Based on the final evaluation indicator system constructed using the Delphi method and the Analytic Hierarchy Process (**Table 11**), the fuzzy evaluation factor set in this study is divided into two levels.

The set of first-level factors is:

$U = \{U_1, U_2, U_3\}$ = {"Startup Team Attributes", "Large Enterprise Advantages", "External Environmental Factors"}

The sets of second-level factors are:

$U_1 = \{B_1, B_2, B_3\}$ = {"Industry Experience and Background", "Innovation and Execution Capabilities", "Alignment of Objectives"}

$U_2 = \{B_4, B_5, B_6\}$ = {"Brand and Resource Empowerment", "Internal Synergy Support", "Financial and Policy Support"}

$U_3 = \{B_7, B_8, B_9\}$ = {"Market Competition Landscape and Opportunities", "Technological Innovation Trends and Applications", "Industry Ecosystem Maturity and Synergy"}

3.1.2. Determination of the weight set

The weight set reflects the differences in the importance of each factor to the evaluation objective. This study directly adopts the weight vectors obtained from the Analytic Hierarchy Process (AHP). The weight vectors for the first-level factors (W) and the second-level factors (W_1, W_2, W_3) are as follows:

$W = [0.568, 0.334, 0.098]$

$W_1 = [0.201, 0.707, 0.092]$, $W_2 = [0.532, 0.366, 0.102]$, $W_3 = [0.373, 0.072, 0.555]$

3.1.3. Determination of the set of evaluations and scoring criteria

The set of evaluation comments comprises all possible evaluation results that an evaluator may assign to the evaluation object. In accordance with standard practices in fuzzy comprehensive evaluation and considering the actual circumstances of venture-style fission entrepreneurship pathways in large enterprises, this study defines the set of evaluation comments as four levels: $V = \{v_1, v_2, v_3, v_4\}$ = {"Excellent", "Good", "Average", "Poor"}

To convert the fuzzy evaluation results into comparable quantitative scores, specific numerical values are assigned to each evaluation grade, as shown in **Table 21**. The criteria for assigning evaluation scores to grades are as follows: Excellent (100, 85), Good (85, 70), Average (70, 55), Poor (55 and below). The results of the fuzzy comprehensive evaluation will be classified into grades according to these criteria.

Table 21. Evaluation grade scoring table

Level	Value
Excellent	100
Good	85
Average	70
Poor	55

3.2. Evaluation process for implementation pathways

3.2.1. Data sources and construction of membership values

This study employed a questionnaire survey, inviting 10 experts who had participated in the preliminary Delphi and Analytic Hierarchy Process (AHP) consultations to rate the performance of each secondary indicator under the four pathways. The membership value for a given rating level of an indicator was calculated by dividing the number of experts assigning that rating by the total number of experts. Taking Gradual Pathway A as an example, the rating results for each secondary indicator by the 10 experts are shown in **Table 22**.

Table 22. Expert evaluation membership table for gradient path A

Secondary Indicator	Poor	Fair	Good	Excellent
The startup team's industry experience and background B1	0.3	0.2	0.3	0.2
Innovation and Execution Capabilities of Startup Teams B2	0.5	0	0.1	0.4
Alignment of Goals Among the Founding Team B3	0.4	0.4	0.2	0
Brand and Resource Empowerment from Large Enterprises B4	0.2	0.3	0.4	0.1
Support for internal collaboration within large enterprises B5	0.1	0.2	0.3	0.4
Financial and Policy Support for Large Enterprises B6	0.1	0.3	0.4	0.2
Market Competition Landscape and Opportunities B7	0.1	0.4	0.3	0.2
Trends and Applications in Technological Innovation B8	0	0.4	0.5	0.1
Completeness and Synergy of the Industrial Ecosystem B9	0.1	0	0.5	0.4

Based on **Table 22**, fuzzy evaluation matrices are constructed for each of the three first-level indicators. Taking the entrepreneurial team's endowment (A1) as an example, its fuzzy evaluation matrix is as follows:

$$R_1 = \begin{bmatrix} 0.3 & 0.2 & 0.3 & 0.2 \\ 0.5 & 0.0 & 0.1 & 0.4 \\ 0.4 & 0.4 & 0.2 & 0.0 \end{bmatrix}$$

Similarly, the fuzzy evaluation matrix R_2 for the advantage of large enterprises (A2) and the fuzzy evaluation matrix R_3 for external environmental factors (A3) are constructed sequentially based on the corresponding data in the table.

3.2.2. First-level fuzzy comprehensive evaluation

First-level fuzzy comprehensive evaluation involves the comprehensive evaluation of the second-level indicators under each first-level indicator. By performing fuzzy synthesis operations on the second-level indicator weight vectors W_i determined by the Analytic Hierarchy Process (AHP), and the corresponding fuzzy evaluation matrices R_i, the fuzzy evaluation vector S_i for that first-level indicator is obtained.

Taking the entrepreneurial team's endowment A1 as an example, its weight vectorW_1=[0.201,0.707,0.092]. After fuzzy synthesis calculations, the fuzzy evaluation vector for A1 is obtained as:

S_1=W_1×R_1[0.4506,0.0770,0.1494,0.3230]Multiplying S_1 by the score vector$[55,70,85,100]^T$ from the set of comments yields the fuzzy comprehensive evaluation score for A1:K_{A1}=75.17. Using the same method, calculate the scores for A2 and A3. The weight vector for A2 isW_2=[0.532,0.366,0.102], and the fuzzy evaluation vector is S_2=[0.1532,0.2634,0.3634,0.2200], resulting in a score of K_{A2}=79.75. The weight vector for A3 is W_3=[0.373,0.072,0.555], the fuzzy evaluation vector isS_2=[0.1532,0.2634,0.3634,0.2200] S_3=[0.0928,0.1780,0.4254,0.3038], and the score is K_{A3}=84.10.

Multiplyingby the score vector from the set of comments yields the fuzzy comprehensive evaluation score for A1: . Using the same method, calculate the scores for A2 and A3. The weight vector for A2 is , and the fuzzy evaluation vector is , resulting in a score of . The weight vector for A3 is , the fuzzy evaluation vector is, and the score is .

The scores for each secondary indicator are calculated by directly multiplying its membership vector by the corresponding score in the evaluation set. The summary of the fuzzy comprehensive evaluation scores for indicators at each level of the gradual path A is shown in **Table 23**.

Table 23. Fuzzy Comprehensive evaluation scores for gradient path A

Primary Indicator	Score	Secondary Indicator	Score
Startup Team Attributes A1	75.17	The startup team's industry experience and background B1	76.00
		Innovation and Execution Capabilities of Startup Teams B2	76.00
		Alignment of Goals Among the Founding Team B3	67.00
Advantages of Large Enterprises A2	79.75	Brand and Resource Empowerment from Large Enterprises B4	76.00
		Support for internal collaboration within large enterprises B5	85.00
		Financial and Policy Support for Large Enterprises B6	80.50
External environmental factors A3	84.10	Market Competition Landscape and Opportunities B7	79.00
		Trends and Applications in Technological Innovation B8	80.50
		Completeness and Synergy of the Industrial Ecosystem B9	88.00
Overall Score		77.57	

3.2.3. Two-level fuzzy comprehensive evaluation

Two-level fuzzy comprehensive evaluation involves combining the fuzzy evaluation vectors of each first-level indicator into a new evaluation matrix, performing a composite operation with the first-level indicator weight vector, and obtaining the comprehensive evaluation results at the target level. By combining S_1, S_2, and S_3 into the second-level fuzzy evaluation matrix R and performing a fuzzy synthesis with the first-level indicator weight vector W=[0.568,0.334,0.098], the authors obtain the final fuzzy evaluation vector S for the gradual path A and the comprehensive score K_A=77.57.

3.2.4. Summary of scores for the four paths

Using exactly the same method and steps, fuzzy comprehensive evaluations were performed separately for iterative path B, abrupt path C, and hybrid path D. The summary of scores for the four paths is shown in **Table 24**.

Table 24. Summary of comprehensive evaluation scores for the four pathways

Primary indicators	Secondary indicators	A	B	C	D
Startup Team Attributes A1	The startup team's industry experience and background B1	76.00	70.00	79.00	73.00
	Innovation and Execution Capabilities of Startup Teams B2	76.00	70.00	76.00	68.50
	Alignment of Goals Among the Founding Team B3	67.00	71.50	88.00	68.50
Advantages of Large Enterprises A2	Brand and Resource Empowerment from Large Enterprises B4	76.00	76.00	82.00	76.00
	Support for internal collaboration within large enterprises B5	85.00	83.50	95.50	71.50
	Financial and Policy Support for Large Enterprises B6	80.50	74.50	89.50	74.50
External environmental factors A3	Market Competition Landscape and Opportunities B7	79.00	79.00	85.00	74.50
	Trends and Applications in Technological Innovation B8	80.50	82.00	91.00	86.50
	Completeness and Synergy of the Industrial Ecosystem B9	88.00	85.00	92.50	82.00
	Overall Decision Score	77.57	74.18	82.81	72.00

3.3. Discussion of the evaluation results for implementation pathways

Using a fuzzy comprehensive evaluation model to conduct a quantitative analysis of the four types of venture-style spin-off entrepreneurship pathways in large enterprises, the abrupt pathway achieved the highest composite score (82.81), followed by the gradual pathway (77.57), the iterative pathway (74.18), and the hybrid pathway (72.00) in descending order. The significant differences among these pathways indicate that the indicator system constructed in this study can effectively distinguish the relative merits and suitability of different implementation pathways. The results show that the abrupt path performs best overall, demonstrating significant advantages in team support, parent company empowerment, and external environment adaptability; the gradual path operates steadily with stronger risk controllability; the iterative path exhibits relatively balanced performance across all dimensions; and the hybrid path, constrained by internal coordination and team capabilities, yields relatively weaker overall results.

The startup team's endowment dimension carries the highest weight and plays a decisive role in the path outcomes. The "Disruptive" and "Gradual" paths scored significantly higher in this dimension, particularly in the indicators of the startup team's innovation and execution capabilities, as well as industry experience and background. This demonstrates that team execution and industry expertise are the core guarantees for driving fission. The "Disruptive" path also scored significantly higher in terms of the startup team's alignment of goals, further indicating that a high degree of alignment between the team and the parent company's strategy is a key prerequisite for achieving leapfrog fission.

The "Large Enterprise Advantages" factor ranks second in its weight in the model and plays an important role in implementing the pathway. The "Disruptive Path" has the highest ranking in the factor because of the high empowerment across three dimensions: synergy of the large enterprise, finance and policy support, as well as brand power. The accumulated resources and strong organizational security allow for consistent empowerment of fission-based entrepreneurship. The "Gradual Path" and "Iterative Path" perform equally well because of moderate and balanced resource empowerment suitable for implementing incremental steps. The hybrid pathway lags behind in this factor because of a weakness in empowerment from the parent firm due to poor internal synergy and dispersion of resources.

The external environmental factors dimension carries a relatively low weight but imposes significant constraints on the feasibility of the paths. The radical path leads in terms of the application of technological innovation trends, the maturity and synergy of the industrial ecosystem, and market competition dynamics and opportunities, making it better suited to the development environment of cutting-edge technologies and emerging industries. The gradual path relies on a mature industrial ecosystem for stable support and faces lower external risks. In contrast, the iterative and hybrid paths demonstrate a relative lack of grasp on market opportunities and technological trends, resulting in poor external adaptability, which consequently impacts the overall effectiveness of these paths.

4. Analysis of scenario-specific pathways for venture capital-style fission entrepreneurship in large enterprises

The degree of resource constraints and the level of risk appetite are the core decision-making prerequisites for enterprises engaging in venture capital-style fission entrepreneurship, directly determining whether an enterprise can commit resources and dare to attempt such ventures; the capabilities of the entrepreneurial team, the advantages of large enterprises, and external environmental factors serve as the intrinsic supporting conditions for the implementation of these pathways, determining whether projects can proceed and succeed. Combining the distribution of indicator weights and the results of the fuzzy comprehensive evaluation discussed earlier, this paper constructs a model for assessing the suitability of venture-style spin-off entrepreneurship pathways. This model clearly defines the applicable conditions and matching scenarios for the four types of pathways, serving both as a practical extension of the previous evaluation conclusions and as the primary innovation of this paper in integrating quantitative evaluation with application scenarios.

In terms of internal relationships, the degree of resource constraints directly corresponds to the supply capacity of large enterprises' advantages; the more abundant the resources, the higher the levels of brand empowerment, financial support, and internal synergy, resulting in a correspondingly higher path evaluation score. The extent of risk appetite is entirely aligned with the matching of the startup team's competencies to the goals and risks; hence, the higher the risk appetite, the greater the execution vigor and investment in innovation, allowing for better path realization. Environmental variables represent scenario constraints and opportunities and match very closely with the evaluation results in terms of market structures, technology, and industry ecosystems. The level of alignment of decision-making assumptions and intrinsic enabling conditions directly determines the total path score; the greater the level of coupling, the more successful the venture-capital model of fission entrepreneurship is.

The "Disruptive Path" earned the best composite score of 82.81. In particular, the aptitude of the startup team was evaluated at 80.12 points, the advantage of big enterprises was worth 83.45 points, and the external environment factors were worth 81.26 points. The scores in all three dimensions ranked first among the four paths, indicating full-scale superiority. It also ranked first in three core indicators: alignment of startup team objectives, internal synergy and support from large enterprises, and the application of technological innovation trends, reflecting the combined advantages of a strong team, strong empowerment, and a strong environment. Huawei HiSilicon, a company spun off from within the Huawei Group and focused on chip design, is a typical representative of the "catastrophic" path. The Group is able to provide the spin-off project with comprehensive resources—including funding, technology, and talent—and the startup team's strategic objectives are highly aligned with those of the parent company. Furthermore, when facing external challenges such as critical technology bottlenecks and industry windows of opportunity, the company can achieve disruptive technological breakthroughs and secure a leading position in the market through high-risk, high-intensity investments. Consequently, the "sudden mutation" path is suited to decision-making scenarios with low resource constraints and a high risk appetite. It is particularly well-suited for leading large enterprises with abundant resources, highly efficient organizational synergy, and a focus on cutting-edge technological breakthroughs and securing positions in future industries.

The "Gradual Path" gained the second-highest score of 77.57 points. In the incremental development model, the endowment of the startup team got a score of 75.17, large enterprise advantages were worth 79.75 points, and external environmental factors were valued at 84.10 points. While the latter scored the best, the former two also did rather well; the endowment of the startup team scored relatively lower. The strengths of this model lie in its completeness of the industrial ecosystem as well as its stable internal coordination. Haier Smart Home is an example derived from the incremental incubation of the smart home business by small and micro enterprises within the group. This is achieved with the help of a mature industrial chain for home appliances, its massive user base, and a stable supply chain. This model does not strive for disruptive innovation but steadily moves forward through pilot tests and gradual implementation to minimize the risks of trial and error. Such an approach corresponds fully to the features of the Gradual Path: steady, safe, and ecosystem-based. The studies on spin-offs within industrial ecosystems prove that the matured industrial environment facilitates the incremental resource exchange and steady entrepreneurship [26]. Hence, the incremental path is a good option for decision-making situations with high resource constraints and low risk tolerance. Incremental approaches are well-suited for use in traditional large-scale manufacturers and local SOEs facing high resource limitations, high risk aversion, and business upgrading.

The Iterative Path, in comparison with the Disruptive Path and the Gradual Path, which both have their own strengths, received a moderate score of 74.18 points. The iterative path received 73.25 points for startup team endowment, 74.68 points for large enterprise advantages, and 75.02 points for external environmental factors. In each of the three categories, the scores are moderate, without significant differences among them. Indicators show good balance without any weak aspects, representing a state of moderation in terms of resources, risk neutrality, and adaptability. It is believed that with a moderate level of resources, iterative methods are able to make trade-offs between growth speed and risks to enhance the success of fission [27]. In cases where emerging sectors are not yet mature and markets are unclear, enterprises can proceed with fission by establishing phased goals, constant validation, feedback collection, and iterative optimization instead of being too cautious or rash. In consequence, the iterative method can be well applied in the process of decision making in circumstances where there are medium-level resource limitations and medium-level risk preferences. The method is suitable for technology-oriented and vital industry groups in their growth stage that have enough resources and seek to develop new business ventures via dynamic optimization.

Among the four implementation paths, the Hybrid Path received the lowest score of 72.00. For example, the endowment of the startup team got a score of 69.86, while the advantages of the large enterprise earned a grade of 71.35, and external environmental factors got 73.42 points. In particular, it can be seen that the lowest scores belong to the startup team endowment and the large enterprise advantages dimensions. While the external environmental factors dimension scores a little higher, the problem in internal cooperation effectiveness and team objective consistency is remarkable. This fission approach is generally seen in big, diversified conglomerates. This is because they have numerous and widely dispersed units that operate in their own resource environments and different risk circumstances, forcing them to use several types of fission speeds concurrently. Diverse units make the coordination and control of spin-offs more difficult and expensive [28]. The dangers associated with diverse spin-offs include a lack of focus on the growth of the corporation, heightened internal competition for resources, and strategy ambiguity, increasing the challenges involved in controlling operations [29]. This, therefore, leads to challenges in the effective concentration of resources, a lack of team agreement, high coordinating costs, and negative effects on the reputation and asset value of the parent firm. In other words, this approach cannot be used generally because it can only be applied to extremely large corporations with diversified resources and risk preferences, and a strong capability for centralized management, thus combining several industries and approaches at once.

In view of this analysis, this paper presents **Figures 1** and **2**, which provide a clear picture of decision mapping. This kind of approach has brought about the combination of quantitative and qualitative decision-making, offering an easy, effective, and practical model for choosing a venture-style spin-off entrepreneurship path for large firms. The key innovation of this paper is that it differs from currently prevailing qualitative research.

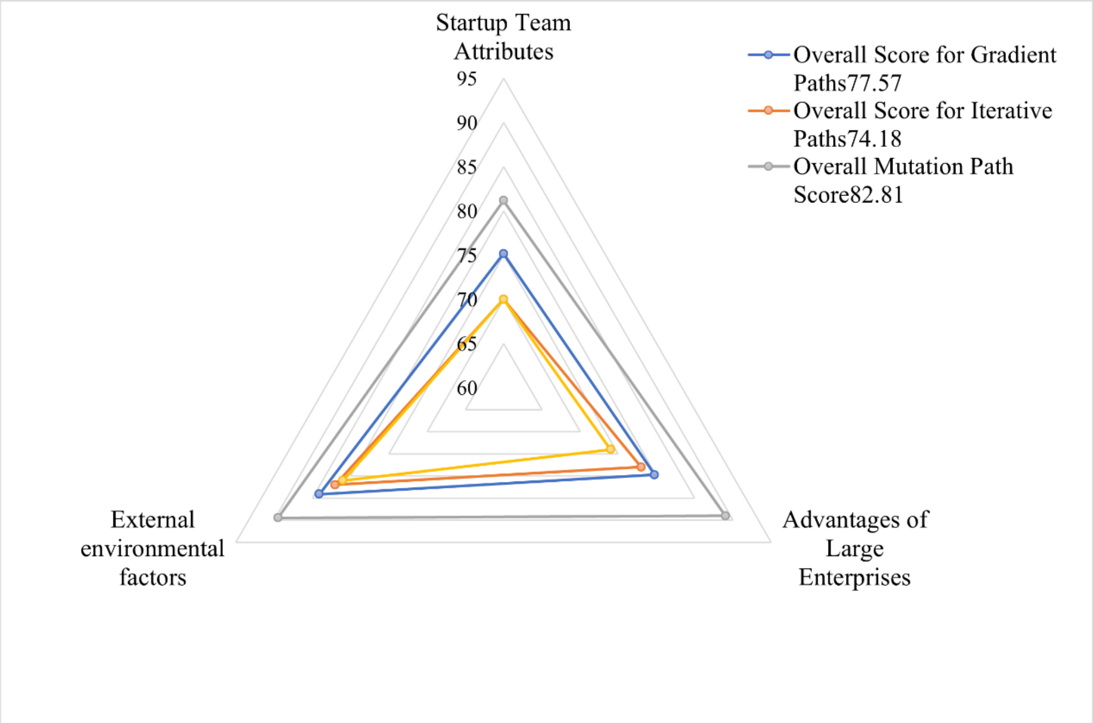

Figure 1. Radar chart showing the overall performance of four implementation pathways for venture capital-style spin-off startups in large enterprises

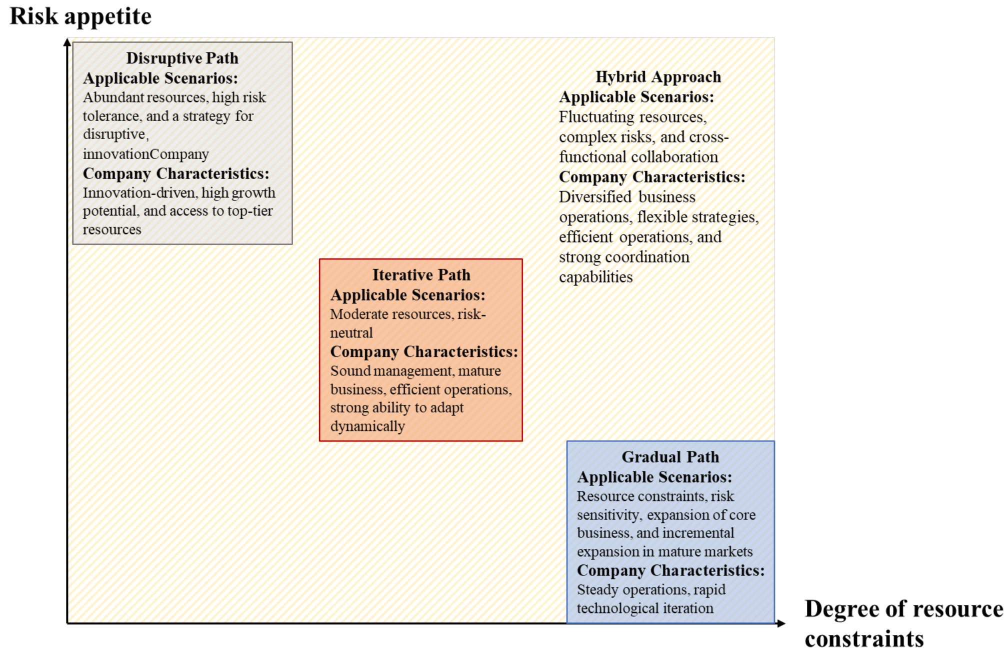

Figure 2. Scenario model for the venture capital-style spin-off startup pathway in large enterprises

5. Research conclusions

This study makes a systematic analysis of the implementation paths of venture-capital-style spin-off entrepreneurship in large corporations, according to the innovation development policy of new-quality productive forces and state-owned assets. For the construction of the evaluation system, this study first proposed a two-dimensional framework of "resource constraints and risk preference", and then a framework for path evaluation from three aspects was designed, including entrepreneurial team endowments, advantages of large corporations, and external environmental factors. Finally, indicators were selected and optimized by conducting two rounds of the Delphi method, which formed a scientific and rigorous evaluation indicator system. Moreover, the weights of each indicator were calculated using the Analytic Hierarchy Process (AHP). The research findings showed that the endowments of the entrepreneurial team and advantages of large corporations have great impacts on the choice of path, among which the ability of innovation execution, internal synergy of enterprises, and resource empowerment played an important role. As for the comprehensive evaluation of paths, the Fuzzy Comprehensive Evaluation Method was adopted to quantitatively compare four types of paths, including gradual, iterative, abrupt, and hybrid paths. The findings show significant disparities between the various paths in respect to their effectiveness in implementation and applicability conditions: the abrupt path had the best overall performance, the gradual path was distinguished by robustness, the iterative path was distinguished by balanced adaptability, and the hybrid path had very low adaptability overall. Furthermore, this paper identifies the application conditions for the four paths based on the corporate resource conditions, risk-taking capacity, and objectives. Lastly, a whole decision chain has been formulated, incorporating indicator creation, weighting, path evaluation, and scenario matching.

In summary, this paper provides an approach to path selection and decision-making that can be measured, compared, and implemented in practice, thus overcoming some of the weaknesses of previous literature in this area, which usually emphasizes qualitative studies and struggles to match the paths to real-life situations. Not only does this enhance the theory of venture-style fission entrepreneurship, but, most importantly, it also offers actionable recommendations for companies that wish to enter new industrial fields and build new productive capacity.

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The authors declare no conflict of interest.

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