

Article

Research on the Configuration Path of Innovation Performance of Strategic Emerging Enterprises

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Abstract: As vehicles for implementing innovation-driven strategies, the strategic emerging industries are crucial for enhancing national competitiveness and sustainable development. Improving innovation performance in these industries has been a central focus of academic research. Notably, existing studies have primarily analyzed the net effects from a single perspective. This study examined 261 strategic emerging Chinese enterprises listed on the A-share market. Utilizing the Technology–Organization–Environment framework and fuzzy set qualitative comparative analysis, this study explores the impact paths and mechanisms of the coupling configurations of technology, organization, and environment to enhance enterprises’ innovation performance from a configuration perspective. We discovered that, first, no single antecedent condition is necessary to achieve high enterprise innovation performance. However, increasing the level of digital transformation and intensity of innovation investments universally results in high innovation performance. Second, the technological, organizational, and environmental conditions exhibit “multiple concurrency”, forming diverse configurations that drive enterprise innovation performance; hence, the driving paths of enterprise innovation performance are varied. Third, four schemes exist for achieving high innovation performance in strategic emerging enterprises: environment-driven under technological dominance, technology–organization driven type, organization-driven under technological–environmental dominance, and technology–organization–environment co-driven type. Exploring the synergistic paths driving innovation performance from a configuration perspective enhances our understanding of the complex interactions among multiple factors in improving such performance. This provides significant theoretical and practical implications for enterprises aiming to improve their innovation performance.

Keywords: innovation performance; Technology–Organization–Environment framework; fuzzy set qualitative comparative analysis; strategic emerging Chinese enterprises



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1. Introduction

Given globalization and rapid technological advancement, innovation has become the core driver of global economic growth and scientific and technological progress. The United Nations’ Sustainable Development Goals 12 (SDG-12) advocate that countries enhance their scientific and technological capabilities, research, and innovation to achieve more sustainable production and consumption patterns. For nations, innovation is not only an engine driving economic growth but also a crucial means of strengthening comprehensive capabilities and elevating international status. Innovation is a key approach for addressing market competition, technological changes, and environmental shifts, as well as a necessary condition for maintaining competitive advantage and achieving sustainable development [1]. Ye et al. predicted the GDP of various countries using a technology

centrality index derived from patent data [2]. The results indicated that a country's technological development strength can predict its economic development [2]. According to annual patent statistics from the World Intellectual Property Organization (WIPO) and the World Bank's statistical reports, global patent applications grew from approximately 2.14 million in 2011 to 3.4 million in 2021, while global GDP increased from \$73.32 trillion to \$94.93 trillion over the same period. This trend indicates that innovation is a key antecedent to global economic development. During the COVID-19 pandemic, the number of global patent applications exhibited only minor fluctuations, demonstrating innovative activities' resilience. In the post-pandemic era, innovation is critical for global economic recovery. According to WIPO and World Bank data, global patent applications surged from 3.27 million in 2020 to 3.4 million in 2021, while global GDP also robustly rebounded to USD 94.93 trillion. This further confirms innovation's importance in economic recovery and growth. Given this context, innovation performance is an important indicator of enterprises' innovation outcomes and efficiency and is critical to research.

Prior academic research on enhancing enterprises' innovation performance has been explored from three perspectives: technological, organizational, and external environmental conditions. Scholars analyzed the role of information and communication technologies (ICTs) in the impact of innovative cooperation models on innovation outcomes, which founded that implicit cooperation stems from the spillover effects of research and development (R&D) and ICTs, significantly increasing the likelihood of companies introducing process, product, and organizational innovations [3]. Meanwhile, Giovannetti et al. provided a theoretical basis for how strategic emerging companies can jointly promote innovation through organization and technology [3]. In terms of technological conditions, the existing literature has focused on the effects of single factors—such as digital transformations, digital technology, Big Data application capabilities, and R&D investments—on improving enterprises' innovation performance [4–7]. Li et al. used a fixed-effects model to explore digital transformations' impact on innovation output and demonstrated that such transformations can promote enterprises' innovation [4]. However, other scholars using principal component analyses have revealed that digital technology has minimal impacts on innovation performance [5]. Regarding organizational conditions, researchers have primarily used traditional linear regression analysis methods to study the single net effects of various factors, such as human capital levels, the top management team's heterogeneity, entrepreneurship, internal control levels, and enterprises' dynamic capabilities on the generation and transformation of technological innovation outcomes [8–15]. Ge noted that dynamic capabilities positively affect product, process, and collaborative innovation performance [8]. Zhang et al. observed that the top management team's heterogeneity positively moderated digital transformations' impacts on enterprises' innovation [13]. Crépon et al. emphasized the significance of innovation management, particularly in developing a high-quality talent team, which is crucial for enterprises to promote technological innovation and maintain competitive advantage, and offers a useful reference for strategic emerging enterprises to enhance their innovation performance [14]. When examining external environmental conditions on enterprises' innovation, existing research has focused on the linear relationships between factors such as government subsidies, regional innovation policies, tax incentives, the business environment, market competition, and innovation performance [16–22]. For example, Xu et al. found a reversed U-shaped in the relationship between government subsidies and the innovation performance of enterprises, with internal controls acting as a significant moderator [16]. Other scholars also believed that optimizing the business environment can enhance corporate innovation efficiency [20]. A favorable business environment can enhance enterprises' risk-taking capabilities and promote technological innovation by increasing government subsidies [21].

Although these studies provide a rich theoretical foundation for exploring differentiated paths to achieve high levels of innovation performance, most are based on a single theoretical perspective that focuses on independent mechanisms of different factors impacting enterprises' innovation performance. The literature has focused less on the

interdependence of factors, the configurational effects among conditions, and the complex causal relationships between these factors and outcome variables [23,24]. Therefore, this study argues that a scope for research still exists on the selection of differentiated paths to improve enterprises' innovation performance. The key issue lies not in which factor has the largest net effect but in how different conditions interact and whether one or multiple condition configurations can lead to high innovation performance in enterprises. Moreover, and based on real-world contexts, research on paths to improve this performance should be viewed as a complex, dynamic process involving multifactor combinations and synergies [25]. Focusing solely on different factors' independent effects on innovation may constrain managers' understanding of their interactive and synergistic effects.

Traditional analytical methods focus primarily on the net effects of individual factors, and thus, limiting their ability to explore the synergistic effects of multiple factors [26]. Qualitative comparative analysis (QCA), based on a configurational perspective, can effectively address these limitations [27]. Recently, QCA has become a useful method for examining complex causal relationships. Zheng et al. and Reichert et al. applied this method to investigate the linkage-matching effects of different antecedent elements on enterprises' innovation performance [20,28]. Ding et al. used the fuzzy set qualitative comparative analysis (fsQCA) method to investigate the relationship between various antecedent configurations—such as R&D investments, human capital, and national wealth—and high national innovation performance from the national innovation system perspective [29]. These studies collectively demonstrate that improving innovation performance relies on the synergistic effects of multiple factors, thus proving the fsQCA's applicability in research on innovation performance issues, which uses set theory and Boolean operations to uncover multiple factors' "configurational effects" [26,30], revealing different paths that ultimately demonstrate that "All roads lead to Rome". Therefore, it is imperative to comprehensively explore the synergistic effects of multiple factors, and the complex causal relationships in improving enterprises' innovation performance from a holistic perspective [25,31].

Emerging economies have become increasingly prominent in global economic and technological development. According to the WIPO, several emerging economies ranked among the top 10 countries for global patent applications in 2021. Notably, China has had approximately 1.5 million patent applications, accounting for nearly 46% of the global total, indicating that emerging economies as represented by China are increasingly important in the global innovation system. As a new force in China's innovation-driven development strategy, strategic emerging industries represent the direction of a new technological revolution and industrial transformation. These strengths are key for China to advance technologically and build an innovative-based nation. China's unique innovation capabilities and significant development potential are considered core drivers for optimizing its economic structure, enhancing industrial competitiveness, and achieving sustainable development. Moreover, the national government has issued a collection of policy documents to promote the growth of strategic emerging industries, such as the "13th Five-Year Plan for Developing National Strategic Emerging Industries" and the "Guidelines for increasing investment in strategic emerging industries and developing new growth points and poles", etc.; this lays a solid foundation for their innovative development while also indicating future development directions. Therefore, this study considers the noted research background and issues to select Chinese strategic emerging enterprises as a sample to explore differentiated paths to achieve high innovation performance. The findings have substantial practical significance for understanding the complex causal relationships underlying the improvement of innovation performance in emerging strategic enterprises.

This study adopts a configurational perspective, drawing on a Technology–Organization–Environment (TOE) analysis framework and using Chinese A-share-listed strategic emerging enterprises as research cases. This study employs the fsQCA method to thoroughly analyze the antecedent configurations affecting enterprises' innovation performance across the technological, organizational, and environmental dimensions. It aims to reveal the differentiated driving paths to achieve high innovation performance in strategic emerging

enterprises, which is crucial for deepening our understanding of the complex mechanisms behind improving innovation performance in these enterprises. Specifically, this study explores the following three core issues: First, are these antecedent conditions necessary to achieve high innovation performance? Second, which configurational conditions can promote high innovation performance in strategic emerging enterprises, as “All roads lead to Rome”? Finally, what conditions are key factors for strategic emerging enterprises in achieving high innovation performance? This study broadens the literature studying innovation performance in strategic emerging enterprises, deepens the understanding of their differentiated driving paths, and promotes innovative development among strategic emerging enterprises.

2. Literature Review and Research Framework

2.1. Literature Review

The TOE framework is fundamentally a theoretical model for analyzing enterprises' adoption and implementation of technological innovations. This framework categorizes the factors influencing the adoption of technological innovation into three primary dimensions: technological, organizational, and environmental [32]. Through its widespread application in academia, this framework has gradually evolved into a multidimensional analytical framework that comprehensively considers technological, organizational, and external environmental conditions. The technological conditions include the technological innovation capability, level of digital transformation, and intensity of innovation investments [33]. The organizational conditions are mainly characterized by internal features, such as the top management team's heterogeneity, internal controls, and equity incentives [34]. The environmental conditions focus on an organization's external environment, including its business environment, market competition, and related government policies [35,36]. The three factors are interrelated jointly influencing the innovation performance of enterprises. Owing to its strong generalizability and applicability, scholars across various fields have utilized the TOE framework to identify influencing factors, such as corporate green innovation [37] and digital transformation performance in manufacturing enterprises [38]. This study emphasizes that enhancing the innovation performance in strategic emerging enterprises is a systematic and continuous process involving multiple aspects such as technology research and development, organizational management, and external environment. The TOE framework, characterized by its flexibility and practicality, effectively summarizes and evaluates the factors influencing enterprise innovation performance.

2.1.1. Technological Conditions

Factors influencing the technical level include the current state of technology use and the characteristics of the technology to be adopted, such as technology level, innovation capability, technical support, and services. As technology-intensive enterprises, strategic emerging enterprises must strengthen technological innovation and digital transformation to enhance innovation performance. Antonelli et al. conducted a comprehensive study on the knowledge-intensive direction of technological change. Their research demonstrated that enterprises can improve their innovation performance by leveraging knowledge-intensive assets to achieve more efficient and sustainable technological development. This trend aligns with the increasing significance of R&D and organizational capabilities as key drivers of corporate competitiveness [39].

The existing literature has primarily focused on how technological factors impact enterprises' innovation performance based on the level of digital transformation and the intensity of innovation investments. Digital transformation involves utilizing digital technology, products, and platforms to drive changes at the individual, organizational, and industrial levels. It can impact enterprises' production, operations management, and information-acquisition and resource-allocation capabilities, thereby creating opportunities for enterprises' innovation [40]. Zhuo et al. argue that digital transformations can surmount innovation dilemmas by improving innovation quality and enhancing the enterprise's ab-

sorptive capacity [41]. Additionally, digital transformations can enhance innovation output by reducing agency costs and increasing an enterprise's risk-taking capacity [42]. Based on the resource-based theory, enterprises have introduced such advanced technologies as Big Data analytics and cloud computing through digital transformations [43]. This has significantly improved resource allocations' efficiency while helping enterprises better allocate R&D resources, ultimately enhancing innovation efficiency [44]. Xue et al. studied the relationship between digital transformations and green technological innovations to reveal that digital transformations enhance innovation by alleviating financing constraints and attracting government subsidies [45].

Enterprise innovation investment is the source of innovation and a crucial factor that determines the innovation performance of enterprises [46]. Innovation investment intensity is a key determinant of innovation performance. Fabrizio and Tsolmon and Artz et al. argued that increasing R&D investments can significantly improve innovation output and is a fundamental path for enterprises to enhance their innovation performance [47,48]. Innovation investments typically and directly relate to R&D activities, affecting the digital transformation process as well as the ability to absorb external technological resources. Escribano et al. noted that enterprises with high innovation investments can better identify external knowledge flows and effectively utilize them, which helps them to continuously update and expand products and services, thereby improving innovation performance [49]. Additionally, greater R&D investments can help enterprises quickly acquire the latest technological information, thereby strengthening their R&D teams and promoting the development of new technologies, products, and services [9,50]. Digital transformation and innovation investments are key factors driving businesses' process optimization, improving efficiency, and reshaping value-creation methods, thus significant in promoting enterprises' innovation development.

2.1.2. Organizational Conditions

Enterprise technological innovation requires diverse resource investments. Organizational conditions are crucial for implementing advanced technologies effectively. Human capital is considered more significant than material capital [51], playing a vital role in enterprise technological innovation. It directly influences the generation and transformation of technological innovation results, and ultimately determining performance levels [52]. The new economic growth model proposed by Romer revealed that special knowledge and specialized human capital are the primary factors of economic growth [53]. Scholars, including Christensen [54], identified senior management as key drivers of disruptive innovation in enterprises. Senior executives, particularly CEOs, incorporate their experiences and preferences into corporate decision making, thereby influencing disruptive innovation [54]. Most existing literature on the impact of organizational factors on enterprises' innovation performance has focused on the top management team's heterogeneity. Based on the upper echelon theory, the top management team's heterogeneity can cause differences in cognitive bases and values that can affect business decisions, and consequently, enterprises' strategic choices and innovation performance [55]. Enterprise behavior is the concrete execution of strategic decisions, largely determined by top management [56]. Therefore, it is necessary to research top management teams to discuss enterprises' innovation performance issues. In examining the factors influencing enterprises' innovation performance, the top management team—as a strategic decision maker and resource allocator—is crucial in determining innovation performance through heterogeneity [57].

This study refers to Talke's research in categorizing the top management team's heterogeneity as either relationship-oriented (focusing on differences in gender or age, among other traits) or task-oriented (focusing on differences in education or functional experience, among others) [58]. Task-oriented heterogeneity reveals deeper, more implicit differences in characteristics than relational heterogeneity, as it reflects the personal abilities and experiences of the top management team's members. These differences can affect thinking habits and cognitive bases, thereby influencing enterprises' strategies and performance

through the top management team's business decisions. Therefore, this study focuses on task-oriented heterogeneity to explore the impacts of the top management team's educational and functional backgrounds heterogeneity on enterprises' innovation performance. The top management team's educational backgrounds heterogeneity refers to the differences in educational levels within the team. Simons et al. argued that executives with different educational levels can view problems from different perspectives before proposing comprehensive solutions and putting them into action [59]. During the innovation process, viewing problems from a broader perspective and gathering more diverse information can better identify uncertainties in innovation investments, reducing investment risks and positively impacting innovation performance [12].

The top management team's functional backgrounds heterogeneity refers to the differences in professional backgrounds among executives. Executives' work experience directly influences their psychology and cognition, subsequently affecting their perceptions and attitudes toward situations. For example, executives working in R&D may explore novel technologies and regard them as sources of competitiveness for the enterprise [60]. The high top management team functional backgrounds heterogeneity can fully utilize its members' industry knowledge, bringing an advantage to the enterprise in its innovation performance [61]. Therefore, the presence of the top management team's educational and functional backgrounds heterogeneity means that senior management team members can acquire different information sources and perspectives based on differentiated cognition to solve problems, which is conducive to improving enterprises' learning and innovation performance [62,63].

2.1.3. Environmental Conditions

The impact of environmental factors on improving corporate innovation performance is primarily reflected in the resources and support provided to enterprises. Recently, to address changes in the global economic landscape and the reconstruction of the domestic economic structure, local governments have continuously optimized the business environment and implemented a series of fiscal and tax incentives to guide and encourage corporate innovation. The current literature primarily explores the impact of such factors on innovation performance as the business environment and government subsidies. Many studies indicate that a favorable business environment can maximize innovative potential, providing beneficial external conditions for enterprise innovation, and enhancing innovation performance [20,21,64]. Moreover, the business environment can improve government services' efficiency, reduce transaction costs, and create a fair competitive environment, while stimulating enterprises' willingness to invest in R&D and reducing R&D investment risks [65]. Additionally, a superior business environment is advantageous for reducing institutional transaction costs, for example, by positively impacting innovation performance through tax incentives. Thai et al. found that a favorable business environment facilitates the government's implementation of fee- and tax-reduction policies, which can alleviate enterprises' financing constraints during the R&D phase [66]. From the enterprise competition perspective, Chen et al. argued that a favorable business environment helps motivate effective competition among enterprises; this will have a competitive learning effect and improve innovation quality [67]. Bonaime et al. argued that in an imperfect business environment, the government's intervention in enterprises' daily operations can increase transaction and operation costs, reduce the willingness for R&D innovation, and consequently diminish innovation investments [68]. Fabová et al. explored how the business environment affects the innovation activities of Slovak enterprises with such innovation resources as manpower, capital, and institutional guarantees to provide a favorable business environment [69]. A favorable business environment can further promote the continuous optimization of administrative approval processes and stimulate the vitality of enterprises' innovation [70]. These studies highlight the importance of a superior business environment in achieving high innovation performance.

According to the resource-based theory, government subsidies are crucial external resources that stimulate enterprises' innovation investments and R&D capabilities. They can directly supplement the resources that enterprises lack. By increasing enterprises' resource endowments, governments can reduce the marginal costs and uncertainties of daily operations as well as management and innovation activities while incentivizing innovation development [71]. Additionally, the market recognizes these government subsidies' role in encouraging enterprises to innovate [72,73]. Another significant role of government subsidies is that they help enterprises alleviate financing constraints to enhance their R&D capabilities [74,75]. Numerous studies have indicated that enterprises receiving government subsidies also increase their innovation expenditures, which subsequently improves their innovation output and innovation performance [76,77]. As environmental factors, the business environment and government subsidies significantly impact enterprises' innovation performance.

2.2. Model Construction

Currently, China's economy has entered a new normal characterized by intense market competition, where innovation has become the core driving force for enterprises to transform their economic development mode. It is also crucial for achieving industrial transformation, upgrading and national high-quality development [78]. The literature review indicates that high innovation performance in enterprises results from the joint cation of various internal and external environment factors. It is difficult to improve the high-quality development of strategic emerging enterprises by relying on a single factor. Sustainable development can only be achieved by focusing on the systematic linkage of various elements within the innovation system [37,38]. Second, the contingency theory demonstrates that the existence of each antecedent condition is not isolated but always functions in a complex interactive relationship. Hence, the technological, organizational, and environmental factors impact the enhancement of innovation performance in strategic emerging enterprises through synergistic matching.

Strategic emerging enterprises, based on major frontier scientific and technological breakthroughs, represent the future of science, technology, and industrial development. These enterprises undertake significant missions such as cultivating new development momentum, optimizing industrial structure, and enhancing national scientific and technological competitiveness. To adapt to the new normal of economic development, China has prioritized the development and expansion of strategic emerging industries as a key measure to accelerate the transformation of the economic development mode, narrow the gap between China's existing industries and the world's industrial frontiers, and build an innovative country. In this context, the innovation performance in strategic emerging enterprises, as a manifestation of technology diffusion, is also influenced by technology, organization, and environment. Compared with general enterprises, strategic emerging enterprises have particularity in building an innovative country, reflecting a key focus of recent Chinese government's work. They are closely connected with the government, and their business activities must consider both organizational and environmental goals. However, in the context of digitalization, strategic emerging enterprises need to leverage technological innovation to improve their innovation performance, emphasizing the integration of innovation performance and digital technology. Therefore, using TOE theory to explore the role of innovation performance of state-owned platform enterprises is highly relevant.

Scholars using the TOE framework have found that it does not clearly define the specific explanatory variables for technology, organization, and environment. This flexibility allows researchers to adjust the framework according to their needs, enabling a deeper analysis of complex social phenomena [79,80]. Therefore, based on this analysis and the actual environment faced by corporate innovation and development, this study employs the TOE framework to explore the complex causal relationships underlining high innovation performance in strategic emerging enterprises. We examine three dimensions:

technological conditions, or the level of digital transformation and intensity of innovation investments; organizational conditions, such as the top management team heterogeneity in educational and functional backgrounds; and environmental conditions, which include the business environment and government subsidies. This study also aims to construct a research framework that enhances high innovation performance in strategic emerging enterprises within the TOE framework. Within this framework, the business environment and government subsidies are objective endowment conditions that enterprises find difficult to change in the short-term. The level of digital transformation, intensity of R&D investment, and the top management team's educational and functional backgrounds heterogeneity are subjective, controllable conditions. Figure 1 illustrates the research framework.

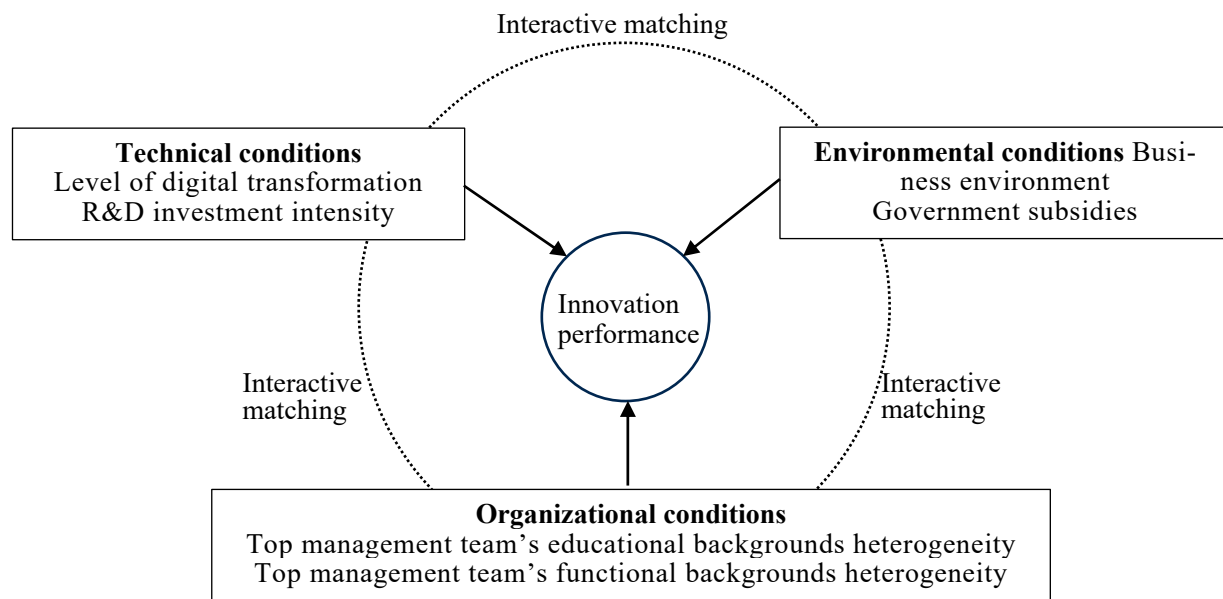


Figure 1. Research framework.

3. Research Methods and Data

3.1. Qualitative Comparative Analysis

From a configurational perspective, the QCA excels in analyzing the complex interactions and associative effects among multiple factors. It can identify the causes of specific situations by analyzing “multiple conjunctural” causations [81], thus revealing the necessary conditions and sufficient configurations to provide diverse equivalent paths for problem solving [82].

To better open the “black box” of achieving high innovation performance in strategic emerging enterprises, this study employs the fsQCA method for demonstration, based on the following considerations: First, the fsQCA is better suited for exploring the joint driving mechanisms of various elements of enterprise innovation performance from an overall relational perspective. Achieving high innovation performance in strategic emerging enterprises requires the synergistic matching of multilevel conditions; the fsQCA can reveal the associations between multilevel conditions, helping to convey how relevant conditions' configurations drive innovation performance. Second, this study focuses on whether differentiated driving paths exist for achieving high innovation performance in emerging strategic enterprises. The introduction of the fsQCA—which recognizes the complete equivalence of different combinations of antecedent conditions to the outcome [83,84]—can further identify the driving paths through which “All roads lead to Rome” to achieve high innovation performance [82].

3.2. Sample Selection and Data Sources

Strategic emerging Chinese enterprises were chosen as the research subjects based on this study's research context and questions. In particular, this study focuses on A-share-listed companies belonging to strategic emerging industries in 2021. The research refers to Sun et al. regarding the database of A-share-listed companies in strategic emerging industries [85]. Given this, according to Appendix A, the study's initial sample is comprised of A-share-listed companies on China's Shanghai and Shenzhen stock exchanges from seven major industries, four sectors and 20 categories. After excluding the financial sector, special treatment companies, and samples with severe data deficiencies, the final research sample included 261 emerging strategic enterprises [86]. The patent application data used in this study were obtained from the CNRDS database and National Intellectual Property Administration. The digital transformation data were sourced from the listed companies' annual reports. Business environmental data were sourced from "the China urban business environment research database". Data on R&D investments, the top management team's heterogeneity, and government subsidies were sourced from the CSMAR database. Table 1 presents the data's descriptive statistics.

Table 1. Descriptive statistics.

Variable	Maximum	Minimum	Average Value	Standard Deviation
Dig	396.000	0.000	11.046	36.155
R&D	0.330	0.000	0.048	0.051
Hedu	0.750	0.000	0.295	0.253
Hcar	0.835	0.000	0.589	0.282
B&E	60.863	19.527	46.148	8.479
Gov	0.046	−0.009	0.009	0.009
Innov	7.077	0.000	3.258	1.644

3.3. Variable Measurement

3.3.1. Result Variable

Innovation performance (Innov). The number of patents is frequently utilized as a key measure of an enterprise's innovation output. Considering that patent authorization often requires a long review period [16], the number of patent applications best reflects the intensity and efficiency of resource allocations. Therefore, this study refers to Li et al. and constructs the dependent variable using the logarithm of the total number of invention patent applications plus one [4]. Patent application data were obtained from the CNRDS database and the National Intellectual Property Administration.

3.3.2. Condition Variables

- (1) Level of digital transformation (Dig). Drawing on Ren's research, text-mining technology was used to measure the level of digital transformation in enterprises by counting the frequency of strategic digital transformation keywords in the listed companies' annual reports [87]. The annual reports of the listed companies are sourced from China Securities Info (CNINFO).
- (2) R&D investment intensity (R&D). To eliminate scale differences among enterprises, this study refers to Wei et al. and measures R&D intensity as the ratio of R&D expenses to operating revenue [88]. Data on R&D expenses and operating revenues were sourced from the CSMAR database.
- (3) The top management team's educational background heterogeneity (Hedu). The data on executive characteristics were obtained from the CSMAR database. Drawing on Talke et al. and Xie et al., this study measures educational background heterogeneity through five levels to define the executive team's educational levels: 1, or below an associate's degree; 2, or associate degree; 3, or bachelor's degree; 4, or master's degree; and 5, or doctoral degree [12,89]. The study uses the Herfindahl–Hirschman index [90]

to calculate the top management team’s educational background heterogeneity, with the following formula:

$$H = 1 - \sum_{i=1}^n P_i^2$$

where P_i represents the percentage of the i th member of the executive team. The H -values range from zero to one, with a larger H -value indicating greater heterogeneity.

- (4) The top management team’s functional backgrounds heterogeneity (H_{fun}). Drawing on Talke et al. and Geulen et al., this study measures functional backgrounds heterogeneity by categorizing the executive team members’ professional backgrounds as follows: 1, or production; 2, or research and development; 3, or design; 4, or human resources; 5, or management; 6, or marketing; 7, or finance; 8, or accounting; 9, or legal; and 99, or other or unspecified [12,91]. This study then used the Herfindahl–Hirschman index to calculate the top management team’s functional backgrounds heterogeneity [90] by employing the same formula as previously described.
- (5) Business environment (B&E). This is assessed by matching the business environment index of the city where the enterprise is located. The city’s business environment index is sourced from “the China urban business environment research report”, which was jointly released by Peking University and Wuhan University [92]. According to Appendix B, the total score of each city’s business environment is weighted through four sub-environments: the market, administrative, legal, and regulatory, and cultural environments.
- (6) Government subsidies (Gov). The details of government subsidies received by A-share-listed companies were downloaded from the CSMAR database. This study considers Xu et al. and uses the ratio of government subsidy funds received by the enterprise to its operating revenue as a proxy variable for government subsidies [16].

3.4. Data Calibration

Calibration, a pivotal process in fsQCA analysis, involves transforming variables into sets and systematically assigning set memberships to individual cases [30]. This study refers to Du et al. and Ragin by using the direct calibration method to convert raw data into fuzzy-set membership scores [81,93]. Drawing on existing research, the 5th, 50th, and 95th percentiles of the outcome and condition variables were selected as anchors for full non-membership, crossover point, and full membership, respectively [80]. To avoid a loss of effective data, the calibrated data were adjusted by incrementing the membership score of 0.5 by 0.001 [82]. Finally, fsQCA software (version 3.0) was used to calibrate the raw data into fuzzy-set data. Table 2 presents the calibration anchors for the outcome and condition variables.

Table 2. Data calibration anchor points.

Variable Category	Variable	Fuzzy Set Calibration		
		Full Membership	Crossover Point	Full Non-Membership
Condition variable	Dig	47.000	2.000	0.000
	R&D	0.160	0.038	0.000
	Hedu	0.625	0.375	0.000
	Hcar	0.795	0.714	0.000
	B&E	59.583	45.513	33.062
	Gov	0.027	0.006	0.001
Outcome variable	Innov	5.707	3.401	0.000

4. Data Analysis and Empirical Results

4.1. Necessity Analysis of Individual Conditions

Before conducting the condition configuration analysis, it is essential to individually test the “necessity” of each condition. This study used fsQCA software (version 3.0) to

initially evaluate whether an individual condition (including its negation) constitutes a necessary condition for strategic emerging enterprises' high/non-high innovation performance. A condition is deemed a necessary condition for an outcome if it is consistently present whenever the outcome occurs [84]. Consistency is a crucial criterion for judging the necessary conditions. A condition was deemed necessary for the outcome when its consistency score exceeded 0.9 [84]. Table 3 presents the test results necessary to gauge the strategic emerging enterprises' high/non-high innovation performance. The results reveal that the consistency levels of all conditions are below 0.9, indicating that no necessary conditions affect the enterprises' high/non-high innovation performance.

Table 3. Necessity test results of single antecedent conditions.

Condition Variable	High Innov		Non-High Innov	
	Consistency	Coverage	Consistency	Coverage
Dig	0.570	0.759	0.570	0.759
~Dig	0.710	0.603	0.710	0.603
R&D	0.657	0.781	0.657	0.781
~R&D	0.689	0.635	0.689	0.635
Hedu	0.576	0.638	0.576	0.638
~Hedu	0.621	0.606	0.621	0.606
Hcar	0.709	0.680	0.709	0.680
~Hcar	0.577	0.653	0.577	0.653
B&E	0.669	0.683	0.669	0.683
~B&E	0.621	0.656	0.621	0.656
Gov	0.599	0.710	0.599	0.710
~Gov	0.699	0.645	0.699	0.645

Note: “~” means “not”.

4.2. Sufficiency Analysis of Configurational Conditions

The configuration analysis aims to reveal the sufficiency of various configurations with multiple conditions in causing outcomes. From the set theory perspective, this study explores whether the sets represented by different configurations are subsets of the outcome set. Schneider et al. observed that the consistency level for assessing sufficiency should not be lower than 0.75 [94]. The frequency threshold was determined according to the sample size [94]. Based on the analysis of case data, this study sets the consistency threshold at 0.85 and the PRI consistency threshold at 0.70 [30]. The frequency threshold was set at 3, ultimately covering 92% of the samples. Table 4 presents the configuration results.

Owing to a lack of evidence and theory on an exact direction regarding the conditions' impact on outcomes, this study assumes that the presence or absence of individual conditions may influence high innovative performance in the context of a counterfactual analysis. By comparing the nested relationship of “intermediate solutions as the main focus and parsimonious solutions as a supplement”, each solution's core and auxiliary conditions are identified [30]. Following the symbolic expression form developed by Ragin et al., a solid circle (●) and a solid triangle (▲) denotes the presence of a condition, a crossed circle (⊗) and a double circle (⊙) signifies the absence of a condition, and a blank space denotes that the condition's presence is indeterminate [26]. A large circle represents a core condition, present in both the intermediate and parsimonious solutions, while a small circle denotes a peripheral condition, found only in the intermediate solution. As Table 4 illustrates, the consistency levels of both the individual configurations and the overall solution exceed the generally accepted standard of 0.80; the overall solution demonstrates a consistency of 0.88 and a coverage of 0.53. Therefore, the six configurations in Table 4 can be regarded as different paths for achieving high innovation performance. Among these six configurations, S6 had the highest unique and original coverage, indicating that it was the most empirically relevant among the six. The following section provides a detailed analysis of each configuration path affecting enterprises' innovation performance. Referring to Xing et al.'s classification method, the six configurations are categorized into three

levels: technology, organization, and environmental conditions [95]. Additionally, four types of high-level enterprise innovation performance with different core characteristics are proposed: environment-driven under technological dominance, technology–organization driven type, organization-driven under technological–environmental dominance, and technology–organization–environment co-driven type. The following analyzes each configuration path that affects enterprise innovation performance in detail.

Table 4. Results of conditional configuration adequacy analysis.

Condition Variable	Environment-Driven Under Technological Dominance	Technology–Organization Driven Type	Organization-Driven Under Technological–Environmental Dominance		Technology–Organization–Environment Co-Driven Type	
	S1	S2	S3	S4	S5	S6
Dig R&D	●	●	●	⊗	●	
	●	⊗	●	●	●	●
Hedu Hcar		⊗	▲	▲	●	⊗
	⊗	●	⊗		●	●
B&E Gov	⊗	⊗	●	●		●
	▲	⊗	⊗	●	●	
Consistency	0.950	0.908	0.940	0.923	0.893	0.932
Raw coverage	0.213	0.203	0.173	0.234	0.211	0.286
Unique coverage	0.041	0.050	0.011	0.044	0.029	0.083
Solution consistency			0.880			
Solution coverage			0.530			

Note: ● or ▲ indicates that the condition exists, ⊗ or ⊙ indicates that the condition does not exist, and “blank” indicates that the condition may or may not exist; ● or ⊗ indicates a core condition, and ▲ or ⊙ indicates a marginal condition.

(1) Environment-driven under technological dominance. Configuration S1 achieves high innovation performance in strategic emerging enterprises through high digital transformations and innovation input intensity, non-high top management team’s functional backgrounds heterogeneity, and a non-high business environment as core conditions, complemented by high government subsidies as an auxiliary condition. Therefore, even when the top management team’s functional backgrounds heterogeneity and the business environment are not high, the enterprise can achieve high innovation performance as long as the level of digital transformation, R&D investment intensity, and government subsidies are high. Whereas Xu et al. believed that an inverted U-shaped relationship exists between government subsidies and innovation performance [16], Configuration S1 suggests that innovation subsidies as a condition for improving innovation performance can financially support enterprises’ innovation, reduce financial support and other risks in the innovation process, and stimulate innovation vitality.

In Configuration S1, a high level of digital transformation, by introducing advanced digital technologies, improves enterprises’ R&D efficiency and reduces uncertainty in data-driven decision-making processes [4], increasing the innovation success rate. Berchicci argued that innovation input intensity helps build a good innovation ecosystem for enterprises [7] and enhances their attractiveness to external investors and innovation talent. The consistency of S1 was 0.950, unique coverage was 0.041, and raw coverage was 0.213. Hence, this path can explain approximately 21.3% of high innovation performance cases. Approximately 4% of the cases could only be explained by this path. As a typical case under this configuration, YLHKJ Co., Ltd., greatly enhanced its data-processing capabilities through a series of digital measures, such as refined upgrades to its ERP system and the comprehensive launch of an SAP project. These measures provided accurate information support at the decision-making level, significantly accelerated the market response speed, and significantly improved the customer service experience. In the innovation field, YLHKJ ad-

heres to a strategic policy “focusing on precision electromechanics, strengthening magnetic materials, and optimizing downstream applications” while continuously increasing R&D investments and promoting technological innovation. Meanwhile, YLHKJ’s innovation and R&D efforts have also received full recognition and support from the government, further promoting continuous innovation in its products and technologies and consolidating its leading position in the industry.

(2) Technology–organization driven type. Configuration S2 achieves high innovation performance in strategic emerging enterprises through high levels of digital transformation, high top management team’s functional backgrounds heterogeneity, non-high innovation investment intensity, non-high top management team’s educational backgrounds heterogeneity, non-high business environment, and non-high government subsidies as core conditions. This also means that the synergy between high digital transformations and the high top management team’s functional backgrounds heterogeneity can effectively overcome the constraints of innovation investments, the top management team’s educational backgrounds heterogeneity, the business environment, and government subsidies’ effects on innovation performance. This contradicts the conclusion by Han et al. that optimizing the business environment can improve enterprise innovation efficiency through empirical research [21]. Zhang et al. believed that innovation growth often significantly increases through digital transformations, and that the top management team’s heterogeneity actively moderates this process [13]. A high-level digital transformation can bring new technologies to enterprises [43], and the top management team’s functional backgrounds heterogeneity can bring diversified knowledge, methods, and perspectives to the enterprise [61]. These can all significantly enhance an enterprise’s innovation capability and performance. The consistency of S2 is 0.908, unique coverage is 0.050, and raw coverage is 0.203, indicating that this configuration can explain approximately 20.3% of the cases; among these, approximately 5% of the cases can only be explained by this path. A typical enterprise in this configuration is Ningxia JCJT Co., Ltd., which has actively responded to trending digital transformations by building an intelligent, unmanned shared warehouse-management SaaS platform. This “e-Storage” has evolved through a high-end, intelligent, and green development strategy toward intelligent warehouse management. Simultaneously, JCJT fully recognizes the importance of heterogeneity in the top management team’s educational background, and effectively utilizes this advantage to broaden the company’s innovation horizons and thinking. They have continued to invest substantial funds in the cement industry’s high-end, intelligent, and green development. These measures continuously drive the company’s technological innovation and product upgrades, enabling JCJT to achieve significant, innovative development. Configuration S2 and the typical case of JCJT demonstrated that even in a challenging business environment and government subsidies, enterprises can still enhance their innovation performance through technological and organizational innovations.

(3) Organization-driven under technological–environmental dominance. In this configuration, both technological and environmental conditions are key, whereas the organizational conditions are only auxiliary. In Configuration S3, the high digital transformation, high R&D investment intensity, high business environment, non-high top management team’s functional backgrounds heterogeneity, and non-high government subsidies are core conditions. With the high top management team’s educational backgrounds heterogeneity as an auxiliary condition, this can produce high innovation performance in strategic emerging enterprises. Hence, the synergistic effects of the high digital transformation, high R&D investment intensity, high top management team’s educational backgrounds heterogeneity, and high business environment can effectively break the constraints of top management team functional backgrounds heterogeneity and government subsidies for innovation performance. This contradicts the conclusion by Yoon et al. that the top management team’s functional backgrounds heterogeneity significantly and positively effects organizational creativity [61]. Therefore, the heterogeneity of top management teams’ functional backgrounds does not always enhance enterprises’ innovation performance. Zheng

et al. believed that a high-level business environment can safeguard enterprises' innovation under the aspects of government affairs, the market, legal affairs, and humanities [20]. As the consistency of S3 is 0.940, unique coverage is 0.011, and raw coverage is 0.173, this path can explain approximately 17.3% of the high-level enterprise innovation performance cases, among which approximately 1% can only be explained by this path. A typical example of S3 is YYWLKJ Co., Ltd. With its keen grasp of market development opportunities, the company closely follows digital and domestic information innovation trends by building an operational business innovation platform and promoting digital transformation in a platform-based and ecological manner. To maintain their lead in product iteration and maturity speed, YYWLKJ continuously increased their R&D investments to provide ample financial support for technological innovations. Furthermore, the company has an executive team with rich professional knowledge, bringing diverse perspectives to the enterprise's innovation development and fostering innovative thinking. The combined effect of these factors has enabled YYWLKJ to achieve high innovation performance.

In Configuration S4, the core conditions of the high R&D investment intensity, high business environment, high government subsidies, and non-high digital transformation level—combined with the auxiliary conditions of the top management team's educational backgrounds heterogeneity—can produce high innovation performance in strategic emerging enterprises. Hence, the synergy of the R&D investment intensity, business environment, government subsidies, and top management team's educational backgrounds heterogeneity can effectively overcome any constraints from the level of digital transformation and their effect on innovation performance. This configuration complements the view of Urbinati et al. in that digital transformation is a key driver of innovation [43]. Liao et al. argued that high innovation investment intensity directly provides the necessary funds and resources for a company's R&D activities, which is the basis for implementing enterprise innovation [9]. A good business environment provides stable market expectations and lowers the operational risks for enterprises' innovation. Government subsidies increase the enthusiasm for technological research and innovation by reducing corporate innovation costs. Additionally, the top management team's educational backgrounds heterogeneity can bring diversified innovation perspectives and innovative thinking to the enterprises, which helps in forming innovation decisions. These factors interact to jointly improve corporate innovation performance. The consistency of this configuration was 0.923, the unique coverage was 0.044, and the raw coverage was 0.234. This indicates that this path can explain approximately 23.4% of the high-level enterprise innovation performance cases, among which only approximately 4% can be explained by this path. As a typical case of Configuration S4, ZCKJ Co., Ltd. further verified this path through its successful experience. ZCKJ adhered to the strategic concept of innovation-driven development and benefited from the efficient services and policy support provided by government departments. By continuously increasing R&D funding in its new product development and key technology fields, it maintained a leading technological advantage in key applications, such as aerospace, electronic technologies, and new energy. Meanwhile, ZCKJ has effectively integrated high-end resources, such as the group's quality inspection and testing institutions, engineering technology centers, and key laboratories in Beijing, which provide solid support for the company's technological innovation and industrial structure upgrades.

(4) Technology–organization–environment co-driven type. This emphasizes the importance of high-level synergy across the technology, organization, and environmental dimensions to achieve high innovation performance. In other words, high-level technologies, organizations, and environments can promote enterprises' high innovation performance. This is an extension of research by Urbinati et al., Berchicci, and Yoon et al., who studied the net effects of digital transformation [43], innovation investments [7], and the top management team's heterogeneity [61] on innovation performance from a single perspective. This configuration suggests that the enterprises' improved innovation performance is not due to a single independent factor, but the synergy among multiple factors. This view highlights the necessity of analyzing and understanding the differentiated paths to enhance enterprise

innovation performance from a holistic perspective and reveals the “causal complexity” behind improvements to strategic emerging enterprises’ innovation performance.

In Configuration S5, the high level of digital transformation, high R&D investment intensity, high top management team’s educational and functional backgrounds heterogeneity, and high government subsidies as core conditions can produce high innovation performance in strategic emerging enterprises. The consistency of this configuration is 0.893, with unique coverage at 0.029 and a raw coverage of 0.211, which can explain approximately 21.1% of the high innovation performance cases. Among these, only approximately 3% could be explained by this path. A typical example of this configuration is TMWDZ Co., Ltd., which has established a digital, global marketing service platform to extract data value, gain comprehensive insights into user needs, eliminate system barriers, and achieve seamless data interaction. This provided customers with personalized products and services while significantly improving the company’s operational efficiency and service quality. Benefiting from government subsidies, TMWDZ invested heavily in building innovation platforms and integrating industrial innovation resources to continuously develop its technological innovation. Meanwhile, TMWDZ’s top management team has diverse educational backgrounds and professional experiences covering technology, management, and business. This brings multidimensional innovation perspectives and decision-making advantages to the company, and further promotes the collision and integration of innovative thinking. Therefore, the TMWDZ case fully demonstrates this configuration’s strong explanatory power of in achieving high innovation performance.

In Configuration S6, high innovation investment intensity, high top management team’s functional backgrounds heterogeneity, high business environment, and non-high top management team’s educational backgrounds heterogeneity are core conditions for strategic emerging enterprises’ high innovation performance. Therefore, regardless of the levels of digital transformation and government subsidies, if the enterprise has high innovation investments, the high top management team’s functional backgrounds heterogeneity, and a high-level business environment, it can overcome its top management team’s educational backgrounds heterogeneity and achieve high innovation performance. This configuration’s consistency is 0.932, with a unique coverage of 0.083 and an original coverage of 0.286, explaining approximately 28.6% of high-level enterprise innovation performance cases; among these, approximately 8% can be explained only by this path. A typical case is that of ZXTX Co., Ltd. Located in Shenzhen, China, the company benefits from the city’s tax incentives, financial support, and talent policies, creating a favorable environment for innovative development. To this end, the company continuously increases its R&D investments in cutting-edge technology fields, such as 5G technologies, cloud computing, and artificial intelligence, to maintain a leading position. Meanwhile, ZXTX has a top management team with rich cross-disciplinary experience and deep industry knowledge, which helps the company analyze problems from multiple perspectives, stimulate innovative thinking, and improve the quality and efficiency of its decision-making processes. These factors’ combined effects have allowed ZXTX to maintain its leading position in the high-tech industry.

4.3. Robustness Test

The various robustness tests’ results reveal a lucid subset relationship to the original configurations; changes in consistency and coverage did not substantially affect the explanation of the original configurations, indicating that the results were highly robust [20]. Referring to existing studies [20,80], we then employed three methods to test the results’ robustness. First, we adjusted the original consistency threshold. Raising the original consistency threshold from 0.85 to 0.90 results in new configurations that are identical to the original. Second, we adjusted the PRI consistency threshold. As Table 5 demonstrates, raising the PRI consistency from 0.70 to 0.75 results in new configurations in which S2’, S3’, and S4’ are true subsets of the original configurations S4 and S6, and S1’ completely corresponds to the original S1 configuration. Third, raising the case frequency threshold

from 3 to 4, as noted in Table 6, yields new configurations in which S1'', S2'', S3'', and S4'' are true subsets of the original configurations S1, S2, S4, and S5, respectively. Further, Configuration S5'' is identical to the original configuration S6. In summary, this study's results were robust.

Table 5. Robustness test of adjusting PRI consistency threshold.

Condition Variable	S1'	S2'	S3'	S4'
Dig	●	⊗	●	
R&D	●	●	●	●
Hedu		▲	⊗	⊗
Hcar	⊗	⊗	●	▲
B&E	⊗	●	●	●
Gov	▲	●		⊗
Consistency	0.950	0.942	0.946	0.949
Raw coverage	0.213	0.194	0.208	0.253
Unique coverage	0.056	0.042	0.015	0.052
Solution consistency			0.924	
Solution coverage			0.403	

Note: ● or ▲ indicates that the condition exists, ⊗ or ⊙ indicates that the condition does not exist, and “blank” indicates that the condition may or may not exist; ● or ⊗ indicates a core condition, and ▲ or ⊙ indicates a marginal condition.

Table 6. Robustness test of adjusted frequency.

Condition Variable	S1''	S2''	S3''	S4''	S5''
Dig	●	●	⊗	●	
R&D	●	⊗	▲	▲	●
Hedu		⊙	▲	●	⊗
Hcar	⊗	●		●	●
B&E	⊗	⊗	●		●
Gov	●	⊗	●	●	
Consistency	0.950	0.908	0.923	0.893	0.932
Raw coverage	0.213	0.203	0.234	0.211	0.286
Unique coverage	0.043	0.050	0.048	0.034	0.088
Solution consistency			0.883		
Solution coverage			0.519		

Note: ● or ▲ indicates that the condition exists, ⊗ or ⊙ indicates that the condition does not exist, and “blank” indicates that the condition may or may not exist; ● or ⊗ indicates a core condition, and ▲ or ⊙ indicates a marginal condition.

5. Discussion and Conclusions

Given the significance of innovation for global economic growth, national competitiveness, and enterprises' sustainable development, research on innovation performance has garnered increasing attention from scholars, although their research perspectives vary. This study combines the TOE theoretical framework to explore the configuration path for enterprises to achieve high-level innovation performance from the perspectives of technology, organization, and environment. This study used the fsQCA to sample strategic emerging enterprises and explore the “joint effects” and driving paths of various factors—such as the level of digital transformation, R&D investment intensity, top management team's educational and functional backgrounds heterogeneity, the business environment, and government subsidies—on strategic emerging enterprises' innovation performance. In doing so, this study revealed the core conditions affecting such performance and their complex, interactive nature.

This study examined 261 strategic emerging enterprises in China and employed the fsQCA method to explore the configuration path for emerging enterprises in emerging economies to achieve high-level innovation performance. The following conclusions were drawn: First, we combined the analysis of the necessary conditions with a configuration

analysis of antecedents for high innovation performance. This revealed that none of the six antecedent conditions were necessary to facilitate high innovation performance in strategic emerging enterprises. Therefore, high innovation performance in strategic emerging enterprises results from the interactive matching of multiple antecedents. Second, we used a configuration analysis and the fsQCA method to reveal six driving paths to achieve high innovation performance in strategic emerging enterprises. These paths can be categorized into four types: environment-driven under technological dominance, technology–organization driven type, organization-driven under technological–environmental dominance, and technology–organization–environment co-driven type. This indicates that different configurations of conditions promote high innovation performance in strategic emerging enterprises, indicating that “All roads lead to Rome”. Third, compared to other antecedent factors, digital transformations or innovation investments appear in every high innovation performance configuration. Hence, under the new wave of the technological revolution, technological conditions are key in improving strategic emerging enterprises’ innovation performance.

Compared with other research related to enterprises’ innovation performance, this study offers the following main theoretical contributions: First, it combines the TOE framework with enterprises’ innovation performance to expand this framework’s application in innovation performance research while enriching and broadening theoretical innovation performance research. This study associates innovation performance with the TOE framework’s three dimensions to address the shortcomings from analyzing high innovation performance from a single perspective (e.g., digital transformations, the executive team, or market competition) [6,12,21]. Second, this study enriches the literature on the causal complexity of innovation performance from a configurational perspective. By employing the fsQCA method to explore how various factors drive strategic emerging enterprises to achieve high levels of innovation performance, the methodology and results enrich research perspectives on enterprises’ innovation performance. This finding represents a new attempt to explain high innovation performance from an overall perspective. Finally, the current academic analysis of various conditions’ impacts on innovation performance has mainly focused on traditional linear regression models, considering that single factors—such as the level of digital transformation, top management team’s heterogeneity, or the business environment, among other factors—have linear relationships with enterprise innovation performance [6,12,21]. However, this study indicates that these factors are not essential for achieving high innovation performance. For example, the top management team’s functional backgrounds heterogeneity and the business environment are absent as core conditions in Configuration S1. However, the core roles of digital transformation level and innovation investment intensity combined with the auxiliary role of government subsidies can also result in high enterprise innovation performance on this path. This study addresses the shortcomings in innovation performance research to bridge the methodological gap [93].

The study provides practical suggestions for improving innovation performance in China’s strategic emerging enterprises and offers a reference for global emerging economies to enhance their national innovation capabilities. From the enterprise managers’ perspective, the paths to achieving high innovation performance in strategic emerging enterprises are diverse. Managers should focus on the coordinated effects of multiple factors, shifting their thinking from a single to a “configurational” perspective. Meanwhile, managers should choose high innovation performance paths that align with the enterprise’s resources and external environment; adopt an overall perspective to strive for the interactive matching of technology, the organization, and the environment; and make targeted high-level innovation performance decisions. As the world’s largest emerging economy, this perspective is practically significant for improving the innovation performance in China’s strategic emerging enterprises and applicable to improving the scientific and technological innovation capabilities of emerging economies worldwide. Considering China’s strategic emerging enterprises as an example, they may enhance their innovation performance by

increasing the level of digital transformation and innovation investment intensity, potentially overcoming the limitations of such objective conditions as the business environment. However, the importance of investing in technological conditions should not be blindly emphasized, as digital transformation and innovation investment alone do not constitute sufficient conditions for strategic emerging enterprises to achieve high levels of innovation performance. Managers should focus more on the synergy between technology, the organization, and the environment. Second, government departments must continuously optimize urban business environments and comprehensively support innovation subsidies. During the process of achieving high innovation performance through six different paths, the business environment and government subsidies were core conditions in four different configurations. Therefore, relevant government departments must optimize the business environment and formulate targeted policies to improve emerging industries' innovation performance, compensating for enterprises' lack of internal innovation resources and providing an essential foundation for high-level innovation performance.

This study has some limitations that need to be addressed in future research. First, this study considers the TOE framework and an inductive approach to identify six factors affecting enterprise innovation performance from existing research, without exploring other factors that have not yet been considered. Future research can use a deductive approach [96] to further investigate and enrich the factors influencing enterprises' innovation performance from other perspectives or dimensions. For example, future research can incorporate organizational factors, such as organizational resources and learning capabilities into the framework to enhance completeness. Second, owing to data availability, this study only selected 261 strategic emerging enterprises, to some extent, limits the coverage of typical cases. Future research should focus on fledgling industries in other emerging economies by increasing the sample size to enhance the research findings' generalizability and applicability. Finally, this study uses the fsQCA method to analyze multiple paths to achieve high innovation performance in strategic emerging enterprises from a static perspective. Future research should incorporate time into the analysis of influencing factors and use a temporal QCA method for more dynamic studies.

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Appendix A

Table A1. Sample selection of strategic emerging enterprises.

The Seven Major Industries	The Four Categories	The 20 Subcategories
Energy conservation and environmental protection industry New generation information technology industry Biotechnology industry High-end equipment-manufacturing industry New energy industry New materials industry New energy vehicle industry	Manufacturing (C)	Petroleum processing, coking, and nuclear fuel processing (25)
		Chemical fuel and chemical products manufacturing (26)
		Pharmaceutical manufacturing (27)
		Chemical fiber manufacturing (28)
		Rubber and plastic product manufacturing (29)
		General equipment manufacturing (34)
		Special equipment manufacturing (35)
		Automobile manufacturing (36)
		Railway, ship, aerospace, and other transportation equipment manufacturing (37)
		Electrical machinery and equipment manufacturing (38)
	Information transmission, software and information technology services (I)	Computer, communication, and other electronic equipment manufacturing (39)
		Instrumentation manufacturing (40)
		Other manufacturing (41)
		Comprehensive utilization of waste resources (42)
		Telecommunications, broadcasting, television, and satellite transmission services (63)
		Internet and related services (64)
		Software and information technology services (65)
		Research and experimental development (73)
		Professional technical services (74)
		Ecological environment management (77)
	Scientific research and technical services (M)	
	Water conservancy, environment, and public facilities management (N)	

Appendix B

Table A2. Evaluation index system of China's urban business environment.

First-Level Indicators and Weights	Objectives	Second-Level Indicators and Weights	Third-Level Indicators	Measurement Method	Source of Basic Data
Market environment 26.93%	Fair competition	Financing 2.69%	Financing level	Scale of deposits and loans of financial institutions/number of registered residents	China Urban Statistical Yearbook
		Innovation 2.69%	Number of patents	Patent grants volume/number of registered residents	China Urban Statistical Yearbook
		Fair competition 10.78%	R&D investment	Science and technology expenditure/number of registered residents	National Intellectual Property Trademark Office (China Trademark Network)
			Establishment of enterprise brands	Number of trademark registrations/number of registered residents	
			Number of start-up enterprises	Number of start-up enterprises	Qichacha
		Resource acquisition 4.04%	Water supply	Total water supply/number of water users	China Urban Construction Statistical Yearbook
			Electricity supply	Total electricity consumption/number of registered residents	China Economic Information Network
			Land supply	Urban construction land area/number of registered residents	China Urban Construction Statistical Yearbook
			Human capital	Number of college students	China Urban Statistical Yearbook
			Internet	Number of broadband internet access households/number of registered residents	China Urban Statistical Yearbook
Government environment 49.85%	Efficient and integrity	Market intermediaries 6.73%	Transportation services	Freight and passenger volume	National Economic and Social Development Statistics Bulletin
			Leasing and business services	Number of leasing and business service personnel/number of registered residents	Provincial Statistical Yearbooks, EPS Database
		Government care 12.13%	Government care index	Government concern index	China Urban Government-Business Relations Report
		Government efficiency 24.25%	Government scale	General public budget expenditure/GDP	EPS Database
		Government integrity 13.47%	E-government level	E-service capability index	Chinese Government E-Service Capability Index Report
			Government integrity index	Government integrity index	China Urban Government-Business Relations Report

Table A2. Cont.

First-Level Indicators and Weights	Objectives	Second-Level Indicators and Weights	Third-Level Indicators	Measurement Method	Source of Basic Data
Legal environment 16.48%	Justice and transparency	Intellectual property protection 7.57%	Administrative ruling on patent disputes	Number of patent infringement rulings/number of patent grants	China Judgments Online
		Social security 5.17%	Criminal cases per ten thousand people	Number of criminal cases/number of registered residents	China Judgments Online
		Judicial services 3.74%	Law firms	Law firms	Qichacha
Cultural environment 6.73%	Openness and inclusiveness	Foreign openness 1.35%	Trade dependence	Foreign economic trade/GDP (number of Hong Kong, Macau, Taiwan + foreign direct investment enterprises)/number of industrial enterprises above designated size	China Urban Statistical Yearbook
		Social credit 5.38%	Contract disputes	Number of contract disputes/GDP	China Judgments Online

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