What factors determine the survival of green innovative enterprises in China? -- A method based on fsQCA

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ABSTRACT

Increasingly serious environmental problems have generated a large number of small and medium-sized green innovative enterprises. Against the background of rapid technological changes and increasingly fierce market competition, survival is the main problem faced by these enterprises. Exploring the mechanisms and core elements that determine the survival of green innovation enterprises is of great practical significance for improving the survival probability of green innovation enterprises and achieving environmental improvement through green innovation.

In this paper, twenty-nine enterprises that have won the title of "Top 10 Green Innovative Enterprises" in China are considered the research objects, and the fuzzy set qualitative comparative analysis (fsQCA) method is used to examine the path combinations that affect the survival of enterprises from the perspectives of resource-based and dynamic capabilities. The findings are as follows. First, government support is key to the survival of green innovative enterprises; second, China's green innovative enterprises have a research and development dilemma, and only matching high R&D capacity with product competitiveness can enhance their survival capabilities; and third, the lack of resource base capacity is the key factor affecting the failure of green enterprises, and dynamic capacity is the key factor for the survival of green innovative enterprises. The main contribution of this paper to the field of management is that enterprises must always pay attention to the coordinated development of internal resource-based capability and external dynamic capability. Conversely, the Chinese government should provide high R&D support to enterprises with competitive products so that these enterprises can rapidly grow into leading enterprises through continuous innovation and drive the sustained and rapid development of China's green innovation industry.

1. Introduction

With increasingly serious environmental problems, environmental governance has become an urgent problem for all countries worldwide. The Chinese government attaches great importance to environmental problems and has made environmental protection a basic state policy [1]. To effectively solve environmental problems, the Chinese government has considered the establishment of a green innovation system and the promotion of green development through innovation as the fundamental ways to solve environmental problems [2,3]. According to the outline of the national innovation system, enterprises should be the main drivers of innovation in building a green innovation system, and the development of low-carbon technologies and green generic technologies should be guided by market means. Efforts should be exerted to strengthen the research and development of energy conservation and environmental protection industries, clean production industries and clean energy industries to provide strong support for green and sustainable development [4,5]. A large number of studies have been devoted to proving a significant relationship between corporate green innovation behavior and environmental performance. Singh's research showed that corporate green innovation can effectively regulate and promote environmental performance [6]. Long analyzed the impact of green innovation on the economic performance and environmental performance of foreign-funded enterprises in China and found that the impact of green innovation on environmental performance is greater than that on economic performance, and innovation in the production process has a positive impact on the environmental performance of the company [7]. It is in this context that a large number of small and

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medium-sized green innovation enterprises have emerged and played an increasingly important role in the field of green innovation [4,5,8].

Small and medium-sized enterprises (SMEs) are the most dynamic part of the market economy. Hanifah's research statistics showed that Chinese SMEs have made an enormous contribution to GDP growth, accounting for approximately 60% of the total [9]. Encouraging and supporting SMEs in transforming their development models, carrying out green technological innovation, and taking the path of sustainable development are powerful measures for Chinese enterprises to make strategic transformations and adjustments during the 13th Five-Year Plan. However, in the early development of SMEs, it is very difficult for them to survive. Zhang et al. reported that the average life expectancy of SMEs in the United States is less than 7 years and that of large enterprises is less than 40 years, while in China, the average life expectancy of SMEs is only 2.5 years and that of group enterprises is only 7–8 years [10]. Thus, the low life expectancy of enterprises is a common phenomenon. However, the life expectancy of Chinese enterprises is substantially lower than that of European and American countries.

Enterprise survival is considered to be the final criterion for corporate performance. Factors that affect corporate viability are important issues in the field of innovation research. The improvement of green innovation corporate viability is as important as the improvement of environmental performance. Only when green technology innovation improves the performance of the enterprise and thus further enhances the viability of the green innovation enterprise can it provide an endless driving force for the improvement of environmental performance. Therefore, scholars have studied the relationship between green technology innovation and corporate performance from qualitative and quantitative perspectives. Hou constructed a theoretical framework to verify that there is a significant, positive correlation between corporate technological innovation and corporate performance [11]. Santoro demonstrated that dynamic capabilities and knowledge management have significant and positive impacts on corporate innovation and performance [12]. Chege and Wang further evaluated the relationship among green innovation, environmental sustainability and its impact on small business performance. Green technology innovation will have a positive impact on company performance and sustainable development [13]. However, in the context of China, while green technology innovation has brought development opportunities to enterprises, it has also brought many uncertain risks. Chen and Hong's research reported that China's large and medium-sized enterprises, especially state-owned enterprises, generally face obstacles to green technology innovation [14]. Sun divided green innovation risk into green R&D risk, green manufacturing risk, green marketing risk and green service risk from a process perspective [15]. Xu explored and predicted the reasons for the failures of listed energy companies in China. He found that the low efficiency of green technology innovation is a key factor affecting the failures of companies [16]. Therefore, this study attempts to explore the factors that affect the survival of green innovative enterprises and aims to discover and identify the key resources and capabilities that affect the survival of green innovative enterprises to improve the survival probability of green innovation enterprises and thus promote technological innovation to achieve environmental improvement, which has important theoretical and practical significance.

Based on the resource-based view (RBV) and dynamic capability view (DCV), this paper conducts an in-depth study of the factors influencing the survival of green innovative enterprises, attempting to sort out the causal relationships between various factors and the survival and death of green innovative enterprises. The core issues of the research are the following. First, based on the RBV and DCV theories and existing research, we identify the core elements affecting the survival and death of green innovative companies; second, the fsQCA method is used to reveal the combined paths that determine the survival and death of Chinese green innovation enterprises and help these enterprises to make full use of existing resources to effectively avoid death and increase the probability of survival. In 2011, "International Finance" magazine

launched the "Top 10 Green Innovative Enterprises" campaign, and nearly 100 enterprises have so far been selected. Although these enterprises are better than the general green innovative enterprises, the number of enterprises that have failed has exceeded 10%. In this paper, 29 green innovation enterprises were finally selected as the study cases by setting the screening conditions, and the key factors influencing the survival of green innovation enterprises and their combination paths were explored using fuzzy set qualitative comparative analysis (fsQCA). Compared with previous studies, the fsQCA method adopted in this paper has two significant advantages. First, it enables us to explore and compare the key factors influencing the survival of enterprises from the perspectives of success and failure. Second, this paper breaks the shackles of previous single factor studies and carries out multifactor combination path analysis with the help of the QCA method, introducing a new way to study the survival of green innovative enterprises and expanding and enriching the previous research conclusions. In addition, the method of multi-case analysis is more universal than single case analysis.

The rest of the paper proceeds as follows. Chapter 2 is a literature review. Chapter 3 and chapter 4 presents the research methods and data analysis, respectively. Chapter 5 discusses the results of the data analysis. Chapter 6 reports the conclusions and implications. The last chapter reflects on the research limitations of this paper.

2. Literature review

Corporate survival is considered the ultimate criterion for corporate performance [17]. The premise for an enterprise to achieve business performance and results is enterprise survival, while the opposite of enterprise survival is enterprise death. Enterprise survival has been a popular topic of research. Similar research has included the topics of business survival, business life, enterprise death, enterprise failure, business failure, and business adversity [18–22]. This type of research focuses on the reasons for the survival or failure of the enterprise and the process level and analyzes the fatal factors that affect the survival of enterprises under various uncertain environments through quantitative research.

2.1. Research on enterprise survival

Earlier research on enterprise survival showed that enterprise age and scale play crucial roles. Persson believed that the objects of enterprise survival research are mainly concentrated in two aspects [23]. The first category consists of survival studies of startups and incumbents. A report released by Oxford University compared the survival of SMEs in 10 OECD countries. Approximately 20%–40% of companies will die within the first two years of life [24]; therefore, from the perspective of the enterprise life cycle, enterprise deaths often occur in the entrepreneurial period [25], Startups have a short time to be established and lack the experience of entrepreneurs. There are many uncertainties, and the external environment is turbulent, with a high mortality rate. However, enterprise deaths will also occur after the start-up period of continuous operation [26]. Although the incumbent enterprise has been established for a long time and has passed the start-up period safely, it does not mean that it will not be eliminated by the market. The second category is survival research on small and medium-sized enterprises and large enterprises. Due to their lack of resources and capabilities, small and medium-sized enterprises have always had a high mortality rate [27]; however, large enterprises die due to mistakes in strategic decisions [28]. It can be seen that the study of enterprise survival is an important issue throughout the entire life cycle of an enterprise. Regardless of a firm's scale and survival time, it is necessary to be vigilant [29].

However, with the deepening of research, in addition to the significant impacts of endogenous factors, such as age and scale, on enterprise survival, the main research content on enterprise survival has also focused on external factors, such as import and export orientation,

strategic planning, political ties and competition intensity. Zheng compared the survival of Chinese TV manufacturing companies over the past decade and found that political ties can significantly increase the survival probability of enterprises, with even weaker enterprises delaying the death of enterprises [30]. Based on data from German manufacturing companies, Joachim found a strong positive link between the survival of the company and the two-way import trade [31]. In addition, the combination of market positioning, marketing innovation, and business strategy can also build an enterprise's survival advantage, and Naidoo discovered this pattern by modeling structural equations of small and medium-sized manufacturing enterprises in China, with the enterprises surveyed more likely to survive if they developed and maintained a competitive advantage [32].

Nevertheless, existing research has explored various factors related to survivability from various details of the internal and external resources of the enterprise, but it has not described the overall configuration that affects the ability of the enterprise to survive. Enterprise survival research is a complexity theory problem. The relationship between the research variables could be nonlinear, or it could suddenly switch, so the same reason could have different effects in specific situations [33]. For example, when Hui used the Cox proportional hazard model to study the survival of Chinese manufacturing enterprises, it was found that the government subsidy had no significant effect on the survival of enterprises [34]. The same was true for a sample of Chinese manufacturing companies, but the results were mutually exclusive with the results of Zheng's research above, mainly because the complexity of enterprise survival research determines that the same variable can lead to enterprise survival or death in different situations. The key is how it is configured with other variables.

Our research is based on the existing survival research literature and summarizes the factors that affect a company's viability mainly from two aspects: resources and capabilities. Resources are internal elements that companies already possess that can bring core competitiveness to the company, such as human capital, R&D capital, and product competitiveness, while capability refers to the integration and reconstruction that help companies to obtain external connections and break environmental constraints, for example, cooperative R&D in universities and government support. The resource-based view (RBV) and the dynamic capability view (DCV) form the theoretical framework of this paper; that is, advanced resources including intangible resources and capabilities can bring excellent performance to an enterprise [35]. Therefore, this article expands from the two dimensions of the RBV and DCV (internal resource integration and external resource utilization of the enterprise), attempting to construct a comprehensive and complete configuration of the factors influencing the survival of an enterprise and analyzing each element in the internal and external environment One factor is how the combined configuration generates the survival path of the enterprise. Compared with the existing research, this perspective is brand new and can observe realer enterprise survival scenes with the interaction of resources and capabilities.

2.2. Resource-based view and enterprise survival

The RBV believes that the internal elements of an enterprise are the basis for its existence. If an enterprise wants to provide various products and services to the market to obtain economic returns, then it cannot do so without relying on various production resources and factors, and heterogeneous resources can bring competitive advantages to the enterprise so that the enterprise can establish entry barriers to ensure its long-term survival. Peteraf reported that value, scarcity, imitation and irreplaceability are the distinctive characteristics of heterogeneous resources. Heterogeneous resources owned by enterprises can be tangible or intangible assets, such as capital, knowledge, information, capabilities, and enterprises Features or organizational processes can constitute the resource base of an enterprise [36].

The RBV theory systematically explains the relationship between an enterprise's resource base and its survival. The theory holds that the resources that an enterprise can obtain are the key factors that determine its survival and failure. From the RBV, the ability of an enterprise to develop unique resources enhances its ability to adapt to the changing competitive environment and improves its survival prospects [37]. Cook believed that the key to an enterprise's core competitiveness is its resource base [38]. Coleman introduced the theory of resource patching, by which innovative companies can create new entrepreneurial opportunities through the integrated use of existing resources [37].

From the RBV, different scholars have studied the impacts of R&D investment, continuous innovation, product competitiveness, ownership, number of patents, and talent reserves on enterprise survival from different perspectives. R&D investment has a positive impact on the survival of an enterprise. Pérez et al. analyzed the micro-data of 2028 Spanish manufacturing companies and concluded that R&D investment is closely related to the survival of the enterprise [39]. Jung used 2008–2014 data from 588 South Korean small and medium-sized enterprises to further verify whether R&D investment affected the viability of enterprises during the economic downturn, It turned out that R&D investment is an effective strategy for companies with the ability to produce intellectual property [40]. The impact of innovation on the survival of enterprises is complex, although most studies have shown that technological innovation improves the survival of enterprises. For example, Nogueira analyzed the impact of continuous innovation activities on the survival of Spanish companies in 2010–2012 using a data set of Spanish small and medium-sized enterprises, The results showed that different types of innovation activities of an enterprise have important impacts on survival: commercial innovation keeps the enterprise from bankruptcy, while product innovation increases the survival chances of the enterprise [41]. However, other studies have shown that, while technological innovation enhances a company's competitiveness, it also increases the company's financial risk, thereby increasing the company's risk of bankruptcy [42].

Product competitiveness positively affects the survival of enterprises. Markey-Towler believed that, for enterprises, especially innovative enterprises, it is not sufficient to obtain a fairly high-quality product at a reasonable price, and only a relative price advantage can protect an enterprise from failure [43]. The impact of ownership forms on enterprise survival is a unique issue in the Chinese context. Audretsch et al. regressed 10-year panel data of more than 3000 manufacturing companies and found that the impact of ownership forms on enterprises survival is regulated by the market environment [44]. The number of patents has positive significance for the survival of enterprises. The research results of Zhang, Zheng et al. showed that patent applications can improve the survival rate of Chinese high-tech enterprises [10]. Colombelli and Quatraro further found evidence of a positive correlation between the number of technological varieties and the survival of such companies at the level of green innovative companies [45]. Talent reserves positively promote the survival of enterprises. Del Sarto et al. showed that human capital has an important impact on the survival of enterprises [46]. Storey and Wynarczyk were earlier scholars who studied the relationship between talent reserves and enterprise survival. Their study found that talent reserves have a significant impact on the survival of modern manufacturing companies [47]. Chiappetta Jabbour discussed the relationship between green human resources and corporate sustainable development performance and proposed a framework for green human resource management and a circular economy based on RBV theory [48]. Yang used a set of data from a high-tech park in Beijing, China, and used empirical research to capture how the internal resource mix affects the survival opportunities of technological innovation companies. The results showed that the synergy produced by the talent reserve can improve the survival rate of innovative companies [49].

2.3. Dynamic capability view and enterprise survival

The dynamic capability view (DVC) is the ability of an enterprise to integrate, build, and reorganize internal and external capabilities to adapt to changing market conditions [50]. As an extension of the resource-based capability view, the focus of dynamic capabilities is on the examination of external uncertain environments. The theory states that companies must constantly adapt to the rapidly changing external environment to obtain lasting competitive advantages [51]. To survive and prosper in a changing environment, companies must develop dynamic capabilities to create, expand, and change the way in which they make a living. Scholars have studied the relationship between dynamic capabilities and corporate performance under the influence of environmental uncertainty. Oke's research results showed that environmental uncertainty actively alleviates the relationship between the execution of innovation strategies and innovation performance and also proved that environmental uncertainty can enhance corporate income growth [52]. Mikalef used the method of fsQCA to explore the relationship between information technology-supported dynamic capabilities and competitive performance under different degrees of environmental uncertainty, and the results of path configuration showed that, from relatively stable environments to highly uncertain environment conditions, the dynamic capabilities supported by information technology can be used to improve the organization's competitive performance [53].

With the development of theoretical argumentation and empirical research, dynamic capabilities are no longer abstract and can be interpreted from multiple dimensions. This article summarizes the characteristics of dynamic capabilities and understands them as the ability of enterprises to integrate, learn and reconstruct resources in three dimensions [54]. Bellucci believed that dynamic capabilities are the abilities of enterprises for product development, alliance and strategic decision making. The cooperation between enterprises and universities will help to improve the organizational learning ability [55]; In addition, the company's access to government support will be conducive to the improvement of resource integration capabilities and thus affect the company's competitiveness [56]. Huang believed that the ability of high-tech companies to develop and introduce new processes or technologies can help organizations to use dynamic capabilities to build core competitiveness, so technology introduction can be regarded as the main factor restructuring the capability dimension [57].

Smith explored the impact of government high-tech program subsidies (ATP) on the survival rate of start-up companies. The research results show that ATP rewards can effectively improve the survival rate of companies [58]. Hanifah's research on SMEs in Malaysia found that government support plays an important role in the innovation performance of enterprises. The improvement of innovation performance can improve the competitive advantages of SMEs [9]. He and Yang's research showed that government spending is not only reflected in financial support but also in support from government orders and government publicity, increasing the survival rate of enterprises [59]. The cooperation between schools and enterprises under the industry-university-research paradigm is conducive to the complementarity of resources and capabilities, thereby having an important, positive impact on the survival of enterprises, especially startups. Technology introduction can quickly make up for the shortcomings of a company's lack of technology and capabilities. Wagner explored whether there is a significant, positive correlation between the survival of the enterprise and the two-way transaction of technology introduction and output. It was found that technology introduction is much more efficient than technology output in affecting the survival of enterprises [60].

In summary, the existing survival studies have mainly been aimed at general enterprises, and there have been relatively few studies of the survival of green innovative enterprises. Green innovative enterprises are a new type of enterprise that merged in recent years to address

environmental pollution and promote green development [35,61]. Some scholars have studied the survival and development of green innovation companies, and Winston studied how green innovation companies can achieve leading development positions when other companies are stagnant [62]. Chen used questionnaire data and established a multiple regression model to empirically analyze the relationship between government subsidies and the survival of green innovation companies [63]. In China, the scale of green innovation companies is generally small, and the establishment time is not long, but the development of green innovation companies plays a huge role in promoting the improvement of the environment [64]. Currently, the relevant research on the survival of green innovative companies is relatively weak, and only the impact of specific factors on survival has been analyzed from the perspective of quantitative research. This article takes this type of special enterprise as the research object, starting from the two-dimensional comprehensive factors of the enterprise's internal resource base and external dynamic capabilities, and based on the qualitative comparative analysis methods that have emerged in recent years, configuration analysis of the factors affecting the survival and failure of green innovative enterprises is performed. On the one hand, this research can overcome the limitations of previous studies from a single dimension perspective. On the other hand, from the two opposing perspectives of enterprise survival and failure, based on causal logic analysis, each main configuration path can be matched with the case, rendering the research results more specific and instructive and overcoming the shortcomings by which conventional statistics and measurement methods only have abstract average results, which is important for enriching the existing research.

3. Study design

3.1. Research methods

To explore the factors influencing the survival of green innovative enterprises, this paper adopts Quantitative Comparative Analysis (QCA). Ragin believed that, in traditional social studies, quantitative research and qualitative research are the main methods, and there are great differences [65]. The method of quantitative analysis can only explain the simple linear relationship but is unable to address the complexity of cause and effect. Further, the results are unstable; case studies using qualitative methods are often considered to lack universality. The QCA method pioneered by Ragin transcends the boundary of qualitative and quantitative analysis and integrates the advantages of qualitative and quantitative analysis by treating cases as conditional configurations by replacing independent variables with conditional configurations, replacing net benefit thoughts with configuration thoughts, and replacing correlation relations with set relations [66,67].

Complexity theory explains the advantages of the QCA method for survival research issues with a theoretical argument. The configuration and complexity theory includes the following propositions: (1) different combined paths will lead to the same result; that is, there is "'equivalence' in the path" [68]; and (2) the relationship between variables can be nonlinear, and sudden switching can occur; therefore, under certain circumstances, the same "cause" can have different effects [69]. Obviously, enterprise survival research is a typical complexity theory problem, which is suitable for in-depth analysis and research using the configuration method offered by complexity theory. Specifically, we use the fsQCA method to conduct green innovation enterprise survival research for the following reasons.

First, the fsQCA method compensates for key aspects of the case study method by obtaining high-precision descriptions of real-world processes. This method is unique in that it can be greatly summarized across other contexts [70]. The traditional case study encounters difficult summarizing the potential correlation between multiple case combinations, but the fsQCA method breaks the traditional case study's lack of accuracy [71], The literature on enterprise survival can only describe the impact factors of survival from a few indicators, but in this article,

through the combination of paths, specific impact paths that affect multiple indicators of enterprise survival can be correlated. For example, a certain aspect of the internal resource basic ability combined with a certain external dynamic ability can effectively improve the survivability of the enterprise. The resources of an enterprise are limited. We have no way of achieving the ultimate in every aspect, and it is the same in reality. Successful large enterprises are not all inclusive, so to make full use of their own advantages with limited resources to improve the survivability of the enterprise, the way to use fsQCA is to help us to break the thinking limitations in this situation, combine the company's own situation, and reduce the survival dilemma of the company, all of which are very meaningful in theory and reality.

Second, the symmetric research method of regression analysis makes it difficult to explain the causal asymmetry problem in complexity theory, which is also an important reason for us to use the fsQCA method for this research. FISS mentioned in an article that "studies that focus only on success are unlikely to provide all reasons for failure" [72]. Using the qualitative comparative analysis method allows us to determine the internal logic of business operations that are different from the previous research from the two opposing viewpoints of improving survivability and avoiding the risk of death.

Finally, traditional regression research makes it difficult to clearly express the causality of multiple complex theories because over complicated data can have a large number of interference factors [33]. Quantitative research has informed us that, as long as there are certain characteristics (such as low prices or unique products), companies can survive, but this assumption is not the case. The same factor can lead to the survival of the enterprise or the death of the enterprise, and the key depends on how this factor is configured.

It is precisely because the reality of business survival is complex that a single factor can lead to enterprise survival with high probability, but it is difficult to describe the real situation of enterprise survival. To portray the situation of enterprise survival and death as realistically as possible, we use the fsQCA method to attempt to extract the necessary path for enterprise survival from complexity theory to draw from theories and insights that are different from those of previous studies.

3.2. Case selection

On July 19, 2011, "International Financing" magazine launched and co-hosted the "Top 10 Green Innovative Enterprises" award with the China Clean Development Mechanism Fund Management Center of the Ministry of Finance and the International Environmental and Resource Regulatory Agency of the United Nations Industrial Development Organization (UNIDO). In this issue, 50 award-winning enterprises were selected as the sample cases, the time period of which ran from 2011 to 2015. On the one hand, the selection criteria of cases should consider whether the previous literature has fully discussed the variables involved to ensure that the selection of cases is scientific and reasonable; on the other hand, the selection of cases should ensure its internal consistency; that is, all the selected cases involve the same conditional variables to facilitate comparative analysis. Specifically, case screening follows the following criteria.

(1) Delete the energy saving transformation case of traditional enterprises. The research subject of this paper is the sustainability of newly created green innovative enterprises, and the transformation of traditional enterprises does not meet the research requirements.
(2) Delete enterprises that do not create green products as their main products. Some award-winning enterprises are group companies, and green innovative products are only a small branch of the enterprise layout, the survival of which is not comparable with other small and medium-sized enterprises in the case.
(3) Deleting information is not sufficient to support the case of condition variables.

Finally, 29 green innovative enterprises were selected, among which 7 died, and 22 survived. The number of employees of the above enterprises was less than 1,000, and the total assets were less than 40,000,000 yuan, all belonging to the category of small and medium-sized enterprises. The value of each variable of the case was based on the information provided by the "International Finance" of the award-winning enterprise report, as well as Xinhua net, NetEase, the official website of the enterprise and other network media.

3.3. Variable design

3.3.1. Result variable design

In this paper, the survival of the award-winning green innovation enterprise is considered the result variable. If the enterprise survives, then the National Enterprise Credit Publicity Information System (http://www.gsxt.gov.cn/index.html) shows that the enterprise is in existence; if the business dies, it is removed. Because not all dead enterprises will choose to cancel the enterprise immediately, this paper assumes that enterprise death includes two situations: one is the enterprise's self-cancellation; and the other is that the enterprise's legal person is included in the list of breachers of trust, and the enterprise has multiple operating risks, such as contract disputes, pledge of chattel, freezing of deposits, judicial auction, etc. Accordingly, the value distribution of the result variable of the case is shown in Table 1.

3.3.2. Conditional variable design

After reviewing the literature, this paper shows that the conditional variables that affect the survival of green innovative enterprises mainly come from internal and external enterprises. The resource-based theory focuses on the internal resources in a narrow sense, while the dynamic capability emphasizes the acquisition of external resources in a dynamic environment. It is possible to overcome the limitation of a single research perspective by studying the problem of an enterprise's survival from the perspective of internal and external factors. The complex environment of reality also shows that the death of any enterprise is the result of the combined effects of internal and external factors, and the complete picture of the facts cannot be obtained from a single dimension. Therefore, this paper considers two internal and external dimensions and 9 conditional variables to study their specific impacts on the survival and death of enterprises. Table 2 shows the coding rules and literature sources of the study variables, from which it can be seen that enterprise survival is affected by all 9 variables, while enterprise death is not affected by talent reserve, ownership or patents number.

(1) Dynamic capacity dimension

Government Support (GS): Government support refers to a series of supportive behaviors of the government to enterprises, listed as the following: enterprises participating in national demonstration projects and the "863" program; and national awards, such as technological innovation awards. Previous studies have shown that the closer that a firm's relationship with the government is, the stronger that its ability is to innovate, firms with government support are likely to survive longer. Therefore, we code the cases in which there is government support as 1 and the cases in which there is no government support as 0.

University Cooperation (UC): UC mainly refers to whether an enterprise cooperates with universities to research and develop technologies or products. If so, then the code is 1; otherwise, the code is 0.

Technology Introduction (TI). Green innovation, mostly for technical

Table 1
Study cases and their value distribution on outcome variables.

Name of the case	Result	Code	Frequency	Proportion
TypeI	Survival	1	22	0.76
Type II	Death	0	7	0.24

Table 2
Decisive factor coding table.

Condition variables		Outcome variables and their decisive factor			Description	Research literature
		Survival	Death			
Dynamic capability (Winter, 2003)	Government Support (GS)	✓	✓	There are supporting behaviors → code 1 There is no supporting behavior → code 0	[58]	
	Universities Cooperation(UC)	✓	✓	There is cooperative R&D with universities → code 1 There is no cooperative R&D with universities→ code 0	[59]	
	Technology Introduction(TI)	✓	✓	There is introduction of advanced technology → code 1 There is no introduction of advanced technology → code 0	[60]	
Resource-based capacity [39]	Talent Reserve(TR)	✓		Enterprises attach importance to the construction of team personnel → code 1 Enterprises do not pay attention to the construction of team personnel → code 0	[46] [47]	
	R&D Expenditure (R&D)	✓	✓	High R&D input →code 1 Low R&D input → code 0	[73] [49]	
	Patents Number(PN)	✓		Fuzzy set membership is treated as 5%, 50%, 95%	[10] [45]	
	Enterprise 0wnership (EO)	✓		State-owned enterprises → code 1 Private enterprises →code 0	[44]	
	Product Competition (PC)	✓	✓	The product has the economic benefit → code 1 The product has environmental benefit → code 0	[43]	
	Sustainable Innovation(SI)	✓	✓	There is sustainable Innovation → code 1 There is no sustainable innovation →code 0	(Tsvetkova et al., 2014)	

leading enterprises, is the source of the core technology for independent research and development or is imported from abroad and has an important influence on an enterprise's viability. Previous studies have shown that improving the company's ability to adapt to green business, seeking long-term investment and improving the level of technology are important measures to avoid the failure of green innovation enterprises. Therefore, this paper assumes that enterprises with technology introduction are more likely to survive in the fierce market competition environment, so enterprises with existing technology introduction are coded as 1, while none existing enterprises are coded as 0.

(2) Resource-Based capacity dimension

Talent Reserve (TR): The evaluation criterion of this variable is whether the green innovative enterprise in the case attaches importance to talent team building, and the enterprise in some cases clearly indicates that the bottleneck of the company's development is the lack of talents. The research of Del Sarto et al. also showed that talent reserve is one of the main forces driving the survival of innovative enterprises [46]. Therefore, the code for the case of enterprises that attach importance to talent reserve is 1, while the code for those that do not attach importance to it is 0.

R&D Expenditures (R&D): R&D expenditures, as a dynamic capability, provide enterprises with a source of competitive advantage. Previous studies have shown that R&D expenditures are closely related to the survival of enterprises. Therefore, in this paper, enterprises with annual revenue more than 5% for R&D input are regarded as high R&D input enterprises with codes of 1, while those with revenues less than 5% are 0.

Patent Number (PN): Since Colombelli and Quatraro reported in an empirical study that the improvement of technology type and patent number could improve the survival rate of Chinese high-tech enterprises, this paper cites patent number as a conditional variable [45]. This variable is treated with a fuzzy set. The membership classification refers to Woodside, Nagy and Megehee [74]. Membership in a fuzzy set is treated as 5%, 50% and 95%.

Enterprise Ownership (EO): This paper assumes that state-owned enterprises have more resources to extend their viability, so it encodes state-owned enterprises as 1 and private enterprises as 0.

Product Competition (PC): This paper divides product competitiveness into economic benefits and environmental benefits. We assume that all products produced by green innovative enterprises have certain environmental benefits, but on the basis of these benefits, if they still have price advantages in market competition with alternative products, then they are classified as economic benefits. If the price advantage is not obvious, then they are defined as having only environmental benefits. If there is an economic benefit, then the code is 1; if there is only an environmental benefit, then the code is 0.

Sustainable Innovation (SI): Sustainable innovation includes sustainable technological innovation and sustainable market innovation, reflecting the capability of the enterprise resource base. Therefore, the enterprise code for the ability of sustainable innovation is 1, while the enterprise code for lacking the ability is 0.

4. Data analysis

This paper analyzes and tests three conditions of the dynamic capability of green innovative enterprises and six conditions of the resource-based ability to determine the key factors of the survival of innovative enterprises. The data analysis is mainly divided into two parts: the first part is the single-factor necessity analysis, and the second part is the multifactor combination path analysis.

Ragin argued that fuzzy qualitative comparative analysis (fsQCA) before combination path analysis by multiple factors must performed necessity analysis for each single variable [65]. In general, necessary consistency refers to the degree to which the conditional variable explains the outcome variable; that is, if a certain outcome occurs, then the possibility of the existence of the conditional variable is the necessary consistency. If the necessary consistency of a condition is greater than 0.9, then the factor is a necessary condition, and the resulting necessary condition will be excluded in the subsequent analysis. First, we use fsQCA version 3.0, for descriptive statistical variable analysis. Table 3 shows the mean and variance of each variable.

4.1. Single-factor necessity analysis

Table 4 shows the single-factor necessity for enterprise survival. The results show that "~R&D" is a necessary condition for enterprise survival; that is, the low R&D input of green innovative enterprises is a necessary condition for enterprise survival, and in terms of explanatory power, the necessary consistency of low R&D investment reaches 91% because the research samples selected in this paper are award-winning

Table 3
Descriptive statistics.

Variable	VALUE = 0(%)	VALUE = 1((%)	Mean	Std.Dev.
GS	41.4	58.6	0.59	0.49
UC	58.6	41.4	0.41	0.49
TI	72.4	27.6	0.28	0.45
EO	79.3	20.7	0.21	0.41
PC	48.3	51.7	0.52	0.50
SI	20.7	79.3	0.79	0.41
TR	58.6	41.4	0.41	0.49
R&D	89.7	10.3	0.10	0.30
PN	\	\	0.21	0.28
Result	24.1	75.9	0.76	0.43

Note: The number of patents is a continuous variable and cannot be simply classified as 0 and 1. Therefore, we do not provide the frequency of its value in the table.

Table 4
Necessity analysis of single factors for enterprise survival and death.

Condition variables	Necessary consistency		Condition variables	Necessary consistency	
	Survival	Death		Survival	Death
GS	0.64	0.43	~GS	0.36	0.57
UC	0.41	0.43	~UC	0.59	0.57
TI	0.23	0.43	~TI	0.77	0.57
EO	0.23	/	~EO	0.77	/
PC	0.55	0.43	~PC	0.45	0.57
SI	0.82	0.71	~SI	0.18	0.29
TR	0.36	/	~TR	0.64	/
R&D	0.09	0.14	~R&D	0.91	0.86
PN	0.17	/	~PN	0.83	/

green innovative enterprises. These enterprises are small and medium-sized enterprises in scale, so their R&D capacity is generally weak. To improve the survival rate, they must apply superior resources to the market. To prevent low R&D necessity consistency from affecting the enterprise's survival path, we remove this variable in the subsequent analysis.

Compared with the necessity of enterprise survival, the necessity of enterprise death is not as significant. The results show that the necessary and sufficient consistency of the six single factors and their opposite values are all less than the threshold, so no single factor is sufficient or necessary to cause the death of green innovative enterprises.

4.2. Multifactor combination path analysis

When analyzing the multifactor combination path, this paper first discusses the conditional path for the survival of green innovative enterprises and then discusses the combination of causes of death and verifies the two results mutually. The qualitative comparison analysis of fuzzy sets is usually divided into complex solutions, intermediate solutions and parsimonious solutions. The main difference among these three solutions is how many logical remains are contained, respectively, that is, the combination of counterfactual conditions. Existing studies have shown that the coverage and consistency of complex solutions and intermediate solutions are basically the same, and intermediate solutions better simplify the model. Therefore, this paper follows previous studies and focuses on the analysis of intermediate solutions.

In fsQCA analysis, coverage and consistency are used to determine whether the antecedent conditional configuration is a necessary and sufficient condition for the explained variable. Assuming that the X set is the antecedent condition, and the Y set is the interpreted result, then the coverage is the ratio of the intersection of X and Y to the Y set, and the consistency is the ratio of the intersection of X and Y to the X set [75]. In simple terms, consistency is similar to the correlation coefficient of regression analysis, and the coverage coefficient represents the

proportion of coverage results of a particular solution, that is, the degree of fit of the data results. Coverage can be further divided into raw coverage and unique coverage. Raw coverage indicates the part of the result that is interpreted by a particular configuration, while unique coverage refers to coverage that is independently interpreted by the configuration and does not overlap with other configurations of the same interpreted result [76].

In addition, in the data analysis, this article distinguishes between the core and peripheral elements of the combined path by comparing the intermediate solution and the parsimonious solution. The core elements coexist in the parsimonious solution and the intermediate solution, and the peripheral elements are optimized and eliminated in the parsimonious solution, so they only appear in the intermediate solution [77]. The core elements are generally considered to be those with strong causal relationships, while the peripheral elements are those with weak evidence of causality [72,78].

4.2.1. The combination path analysis of green innovation enterprise survival

Table 5 shows the six combined paths that affect the survival of green innovative enterprises. The overall solution coverage of the combined paths is 88%, and the overall solution consistency is 0.99. The highest coverage rate is path 1, the raw coverage rate is 32%, and the unique coverage rate is 15%, that is, "University Cooperation*~ Technology Introduction" – green innovative enterprises can survive with a high probability. As the combination path with the highest unique coverage, it reflects the survival status of green innovative enterprises from the perspective of corporate dynamic capabilities. University cooperation and technology introduction can be regarded as the two main approaches of enterprise technology sources. Obviously, compared with the introduction of foreign technology, enterprises obtaining technical resources through cooperative research and development with universities is more suitable for enterprises to improve their own viability. A deeper analysis shows that, for enterprise survival, the influence of dynamic capability is far greater than that of resource-based capability. If green innovative enterprises want to obtain better viability, then they must give full play to dynamic capability to gain more competitive advantages. Returning to the case, it can be found that the cases of Green Water Source, Shangde Technology and Sanyi Garden confirm the findings of this paper. If an enterprise wants to improve its survival ability, then it must make full use of the external resources of the

Table 5
Multifactor combination path analysis of enterprise survival.

Configuration		Solution					
		1	2a	2b	2c	3a	3b
Dynamic capability view							
GS			●	●	●	⊗	
UC		●	⊗	⊗	⊗	●	
TI		⊗					⊗
Resource-based view							
TR				●		⊗	⊗
PN					⊗	⊗	⊗
EO							⊗
PC			●				●
SI					●		●
Consistency		1	1	1	0.99	1	1
Raw coverage		0.32	0.18	0.18	0.25	0.17	0.21
Unique coverage		0.15	0.05	0.1	0.13	0.04	0.08
Overall solution consistency	0.98						
Overall solution coverage	0.88						

Note: ● indicates that the condition variable exists, ⊗indicates that the condition variable is missing, the large circle represents the core element, and the small circle represents the peripheral element. "Blank" indicates that the condition may or may not appear in the path.

enterprise. Here, we find an interesting phenomenon: usually the technology acquisition of external resources occurs mainly through university research and development and technology introduction, while the cost of independent research and development is much higher than the purchase of high tech. Since most of China's green innovative enterprises are in the initial stage and do not have sufficient financial resources, they will choose the low-risk and high-return way of cooperative research and development of universities to improve the survival probability of enterprises.

Paths 2a, 2b, and 2c, as a set of neutral permutations, have the same core elements of dynamic capabilities, that is, "Government Support*~Universities Cooperation". Among them, the raw coverage rate of Path 2a is 18%, **and the unique coverage rate is 5%,** indicating that, even if some green innovation enterprises do not cooperate with universities to research and develop, the number of patents is relatively small, but as long as they have government support and continuous innovation, enterprises can also achieve good survivability; The "Government Support *~ Universities Cooperation * Talent Reserve" in path 2b can explain the survival path model of 18% of green innovative enterprises **and explain 10% of the sample cases separately;** The raw coverage rate of path 2c is 25%, **and the unique coverage rate is 13%,** in addition to the two core variables of dynamic capabilities, matching the two variables of resource capabilities. The number of patents and continuous innovation can well explain the survival mode of green innovation companies. From these three paths, it can be seen that government support has a crucial impact on the survival of green innovative enterprises, and even if the enterprise's technology source or initial resources are poor, it still has a certain survival space under a series of government support behaviors, in line with the market environment with Chinese characteristics, and the government can adjust the enterprise's viability.

The core elements for the survival of green innovation enterprises can be obtained by analyzing the combinations of the above six paths [65]. Specifically, it includes three factors of the DCV dimension – Government Support, Universities Cooperation, and Technology Introduction – and three factors of the RBV dimension – Talent Reserve, Patent Number and Product Competitiveness. The six combinations of the above six factors can explain the survival of most Chinese green innovative enterprises, but these factors alone cannot constitute a sufficient condition for the survival of green innovative enterprises. Only by forming a specific path combination can the survival of enterprises be improved.

Due to the multiple variable settings in this paper, the path is relatively complicated, and it can be seen that green innovative enterprises exist in a pattern of a hundred flowers blossoming – not a single model. The key point of our research is to determine the resources that can effectively prevent the death of enterprises. What abilities can enterprises use to help themselves survive better? Combined with these problems, this paper analyzes enterprises from the perspectives of internal and external factors to explain how different enterprises should use their own resources and capabilities to continue their specific survival.

From the perspective of the three factors of the dynamic capability of enterprises, Government Support has appeared four times in the six paths, and most of them are positive, so it plays the most important role in the survival of enterprises; The lack of government resources can be compensated for by cooperation with universities to promote the better survival of enterprises. However, Technology Introduction did not help green innovative enterprises to improve their viability, in contrast to Wagner's findings [60]. The reason for this outcome might be that China's green innovative enterprises are relatively small in size, and technology introduction requires too much financial risk, which is not conducive to the survival of enterprises in the initial stage.

From the perspective of the six factors of resource-based capability, Product Competitiveness and Sustainable Innovation have absolutely positive impacts on enterprise survival, while Enterprise Ownership and Patent Number have absolutely negative impacts on enterprise survival. Relatively speaking, resource-based capabilities are more dispersed in the distribution of enterprise survival paths and play less important roles.

4.2.2. The combination path analysis of green innovation enterprise death

The results of the multifactor combination path analysis of the death of green innovation enterprises are shown in Table 6, from which three paths of death can be found, with the overall solution coverage rate of 57%. Among them, the highest coverage rate is Path 2, in which the raw coverage rate and the unique coverage rate are both 29%, indicating that companies without internal and external conditions inevitably die. Path 1 and Path 3 show that only a single enterprise with dynamic capabilities or resource-based capabilities cannot save the company's life. Only by having both internal and external capabilities can an enterprise survive fierce market competition.

From the perspective of internal and external capabilities, it can be found that the lack of Product Competitiveness and Sustainable Innovation has an absolutely negative impact on the death of enterprises, indicating that the lack of resource-based capacity will lead to the death of enterprises. By comparison with the parsimonious solution, it can be seen that the core elements for the death of green innovation enterprises include three factors in the dynamic capability dimension – Government Support, University Cooperation, and Technology Introduction – as well as three factors in the resource-based capability dimension – R&D Expenditure, Product Competitiveness, and Sustainable Innovation. Three permutations and combinations of six factors can explain a large proportion of deaths.

4.2.3. Comparison of the core elements influencing green innovation enterprise survival and death

Table 7 can be obtained by comparing the key factors influencing the multifactor combination path analysis in the previous paper. We found that the two core elements of enterprise survival and death were mutually reinforcing in the two factors of government support and product competitiveness. It can be understood that green innovative enterprises with government support and highly competitive products showed better viability than those without such conditions. This understanding reveals the necessary rules for enterprise survival from one side. In terms of dynamic capability acquisition, enterprises should firmly grasp various supportive policies of the government to improve their viability, while they should also make full use of internal resources to develop competitive products to overcome various uncertain risks in

Table 6

Multi-factor combination path analysis of enterprise death.

Configuration		Solution		
		1	2	3
Dynamic capability view				
GS			⊗	●
UC		⊗	⊗	●
TI		⊗	⊗	●
Resource-based view				
R&D		●	⊗	⊗
PC		⊗		⊗
SI			⊗	
Consistency		1	1	1
Raw coverage		0.14	0.29	0.14
Unique coverage		0.14	0.29	0.14
Overall solution consistency	1			
Overall solution coverage	0.57			

Note: ● indicates that the condition variable exists, ⊗indicates that the condition variable is missing, the large circle represents the core element, and the small circle represents the peripheral element. "Blank" indicates that the condition may or may not appear in the path.

Table 7
Comparison of key influencing factors of enterprise survival and death.

Enterprise survival	Enterprise death
Universities Cooperation (Low)	Universities Cooperation (Low)
Government Support (Existence)	Government Support (None)
Product Competitiveness (High)	Product Competitiveness (Low)
Technology Introduction (None)	Technology Introduction (None)

the market. Comparing the core elements, it can be seen that there is no mutual verification effect among other factors. The asymmetry of the results shows that, even for the same green innovative enterprise, the complement of the core elements affecting its survival is not necessarily the key factor affecting its failure. Even if all of the antecedents are exactly the same, the antecedent combination path that can cause the green innovative enterprise to survive normally is not necessarily the complement of the antecedent combination path that leads to its death [72].

Because of the complex causes of social phenomena, the conclusions are unreliable if only traditional symmetric correlation analysis is used to explain them. As shown in Table 6, the low technology introduction is a favorable factor for the survival of enterprises, while the high technology introduction is not an unfavorable factor for the death of enterprises. This causal asymmetry breaks the stereotype of correlation in traditional analysis. Therefore, whether for the study of enterprise survival or enterprise death, this paper proves the suitability of the principle of causal asymmetry for the subject matter of this study to some extent.

5. Discussion

5.1. R&D dilemma of China's green innovation enterprises

According to the above analysis results, we found that low R&D is a necessary condition for the survival of green innovative enterprises in China; that is, low R&D is a significant feature of surviving enterprises, in contrast to some existing research conclusions. Li et al. held that R&D capability is the core capability for enterprises to survive, and enterprises' R&D investments can significantly reduce the failure of enterprise management [73]. The research subject of this paper is green innovative enterprises. Innovation is its prominent feature. It is difficult to match low R&D with innovation. Thus, how can we understand the conclusions of this article? From the special background of China's green innovation enterprises, on the one hand, green innovation enterprises mostly belong to small and medium-sized enterprises, and such enterprises are established in a short time and on a small scale, so the survival problem is the primary problem that they face. Lower R&D investment can reduce the financial risk faced by enterprises, which is more conducive to the survival of enterprises. On the other hand, since China's green innovative enterprises currently focus mainly on process innovation at present, their innovation belongs to the category of gradual innovation, and they are unable to bear the pressure and risks brought by radical innovation. Therefore, the low R&D investment of Chinese green innovative enterprises is determined by their own technology innovation strategy, and the low R&D investment is also conducive to the survival of enterprises.

Although low R&D is conducive to the survival of enterprises in the initial stage, high R&D is a long-term way for enterprises to survive. Thus, how should China's high R&D enterprises of green innovative enterprises survive? In light of this problem, this paper returns to the case for in-depth investigation and finds that the three high R&D enterprises are Green Water Source Technology Co., Ltd. (Green-Water Source), Tianjin Teda Environmental Protection Co., Ltd. (Teda Environmental Protection), and Shenfu Technology Co., Ltd. (Shenfu Technology). Each spends more than 5% of revenues on research and development, but the three companies show very different outcomes.

Green-Water Source and Teda Environmental Protection survived a decade later, but the operation of Shenfu Technology appeared abnormal, and it is clear that high R&D will not lead to the death of enterprises. At the same time, the study found that the combination of "high R&D″ and "high product competitiveness" can promote the survival of enterprises. That is, if the result of research and development does not bring competitive products, then the enterprise will spend too much energy on research and development, leading to the enterprise finding it difficult to survive. Shenwu Technology is a good example. From 2010 to 2012, R&D expenditures accounted for 6.7%, 7.4% and 9.7% of sales revenue, respectively. The product developed by the company – regenerative high temperature air combustion technology – has saved production capacity to some extent, but it does not have a comparative advantage in terms of price, so the company has not developed well. In contrast, GreenWater Source and Teda Environmental Protection, with high R&D investment, at the same time achieve comprehensive utilization of pollutant resources and greatly reduce the operating costs of enterprises, thus ensuring the healthy operation of enterprises.

R&D is very important for the survival and development of enterprises. Even if low research and development enterprises can survive for a short time, it is not conducive to their long-term development. However, due to the slow start, small scale and poor antirisk capability of China's green innovative enterprises, if the R&D investment fails to produce competitive products in time, then the enterprises will soon fall into business difficulties and lead to failure. Therefore, to solve the research and development dilemma of enterprises and realize the virtuous circle of "R&D - output - profit - R&D″ is the means for the long-term development of China's green innovative enterprises.

5.2. The influence of coordinated development of internal and external capabilities on enterprise survival

From the perspective of resource-based capability and dynamic capability, this paper discusses the influence of these two dimensions on enterprise survival and enterprise death, respectively. The results of fsQCA combined path analysis show that the absence of any type of ability will affect the viability of the enterprise, and resource-based capability has a greater impact on enterprise death, with dynamic capability having a greater impact on enterprise survival. According to the two-factor theory, if an enterprise wants to survive for a long time, then it must build a dynamic ability to support the development of the enterprise, while the resource-based capability plays a fundamental role. Although the resource-based capability cannot guarantee the long-term survival of the enterprise, the shortage of resources will lead to the death of the enterprise, which also verifies previous research conclusions, as Cheah et al. suggested that external institutional support behavior for enterprises plays a dominant role in enterprise performance, such as some financial support and training support from the government, industry partners, and charity organizations [79]. If the company can scientifically show its efficiency in dynamic capability, then these support behaviors will lead to a better achievement.

Combined with the results of this paper, on the one hand, since the Chinese government has a profound impact on China's green innovation industry through financial subsidies and environmental regulations, government support has a decisive impact on the survival of China's green innovation enterprises. In addition, industry-university-research cooperation provides strong technical support for green innovative enterprises, which is also conducive to the construction of competitive advantages in the fierce market competition for green innovative enterprises to survive better. Therefore, external dynamic capability represented by government support is the core capability of enterprise survival.

On the other hand, the death of China's green innovative enterprises is closely related to the lack of internal resources. Even with good external support, enterprises can fail due to the lack of internal

resources, among which the most important factor is product competitiveness. If the enterprise cannot form the advantage of product competitiveness through the integration of internal resources, then it is difficult to reduce the death probability of the enterprise. Considering Aobo Group as an example, the case mentioned that Aobo Group introduced advanced LOW-E coated glass production line and production technology from the UK. In cooperation with Tianjin University of Technology, Aobo Group successfully developed "LED light conversion ecological glass", which can promote plant growth without chemical fertilizers and pesticides. This technology has obtained 54 patents and filled the gap of relevant technologies in China and has been listed as a "key project of 863 program", "national natural science foundation project" and "municipal key natural science foundation project" by the state and has received good external support. However, because the enterprise produces high-tech products with relatively high production costs, the product does not have a relative price advantage in the market competition, and the enterprise is difficult to operate, resulting in the enterprise legal person being included in the list of dishonest persons, receiving equity pledges, and eventually dying.

5.3. The importance of government support for the survival of green innovative enterprises in China

As a transitional economy, the market and the government have formed a unique "dual structure". In addition to the inevitable impact of market forces on the survival and death of enterprises, the impact of the government on the survival or death of enterprises cannot be ignored. On the one hand, the analysis results of this paper show that government support is conducive to the survival of enterprises, while the lack of government support will increase the risk of enterprise death due to the late development of China's green technology innovation industry, and most enterprises in the field of green innovation are small and medium-sized enterprises. Although large enterprises have sufficient strength to implement green innovation, they lack the corresponding impetus; therefore, government support is particularly important. He and Yang's research showed that the government can guide and encourage enterprises to carry out green innovation through fiscal and tax policies [59]. This view is also verified in this paper. The important role of the government is mainly reflected in the two variables of "Government Support" and "Enterprise Ownership". Green innovative enterprises apply for national projects and awards through self-developed core technologies, such as the "863 program" and the "national demonstration project", which are supported by the government, or the ownership of the enterprise belongs to the country and enjoys rich political resources. All of these approaches can help to improve the survival rates of green innovative enterprises in the initial stage.

At the same time, the government can also formulate policies and regulations to regulate the environment, thus forcing enterprises to implement green innovation; On the other hand, through the combination of the two elements of government support and enterprise ownership, we can find that state-owned enterprises are more likely to obtain government support than private enterprises, so the enterprise's survival is also higher.

6. Conclusions and implications

Based on the fsQCA method, this paper provides an in-depth discussion of the sustainability of China's green innovation enterprises. The main conclusions are as follows. First, low R&D is conducive to the survival of China's green innovative enterprises. Although generally speaking, R&D is conducive to the improvement of enterprise performance, it is an uncertain event with large risks and long cycles. For Chinese green innovative enterprises, due to their small scale, limited internal and external resources, and weak ability to resist risks, low R&D is the optimal strategy for their early survival; second, compared with resource-based capabilities, dynamic capabilities can better promote the

survival of green innovative enterprises in China. In particular, government support is crucial to the survival of green innovative enterprises. Compared with dynamic capability, the lack of resource-based capability is key to the death of enterprises. Among enterprises, R&D expenditures, sustainable innovation and product competitiveness are the core elements affecting their death. Third, by comparing the core elements influencing the survival and death of enterprises, we found that government support and product competitiveness had mutually reinforcing effects; that is, green innovative enterprises with government support and highly competitive products showed better viability than those without such conditions.

6.1. Implications for theory

The contribution of the research results of this article to theory is mainly divided into three parts. First, our research has enriched the content of research related to enterprise survival from the resource-based view and dynamic capability view. We have summarized the existing survival research literature by combining abstract theories into nine variables and using case studies combined with qualitative comparative analysis methods to combine the survival scenarios of Chinese green innovation companies to understand the specific aspects that can be used by RBV and DCV to help SMEs to improve their survival probability; second, we have comprehensively interpreted the controversial research results. For the previous survival research literature, some influencing factors have appeared in contradictory conclusions from different studies. For example, government subsidies have produced mutually exclusive conclusions in the study of the survival of the same type of enterprise. This paper effectively resolves this dilemma using the method of fsQCA. By adding situational factors to survival research and combining the analysis methods of multivariate path combination to explain the situation in which the same variable leads to different conclusions, we break through the dilemma and gain new theoretical insights. Third, existing research on survival has often assumed that there is symmetry in causality, while neglecting to discuss the survival dilemma of the enterprise from both sides, Our research found that the lack of resource-based capabilities of an enterprise is more likely to cause the death of the enterprise, and having a certain degree of dynamic capabilities is very conducive to the survival and development of the enterprise. In management research, avoiding the production of a negative result and promoting the production of a positive result should be of equal importance. Using this causal asymmetry method can inspire more scholars to supplement the research on the causes of the reverse results of previous research problems, thereby prompting a more comprehensive study of enterprise survival.

6.2. Implications for practice

The practical implications of this study are as follows. First, under the circumstance that enterprises do not have sufficient resource-based capacity, Chinese green innovation enterprises should be cautious about internal R&D investment and should consider seeking cooperation with universities and research institutes to obtain technological innovation. Second, since resource-based capability and dynamic capability play important roles in the survival and death of China's green innovative enterprises, enterprises must always pay attention to the adjustments and changes of internal resource-based capability and external dynamic capability to ensure their coordinated development. Finally, since government support is of great significance to the survival of China's current green innovation enterprises, and green innovation enterprises themselves find it difficult to carry out large-scale research and development, the government should give strong R&D support to enterprises with competitive products so that these enterprises can implement continuous innovation and grow rapidly into leading enterprises, driving the development of the whole green innovation market and industry and laying a solid foundation for promoting the development of

China's green economy.

7. Research limitations

Although this paper has made some contributions to the theoretical and practical significance of research on the survival of green innovative companies, it still has limitations. First, the research data in this article come from cases, and the amount of information in the cases is limited. To study authenticity and objectivity, we have attempted to find sufficient information to describe the survival scenarios of green innovative enterprises, but we still cannot exclude certain deviations. For example, environmental uncertainty is closely related to dynamic capabilities. This issue has been studied and discussed by a large number of scholars. Under different uncertain environments, the dynamic capabilities of enterprises will have different effects on survival status. However, due to the limited amount of information in the cases, we have no way to investigate the survival status of enterprises in uncertain environments in detail here. In future research, we can discuss the survival of enterprises in uncertain environments based on questionnaire data to further improve research on the survival of green innovative enterprises.

Second, we have determined nine research variables in two dimensions from theoretical derivations and by combing the existing research literature; however, these variables cannot fully describe the overall picture of resource-based capabilities and dynamic capabilities, especially the impact of the new coronavirus epidemic on the internal and external environments of green innovative enterprises. In future research, we will focus on exploring new measurement variables and determining the key factors influencing the survival of enterprises in this new situation.

Declaration of competing interest

The authors declare that they have no conflict of interest.

CRediT authorship contribution statement

Jian-ling Jiao: Conceptualization, Methodology, Resources, Writing - review & editing, Supervision, Funding acquisition. **Xiao-lan Zhang:** Conceptualization, Methodology, Software, Formal analysis, Investigation, Writing - original draft, Writing - review & editing, Visualization. **Yun-shu Tang:** Writing - review & editing.

Acknowledgments

Appendix A

TypeI

National Bio-energy co. LTD, Green Water source Technology co. LTD, the Chinese Wind Power co. LTD, CSCE, Tianjin Teda environmental protection co. LTD, Dalian gancheng technology development co. LTD, Zhejiang saifu Science & Technology co.LTD, Micro Irrigation Technology co.LTD, Shenzhou Automobile co.LTD,Yingweili Technology co.LTD, YuanShen energy-saving co.LTD, Ziguangyitian Technology co.LTD, Sanyi landscaping co.LTD, Interchina water treatment co.LTD, Magnetic valley Group, Beijingliboter technology co.LTD,Kunming Hong Huo Technology co.LTD, Yuneng Group, Technologyco.LTD, Xiarui biotechnology co., LTD, Beijing lanbao new technology co. LTD, Jinan Zhaolong Science and Technology Development Co., Ltd.

Type II

Changzhou Huayue Technology co.LTD, Ruichi Energy-saving co. LTD, Guodiansiwei Technology co.LTD, Xiaoqing Environmental Protection co.LTD, Zhongshi Environment co.LTD, Shenfu Technology co. LTD, Aobo Group.

Appendix B. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.techsoc.2020.101314.

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