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RESEARCH ARTICLE

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Driving mechanism model of enterprise green strategy evolution under digital technology empowerment: A case study based on Zhejiang Enterprises

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Abstract

Digital technology innovation is sweeping the world, endowing the development of enterprises with the new feature of "digital + green," which improves the efficiency of enterprises in implementing green strategy. Previous studies emphasized the driving force of enterprise green strategy evolution under the traditional economic model, but often ignored its driving mechanism under digital technology empowerment. Collecting the data from first-hand interviews and second-hand documents and selecting 11 case enterprises in Zhejiang, China, this study adopts multiple case method to construct a driving mechanism model of enterprise green strategy evolution under digital technology empowerment. This study proposed as follows, first, the enterprise green strategy is innovatively divided into five evolution stages (green beginner, green responder, green adapter, green activist, and green leader), and it is found that most case enterprises reached a higher stage. Second, digital technology empowerment affects the enterprise green strategy evolution through the mediating role of managerial perception, enterprise competitive capabilities, data and information elements, enterprise resource utilization efficiency, green product design, and whole process digitalization and digital marketing. Third, corporate governance (including public ownership, ownership concentration, independence, and diversity of the board of directors) significantly and positively moderate between various factors and enterprise green strategy evolution. Finally, a series of policy implications and managers' coping strategies are proposed.

KEYWORDS
corporate governance, digital technology empowerment, driving mechanism model, enterprise green strategy evolution, managerial perception, multiple case method

1 | INTRODUCTION

China's economic growth is facing more severe pressure on resources and environment. As the micro main body of the market, enterprises have made great contributions to economic development. However, the public goods characteristics of the environment and the self-interest behavior of enterprises lead to the increasingly serious environmental problem in the process of economic development (He et al., 2019). The Fifth Plenary Session of the 19th CPC Central Committee stressed the importance of green development concept and promoting the comprehensive green transformation of economic and social development. Green development has risen to the national strategic level. In response to the call of the government, major

Abbreviations: CPC, Communist Party of China; GHRM, green human resource management; EL, environmental legitimacy; UET, upper echelons theory; IOT, internet of things.

enterprises have also implanted green strategy into the company's development blueprint (Zhang, 2021). For example, Gree Group, one of the world's largest air-conditioning manufacturers, has set its overall strategic goal as "advocating green consumption, actively developing green products, constantly improving environmental behavior and being responsible for society"(Chen, 2021); network operators such as Alibaba have launched the "Green Logistics Plan" (Sun, 2019). Such large well-known enterprises' green strategic transformation has become a popular social phenomenon.

The digital age has arrived. According to the 2017 Digital Index Survey, 88% of enterprises clearly integrate digitalization into their corporate strategy.[1] According to the 41st Statistical Report on China's Internet Development, as of December 2017, China has 592 artificial intelligence enterprises, accounting for 23.3% of the global total.[2] These figures show that enterprises must transform to digitization. At present, cloud computing, big data, artificial intelligence, and other digital technologies are accelerating their penetration into enterprise R & D, design, production, circulation, service, recycling, management, and other links. In the whole business process, digital technology has given the new characteristics of "digital + green"to enterprises, and gradually formed a number of new "digital + green" integrated development models in the industry, which has greatly improved the efficiency and benefits of implementing green strategy.

To some extent, the commitment of enterprises to protect the environment has become an important premise for enterprises to build their competitive advantage under the background of global climate change. This has encouraged many companies to implement green transformation. This promotes the gradual evolution of enterprise green strategy from defensive to active (Hunt & Auster, 1990; Roome, 1992). In the past, scholars paid more attention to the driving force analysis of enterprise green strategy evolution under the traditional economic model, but often ignored the evolution and driving mechanism of enterprise green strategy under the empowerment of digital technology.

Zhejiang's GDP ranks fourth in China in 2020. While developing the economy, Zhejiang attaches great importance to the construction of ecological civilization. Therefore, Zhejiang provincial government has always been firm in the concept of green development and incorporated green development into government decision-making. The "five water co-governance," environmental protection and energy conservation proposed by the provincial government are earnestly exploring the road of green development in Zhejiang. With the strong guidance of policy, many enterprises have carried out green transformation, explored green management practice, and have made some achievements. In addition, Zhejiang is one of the regions with rapid development of digital technology. The concept of "intelligent manufacturing" is inevitably mentioned in the strategies of various enterprises. "Smart manufacturing + green" is becoming a new business card of Zhejiang enterprises. Therefore, this study selects enterprises in Zhejiang, China as the sample enterprises of the case study, and strive to explore the evolution process and driving mechanism model of enterprise green strategy evolution under digital technology empowerment, in order to provide relevant experience reference, theoretical basis and policy implication for relevant government departments and industries.

2 | LITERATURE REVIEW

2.1 | Evolution of enterprise green strategy

The earliest classification of the evolution of enterprise green strategy applied the corporate social responsibility model (Wartick & Cochran, 1985), which established the response of enterprises to social responsibility as four evolutionary models: reaction, defense, accommodation, and proaction. It reflects that in the evolution process, enterprises pay more and more attention to social problems. Since then, many scholars have made classification from different dimensions.

According to the organization's response to the environment, the evolution of enterprise green strategy can be regarded as a continuum of continuous change of reactive, adaptive, and active (that is, the evolution of enterprise green strategy follows a linear path). At one end of this continuum, enterprises take a passive response to the environment and follow the existing regulatory requirements. At the other end, enterprises may respond positively and adopt a strategy aimed at creating competitive advantage. At present, the evolution classification methods of Sharma (2000), Moon (2008), Hart (1995) and Christmann and Taylor (2002) are more representative in this field.

Based on the continuum of continuous change, some studies proposed the dichotomy of enterprise green strategy evolution. Moon (2008) classified the enterprise green strategy into reactive type and proactive type. Venselaar J. (1995) proposed three types: reactive, active, and advanced active. This reflects the increasing positive attitude of enterprises toward environmental problems. Hart (1995) constructed an enterprise's natural-resource-based view and proposed four types: end of pipe treatment, pollution prevention, product monitoring, and sustainable development. The research indicated that under the action of path dependence and embeddedness, the evolution of the enterprise's green strategy depends on the enterprise's specific resources and capabilities. Roome (1992) proposed four stages: non-compliance, compliance, compliance plus, and environmental leader according to the different response modes of enterprises to environmental regulations and social pressure.

Some other scholars proposed five stages. Christmann and Taylor (2002) proposed five types: reactive, capacity-building, defensive, adaptive, and active based on the available resources and capabilities of enterprises. This study provides a theoretical framework for the evolution of enterprise green strategy from low-level to high-level to build its competitive advantage. Hunt and Auster (1990) proposed five stages: (Stage 1) beginners; (Stage 2) firefighters; (Stage 3) caring citizens; (Stage 4) pragmatists; and (stage 5) proactive activists. Zhang et al. (2019) identified two dimensions of enterprise proactive green strategy from the perspective of green human resource management (GHRM) and environmental legitimacy (EL).

It can be seen that in terms of the evolutionary classification of enterprise green strategy, most studies focus on the research from the theoretical perspective. However, few studies use the case study method to make this research, and it is rarer to conduct this study based on the samples of Chinese Zhejiang enterprises. This study aims to bridge this research gap in this regard and provide new insights into the evolution stage of enterprise green strategy under the empowerment of digital technology.

2.2 | Driving mechanism of enterprise green strategy evolution

The driving mechanism of enterprise green strategy evolution has become the research focus. The previous literature made research from four streams: environmental stakeholders, the implicit competitive capability of enterprises, managerial perception, and digital technology.

2.2.1 | Environmental stakeholder impact

The stakeholder theory holds that managers should comprehensively balance the interests of various stakeholders and carry out the company's strategic design and planning (Freeman, 1984).

The environmental stakeholders include not only the government stakeholders, the economic stakeholders such as shareholders, creditors, employees, consumers, and suppliers but also the social stakeholders such as local communities, media, and nongovernmental environmental groups (Hoffman, 2001). These stakeholders are closely related to the survival and development of enterprises. The success of implementing green strategies depends on the response of enterprises to the requirements of various environmental stakeholders (Henriques & Sadorsky, 1999).

Jennings and Zandberger (1995) used institutional theory to explain the driving factors of enterprise green strategy and indicated that compulsion is the main driving force for enterprise green strategy. Henriques and Sadorsky (1999) argued that environmental pressure from social stakeholders significantly promotes enterprises to adopt green strategies. Buysse and Verbeke (2003) found that the proactive strategy is more due to the environmental pressure from internal employees and shareholders than the pressure from external customers and suppliers.

Based on the multiple perspectives of institutional theory, stakeholder theory, legitimacy theory, and environmental externality theory, Qin et al. (2019) showed that the government plays an important role in promoting enterprise green strategy.

It can be seen that previous studies focused on the relative importance of different environmental stakeholder pressures, but less on their interaction, and less on their mechanism on enterprise green strategy in the context of digital economy. This study aims to provide new insights in this regard.

2.2.2 | Implicit competitive capability of enterprises

According to the theory of the resource-based view of enterprises, the specific resources and capabilities of enterprises have a significant impact on their competitive strategy. This theory provides a theoretical framework for integrating environmental considerations into enterprise strategic management (Hart, 1995). Specifically, if enterprises have the unique ability of continuous innovation, which is implicit and difficult to imitate, they tend to adopt the green strategy of pollution prevention rather than the expensive environmental control measures of end-of-pipe treatment. This green strategy of pollution prevention is human capital intensive, so it depends more on enterprises' implicit ability (Cole, 1991). Singh et al. (2019) confirmed this theory and showed that dynamic capabilities have significant positive impacts on green strategies of enterprises.

It can be seen that the previous research explores the impact of implicit competitive capability on enterprise green strategy, but has not examined the mechanisms for the formation of these competitive capabilities. This study will explore the complete mechanism of competitive capability driving enterprise green strategy under digital technology empowerment.

2.2.3 | Managerial perception

According to the Upper Echelons Theory (UET), managers have a unique interpretation of the strategic situation faced by the company and act accordingly. Managerial interpretation of strategic events is significantly influenced by their previous experience, values and personality. The pressure of stakeholders perceived by managers significantly affects the green strategic choice of enterprises (Murillo-Luna et al., 2008). Managerial perception, that is, managerial personal judgment on whether the environment is an opportunity or a threat, has an important impact on enterprise green strategy (Nadkarni & Barr, 2008).

Many factors affect managerial cognition of environmental problems, such as the government, consumers, and the public, as well as the opportunities arising from environmental problems. Murillo-Luna et al. (2008) showed that the response of enterprises to stakeholders is based on managerial perception. The type of green strategy depends on managerial perception. If managers perceive those environmental problems as threats, the enterprise's green strategy will be reactive. If managers perceive those environmental problems as opportunities, the enterprise's green strategy will look for opportunities for competitive advantage from the green strategy (Andersson & Bateman, 2000).

In recent years, some researches proved the important role of managerial perception in the implementation of enterprise green strategy. Based on the survey data of Chinese listed companies, Yang et al. (2019) showed that managers' perception of institutional pressure significantly promotes proactive green strategy. Rivera (2019) constructed a driving model of enterprise green strategy and

confirmed the importance of managers' perception in driving enterprise green strategy.

It can be seen that previous studies have explored the role of managers' perception on enterprise green strategy, but have not examined the role of managerial perception on digital technology, which is a new insight we try to provide.

2.2.4 | Impact of digital technology empowerment

The "digital technology" refers to the collective name of various digital technologies that can realize interconnection, communication, and automation, such as blockchain, big data analytics, cloud computing, artificial intelligence, and the Internet of things (Frank et al., 2019). Digital technology is increasingly used in enterprise green management. Because digital technology greatly improves the efficiency of data generation, processing, analysis, and transmission, enterprises can obtain a large amount of data and expand the scope of green business through digital technology (Galan-Díaz et al., 2015). Entrepreneurs embed digital technology into business model, which effectively realize the environmental value creation (Gregori & Holzmann, 2020) and is conducive to the implementation of green strategy.

Additionally, by applying digital technology to the data collection process of the whole product life cycle, enterprises effectively realize the digital upgrading of manufacturing system (Frank et al., 2019). The digital transformation of enterprises improves not only production efficiency but also the efficiency of resource allocation, which help enterprises realize the upgrading of green strategies (Dubey et al., 2019). Wen et al. (2021) indicated that digital technology improves enterprise green performance through structural effect and technical effect. Specifically, digital technology enables enterprises' green strategy by reducing the production scale of enterprises and introducing cutting-edge cleaner production technology.

It can be seen that previous studies examined the path of digital technology to promote enterprises green strategy from many aspects such as improving data capacity, promoting business model innovation, improving resource allocation efficiency and so on. However, few studies take Chinese Zhejiang enterprises as a typical sample and use multiple case methods combined with other factors to build a comprehensive theoretical model of driving mechanism of enterprise green strategy evolution under digital technology empowerment, which is the goal of this paper.

2.2.5 | Impact of corporate governance

Corporate governance can be defined as "a process that enables the company to respond to the rights and aspirations of stakeholders". Based on the data of listed enterprises in China, Yang et al. (2021) revealed the importance of corporate governance for implementing enterprise green strategy. Ownership structure and the control capability of the board of directors are two elements of corporate governance (Eisenhardt, 1989a).

Public-owned enterprises are more likely to implement environmental strategies, because they are usually required by the government to achieve environmental goals (Beurden & Gössling, 2008).

The research in developed countries argues that the ownership concentration is negatively related to enterprise green strategy (Wang & Coffey, 1992). However, some studies about China showed that, with the increase of ownership concentration, executives in state-owned companies promote the green strategy for personal motives such as politics or promotion. Fan et al. (2007) found that, under a series of political pressure, for China's state-owned companies, the relationship between ownership concentration and enterprise green strategy is likely to reverse from negative correlation to positive correlation. In non-state-owned enterprises, higher ownership concentration may mean more serious agency problems. Large shareholders will exploit small and medium-sized shareholders through interest transfer behavior, which reduces the environmental responsibility level of the enterprise (See, 2009). Li and Zhang (2010) believed that in enterprises with different ownership, the impact of ownership concentration on enterprise green strategy is different. The ownership concentration of state-owned enterprises is positively correlated with enterprise green strategy, while it is the opposite for non-state-owned enterprises.

Gangi et al. (2022) showed that the control ability of the board of directors have a strong predictive effect on corporate green strategy. In order to improve the quality of decision-making, the introduction of external independent directors with professional knowledge and diversified experience helps enterprises generate innovative ideas and better fulfill social responsibilities. Additionally, a larger board better represents the interests of a wider range of stakeholders. Therefore, the diversity of the board of directors positively influences enterprise green strategy.

Previous studies focused on stakeholders (Buysse & Verbeke, 2003; Darnall et al., 2010), managerial perception (Banerjee, 2001; Sharma, 2000), enterprise resource-based view (Sharma & Vredenburg, 1998), and other theoretical frameworks to explore the driving factors of enterprise green strategy. Some scholars examined the interactive effects of the above factors and explored the internal and external dual driving mechanism for enterprise green strategy (Ashrafi et al., 2020). In the past, scholars mostly used quantitative methods such as structural equation model and counting model (Darnall et al., 2010; Sharma, 2000), but few studies are devoted to exploring the comprehensive theoretical model of enterprise green strategy evolution under digital technology empowerment through case studies.

First, most studies explain the driving mechanism of enterprise green strategy under traditional economy from a single theoretical perspective, and few studies explore it under digital economy from a comprehensive theoretical perspective. Second, the existing research rarely involved the specific path of digital technology empowerment on enterprise green strategy, and few studies built a comprehensive theoretical model based on stakeholder theory, enterprise resource-based view and upper echelon theory to explain the logic and driving force behind the evolution of enterprise green strategy. Nowadays, the enterprise "digital + green" strategy has been in full swing, but

the existing theories have not yet made an in-depth explanation. It is urgent to establish a comprehensive theoretical model to explain the driving mechanism of enterprise green strategy evolution under the digital economy. This paper is aimed to use the case studies to conduct this research, so as to provide experience reference and basis for relevant government departments and business circles.

In the first stage of the study, the case companies in pharmaceutical, new energy, chemical, papermaking, electric power, auto parts, steel and cement industries in Zhejiang were explored, in order to examine the green strategy evolution in different industries. This study was conducted by sending a team to conduct semi-structured interviews. In the second stage, the driving mechanism of various factors on enterprise green strategy were explored.

The rest of the paper are arranged as follows: the third section summarizes the methodology, which includes research design, data collection and sorting. The fourth part shows case analysis process aiming to construct a driving mechanism model of enterprise green strategy evolution. And the fifth part provides conclusions and implications.

3 | RESEARCH METHODOLOGY

This study belongs to the theoretical construction case study. This method summarizes the structure and relationship between relevant categories through the analysis and mining of real data, in order to propose new constructs or establish new theories (Dubé & Paré, 2003). This method better reflects the inductive logic of case study and is beneficial to the development of theory. Different from the hypothesis testing of empirical research, theoretical case studies prefer inductive theory construction (Ouyang, 2004). This part includes research design, data collection, and sorting.

3.1 | Research design

When researchers have little control over the studied phenomenon, case study is a preferred method. Through case method, researchers can explore the problems of "what" and "how" (Yin, 1989). The case study of enterprises in different industries under the same geographical background is helpful to explore the driving role of local government and social stakeholders. The case method can be a useful tool to establish constructs, propositions and theoretical models (George and Bennett, 2005).

According to Eisenhardt (1989b), we adopted the method of theoretical sampling (that is, the selection of cases is for theoretical reasons rather than statistical reasons) to select case enterprises. The selection of cases follows the "logic of replication" (Yin, 1989), that is, cases are selected for they are likely to replicate previous cases or extend the emergent theory, or fill the theoretical categories and provide extreme types of examples (Eisenhardt, 1989b).

We adopted a more robust multiple case method, predicted results of each case by similarity rather than comparison, and determined the number of case replications according to discretion and judgment (Eisenhardt, 1989b). This kind of discretion and judgment depends on the degree of certainty on the results of multiple cases.

China's Zhejiang enterprises were selected as the case study objects, because Zhejiang is the birthplace of general secretary Xi Jinping's theory of "Clear waters and green mountains are as valuable as mountains of gold and silver" and also the first place for enterprises to implement green strategy. According to China Economic Green Development Report of 2018, Zhejiang's green development index ranks first in China. Although they come from different industries, these case enterprises selected have their own unique models and successful common experiences to follow in the process of green strategy evolution, which can be used as a practical sample for other enterprises to implement green strategy. Additionally, this study selects enterprises in different industries in the same region, which can facilitate follow-up interviews with managers in case enterprises, and help to improve the efficiency of data collection.

The research team sent letters to executives of 20 companies asking for cooperation. Eleven companies responded by agreeing to provide research opportunities. According to the Measures for the Classification of Large, Medium, Small, and Micro Enterprises (2017), the 11 case enterprises belong to large scale. Additionally, according to the total operating revenue of more than 10 billion yuan in 2020, 6 enterprises belong to super large scale (enterprises C, D, E, H, J, and K, respectively) (Table 1).

Table 1 shows the main characteristics of case enterprises. For the sake of confidentiality, the enterprise names were covered up.

3.2 | Data collection

The data is mainly composed of first-hand data obtained from in-depth interviews and second-hand data obtained from documents. Thirty-four senior and middle managers from 11 case enterprises were interviewed. The interview is semi-structured, that is, the purpose of the interview is to obtain the respondents' own views and experience on the issue, rather than guiding them to make response according to the predetermined conceptual framework (Kaplan & Maxwell, 1994). In this study, individual in-depth interview and focus group interview were selected. Respondents are limited to middle and senior managers with bachelor degree or above, working in the company for more than 3 years and familiar with environmental affairs, including president, vice president, environmental affairs manager, and direct business manager. The size of the interviewed sample size follows the principle of "information saturation" (Malterud et al., 2016). When the next respondent can no longer provide more information, no new interviewees will be selected. The basic information of respondents is shown in Table 2.

We conducted individual in-depth interviews with 10 interviewees for about 1 h. Focus group interviews were conducted with four groups (an average of six interviewees in each focus group) for

TABLE 1 Characteristics of case enterprises

	Company A	Company B	Company C	Company D	Company E	Company F
Company size	Large	Large	Super large	Super large	Super large	Large
Year of establishment	1966	1997	1956	2001	1980	1984
Location	Taizhou city	Hengdian Town	Taizhou city	Hangzhou city	Hangzhou city	Pinghu city
Industry	Pharmaceutical	Pharmaceutical	Pharmaceutical	Electric power	Chemical	Papermaking
Total operating revenue in 2020(RMB)	2.470 million	7.880 million	11.350 million	51.680 million	16.050 million	4.870 million
Net profit in 2020(RMB)	320 million	817 million	420 million	6.090 million	95.375 million	310 million
Total number of employees	3,282	5,719	3,000	23,000	16,000	1956

	Company G	Company H	Company I	Company J	Company K
Company size	Large	Super large	Large	Super large	Super large
Year of establishment	2009	1963	1985	1994	1986
Location	Hangzhou city	Hangzhou city	Hangzhou city	Lanxi city	Changxing county
Industry	Auto parts	Iron and steel	Steel structure	Cement	New energy
Total operating revenue in 2020(RMB)	1.510 million	32.430 million	8.139 million	51.800 million	35.100 million
Net profit in 2020(RMB)	160 million	1.130 million	724 million	6.536 million	2.280 million
Total number of employees	1,000	16,900	5,031	5,000	22,333

TABLE 2 Basic information of interviewed managers

	Classification	Number	Percentage
Position	President	6	17.65%
	Vice president	7	20.59%
	Environmental affairs manager	11	32.35%
	Direct business manager	10	29.41%
Gender	Male	19	55.88%
	Female	15	44.12%
Years of working in the company	3–5 years	7	20.59%
	5–10 years	11	32.35%
	More than 10 years	16	47.06%
Age	26–35 years old	6	17.65%
	36–45 years old	10	29.41%
	46–55 years old	10	29.41%
	56 years and over	8	23.53%
Education	Bachelor degree	16	47.06%
	Master degree	12	35.29%
	PhD	6	17.65%
Types of interviews	Individual in-depth interview	10	29.41%
	Focus group interview	24	70.59%

about 2 h. Individual in-depth interviews enable researchers understand the overall views of the interviewees on the evolution stage and driving mechanism of enterprise green strategy. Focus group interviews are designed to collect higher quality data, because such interviews provide a "more natural environment" for interviewees to fully discuss and inspire with each other, and help researchers understand the logic and motivation behind interviewees' specific thinking mode (Stewart & Shamdasani, 1990).

The interview process is arranged as follows: after the broad discussion about the background, the interviewees were asked questions about the evolution of enterprise green strategy and its driving factors under digital technology empowerment. As the interview is semi-structured, in order not to bias the respondents' response, we designed an interview guide without providing specific information about the conceptual framework (Table 3). We designed it based on the literature (Boiral et al., 2009; Hart, 1995).

TABLE 3 The interview guides

Interview topic	Guide for key questions
Introduction	How long have you worked in your company? What are your position?
Overall cognition of enterprise green strategy	What measures does your company take to implement the green strategy? Has the enterprise established a special environmental department? How about your environmental investment in recent years? What is your overall view on the enterprise green strategy?
Experience of different stages of enterprise green strategy evolution	When did your company begin to implement the green strategy? In what aspects has the company implemented it? Can you talk about the advantages and disadvantages of your company compared with its competitors in implementing the green strategy?
Driving mechanism of digital technology on enterprise green strategy	When does digital technology begin to play a role in the implementation of green strategies? What are the main paths of digital technology in promoting enterprise green strategy? Do you have any other views on this issue?
Driving factors for implementing green strategy under the empowerment of digital technology	What do you think are the main factors driving enterprises to implement green strategy under the digital technology empowerment? What is the interaction between these main factors? What do you think are the main obstacles for enterprise green strategy under the digital technology empowerment? Can you talk more about this factor?

We take the method of making interview records and recording at the same time to ensure that the interview information is not omitted and distorted as far as possible, so as to strengthen the mutual confirmation between the evidence and ensure the reliability and validity of the interview. On the day of the interview, we sorted out the interview recordings, discussed the problems of unclear information and inconsistent understanding, repeatedly listened to the recordings or fed back to the respondents for verification and finally reached a consensus, so as to ensure the reliability and validity of the data sorting and analysis.

During the interview, due to various factors, the respondents' answers may be subjective. Following the suggestions of Eisenhardt (1989b), this study attempts to collect second-hand data to avoid or reduce this impact, constituting the evidence triangle through interview records, internal reports, public documents and literature, and conducting content analysis to make the collected data reflect the real situation of the case enterprises. These data are mainly used to verify the interview data. Specific second-hand data are shown in Table 4.

3.3 | Data sorting

First, we sorted out the first-hand data and screened out irrelevant materials, and formed a first-hand interview database; in addition, we screened the second-hand materials (including 22 internal reports and 23 public documents) and formed a second-hand document database. Thus, we obtained 440 texts on the dimensions of enterprise green strategy evolution, and 1320 texts on the driving mechanism of enterprise green strategy evolution. Second, the 440 texts data are analyzed with the help of NVivo 12 software, and the dimensions of enterprise green strategy evolution are scientifically counted through Affinity Diagram.

Through analysis on the 440 texts, we got eight dimensions for the evolution of enterprise green strategy under digital technology empowerment: green production, green marketing, green culture, emission reduction, resource conservation, energy conservation, environmental risk control, and green alliance. After the scope is defined, we use the Affinity Diagram to display, classify these eight dimensions, and ensure that there are 3–4 typical sub categories in each major category (Figure 1).

Third, the number and category of driving factors for the evolution of enterprise green strategy empowered by digital technology are scientifically counted through Causality Diagram analysis, in order to more accurately identify the relative importance of driving factors. Specifically, these driving factors can be summarized into three categories: first, government stakeholders, social stakeholders, and economic stakeholders can be summarized as external environmental stakeholders. Second, managerial perception and corporate governance can be summarized as internal driving factors. Finally, digital technology empowerment is the driving factor of technological change. After classifying and analyzing the above factors, we use the Fishbone Diagram (Causality Diagram) to visually show the relative importance of driving factors.

From Figure 2, the frequency of text items of economic stakeholders (25.9%), managerial perception (22.5%), digital technology empowerment (18.9%) and corporate governance (15.6%) are 342, 297, 249, and 206, respectively. The number of text items of these four factors accounts for 82.8%. Thus, these four factors are the main factors driving the evolution of enterprise green strategy, which are the factors that enterprises should emphasize. Furthermore, it can be seen that among the elements of economic stakeholders, consumer green demand, competitive pressure and motivation, and green supply chain management requirements are relatively important driving factors. Among the elements of managerial perception, environmental values of managers and managers' interpretation of

TABLE 4 Second-hand data list

Case enterprises	Time	Internal reports	Public documents	Total text (article)	Sample text (article)
Company A	2015–2021	Strategic planning report, management control internal report	corporate annual reports, social responsibility reports	236	80
Company B	2015–2021	Strategic planning report, Strategic control internal report	social responsibility reports, local newspaper reports (2020, 2021)	345	80
Company C	2015–2021	Strategic control internal report, Operational capacity report	corporate annual reports, local newspaper reports (2020, 2021)	412	80
Company D	2015–2021	Enterprise Investment Report, Strategic control internal report	social responsibility reports, company bulletin	224	80
Company E	2015–2021	Strategic planning report, Operational capacity report	corporate annual reports, social responsibility reports, and local newspaper reports (2021)	268	80
Company F	2015–2021	Strategic planning report, financial analysis report	corporate annual reports, social responsibility reports,	369	80
Company G	2015–2021	Enterprise Investment Report, Strategic control internal report	social responsibility reports, local newspaper reports (2021)	388	80
Company H	2015–2021	Strategic planning report, Strategic control internal report	corporate annual reports, company bulletin	216	80
Company I	2015–2021	Profit forecast report, financial analysis report	social responsibility reports, local newspaper reports (2019, 2020)	328	80
Company J	2015–2021	Strategic planning report, Operational capacity report	social responsibility reports, company bulletin	416	80
Company K	2015–2021	Enterprise Investment Report, Financial analysis report	social responsibility reports, national newspaper reports (2020, 2021) and local newspaper reports (2020, 2021)	372	80

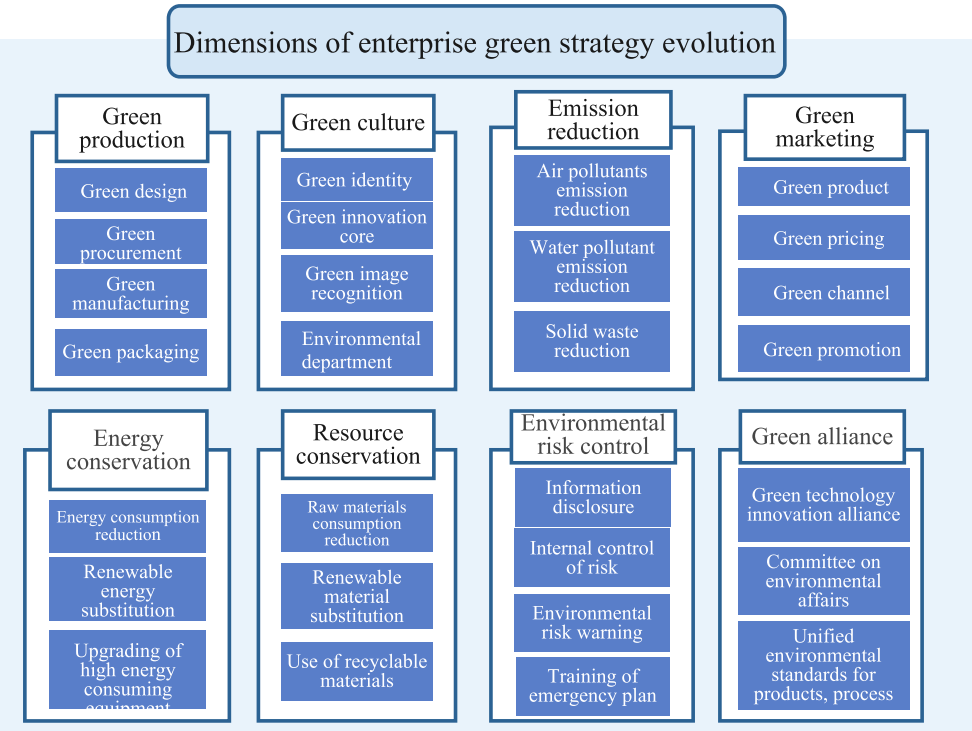

FIGURE 1 Affinity Diagram of dimensions of enterprise green strategy evolution

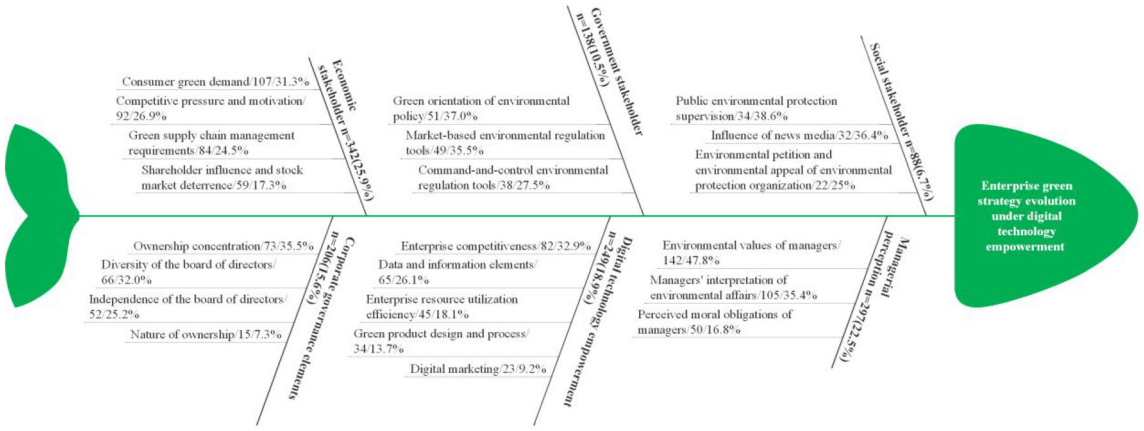

FIGURE 2 Fishbone Diagram of driving factors of enterprise green strategy evolution

TABLE 5 Criteria for dividing the evolution stages of enterprise green strategy

Dimension	Green beginner	Green responder	Green adapter	Green activist	Green leader
Green production	Very low	Low	Moderate	High	Very high
Green marketing	Very low	Low	Moderate	High	Very high
Green culture	Very low	Low	Moderate	High	Very high
Emission reduction	Very low	Low	Moderate	High	Very high
Resource conservation	Very low	Low	Moderate	High	Very high
Energy conservation	Very low	Low	Moderate	High	Very high
Environmental risk control	Very low	Low	Moderate	High	Very high
Green alliance	Very low	Low	Moderate	High	Very high

environmental affairs are relatively important. Among the elements of digital technology empowerment, enterprise competitiveness, data and information elements, enterprise resource utilization efficiency, green product design, and process are relatively important. Among the elements of corporate governance, ownership concentration, diversity, and independence of the board of directors are relatively important.

4 | CASE ANALYSIS: CONSTRUCTING A THEORETICAL MODEL OF ENTERPRISE GREEN STRATEGY EVOLUTION

In the first stage, this study focuses on the evolution process of enterprise green strategy. In the second stage, we use the text coding method to explore the driving factors and their mechanism on the green strategy evolution of case enterprises.

4.1 | Evolution process of enterprise green strategy

Referring to the research (Hunt & Auster, 1990; Roome, 1992), we adopt a linear continuum to define the evolution of enterprise green strategy. According to the response of the organization to the environment, it is defined that the evolution of enterprise green strategy follows a continuous change path from passive response to adaptation and then to active response. Specifically, according to the eight dimensions counted from Affinity Diagram analysis, this study divides enterprise green strategy into five evolution stages: green beginner, green responder, green adapter, green activist and green leader. Thus, compared with previous studies, the definition of this study is more detailed and vivid. The division criteria are shown in Table 5, which can be used as the basis for dividing the evolution process of enterprise green strategy for 11 case enterprises. And the results are shown in Table 6.

From the average scores of all dimensions, the five companies (Company D, E, F, H, and K) have reached the green leader stage (the average score is rounded to 5). In contrast, four companies (Company C, G, I, and J) have reached the green activist stage (with an average score of 4), and two companies (Company A and B) have reached the green adapter stage (with an average score of 3).

From each specific dimension, green production is the premise and guarantee for enterprises to implement the green strategy. Therefore, most case enterprises (except Company A, B, and E) have reached the green leader stage in this dimension. In particular, the business manager from company K mentioned that the company not only realized the strict management of green production but also laid

TABLE 6 Division of green strategy evolution stages of case enterprises

	Green production	Green marketing	Green culture	Emission reduction	Resource conservation	Energy conservation	Environmental risk control	Green alliance	Average score
Comp. A	4	4	4	2	3	3	3	3	3.3
Comp. B	4	4	4	2	3	2	3	3	3.1
Comp. C	5	5	4	2	3	4	3	5	3.9
Comp. D	5	4	4	5	5	5	5	5	4.8
Comp. E	4	5	5	5	4	5	5	3	4.5
Comp. F	5	5	5	5	5	4	4	4	4.6
Comp. G	5	5	4	3	3	4	3	3	3.8
Comp. H	5	5	5	5	3	5	4	5	4.6
Comp. I	5	4	4	4	4	5	4	5	4.4
Comp. J	5	5	3	5	3	4	3	3	3.9
Comp. K	5	5	5	4	5	5	4	4	4.8

Note: These figures represent the different stages of the enterprise green strategy, 1 = "green beginner," 2 = "green responder," 3 = "green adapter," 4 = "green activist," 5 = "green leader."

out green intelligent manufacturing in advance. The company establishes a green smart manufacturing industry chain and runs green smart manufacturing through the whole process of production and operation with the help of Internet, big data, cloud computing, and other means, so as to lead the industry to develop in the direction of green, high-end and intelligence.

Green marketing is the key link to create green value through green strategy. Most case enterprises (except Company A, B, D, and I) have reached the green leader stage in green marketing. The business managers from Company I and J said that developing green products, expanding environmental business, implementing green product innovation strategy, and green market research are the main measures of green marketing strategy. Some case enterprises have laid marketing networks in the domestic market and even the international market to create a broad green marketing platform. For example, the direct business manager of company C said that its marketing network covers more than 70 countries around the world.

Green culture is the forerunner for enterprises to implement green strategy. Under the influence of green culture, managers advocate environmental protection, employees agree with the green values of the enterprise, and the enterprise constructs a company culture and green image identification system with innovation as the core. Company E, F, H, and K have reached the stage of green leaders in green culture. The executives of some case enterprises integrate the green concept into business processes and brand building. For example, the top executive of company K said that the concept of "clean water and green mountains are as valuable as mountains of gold and silver" are the guiding ideology of the group's development.

On the other hand, the four companies (Company C, G, I, and J) which have reached the green activist stage are mainly committed to green production and green marketing, and generally pay less attention to green culture, emission reduction, resource conservation, energy conservation, environmental risk control, and green alliance strategy than Company D, E, F, H, and K. For example, in 2019, Comp. J's subsidiary in Gansu was reported to have caused dust pollution and damaged local lawns and shrubs. The two companies (Company A and B) in the green adapter stage are inadequate in emission reduction, resource and energy conservation, environmental risk control, and green alliance. In 2020, it was verified that Comp. A's subsidiary directly discharged toxic and harmful industrial wastewater to Jiaojiang River through concealed pipes. Coincidentally, in April 2021, the subsidiary of Comp. B was ordered by the local environmental department to carry out environmental rectification and imposed administrative punishment for excessive exhaust gas emission. It can be seen that the enterprises in the green activist and green adapter stage are insufficient in environmental risk control compared with the enterprises in the green leader stage.

In contrast, the case enterprises in the green leadership stage (Company D, E, F, H, and K) are outstanding in green culture, emission reduction, resource conservation, energy conservation, environmental risk control, and green alliance strategy. For example, the environmental affairs manager of Comp. H mentioned that through "five gas co-governance," the company has strengthened strategic cooperation with industry-leading enterprises, established a professional atmospheric treatment company, developed biological purification technology, and actively expanded new energy industry. This showed that the enterprise realized the integration of green resources among peer enterprises by building a green technology innovation alliance with upstream and downstream enterprises.

4.2 | Driving mechanism of enterprise green strategy evolution under digital technology empowerment

It is a major feature of case analysis to realize effective, verifiable, and relevant theoretical development through the connection with factual experience (Eisenhardt, 1989b). In order to better reflect the empirical

facts and achieve the theoretical construction, this paper uses text coding method (Thompson, 1997) to analyze the case data. This study analyzes the collected data by encoding and classifying the texts, summarizes key categories and constructs, and demonstrates the theoretical model (Li et al., 2010).

4.2.1 | Text coding

This study mainly uses the text coding method to extract the categories and subcategories from a large number of qualitative data and then demonstrate the theme of "the driving mechanism of enterprise green strategy evolution under the empowerment of digital technology." First, the data are coded according to the data source. For the first-hand data, 11 senior management respondents are coded as S1–S11 and 23 middle management respondents are coded as M1–M23 respectively; For second-hand materials, the codes of 11 case enterprises are SH1–SH11. Then, the data are coded and analyzed. According to the research theme, the case data are analyzed in a gradual way. We conduct text coding analysis on a total of 1320 text items from first-hand interview data and second-hand text materials and encode each data into corresponding text items of driving factors of enterprise green strategy evolution.

In order to ensure the consistency of coding, we adopt the method that three graduate students of relevant majors in the research team code independently, discuss the differences to reach a consensus, then another two graduate students check and discuss (Li et al., 2010). After three coding checks, the coding consistency rate of the six text items under the research theme (including government stakeholders, social stakeholders, economic stakeholders, managerial perception, digital technology empowerment, and corporate governance) exceeded 85%. In addition, in order to ensure the accuracy, we submitted the coding results to experts for review. In this way, we eliminated 170 items and retained 1150 valid items. In this way, we finally got 308 text items of economic stakeholders, 117 text items of government stakeholders, 68 text items of social stakeholders, 175 text items of corporate governance, 218 text items of digital technology empowerment, and 264 text items of managerial perception (Table 7).

4.2.2 | Explanation of driving effects of various factors on enterprise green strategy evolution under digital technology empowerment

The effect of environmental stakeholders

Stakeholder theory holds that organizations adopt a more effective governance structure under the pressure of external stakeholders (Donaldson & Preston, 1995). The primary stakeholders mainly include economic stakeholders and government stakeholders, while the secondary stakeholders refer to social stakeholders. Previous studies showed that government stakeholders and economic stakeholders have direct impacts on enterprise green strategy evolution, while social stakeholders have indirect impacts. This study divides the environmental stakeholders into government stakeholders, social stakeholders, and economic stakeholders.

Government stakeholders. The pharmaceutical industry is one of the key pollution industries. This study collects Company A, B, and C for case analysis.

The 2020 annual report of Company A showed that its three subsidiaries were subject to administrative punishment by Taizhou Environmental Bureau. Company C not only strictly follows the relevant emission standards but also promotes the sustainable development of green industry through green technology innovation. As the vice president said: "In the past, there would be waste gas leakage in the production process. Now we adopt automatic, fully enclosed and pipelined operation to make the production cleaner, safer and healthy." All these effectively respond to the government's environmental regulation. To strictly comply with emission standards, company B invested more than 200 million yuan in 2020 to improve the pretreatment capacity and end-of-pipe treatment capacity of wastewater and waste gas, and implemented ISO14001 environmental management system.

Since the government is the primary stakeholder, the operation of enterprises needs to be carried out under government regulations. Under the background of carbon peak and carbon neutralization, the government plays an important role in promoting green strategies for heavy polluting enterprises. Therefore, the pressure from government stakeholders promotes enterprise green strategy and realize the evolution from low to high stage. Among them, company A was punished by the local government for failing to meet the emission standards, while company B and C complied with the relevant standards to avoid this expense. Pharmaceutical enterprises implement the green strategy proactively, which not only meet the emission standards, but also improve green technology innovation. As the direct business manager of company B said, "It can be said that command-and-control tools not only do not damage the productivity of the pharmaceutical industry, but improve its technological innovation efficiency." Additionally, as a market-oriented environmental regulation tool, the environmental tax can promote the implementation of enterprise green strategy. As the top executive of company C said: "under the background of environmental tax, we release more production capacity and reduce costs by purchasing sewage equipment or upgrading the original equipment, while small and medium-sized pharmaceutical enterprises are forced to withdraw due to failing to increase environmental investment. Therefore, environmental tax increases environmental investment level." Therefore, this study believes that environmental regulation from government stakeholders affects enterprise green strategy evolution, and puts forward the following propositions:

Proposition 1. Environmental stakeholders have a significant positive impact on the evolution of enterprise green strategy.

Proposition 1a. Government stakeholders have a direct and significant positive impact on the evolution of enterprise green strategy.

TABLE 7 Text coding of driving mechanism of enterprise green strategy evolution under digital technology empowerment

Construct	Subconstruct	Number of text items	Examples of quotations
Government stakeholder	Green orientation of environmental regulation policy	44	For us, to implement the green concept is to implement the specific goal of "transformation from traditional production to green production" in the national environmental regulation policy. (**S7**)
	Command-and-control environmental regulation tools	42	On the whole, strict mandatory environmental regulation policies, such as emission standards and cleaner production legislation, are the main driving force for green management. (**S6**)
	Market-based environmental regulation tools	31	Compared with those mandatory tools, emission trading has greater flexibility in pollution control, and provides a more lasting economic driving force for a series of energy conservation and emission reduction and green technology innovation activities. (**S5**)
Social stakeholder	Public environmental protection supervision	27	The pollution emission data of our enterprise has been networked with the monitoring system of the Ministry of Environmental Protection. The public can query relevant information on the website and participate in environmental protection supervision. (**S3**)
	Environmental petition and environmental appeal of environmental protection organization	29	As a heavily polluting industry, environmental petition and even environmental appeal of environmental protection organizations have brought severe environmental pressure to our enterprise. (**S10**)
	Influence of news media	12	Media exposure causes widespread concern of the public and brings negative impacts on the operation of enterprises. (**M20**)
Economic stakeholder	Consumer green demand	99	Our investigation shows that the vast majority of consumers are willing to pay higher prices for green products. (**S11**)
	Competitive pressure and motivation	83	To remain invincible in the severe competition, only by carrying out cleaner production and strengthening green management can we obtain greater development space. (**S1**)
	Green supply chain management requirements,	74	At present, green supply chain management has become the inevitable choice to obtain competitive advantage. Therefore, actively formulating and implementing the corresponding green supply chain management strategy sublimate the green production and green management of enterprises to a new height. (**S9**)
	Shareholder influence and stock market deterrence	52	Shareholders' green expectations have great impacts on enterprises' emission reduction behavior. (**S8**)
Managerial perception	Environmental values of managers	132	Under the influence of our chairman's environmental values, we have adhered to the concept of "green environmental protection" and realized the win-win of economic benefits, social benefits and environmental benefits. (**M19**)
	Perceived moral obligations of managers	93	Our chairman regards environmental protection as a social responsibility that every entrepreneur must fulfill and leads the enterprise to implement the green strategy. (**M21**)

TABLE 7 (Continued)

Construct	Subconstruct	Number of text items	Examples of quotations
	Managers' interpretation of environmental affairs	39	Our management regards active environmental management as an opportunity and green technology innovation as an important profit source. (**S4**)
Digital technology empowerment	Enterprise competitiveness	76	Digital technology stimulates the competitive capabilities of enterprises such as continuous innovation, intelligent manufacturing and industrial chain integration, and strives to build "Internet plus" formats, so as to realize the green development. (**M2**)
	Data and information elements	59	Through big data platform, we provide data and information support for industrial expansion and project investment and operation, so as to implement active environmental management. (**M16**)
	Enterprise resource utilization efficiency	38	New digital technologies, such as Internet of things (IOT), big data, artificial intelligence, virtual reality and blockchain, are increasingly used to improve enterprise resource efficiency, so as to promote enterprise green strategy. (**SH6**)
	Green product design and process	28	Enterprises use digital technology to carry out green product R & D and whole process digitalization and realize green development. (**M23**)
	Digital marketing	17	We have strong demand for innovative marketing through digital means, and with the empowerment of Yibai's one-stop SaaS cloud service, most of the marketing work can be transferred from offline to online, and improve the marketing efficiency. (**SH3**)
Corporate governance	Ownership concentration	65	Although we are a private enterprise, the chairman believes that the enterprise green strategy is the most important part of the high-quality development. Therefore, higher ownership concentration promotes our green strategy. (**M18**)
	Independence of the board of directors	44	Our external independent directors generally have a doctor's degree and a background of certified public accountant, and have rich professional knowledge and diversified industry experience, which promotes enterprise environmental responsibilities. (**M9**)
	Diversity of the board of directors	58	Members of our board of directors have multi-disciplinary backgrounds and multi-industry experience in economics, accounting, chemical engineering and law. This diversified composition helps us implement environmental management. (**M17**)
	Nature of ownership	8	Absolute state holding often forms effective supervision over executives, help to reduce agency costs, improve information transparency, and promote green strategies. (**SH8**)

Zhejiang is not only a pioneer area of "beautiful China" but also a pioneer of digital economy. In 2022, the provincial government put forward the grand goal of building a global digital transformation highland. Therefore, in Zhejiang, the combination of digital technology and green development is the general trend. In March 2021, the provincial government issued *the Overall Plan for Digital Reform in Zhejiang Province*, proposing that by the end of 2025, with the data supply chain as the link and the construction of digital trade center as the guide, Zhejiang should promote the integrated application of industrial chain, innovation chain and supply chain, realize the efficient allocation of resource elements and form a fully connected digital economy operation system. It can be seen that the government promotes enterprises to realize the efficient allocation of resources through digital technology, which is conducive to the green development of enterprises. With the help of digital technology, new industries, new formats and new models have sprung up in Zhejiang. The executive of Company E said: "In view that the government has proposed a new path of 'Internet plus environmental protection service', we have adopted the strategy of 'digital technology + green', which has unique advantages in information technology and government policies. It can be seen that the new concept of 'Internet plus green ecology' proposed by the government promotes green strategies." Thus, we put forward the following proposition:

> **Proposition 1b.** Government stakeholders have an indirect and significant positive impact on the evolution of enterprise green strategy through digital technology empowerment.

Economic stakeholders. Economic stakeholders are more closely related to enterprises, mainly including customers, employees, suppliers, shareholders, and peer enterprises in the industry. Under the goals of carbon peak and carbon neutralization, consumers' green demand is increasing, which promotes enterprises to produce more environmental-friendly products. Therefore, it is necessary to implement the green production strategy. The environmental affairs manager of company F said that the environmental strategy helps to obtain the trust of consumers, establish a good brand image, and occupy a favorable position in the competition. Company G accelerates the integration of green supply chain among the same industries and cooperates with Jilin University to develop "green R & D" projects. The senior executive of company I said: "As a listed company, our stock price certainly makes the most direct response to environmental violations. This response of the stock market urges us to implement green strategies to some extent. After all, no company wants to see its market value shrink." Economic stakeholders affect the business performance of enterprises to a great extent, and then affect the evolution of green strategy. Therefore, the following proposition are made:

> **Proposition 1c.** Economic stakeholders have a direct and significant positive impact on the evolution of enterprise green strategy.

Social stakeholders. Social stakeholders include local environmental organizations, communities, and media. These stakeholders will not have a direct interest relationship with the enterprise, but the enterprise must consider their demands, because they are likely to affect the enterprise reputation (Liu et al., 2012). According to previous literature, social stakeholders exert indirect influence on the evolution of enterprise green strategy mainly through government and economic stakeholders.

As a pharmaceutical enterprise, company C adheres to the road of "green medicine," which has been recognized by the media. On the contrary, the subsidiary of Company A was reported by the media for secretly discharging pollutants. Facing the pressure from the relevant media reports, the local regulatory institution punished two subsidiaries of Company A. In this regard, the direct business manager of Company A said that the company would complete the rectification as soon as possible and report it to the environmental department. It can be seen that the media, as a social stakeholder, affects the green strategic decision-making of enterprises. Some enterprises consider the public's beautiful demands for the environment, and actively participate in the cause of environmental protection.

Social stakeholders, such as the public opinion spread by the media, mainly drive enterprise green strategy through economic stakeholders, such as major customers. As a media, its important function is information disclosure and dissemination, which makes the media play a supervisory role. The executive of company H mentioned: "With the dissemination of enterprise environmental information by the media, the demand for green steel is increasing, and because automobile manufacturers and other consumers are facing the environmental pressure and pay more attention to the emissions in their supply chain, which are the driving force for enterprises to realize green transformation."

Additionally, social stakeholders drive enterprise green strategy through government stakeholders. For example, the environmental petition and appeal of environmental organizations exert pressure on enterprises through government departments to urge enterprises to take environmental measures. The executive of Company J said: "The China Environmental Protection Federation sued one of our subsidiaries for causing pollution in the production process, which urged the local environmental department to put pressure on us and force us to take corrective measures." It can be seen that social stakeholders drive enterprise green strategy evolution through economic and government stakeholders.

Therefore, the following proposition can be made:

> **Proposition 1d.** Social stakeholders have an indirect and significant positive impact on the evolution of enterprise green strategy through government and economic stakeholders.

The mediating effect of managerial perception

The mediating effect of managerial perception in the influence of environmental stakeholders on enterprise green strategy evolution. The environmental value of managers has an important mediating effect between environmental stakeholders and enterprise green strategy. Many

studies regarded managerial perception as an important factor affecting enterprise green strategy (Dowell & Muthulingam, 2017; Liu et al., 2012).

Managerial perception not only directly affects the green strategy of enterprises but also is a mediating variable for other stakeholders to exert influence. Institutional pressure from environmental stakeholders promotes the transformation and upgrading of enterprise green strategy through managerial perception. When managers perceive the business pressure from economic stakeholders, they consider how to meet their expectations and maintain the business legitimacy. Similarly, when managers perceive social pressure from the government, the media, and environmental NGOs, they feel pressure to achieve social legitimacy by green strategies (Wei et al., 2017). The high institutional pressure from different environmental stakeholders urges managers to regard the green strategy as a necessity through managerial perception (Berrone et al., 2013).

The executive of Comp C admitted that the reason why the company's profit decreased was that the environmental rectification from the local government affected the production of antitumor drugs, which is a major source of profit.[3] The executive of Company D stressed: "energy cleaning should rise from the technical and tactical level to the strategic level of the enterprise." Therefore, when facing the most stringent atmospheric emission standards in history, the company took the lead in trying to achieve ultra-low emission, and proposed to achieve or even beyond the emission standards of gas units.[4]

A business manager of company H said that the company actively promoted the development of emerging industries, and their cloud data center adopts green power supply system to build a green cloud data center. In the context of managerial perception of the pressure of social stakeholders, in just a few years, company H has transformed from a large coal-fired enterprise to a green digital enterprise.

The executive of comp K said that the imperfect industrial policies have become the bottleneck restricting the healthy development of the electric vehicle industry, and the decisive role of the market has not been effectively reflected. And in the context of perceiving the environmental expectations of all stakeholders, the management takes green and recycling as the unswerving development concept of the group. The executive of Comp F said: "It is because our management have forward-looking environmental awareness and perceive the pressure from economic stakeholders that the enterprise not only emphasizes pollution control, but also regards the innovation of papermaking technology as its own responsibility."

The case enterprise chooses the green strategy, largely because the managers perceive the pressure from different stakeholders, have environmental values and a high sense of social responsibility, and regard assuming environmental responsibility as an opportunity to obtain competitive advantage. Therefore, the following propositions are made:

> **Proposition 2.** Managerial perception has a significant mediating effect in promoting enterprise green strategy evolution by other factors.

> **Proposition 2a.** Managerial perception has a significant mediating effect in promoting enterprise green strategy evolution by government stakeholder.

> **Proposition 2b.** Managerial perception has a significant mediating effect in promoting enterprise green strategy evolution by social stakeholder.

> **Proposition 2c.** Managerial perception has a significant mediating effect in promoting enterprise green strategy evolution by economic stakeholder.

According to *the survey report on the chief executives of Accenture Mobile Technology in 2015*, most Chinese executives perceived the great potential of digital technology and said that their companies clearly expect to use digital technology to achieve business growth.

The executive of Company K said: "The management has realized that the future success of enterprises largely depends on whether they open up an unconventional growth path with the help of digital technology. Now we are using Internet of things, big data, cloud computing and other means to promote traditional industries to be digital, intelligent and green." The executive of Company D said: "Our executives expect to use digital technology to promote intelligent transformation, green transformation and business growth. With the support of digital technology, we vigorously innovate energy business forms and models and improve the operation efficiency." The executive of Company E stressed: "Digital reform is the core of improving the efficiency and green management. We should establish a digital reform system and improve the environmental protection level through digital transformation."

It can be seen that under digital technology empowerment, managers perceive the opportunities brought by digital technology to enterprises' implementation of "digital + green transformation," so as to promote green strategies. Therefore, the following proposition is made:

> **Proposition 2d.** Managerial perception has a significant mediating effect in promoting enterprise green strategy evolution by digital technology empowerment.

The impact of digital technology empowerment

The mediating role of competitive capabilities. Digital information has become the key factor of production in the era of digital economy. Enterprises improve their core competitive capabilities by effectively acquiring, controlling, and using digital information. Digital capital has a significant synergistic effect in driving the competitive capabilities of enterprises (Domazet et al., 2018). The unique competitive capabilities, such as continuous innovation, stakeholder integration, industrial chain integration, and intelligent manufacturing, tend to promote enterprises to adopt green strategies (Cole, 1991; Sharma & Vredenburg, 1998).

The enterprise resource-based view holds that the specific organizational resources and capabilities have significant impacts on the

competitive strategy of enterprises (Hart, 1995). In the process of combing the cases, we found that digital technology empowerment promotes the evolution of enterprise green strategy by forming continuous innovation capabilities. The executive of Company G said: "Enterprises promote the deep integration of digital economy and real economy, vigorously introduced high-end research institutions, and improved the continuous innovation capabilities, so as to promote green strategies". The executive of Company I said: "with the empowerment of digital technology, we are building a green intelligent building laboratory with relevant research institutes to strengthen product R & D, innovation and upgrading and maintain the continuous innovation capabilities." With the empowerment of digital technology, the continuous innovation capabilities formed by enterprises enable enterprises to actively implement energy conservation and emission reduction in advance. This promotes the evolution of enterprise green strategy to a certain extent.

Digital technology empowerment contributes to the effective communication and integration between enterprises and stakeholders. The application of cloud computing, big data, and other digital technologies help the case enterprises actively disclose environmental information. Company D, E, and H publicized the corporate social responsibility report and corporate environmental information through the Internet. In the plant area, many enterprises set up real-time online monitoring. Company E sets up an online data screen at the main sewage outlet to consciously accept the social real-time supervision. Company G sets up a green information command center to conduct on-line monitoring of production sewage discharge. This stakeholder integration capability encourages enterprises to listen more to the opinions of stakeholders and stimulate their green innovation capability.

The integration capability of the industrial chain (i.e., the coordination, communication, close cooperation, and integration between the upstream and downstream links of the industrial chain) helps to realize the reuse or recycling of waste products, so as to contribute to the evolution of the enterprise green strategy (Hunt & Auster, 1990). Many case enterprises form the green industrial chain integration capability under digital technology empowerment. The executive of Company K said: "Digital technology helps to build the industrial chain integration capability of the energy storage industry, reconstruct the new value chain, and contribute to the green development."

Coincidentally, the environmental manager of Company B said: "with the support of the digital system, we improve the integration capability of the pharmaceutical industry chain, and the green and intelligent level of factory operation". The executive of Company I said: "under the support of industrial Internet platform, the company changed from the traditional mode of 'marketing, purchasing and manufacturing' to the integration of resources and capabilities." It can be seen that digital technology promote enterprise industrial chain integration capability.

In the case interview, we found that digital technology empowerment drives enterprise green strategy by improving enterprise intelligent manufacturing capability. The executive of Company J said: "During the 14th Five-Year-Plan period, the company continued to conduct green technology innovation and promote green development by improving intelligent manufacturing capacity." The vice president of Company K said: "Enterprises implement green strategies by realizing the digital operation of lead battery and lithium battery manufacturing scenarios, that is, intelligent manufacturing." "Through strategic cooperation with leading companies in digital technology, we are committed to the industry layout of digital and intelligent manufacturing, so as to improve the green level of enterprises," said an executive of Company B. It can be seen that digital technology enhances the intelligent manufacturing capacity and helps the green development.

It can be seen that digital technology empowerment has positive impacts on enterprise green strategy evolution through the competitive capabilities, such as continuous innovation, stakeholder integration, industrial chain integration, and intelligent manufacturing. Moreover, under the digital technology empowerment, there is mutual synergy between these competitive capabilities; that is, these competitive capabilities complement each other, enhance each other, and develop together. Therefore, the following propositions are made:

Proposition 3. Digital technology empowerment has a positive impact on the evolution of enterprise green strategy through the mediating role of a series of competitive capabilities.

Proposition 3a. Digital technology empowerment has a positive impact on the evolution of enterprise green strategy through the mediating role of continuous innovation capabilities.

Proposition 3b. Digital technology empowerment has a positive impact on the evolution of enterprise green strategy through the mediating role of stakeholder integration capabilities.

Proposition 3c. Digital technology empowerment has a positive impact on the evolution of enterprise green strategy through the mediating role of industry chain integration capabilities.

Proposition 3d. Digital technology empowerment has a positive impact on the evolution of enterprise green strategy through the mediating role of intelligent manufacturing capabilities.

Proposition 3e. Under the empowerment of digital technology, there is mutual synergy and integration between different competitive capabilities.

The mediating role of data and information elements. The executive of Company H said: "We have built the largest cloud data center, which provides a solid computing guarantee for industrial Internet, intelligent manufacturing and intelligent environmental protection. With the

power of digital technology, we conduct the analysis of energy consumption data and promote the efficient allocation of energy resources. In the future, we will strive to build a smart energy Internet Ecology, so as to promote the implementation of green strategies." The executive of Company C said: "we are planning to develop traditional Chinese medicine health products. We learned that German companies apply digital detection technology to the detection of some heavy metals and residual pesticides in traditional Chinese medicine. We hope to learn from them and strive to achieve environmental goals through digital transformation."

It can be seen that digital technology empowers enterprises to promote green strategy by providing data and information support. Therefore, the following proposition is made:

> **Proposition 4.** Digital technology empowerment has a positive impact on the evolution of enterprise green strategy through the mediating role of data and information elements.

The mediating role of enterprise resource utilization efficiency. New digital technologies, such as Internet of things (IOT), big data, artificial intelligence, virtual reality, and blockchain, are increasingly used to improve the resource efficiency of the industry, so as to promote enterprise green strategy. For example, with the empowerment of digital technology, paper enterprises maximize the utilization of each part of trees to achieve the maximum value, including all processes from fiber to lignin. Various digital tools not only improve the resource efficiency of raw material supply, logistics, and production in the upstream but also improve the conversion and distribution, product use, and waste recycling in the downstream. In a personal in-depth interview, the executive of company F said: "On the one hand, digital technology improves the utilization efficiency of water resources and energy. On the other hand, digital technology helps us use different parts of trees as much as possible." It can be seen that digital technology empowerment promotes the evolution of enterprise green strategy by improving the resource utilization efficiency. Therefore, the following proposition is made:

> **Proposition 5.** Digital technology empowerment has a positive impact on the evolution of enterprise green strategy through the mediating role of enterprise resource utilization efficiency improvement.

The mediating role of green product design and whole process digitalization. With the digital technology empowerment, some enterprises use the market information supported by digital technology to perceive the opportunities related to green development and respond to these opportunities through green product design and whole process digitization (Barreto, 2010; Sharma, 2000).

The executive of Company K said: "With the digital technology, enterprises use a large amount of data to carry out green product R & D and realize low-carbon development." The executive of Company J said: "The group takes 'Internet plus' as the starting point to realize the digitalization of the whole process of cement manufacturing." The executive of Company F said: "In the context of industrial Internet, the digital cloud platform makes the pulping, papermaking and other processes transparent and visual, realizes the digital design of the whole process, and helps the green development." The executive of Company E said: "Specifically, we have evolved the application of digital technology from the original low-carbon and decarbonization utilization of raw materials to green product research and development, green process and green development in the whole life cycle."

It can be seen that digital technology promotes the evolution of enterprise green strategy by promoting enterprises to design green products and realize the digitization of the whole process. Therefore, the following proposition is made:

> **Proposition 6.** Digital technology empowerment has a positive impact on the evolution of enterprise green strategy through the mediating role of green product design and whole process digitalization.

The mediating role of digital marketing. The environmental manager of Company D said: "The enterprise has developed and built a customer management system and all media interaction center, which cover customer data management, so as to promote green strategies". The executive of Company C said: "Under the current medical policy, our demand for innovative marketing through digital means is strong. With the empowerment of one-stop SaaS cloud service, our marketing can be transferred from offline to online, and the marketing efficiency can be improved accordingly." Coincidentally, the executive of Company A spoke highly of the whole process SaaS platform: "We are ready to adopt SaaS services, because the core competitiveness of the platform is mainly reflected in data. For example, artificial intelligence algorithms can be applied to disease prevention and treatment, which has obvious advantages in big data analysis and mining." It can be seen that the digital transformation of marketing helps improve the business efficiency, and ultimately contributes to enterprise green strategy.

It can be seen that digital technology empowers enterprises to implement green strategy evolution through digital marketing. Therefore, the following proposition is made:

> **Proposition 7.** Digital technology empowerment has a positive impact on the evolution of enterprise green strategy through the mediating role of digital marketing.

The moderating effect of corporate governance

Corporate governance factors include enterprise ownership structure and the control ability of the board of directors, which have significant impacts on the evolution of enterprise green strategy.

Enterprise ownership structure includes nature of ownership and ownership concentration. In this study, four enterprises are state-owned enterprises and the other seven are private enterprises. The executive of Company D said that as a large state-owned enterprise, we have more pressure to disclose higher quality environmental information and are more motivated to meet the national expectations to implement green strategies. Coincidentally, the environmental

manager of Company H said that for large state-owned enterprises, the state has a dominant share, and absolute state holding is more effective in supervising executives, helping to reduce agency costs and promoting enterprise green strategies.

In addition to public ownership, ownership concentration has a significant impact on the evolution of enterprise green strategy. Most of the case enterprises are private enterprises, but the actual controllers of the enterprises have high environmental awareness and have many years of experience in state-owned enterprises. Therefore, the higher the ownership concentration of these private enterprises, the higher the motivation of enterprises to implement green strategies. An executive of Company K said, "Although we are a private enterprise, our actual controller has many years of state-owned enterprise experience and high environmental awareness. He won many honors such as excellent entrepreneur and national labor model. Under his leadership, we actively practice the green strategy." According to the previous literature, in non-state-owned enterprises, higher ownership concentration may mean more serious agency problems and lower level of corporate environmental responsibility, which is not applicable to the case enterprises in this study.

Among them, the control ability of the board of directors includes independence and diversity. The appointment of independent external directors has the greatest impact on corporate social performance. The executive of Company F said that constantly optimizing the corporate governance is one of priorities of the company in fulfilling its environmental responsibilities. The executive of Company H said that these external independent directors with innovative ideas generally propose that the company implement the green strategy. The executive of Company I said that the members of the group's board of directors have a multidisciplinary professional background and a multi-industry background such as steel structure production and operation, government departments, academia, and consulting institutions. This diversified composition undoubtedly contributes to the positive green strategy.

Proposition 8. Corporate governance factors have a significant moderating effect on the driving mechanism of various factors on the evolution of enterprise green strategy.

Proposition 8a. The nature of public ownership has a significant positive moderating effect on the driving mechanism of various factors on the evolution of enterprise green strategy.

Proposition 8b. Ownership concentration has a significant positive moderating effect on the driving mechanism of various factors on the evolution of enterprise green strategy.

Proposition 8c. Independence of the board of directors has a significant positive moderating effect on the driving mechanism of various factors on the evolution of enterprise green strategy.

Proposition 8d. Diversity of the board of directors has a significant positive moderating effect on the driving mechanism of various factors on the evolution of enterprise green strategy.

4.3 | Construction of comprehensive theoretical model

Based on the analysis of the above cases and the eight propositions, combined with stakeholder theory, enterprise resource-based view and upper echelon theory, and based on relevant literature, this study constructs a comprehensive theoretical model of the driving mechanism of enterprise green strategy evolution under digital technology empowerment (Figure 3).

5 | CONCLUSION AND IMPLICATION

Although today's enterprise "digital + green" strategy has been in full swing, it has not received enough attention. We adopt multiple case method to propose a driving mechanism model of enterprise green strategy evolution under digital technology empowerment.

The findings proposed that the evolution of enterprise green strategy is due to the comprehensive action of digital technology empowerment, environmental stakeholders, managerial perception and company governance. Our study contributes to the existing research as follows: (1) Enterprise green strategy is innovatively divided into five evolution stages (green beginner, green responder, green adapter, green activist, and green leader). (2) Managerial perception significantly mediates in the process of digital technology empowerment promoting enterprise green strategy evolution. Digital technology empowerment indirectly drives the evolution of enterprise green strategy through enterprise competitive capabilities, data and information elements, enterprise resource utilization efficiency, green product design and process design and digital marketing. It can be seen that this study expands and enriches the upper echelon theory, enterprise resource-based view theory and digital economy theory to a certain extent. (3) Corporate governance (including public ownership, ownership concentration, independence, and diversity of the board of directors) significantly and positively moderate the driving mechanism of various factors on enterprise green strategy evolution.

Today's world is in the intersection of digital economy and industrial economy, and a new path of leapfrog development is taking shape. Digital economy has become a new driving force to promote the green development of enterprises under great changes (Xu et al., 2019). These results provide policy implications for industry and relevant decision-makers.

First, the theoretical model constructed shows that in the era of digital economy, the driving force from digital technology empowerment and environmental stakeholders are both important. With the digital transformation, enterprises improve their dynamic competitive capabilities, especially the capabilities of continuous innovation,

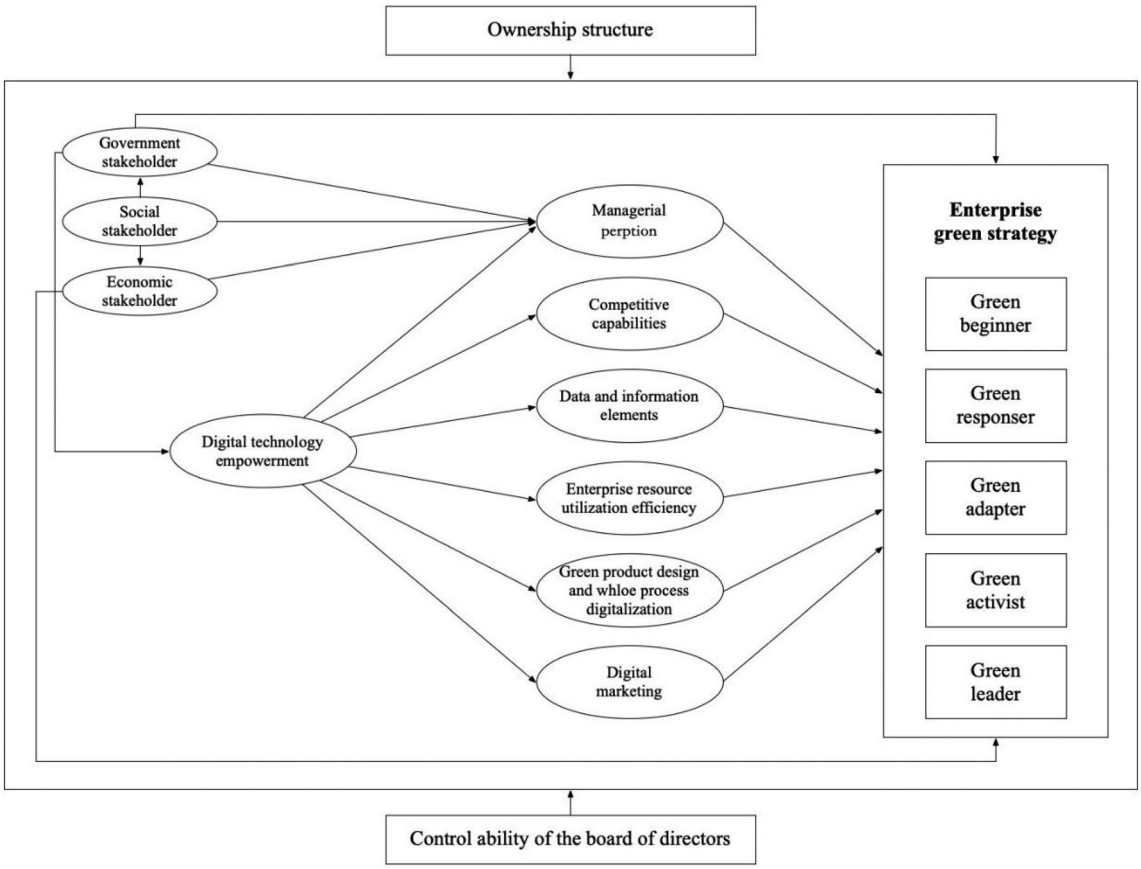

FIGURE 3 Comprehensive theoretical model of driving mechanism of enterprise green strategy evolution under digital technology empowerment

stakeholder integration, industrial chain integration, and intelligent manufacturing. Continuous innovation capability is an indispensable element for enterprises to win the market and implement green strategy. In the era of epidemic, enterprises need to use intelligent analysis of digital platform to find business opportunities. Moreover, enterprises can tap the value of data, embed the digital strategy into various functional departments, and realize the innovation of decision-making mode, R & D mode and business models (Wamba et al., 2017).

The government should actively promote the disclosure of enterprise environmental information empowered by big data platform, and provide information push about enterprise environmental violations and rectification for all stakeholders. This can help enterprises enhance their stakeholder integration capability.

The government can introduce policies to promote enterprises to realize the industrial chain integration mode driven by digitization. Through embedded digital technology, the government should take enterprises as the leading role, build an integrated model of cross-border services, expand the integrated services of upstream and downstream industrial chains, integrate multiple links such as online information exchange, transaction, logistics distribution and payment settlement, and innovate the whole chain service system. These help enterprises enhance the capability of industrial chain integration.

The results provide a basis for the global transformation from traditional manufacturing to green intelligent manufacturing. In view of the important impact of technological innovation, national incentive policies, new generation information technology, and talent cultivation on the transformation of enterprise green intelligent manufacturing (Meng & Zhao, 2018), enterprises should pay attention to realizing original innovation and establishing intelligent manufacturing technology innovation system. The government should also support the intelligent manufacturing transformation through fiscal and tax policies. Additionally, the government should cultivate a number of talents in the R & D field of intelligent manufacturing to provide "fresh driver" for the upgrading of green intelligent manufacturing.

This case study shows that data have become the main driving force for the innovation of new models and new business formats in the digital age, and enterprises can make use of big data to constantly explore new business models. The future business model can be driven by digital technology and continue to develop in a green and efficient way.

Enterprises can implement digital marketing through the transformation of digital business model. In order to ensure product quality traceability, digital marketing should be based on digital coding technology. With the empowerment of digital technology, the cultivation

of the above-mentioned competitive capabilities contributes to the evolution of enterprise green strategy.

Second, considering the positive moderating effects of corporate governance on the enterprise green strategy evolution, enterprises should improve the corporate governance mechanism. It is necessary to improve the relevant supervision and management mechanism, so that the proportion of independent directors should not only meet the requirement of one third, but also a standardized credit evaluation system should be established to ensure the independent role of the independent directors. In order to improve the control ability of the board of directors, we should emphasize a certain scale and diversity of the board of directors (Liu, 2012).

Third, this study verifies that, whether in the process of environmental stakeholders or digital technology driving the evolution of enterprise green strategy, managerial perception plays an important mediating role. Therefore, we should establish and improve the company's management incentive system to enable managers to play a more effective role. This study proposes that enterprises should emphasize equity incentive and non-material incentives, which can stimulate managers to behave from the long-term development of enterprises, and effectively promote enterprise green strategy.

From the perspective of managers' response, managers should realize the transformation from the empirical decision-making mode based on limited information under the traditional economic form to the digital decision-making mode based on massive data under digital technology empowerment as soon as possible (Erevelles et al., 2016). With the empowerment of digital technology, if entrepreneurs still rely on their own past experience to make decisions, their decision-making results may produce selective errors to a large extent due to the lack of information processing ability, which will affect the decision-making performance of enterprises. Under the digital economy, big data and increasingly mature data analysis technology provide a solid foundation for enterprises to conduct accurate business activities prediction. Therefore, managers should transform to the digital decision-making mode as soon as possible.

In addition, this study proposes that managerial perception of environmental expectations of environmental stakeholders is related to the evolution of enterprise green strategy. Therefore, managers should regard implementing proactive green strategy as an opportunity to create unique competitive advantage. The government should organize environmental trainings to consciously improve the environmental awareness of managers. More importantly, the government should and guide managers to regard abiding by environmental regulations as an opportunity for achieving innovative development. Managers should pay attention to leading enterprises to cultivate competitive capabilities (Christmann, 2000), which is conducive to the evolution of enterprise green strategy.

In the era of digital economy, the digital technology industry has become a fulcrum for transforming, empowering, and upgrading traditional industries. In the context of digital technology empowerment, the objectives of enterprises in formulating green business strategy are as follows: Actively participate in and realize digital transformation; rely on digital technology to improve the capabilities of continuous innovation, stakeholder integration, industrial chain integration, and intelligent manufacturing; launch more intelligent ecological solutions supported by digital technology, such as greenhouse gas tracking and carbon data management, so as to realize the "digital + green" goal of enterprises.

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CONFLICT OF INTEREST

We declare that we have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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ENDNOTES

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