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A study on digital transformation of SMEs from the perspective of information technology

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Abstract

Purpose – With the rapid development of information technology, the digital economy has become an important grip of the new development pattern, and the digital transformation of enterprises is a major trend. As SMEs are the mainstay of the economy and employment, it is important to study the digital transformation of SMEs to promote the development of the digital economy.

Research design, data, and methodology – Based on a resource-based view, this report analyses the current situation and issues of digital transformation of SMEs from the perspective of digital orientation as well as the breadth and depth of technological capabilities of enterprises, using data from a survey of 200 manufacturing enterprises in China.

Result – The results show that SMEs generally have a digital transformation mindset, but a weak digital foundation. In order to execute a digital strategy, companies need digital transformation capabilities. These behavioral capabilities are guided by the strategic direction of the business, and companies with strong capabilities are always trying to tap into the full digital potential.

Conclusion – In order to effectively promote the digital transformation of SMEs, we suggest that SMEs pay attention to digital capability building, make good use of digital platforms and network resources, and lay a solid foundation for digital transformation; meanwhile, we suggest that government departments play a guiding and supporting role to build a cross-industry and cross-sector digital synergy system to help promote the development of SMEs' digital transformation. This paper presents some suggestions from both the internal and external environment of the enterprise, with the expectation of contributing to the digital transformation practices of SMEs.

Keywords: Digital Transformation, Technological Capabilities, Breadth, Depth, Transformation Orientation

JEL Classification Code: M10, O14, O33

1. Introduction

With the rapid development of digital technology, the digitalization of enterprises has led to disruptive changes in traditional business models, and epidemics and environmental crises have accelerated the digital transformation of enterprises. It is a worldwide consensus that manufacturing is the core industry for solid economic health and maintaining national competitiveness. The manufacturing industry has long operated in a relatively stable environment. Rapidly evolving technologies have brought unprecedented opportunities and challenges to the manufacturing industry, and the ability of companies to leverage technology is key to achieving competitive advantage (Haleblian, McNamara, Kolev, & Dykes, 2012), so there is also a greater need for companies to create these capability resources and to make the right integration and configuration according to the environment to cope with possible future changes. As a result, the digital transformation of the manufacturing sector is receiving extreme attention from the government and industry, and its digitization is seen as the fourth industrial revolution. The government is encouraging companies to benefit from this wave of industrial revolution by undertaking digital transformation on a wider scale to cope with the turbulent business environment. In the process of digital transformation, manufacturing enterprises need to be able to apply a large number of intelligent industrial software, use and build a good industrial platform ecosystem, not only large enterprises need intelligent applications, as an important pillar of the national economy, SMEs also need to receive more attention. At present, due to the various crises, SMEs are in an unpromising state of operation, with shortages of raw materials, restricted working hours leading to order cancellations and tight cash flows. It is therefore important and relevant to explore the issue of resource allocation in the transformation process of SMEs compared to large enterprises with mature infrastructure and invested capital.

First, the academic field has begun to focus extensively on the relationship between digital transformation and business performance (Sebastian, Ross, Beath, Mocker, Moloney, & Fonstad, 2017; Frank, Mendes, Ayala, & Ghezzi, 2019), but mostly in the form of case studies exploring the impact of specific digital technologies on business performance impact, such as an operational backbone and a digital services platform, or the ease with which companies can approach markets and better predict growth through big data analytics. In the manufacturing industry, digital simulation has greatly facilitated new product development in the food industry and in the development of pharmaceuticals. Digital mining systems consisting of virtual and sensor technologies have facilitated real-time remote monitoring in the mining industry, improving safety and efficiency (Prinsloo, Vosloo, & Mathews, 2019). However, the use of digital technologies in digital transformation is not isolated and the explicit focus on assessing the impact of digitalization projects on manufacturing performance has not yet received sufficient attention (Felsberger, Qaiser, Choudhary, & Reiner, 2020).

Second, emerging technologies accelerate the complexity and uncertainty of change (Warner & Wäger, 2019), and research has found that firms' technological capabilities are an important resource needed in the process of improving organizational performance and developing innovations (Freel, 2005; Renko, Carsrud, & Brannback, 2009), and that firms' capabilities in the technological environment lie in their digital capabilities (Liu, Chen & Chou, 2011), which facilitate more product and service innovation in industrial firms (Blichfeldt & Faullantb, 2021). Therefore, based on a resource-based view (RBV), this paper collects data from 200 manufacturing companies in China to comprehensively assess the effectiveness of their digital capabilities in terms of the breadth (number of uses) and depth (degree of use) of their use of digital technologies, in order to achieve a more refined analysis and to answer two questions: (1) What are the challenges of digital transformation for SMEs? (2) How can SMEs' digital transformation address these challenges? This paper addresses this issue with SMEs as the research object and expects to contribute to the practice of digital transformation of SMEs.

This paper consists of six parts. First, we present the significance of digital transformation for SMEs and its theoretical basis in the first and second parts. The third part illustrates the current status of digital capabilities in the digital transformation process of SMEs through data from 200 Chinese manufacturing companies, the fourth part analyses the constraints of digital transformation in SMEs, the fifth part gives the results and recommendations, and the last part shows the research contribution of this paper and the outlook for future research.

2. Theoretical foundations

2.1. Digital transformation

Digital transformation is the process of improving an entity by triggering significant changes in its attributes through a combination of information, communication and connectivity technologies (Vial, 2019). Digital transformation

becomes a sustainable way for companies to meet market demands and improve their performance. Companies on the digital frontier are being pushed to new competitive heights, increasing profits and benefiting from them (Scott, van Reenen & Zachariadis, 2017), and the positive impact of digital transformation on business performance (Dalenogare, Benitez, Ayala, & Frank, 2018) has not only increased the efficiency of company operations but also expanded innovation efforts (Yoo, 2010).

Companies based on digital transformation are happy to embrace digital change quickly, are more open to technology and are committed to harnessing the power of technology by using digital technology to create stronger networks and data processing analysis between different business processes (Verhoef, Broekhuizen, Bart, Bhattacharya, Dong, Fabian, & Haenlein, 2019). Failed digital transformation not only stifles business resilience and growth, but also has a direct impact on business performance and sustainability. In the face of a volatile international and domestic business environment, as well as the severe impact of the new epidemic, the Chinese government has encouraged and vigorously promoted the digital transformation of enterprises, clearly stating that it will accelerate the promotion of digital industrialization and digital transformation of industries. Strategic orientation is seen as a corporate culture that reflects a philosophy of action to gain competitive advantage, a belief in promoting sustainable development and a direction for decision making, and the way it is positioned affects corporate performance. This study conceptualizes digital transformation as technological orientation in a digital context, based on Gatignon and Xuereb.

2.2. Digital capabilities

Research based on the support of RBV (Barney, 1991) found that digital capabilities are the main competencies of firms in a technological environment (Liu, Chen, & Chou, 2011), a set of conventional strategies to create differentiated value using digital assets (Grover & Kohli, 2012), and that in order to execute a digital strategy, firms need digital transformation capabilities (Warner & Wäger, 2019). Overall, we believe that digital technologies have a positive overall impact on capabilities and achieve higher industrial performance for firms, thereby contributing to sustainable competitive advantage (Dalenogare et al., 2018).

In industry, the application of virtual computing spaces and physical shop floor information has made manufacturing processes more transparent and efficient (Mladineo, Veza, & Gjeldum, 2017); the implementation of automated equipment has not only made production processes more efficient, but also improved product quality; and lean manufacturing (LP) practices complement Industry 4.0 technologies, allowing for greater performance improvements (Tortorella & Fettermann, 2018). In addition, the application of digital technologies such as the Internet of Things and Big Data has likewise had a positive impact on industrial operations (Gölzer & Fritzsche, 2017).

3. Study Design

This study surveyed 200 manufacturing enterprises in Jiangsu Province, China. The questionnaire consisted of three parts: basic information about the enterprises, their digital transformation orientation, and their digital capabilities (breadth and depth of technology application), with the aim of gaining an in-depth understanding of the current status of digital transformation in small and medium-sized manufacturing enterprises. In addition, this paper also conducts semi-structured interviews with managers of five enterprises to gain a deeper understanding of the research context during the fieldwork process.

3.1. Data Sources and Sample Composition

The research questionnaire consists of three areas: basic information about the company, digital transformation orientation and digital competence.

Firstly, the basic information of the enterprises includes the age of the enterprise, the size of the enterprise, the type of enterprise and the industry in which the enterprise is located. To ensure the variability and universality of the study results, we surveyed manufacturing enterprises in different industries such as chemical and petrochemical products, machinery and steel manufacturing, electronics and electrical equipment, medical devices and biopharmaceuticals; in an objective and rigorous manner, we first used 30 pilot enterprises for validation (the final study data did not include these 30), making minor modifications according to the actual situation so that respondents could accurately comprehend and correct responses. In order to improve the recall rate, we were assisted by government departments and industry associations with which we had partnerships to distribute the questionnaires, and also visited some older business owners to ensure that the questionnaires were correctly understood. A total of 243 questionnaires were

collected, excluding those with incomplete information and those with obvious patterns of answers, resulting in 200 valid questionnaires with a valid return rate of 82.3%. The data collected was processed using SPSS 26.0 statistical software and the basic characteristics of the sample companies are shown in Table 1. In general, the sample covered enterprises of different ages, types, sizes and industrial attributes, indicating that the sample of this study is representative.

Table 1: Demographic Characteristics of the Sample

Variables	Frequency	%
Firm age		
Below 10	32	16．0
11–30	118	59.0
Over 30	50	25.0
Ownership structure		
State-owned enterprise	16	8.0
Private enterprise	134	67.0
Foreign-owned enterprise	26	13.0
Joint venture	10	5.0
Others	14	7.0
Firm size		
Below 300	113	56.50
301–2,000	55	27.50
Over 2,000	32	16.0
Average annual sales		
Below 3 million	22	11.0
3 million–20 million	42	21.0
20 million—400 million	77	38.5
Over 400 million	59	29.5
Product category		
Consumer durables	15	7.5
Consumer non-durables	25	12.5
Complete industrial products	37	18.5
Raw materials/component industrial goods	50	25.0
Others	73	36.5

Note: N = 200.

Secondly, this study builds on Gatignon and Xuereb's (1997) conceptualisation of digital transformation as a technological orientation in a digital context (Khin & Ho, 2019), an orientation that focuses on technological investment, emphasises the introduction or use of new technologies to create value, reflects the firm's philosophy of action to gain competitive advantage, and is a belief and direction of decision making to promote sustainable development. The way it is positioned affects firm performance (Gatignon & Xuereb, 1997; Zhou & Li, 2010; Hakala & Kohtamäki, 2011). The digital transformation orientation measure is based on previous literature (Berman, 2012; Frank et al., 2019; Matt, Hess, & Benlian, 2015; Nasiri, Ukko, Saunila, & Rantala, 2020) and measures the action orientation of digital transformation in business operations through five items, which are: the firm's goal to digitize everything that can be digitized; businesses collect large amounts of data from different sources; businesses aim to use digital technologies to create stronger networks between different business processes to harness the power of technology; businesses aim to digitally enhance efficient customer interfaces to allow customers to experience more

three-dimensional services and pinpoint the resources they need; and businesses aim to enable digital information exchange.

Finally, we measure the digital capabilities of companies in terms of the breadth (number) and depth (degree) of technology adoption through ten technologies related to digitalization and Industry 4.0: industrial robots for manufacturing processes, industrial robots for handling processes, safe human-computer interaction technologies, additive manufacturing technologies for prototyping, additive manufacturing technologies for mass production, software for product planning and scheduling software, real-time production control systems, supply chain management systems, intralogistics automation and management systems, and product lifecycle management systems (Blichfeldt & Faullantb, 2021). In our survey, a company's non-adoption of this technology is indicated by a '1', and there are five levels of technology use from low to high, based on which the number of technologies implemented by companies ranges from a maximum of 10 to a minimum of 0; the highest level of technology use is 60.

3.2 Current Status of Digital Transformation in SMEs

3.2.1 Enterprise digital transformation orientation

The results are shown in Table 2. As the size of enterprises increases, the stronger their digital transformation orientation and the higher their evaluation of the utility of digital transformation, their bias towards technology investment and their emphasis on introducing or using new technologies to create value; compared to medium and large enterprises, small enterprises' digital transformation attitude is significantly less positive and carries a very strong uncertainty. In another empirical paper, I verified the significant positive relationship between digital transformation orientation and digital capabilities and firm performance. Combined with case interviews, small firms are highly influenced by epidemics and environmental policies and have more difficulties in their operations. This paper will give some suggestions in the next section to address these issues arising from the digital transformation process of SMEs.

Table 2: Enterprise Digital Transformation Orientation

	Micro		**Small**		**Medium**		**Large**	
	AVE	**SD**	**AVE**	**SD**	**AVE**	**SD**	**AVE**	**SD**
Digitizing everything that can be digitized	3.36	0.810	3.60	0.810	3.69	0.841	3.69	0.841
Collecting large amounts of data from different sources	3.76	0.926	3.86	0.730	4.21	0.520	4.21	0.520
Building stronger networks between different business processes	3.68	0.748	3.86	0.664	4.00	0.584	4.00	0.584
Efficient customer interface enhanced by digitalization for a more three-dimensional customer experience	3.68	0.748	3.81	0.692	3.98	0.643	3.98	0.643
Enabling digital information exchange	3.76	0.723	3.85	0.687	4.02	0.680	4.02	0.680

3.2.2 Enterprise digital capabilities (breadth and depth)

The breadth of digital technology use indicates one aspect of a company's digital technology level. This paper has counted the number of enterprises of different sizes using these data technologies through 10 technologies related to digitization and Industry 4.0, and the results are shown in Table 3. As enterprises continue to grow in size, they will give more consideration to investing more resources and adopting emerging technologies to facilitate their production and management, while the relative lack of resources and capital of small enterprises reflect a large gap in the breadth of technology use.

In addition, excluding the sample of large enterprises, the descriptive statistics for SME technologies also reflect the extent of technology use by enterprises (as shown in Table 4), which shows that technology 6, "software for production and scheduling", has a usage rate of over 70% (e.g. SAP and ERP systems such as UFIDA developed by China) and is widely used. At present, industrial production ERP is able to manage common business needs such as finance, sales and inventory, batch ordering, production management, multi-store operations, etc. from anywhere and anytime via PC/mobile phone, easily linking the whole chain of business management, and the extent of its use reflects the medium to high level of utilization of the technology's potential. We also found that "industrial robots for processing", "real-time production control" and "supply chain management and logistics automation systems" are also

widely used. The use of systems for large-scale production technology, large-scale additive manufacturing technology and lifecycle management is low.

There are also some differences between SMEs of different sizes, both in terms of transformation orientation and the digital capabilities of enterprises. Micro and small enterprises face a greater resource crisis than medium-sized enterprises, but medium-sized enterprises are under significantly higher pressure for digital transformation and technological innovation.

Table 3: Technology Breadth (number of uses)

	Micro	Small	Medium	Large
AVE	1.08	3.47	5.71	8.29
SD	0.909	2.186	3.638	2.617

Table 4: Technical Depth

Technologies	Technical depth					
	No-use	Lower	Low	General	High	Higher
1. Industrial robots for manufacturing processes	72.3	6.5	5.2	12.3	2.6	1.3
2. Industrial robots for handling processes	58.7	7.7	9.0	18.7	3.9	1.9
3.Technologies for safe human-machine interaction	81.3	1.9	3.2	9.0	3.2	1.3
4. Additive manufacturing technologies for prototyping	78.7	2.6	4.5	9.7	3.2	1.3
5.Additive manufacturing technologies for mass production	88.4	0.6	3.9	4.5	1.9	0.6
6. Software for production and scheduling	23.9	7.1	13.5	29.7	15.5	10.3
7. Near real-time production control system	56.8	7.1	11.0	10.3	10.3	4.5
8. Digital exchange of product/process data in supply chain	56.1	3.9	6.5	12.3	13.5	7.7
9. Systems for automation and management of internal logistic	41.9	8.4	9.0	20.0	12.9	7.7
10. Product-Lifecycle-Management system or product / process data management	72.9	1.9	11.6	13.5	–	–

4. Problems of digital transformation in SMEs

Enterprises use emerging technologies to make resource allocation more flexible, enabling them to be more agile in responding to turbulent business environments and facilitating their growth. (China) The National Industrial Information Security Development Research Centre reports that only 7% of enterprises have successfully transformed, and the failure rate of digital transformation in traditional enterprises is as high as 70%-80%. The lack of funds, talent shortage and low digital level have become influencing factors that stifle successful transformation, and even more so, they have become excuses that restrict the digital transformation of SMEs. In this article, we have taken a survey to understand the current situation of digital transformation of SMEs from the perspective of enterprises' technological capabilities, and in general, we found that the reality may not be as bad as we think.

Firstly, by investigating the digital transformation orientation and digital capabilities (breadth and depth) of manufacturing companies, this paper finds that SMEs perceive the implementation of digital transformation as positive and the cost of achieving it as expensive. However, although SMEs have obvious resource disadvantages, their flexible and resilient organizational structure, highly centralized business decision strengths and dedicated and refined market strengths can be enablers in the transformation process compared to larger enterprises. SMEs should identify their own strengths and weaknesses, eliminate uncertainty about the transformation, and look at the digital transformation of their enterprises scientifically. They should neither stick to the rules nor seek to be big, but must do a good job of transformation according to their own characteristics and strengths.

Secondly, we know from our analysis that the usage rate of "software for production and scheduling" exceeds 70% (e.g. SAP and China's own developed ERP systems such as UFIDA), which is a good indication that industrial

production ERP is widely used. If the level of use goes further, this will be very important for the implementation of the next transformation strategy. The digital platform, for example, would integrate front-end web systems and back-end enterprise resource planning (ERP) systems to support e-commerce initiatives through different partners (Zhu & Kraemer, 2015).

Finally, this paper also found that supply chain management as well as logistics automation systems are also well used, which is not easy for resource-constrained SMEs. Based on interviews with five company managers, we found that this may be related to the sample from the same region, where the stainless-steel industry chain is known to have been selected as one of the national Top 100 industry clusters, with the government taking the lead in planning an integrated logistics park, which is important in promoting the optimization and upgrading of the industry and helping SMEs with their digital transformation.

5. Digital Transformation Response for SMEs

Once again, the findings show that SMEs are small and have limited capital, and due to the pressure of various crises such as epidemics, environmental and economic crises, it can be argued that without transformation or failure to transform, many SMEs will struggle in an increasingly complex business environment. In this paper, based on a resource-based view and through the lens of information capability, through the data collection and analysis of manufacturing companies, we found that the biggest challenge in facing digital transformation is the lack of resources. Through statistical data analysis and targeted in-depth interviews with some companies, we found some other meaningful gains, therefore, we give relevant recommendations in the context of SME transformation, hoping to give practitioners some insights.

5.1 Digital Transformation Response for Enterprises

5.1.1. Properly Understanding Digital Transformation and Choosing the Right Transformation Path

We are entering the digital economy, and with the rapid development of digital technologies, digital transformation has become a sustainable way for companies to meet market demands and improve their performance. Research has shown that digitally transformed companies improve business performance by opening up customer engagement, streamlining operations, creating new business models, etc., and are otherwise highly vulnerable to being beaten by competing companies implementing such strategies (Ong & Chen, 2013), and many industry reports analyzing digital transformation in industrial environments claim that successful digital transformation initiatives lead to improved and sustained performance (Kane et al, 2015; Dalenogare et al., 2018; Vial, 2019). It is therefore important that SMEs recognize the current form and neither turn a deaf ear to superficiality nor rush the transformation with a fixed timeline. Digital transformation is a long-term strategic planning and implementation process, and each company's transformation path is unique and dynamic, encompassing not only the use of technology, but also the specification of organizational strategies and business processes, which are fundamental factors that cut across many aspects of the company's daily management, manufacturing and even supply chain.

At present, digital transformation is still in the development stage, and both developed and developing countries are in the exploration period. Our government attaches great importance to the integration and application of new-generation technologies and has made a series of deployments at the national strategic level, which further illustrates the forward-looking and strategic nature of the government's work, helping to foster the digital orientation of enterprises, accelerate their acceptance of new digital technologies and assist them in successful transformation. It also shows that SME management should pay attention to and seize the national policy dividend, learn more about the latest transformation dynamics and support benefits, and at the same time, guide enterprises to improve the digital quality of their employees through technical training and continuing education to reduce grassroots resistance in the transformation process.

5.1.2. Enhancing the Digital Infrastructure Capacity of the Manufacturing Industry and Rationalizing the Use of Shared Resources

Businesses need to continuously develop and adopt digital technologies, and there are studies showing that technologies related to data and software can facilitate business innovation and help companies achieve superior performance (Blichfeldt & Faullantb, 2021). Although the implementation of basic technologies such as big data and analytics is still inefficient for small and medium-sized manufacturing companies, in the case of manufacturing companies, smart manufacturing is central to the realization of Industry 4.0 for manufacturing companies (Frank et

al., 2019). On the one hand, fledgling SMEs need to build a solid foundation of hardware and software, starting slowly with in-depth and expanded software that meets the enterprise's development of inventory and sales functions. On the other hand, China's manufacturing industry is showing a good momentum of high-end, intelligent and green development, with the capacity layout of some major companies in the fields of welding robots, collaborative robots and small multi-joint robots being upgraded. (China) Data from the National Bureau of Statistics shows that domestic industrial robot production in August 2021 increased by 57.4% year-on-year; domestic industrial robot production from January to August increased by 63.9% year-on-year. The country encourages independent research and development, science and technology, and its own brands, which is a boon for SMEs to be able to invest resources at low cost. At the same time, China has promoted the digital infrastructure of SMEs through new infrastructure, helping enterprises to successfully transform.

In summary, in the face of a turbulent business environment, the Chinese government has encouraged and vigorously promoted the digital transformation of enterprises, and in recent years China's digital leaders have continued to create new growth points. SMEs need to proactively seek opportunities to take advantage of the data sharing platforms provided by the government and large enterprises, integrate resources within industry clusters, and start with relatively easy and low-investment links according to their own development needs. By establishing close collaborative relationships with large enterprises through specialized production, SMEs not only strongly support and promote the development of large enterprises, but also provide a reliable basis for their own survival and development.

5.1.3 Highlighting the Operational Strengths of the Business and Encouraging Partial Transformation

Due to their small scale and relatively limited human, financial and material resources, SMEs are unable to form a scale effect. However, focusing on niche markets and improving operational efficiency through specialized production is one of the most effective ways for many SMEs to survive and develop in the face of fierce competition. Each of them plays a role in production, design, logistics, sales and service, providing supporting support for the upstream and downstream of the industry chain. Therefore, SMEs can also consider focusing their limited resources on key business areas to increase their market share.

For example, SMEs have always adhered to the concept of low cost, but in the face of the epidemic and environmental crisis, the impact of emerging technologies and the challenge of new economic thinking, this pressure for survival also happens to give SMEs an opportunity to adjust passively, and companies need to cater to the development trend with consumer orientation. We have been pursuing technology to drive manufacturing processes and add value, and sterilization is seen as a new trend that is changing industrial companies (Frank et al., 2019), focusing mainly on adding value to customers and allowing them to experience a more precise and three-dimensional service. Digital sales have been shown to be the most popular transformation method for SMEs. SMEs with low digital maturity transform digitally in their sales function and generate revenue by creating a customer experience.

Overall, in order to effectively promote the digital transformation of SMEs, it is recommended that SMEs pay attention to digital capacity building, make good use of digital platforms and network resources, solidify the foundation of digital transformation, and make rational use of their own and external resources to transform scientifically. At the same time, it is recommended that government departments play a guiding and supporting role to build a cross-industry and cross-departmental digital collaboration system to help promote the development of SMEs' digital transformation.

5.2 Measures to Improve the External Environment for SMEs' Digital Transformation

At present, digital transformation is still in the development stage, with both developed and developing countries in the exploration period. Our government attaches great importance to the integration and application of new generation technologies and has made a series of deployments at the national strategic level, which further demonstrates the forward-looking and strategic nature of the government's work, helping to foster the digital orientation of enterprises, accelerate their acceptance of new digital technologies and assist them in successful transformation.

5.2.1 Focusing on the Systemic Construction of Enterprise Digital Transformation

In recent years China's digital leaders have continued to create new growth points, but the average digitalization rate in the manufacturing sector is not yet high. As SMEs with relatively few resources cannot blindly follow the trend, they need to establish a solid technical foundation through scientific guidance, enhance their digital business support capabilities and their ability to create with technological resources. They should not easily deliver digital answers with high expectations, but perceive, capture and deploy relevant resources better, and actively promote the transformation and upgrading of their enterprises in order to seize and exploit the ever-changing opportunities.

Therefore, the government should focus on the systematic construction of the digital transformation of enterprises, according to the internal and external environment and the current situation of the development of enterprises, and clearly define the positioning and objectives of the stage of development, so as to promote the construction of the digital transformation system of SMEs in a purposeful and planned manner and help them develop sustainably. Firstly, the government can organize training programmes for enterprise managers to provide them with opportunities to learn and share, through iterations and interactions between learning to achieve a break from old perceptions and thinking patterns and update management cognition. Secondly, build a cross-industry and cross-sector digital collaboration system to help SMEs expand and solidify their social networks, guide enterprises in the region to not only compete with each other but also learn and cooperate with each other, and developing industrial clusters and industrial zones as a carrier of industrial agglomeration can play a good role in economic enhancement, driving SMEs to better participate in the division of labour in global industrial and value chains. Third, strengthen the construction of SME service system, actively play the role of industry associations and intermediary organizations, unite the power of business, science and technology, finance and universities to provide information, market, financing, training, rights protection and other extensive and quality services for the digital transformation of private enterprises, so as to assist the smooth transformation of enterprises. Fourthly, we should emphasize the introduction of talents and give full play to their role, and strengthen relevant incentive policies to promote the training of digital talents and the enhancement of enterprises' technological innovation capabilities.

5.2.2 Integration of the digital and environmental economies

Environmental degradation has become a worldwide problem. Stakeholders exert enormous pressure on organizations to minimize the impact of their production activities on the environment. Around the world, business trends are changing rapidly due to the competitive environment and it is not enough to earn profits and gain a competitive advantage. Organizations must also be responsible for the environmental impact, especially in the manufacturing sector. In this context, China's Ministry of Industry and Information Technology has implemented industrial low-carbon actions and green manufacturing projects around the carbon peak and carbon neutral target nodes, developed action plans and roadmaps for carbon peak in key industries, encouraged industrial enterprises and parks to build green microgrids, economically use of renewable resources, and built green factories and green industrial parks in various industries and regions to accelerate the green and low-carbon transformation of industry.

At a time when the energy efficiency management market is witnessing tremendous development opportunities, electrification and digitalization, as the recognized mainstream direction of energy efficiency management, have become a must for enterprises in the relevant industries. In the era of digital economy, how to use internet platforms and digital technology to promote green and sustainable development of the economy and society will become another important issue. The internet and digital technology provide more convenience and opportunities, and the nature of their openness, interactivity and real-time makes up for the lack of environmental monitoring and governance in the past. The integration of the digital and environmental economies will therefore become a fresh start in promoting the healthy and stable development of our country.

6. Summary and research outlook

6.1 Summary

In the era of digital economy, with the continuous development of a new generation of information technology, production enterprises are facing an industry reshuffle, and traditional production enterprises can no longer keep pace with the development of the times, so promoting the digital transformation of factories is the general trend. Actively promoting the deep integration of a new generation of information technology and manufacturing, and vigorously developing advanced manufacturing and intelligent manufacturing, will be an important initiative commonly taken by countries around the world. Small and medium-sized enterprises (SMEs) are an important subject in promoting sound socio-economic development and are also the backbone of China's innovation and development. In order to promote the development of the digital economy, it is very important to study the digital transformation of SMEs.

The Resource-Based View (RBV) finds that the competitive advantage and superior performance gained by firms derives from the organization’s unique and they are some resources and capabilities that cannot be easily imitated, which explains the differences in performance between firms. In this regard, strategic orientation is seen as a corporate culture that reflects a philosophy of action to gain competitive advantage, a belief in promoting sustainable development and a direction for decision making. Digital capabilities are the main competencies of a company in the

technological environment and are a set of conventional strategies for creating differentiated value using digital assets. In order to execute a digital strategy, companies need digital transformation capabilities. These behavioral capabilities are guided by the strategic direction of the company, and companies with strong capabilities are always trying to tap into the full digital potential. Overall, the theoretical contribution of this study is that we have introduced the new terms "digital transformation (orientation)" and "digital capabilities" to further extend the resource-based theory by conceptualizing digital transformation as a driver of firm performance.

The practical contribution of this report lies mainly in: based on the resource-based view (RBV), the current situation and problems of digital transformation of SMEs in China are analyzed from the perspective of information technology. Through the data collected from manufacturing enterprises, the effectiveness of digital capabilities is comprehensively assessed in terms of the breadth (number of uses) and depth (degree of use) of digital technologies used by enterprises, and the issues of transformation orientation and technology use capabilities in the digital transformation of Chinese SMEs are analyzed in a more refined manner, and from the internal and external environment of enterprises, some suggestions are put forward.

6.2 Research limitations and research prospects

This paper is based on a resource-based view, and from an information capability perspective, some meaningful take-aways were obtained through data collection and descriptive statistical analysis of manufacturing companies. There are some limitations to this study that need to be further explored.

Firstly, the limitations of the data are that this paper is limited to manufacturing enterprises in a particular region of China, whereas a longitudinal study with multiple sources of data and validation in multiple research contexts may be more conducive to the conclusions drawn; secondly, as a further extension of this paper, we should explore the drivers of digital transformation and the relationship between the digital capabilities (breadth and depth) of enterprises and their performance in the broader context of digital transformation through an empirical approach relationship, delve into the boundary conditions of digital transformation, and provide more detailed insights through quantitative analysis into how enterprise capabilities may change after the implementation of certain technologies, which has important theoretical and practical implications for the digital transformation path of manufacturing enterprises. Finally, we would prefer to further explore issues related to digital transformation of enterprises by combining multidisciplinary theories.

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