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Leveraging Digital Capabilities for Enhancing Innovation Performance of Cross-border E-commerce Enterprises

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Abstract. In the digital economy era, enterprise digitalization is the main source of sustainable competitiveness. Cross-border e-commerce (CBE) has become the new power of China's foreign trade growth. The in-depth integration of CBE and the manufacturing industry helps stimulate the vitality of traditional industry innovation. Following the logical chain, this paper examines how digital capabilities promote innovation performance of cross-border ecommerce enterprises through value co-creation mechanisms and under influence of network embeddedness (NE) of firms.Survey data from 626 small and medium manufacturing enterprises in China was analyzed using structural equation modeling technique. Results indicate digital capabilities enhance innovation outcomes both directly and indirectly via mediating effects of customer and supplier value co-creation. NE positively moderates these relationships such that highly embedded firms exhibit greater capability building through participation.The study provides guidance to cross-border e-commerce enterprises on how to strategically develop digital capabilities, strengthen network ties, and foster partnerships to boost innovation capacities.

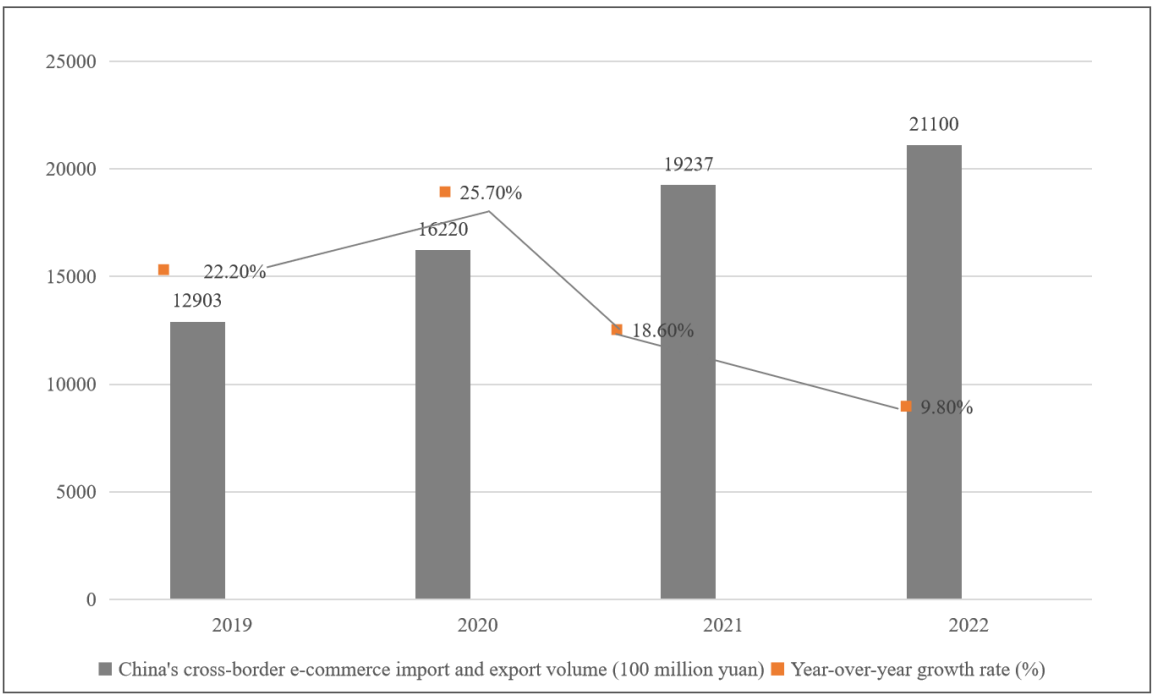
Keywords: digital capabilities, value co-creation, innovation performance, network embedding

1. Introduction

With the arrival of the knowledge economy era, innovation is essential to promote a sustainable competitive advantage. Although China has achieved significant development in patent applications and authorizations, there is a lack of independent innovation and the core technology "neck" phenomenon; the level of innovation needs to be further improved.

One of the main challenges today is adapting to technology in an industrial revolution with a digital nature (Schwab, 2017). An effective strategy to achieve this goal is to engage in digital exporting by using e-commerce to enter new international markets (Pergelova et al.,2019). China is the world's largest commodity trading country, and Cross-border e-commerce (CBE) has become a significant driving force and a "new engine" for foreign trade growth (Guo, Sivi, et al., 2018). Facing various uncertainties in China and abroad, the CBE model has attracted traditional enterprises to transform into this new model to stimulate the innovation vitality of the traditional industry

By the end of 2020, China's export share of CBE accounts for 77.6% of its market size (Chen et al., 2022). According to customs data, in 2022, China's imports and exports of CBE reached 2.11 trillion yuan, with a growth of 9.8% by the year, of which exports were 1.55 trillion yuan, an increase of 11.7% (Figure 1). B2B accounts for 77.3% of export transactions, and industrial products reach over 90% of exports.



Source: General Administration of Customs

Fig 1. China’s cross-border e-commence import and export volume and growth rate from 2019 to 2022

However, after analyzing its development situation in China, it can be found that there are some pain points, such as low-end products, low value-added commodities (Jiang Zifen et al., 2023), the predicament of solid manufacturing and weak branding (Li Tian et al., 2019), the severe homogenization of products, the reduction of large orders and so on. Whether enterprises can transform successfully depends on the enterprise's digital capabilities, which are embedded in all processes and permeated in the business management process (Chi Renyong et al., 2022). Therefore, CEBC needs to innovate urgently their products, services, and business models and to improve their innovation performance, which is the core issue to be resolved.

Based on the dynamic capability theory and business ecosystem theory, this paper constructs digital capability as the independent variable, VCC as an intermediary variable, network embedding as a moderating variable, and EIP as a dependent variable of the theoretical framework. It guides cross-border e-commerce enterprises on strategically developing digital capabilities, strengthening network ties, and fostering partnerships to boost innovation capabilities.

2. Theoretical Background and Research Design

2.1. Dynamic Capability Theory

Dynamic capability emphasizes that enterprises can have sustainable competitive advantages only if they entirely use their resources and form dynamic capabilities to respond to environmental changes (Teece, 1997; 2007). Among them, dynamic capability refers to the ability of enterprises to create, expand, or change their resource base purposefully (Helfat et al., 2009). Even though studies related to the resource-based view point out that firms that are limited in resources can have and need to cooperate with external resource holders (Pfeffer and Salanck, 1978), the main emphasis in the cooperation process is on the control of resources (Hallen, 2014; Jansen, 2006). Dynamic capabilities can help organizations collect and process information in the shortest possible time, integrate digital resources, rationally help organizations make business decisions, dynamically manage the organization's database, achieve organizational innovation (Perry-Smith & Mannucci, 2017), create new business value for organizations (Rialti et al., 2019).

2.2. Digital capabilities

Digital capabilities are seen as the primary source of competitiveness and the foundation of digital transformation for enterprises. Scholars have defined its meaning from multiple perspectives, such as competence, strategy, and value. Khin & Ho (2018) consider it to be the skills and knowledge of firms to manage digital technologies for new product development. Warner and Wager (2019) define it as the collection of routines for strategizing by leveraging digital assets to create differentiated value. This paper agrees with Annarelli et al. (2021) study that defines it as the organizational ability of a firm to extensively combine digital assets and business resources, leverage digital networks, and innovate products, services, and processes for organizational learning and value creation, and to gain sustained competitive advantage through managerial innovation.

Regarding its dimensions, there are studies from the aspect of digital technology (Lenka, Parida, & Wincent, 2017; Ritter & Pedersen, 2020), from the role and impact of abilities as well (Jing Hao, Liu Ya, & Xu Xianying ,2017). In this paper, digital capability is divided into three dimensions: digital perception capability (DP), digital connectivity capability (DC), and digital analytic capability (DA). DP refers to the enterprise's hardware platform and software system as a carrier, digital production, process digitization, and service digitization. DC refers to the ability of exponential products to connect with the Internet, reflecting the interconnection of all things. DA refers to the ability of enterprises to identify and screen out adequate data, use analytical models and hardware tools, etc.

2.3. Digital Capability and Enterprise Innovation Performance

The enterprise can use new technology to embody its products or services, redesign the internal supply chain to optimize the business process, or find new partners to realize the business model of technological innovation. Applying digital technology can provide enterprises with a new way of creating value. Integrating information technology and physical components facilitates the development of new processes and products (Zhang, Sheng&Yang, Qian, 2021). DP enables enterprises to apply digital technology to production, service, and sales, thus optimizing the process and improving the efficiency of information collection, organization, and enterprise information transmission. DC can quickly open up the internal links and enhance the connection between the

enterprise, the consumer, and the value chain (Guan Yungfang et al., 2022). DA can promote the enterprise to optimize the knowledge management mode, externalize the participation in open innovation, and systematically improve the supply capacity, which makes the diversity and scientificity of enterprise resource allocation, thus enhancing the enterprise's innovation strength in product innovation, operation innovation, and system innovation, which is ultimately manifested in the enhancement of the enterprise's innovation performance.

Based on this, the following hypotheses can be made:

H1a: Digital perception capability positively affects innovation performance.

H1b: Digital connectivity capability positively impacts innovation performance.

H1c: Digital analytic capability significantly affects innovation performance.

2.4. The mediating role of value co-creation

Once the concept of VCC was put forward, it received extensive attention and achieved fruitful research results. Scholars have explored it from multiple perspectives, such as marketing, management, and innovation ecosystems. The adoption of VCC in different industries also shows the proliferation of various concepts, customers from the passive target of marketing activities, transformed into a contributor and creators in the process of value creation (Vargo and Lusch, 2004; Tapscott and Williams, 2006), with further research, the participation of stakeholders has gained the attention of scholars, and the object of co-creation has also been expanded from the interaction between enterprises and individuals to enterprises and enterprises. The main body of co-creation has also evolved into a dynamic and complex multinational network, and the co-creation has shifted from the product to the value and finally to the brand (Sarkar & Banerjee,2023).

In the digital era, firms face more complex competitive environments and need more heterogeneous resources to meet market demands. The digital capabilities enhance their connectivity, generate more cross-border synergies, and thus acquire more data resources and gradually form sustainable development advantages. The digitization of products or services significantly impacts enterprises' value creation (Rachinger et al., 2018).

Customers are considered resources in innovation, providing ideas to develop new products or services. With the development of Internet technology, customer participation has shifted from offline to online. Through the information network platform, customers can more conveniently join in the development of new products, which can improve the efficiency of innovation (Fang, Palmatier & Evans, 2008; Souder, Buisson & Garrett,1997), and the innovation performance of the enterprise is the result of innovation, i.e., the results of innovation activities carried out by enterprises to bring the results of the feedback, so customer engagement will have a positive impact on EIP.

With in-depth research, VCC, based on the business ecosystem as a carrier, has become a new paradigm for market competition and CBE ecosystems (Xue Chaocai, 2023). In different industries, suppliers are recognized as the primary source of innovation and market knowledge (Kim & Wilemon, 2002). In a manufacturing outsourcing environment, core firms and outsourced suppliers establish a highly trusting partnership, where both parties collaborate based on shared goals and effective coordination mechanisms and respond quickly and efficiently to customer needs in a shorter period. Suppliers ' use of VCC can shorten product development cycles, reduce development costs, improve and enhance product quality, increase the effectiveness of R&D, and thus enhance firms' innovation performance.

Based on this, the hypotheses can be made as follows:

H2a-H2c: Digital perception (connectivity, analytic) capabilities positively affect customer engagement value co-creation.

H3a-H3c: Digital perception (connectivity, analytic) capabilities significantly impact supplier engagement value co-creation.

H4a-H4b: Customer (supplier engagement) value co-creation mediates the relationship between

digital capabilities and innovation performance.

2.5. The moderating role of network embedding

NE was first proposed by Granovetter in 1985. Bonner, Kim, and Cavusgil (2005) define it as "the extent to which trust, mutuality, and flexibility are utilized to facilitate a firm's alliance relationships." Scholars classify it into relational and structural embeddedness (Granovetter, 1992). Good structural embedding is conducive to functional complementarity, ability matching, synchronous value creation among value co-creators, and a dynamic transmission mechanism. At the same time, relational embeddedness emphasizes trust, the frequency of interactions, and the degree of relationship with the partner firms (Wei & Xu, 2014). The degree of relational embeddedness reflects the position of enterprises in the network and can bring rich resources for VCC activities (Bao Fengnai & Peng Zhengyin, 2015); as the strength of inter-organizational relationships increases, the cognitive gap between managers and the uncertainty among participating subjects due to organizational differences can be effectively reduced, contributing to the realization of inter-organizational VCC（Liu, Xiaolang, Liu, Shanshi, & Wang, Hongli, 2016) and form closer cooperative relationships with each other, which helps to co-create new value in subsequent cooperation. In conclusion, the higher the degree of embeddedness in the enterprise's network, the easier it is to access digital resources within the network and realize accurate matching of resources and capacity.

Thus, the following assumptions are proposed:

H5a-H5c: Network embedding positively moderates the influence of digital capabilities (perception, connectivity, and analytic) on customer engagement value co-creation.

H6a-H6c: Network embedding positively moderates the influence of digital capabilities (perception, connectivity, and analytic) on supplier engagement value co-creation.

Based on the assumptions, a theoretical model of cross-border e-commerce enterprises' digital capability and EIP is constructed (as shown in Figure 2).

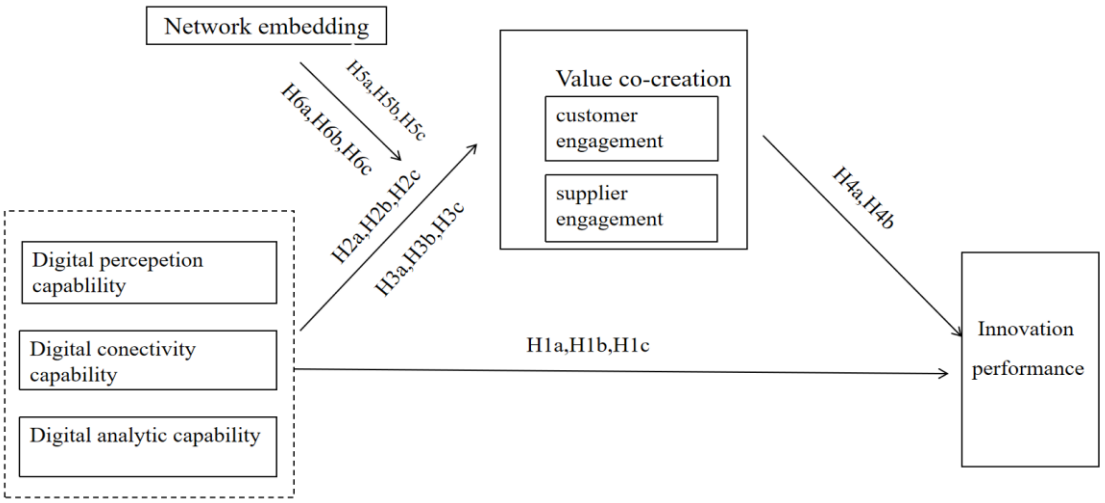


Fig 2. Theoretical model

3. Research Methods

3.1. Questionnaire Design and Data Collection

This paper adopts the questionnaire survey method to collect data. To guarantee reliability and validity, the questionnaire was distributed to top managers (CEOs, CDOs, etc.) and middle managers

(in charge of product development and e-commerce departments).

From August to November 2023, data collection was conducted in two stages. First, a pre-survey was conducted in Henan, and 80 valid questionnaires were recovered and analyzed for reliability and exploratory factor analysis. The results showed that the scale had good reliability and validity. Then, the formal research was conducted in Guangdong, Shandong, Henan, Fujian, and Zhejiang provinces, of which the import and export value accounted for more than 65% of the total and are located in the northern, central, and southeastern regions of China. The population was divided into different groups according to specific characteristics, and then samples were randomly selected within quota sampling (Cui yingan et al., 2014). One hundred fifty questionnaires were randomly distributed to export enterprises in each of the five provinces, which were selected in the list of the Small and Medium-sized Enterprises Association and E-commerce associations. Seven hundred fifty questionnaires were distributed. Besides the invalid samples, 626 valid questionnaires were obtained, with a validity rate of 83.5%. The electronic questionnaires were randomly distributed to enterprises, and the data were collected mainly by Questionnaire Star. Statistical tools were used for descriptive statistical, reliability and validity analysis, confirmatory factor analysis, SEM model, and mediation effect model analysis.

3.2. Variable Measurement

The measurement of each variable was modified according to the actual situation of CBEC in China and concerning the studies of scholars. The scale of digital capabilities was determined as 14 question items concerning the studies of Nasiri et al., (2020), Chi, Renyong & Zhu, Rui (2022), Yi et al., (2022), Seven questions are proposed to measure EIP, according to studies of Frenz&Ietto-Gillies (2009); Mardani, (2018); Xie Hongming et al. (2012). Customer engagement VCC is classified into three types, including information sharing, responsible behavior, and interaction, with a total of five items (Fang et al.,2008; Yao, 2016; Yi & Gong, 2013). VCC is designed as 9 topic items for supplier engagement with the DART model (Prahalad & Ramaswamy, 2004; Ren Jifan et al., 2014). Regarding NE, reference to Gilsing (2008); Uzzi (1997), it is measured with 5 question items.

3.3. Homogeneous variance

There may be a problem of common methodological variation because of the same subjects or data sources, similar measurement situations, everyday item contexts, and the item's characteristics (Podsakoff et al., 2003). To minimize the impact of common methodological variation, this paper uses program control and post-tests to ensure the authenticity of the data， such as anonymity and psychological isolation (Pang Tai-kwang et al., 2006). Harman's one-way test was also used to test the homogeneity of the data. After testing, the results show that the amount of variation that the first factor can explain is 34.884%<50%, so there is no significant homogeneous variance problem.

4. Empirical Research

4.1. Reliability and validity test

Advanced statistics software was used to test the reliability of the sample, and the results are shown in Table 1. Cronbach's alpha of each scale is higher than the critical value of 0.7, which indicates that the scales in this paper are reliable. All the CR values of variables are higher than 0.7, and the AVE value is higher than 0.5, which indicates good convergent validity (Fan Jingbo,2018). The square root of the AVE of any variable is greater than the value of the correlation coefficient with the other factors, so the discriminant validity of the factors within each variable is good (Fornell & Larcker,1981).

Table 1. Reliability and vadility analysis

variable	Items	Corrected Item-Total Correlation (CITC)	Cronbach Alpha if Item Deleted	Cronbach α	CR	AVE
Digital capabilities	DP1	0.779	0.896	0.914	0.914	0.64
	DP2	0.748	0.9			
	DP3	0.77	0.897			
	DP4	0.759	0.899			
	DP5	0.74	0.901			
	DP6	0.753	0.899			
	DC1	0.727	0.839	0.874	0.874	0.634
	DC2	0.717	0.843			
	DC3	0.75	0.83			
	DC4	0.722	0.841			
	DA1	0.698	0.846	0.872	0.872	0.63
	DA2	0.719	0.838			
	DA3	0.749	0.826			
	DA4	0.735	0.832			
Value co-creation	CE1	0.766	0.874	0.9	0.9	0.642
	CE2	0.752	0.877			
	CE3	0.748	0.878			
	CE4	0.75	0.878			
	CE5	0.737	0.881			
	SE1	0.763	0.932	0.939	0.939	0.631
	SE2	0.774	0.932			
	SE3	0.753	0.933			
	SE4	0.753	0.933			
	SE5	0.788	0.931			
	SE6	0.757	0.932			
	SE7	0.79	0.931			
	SE8	0.766	0.932			
	SE9	0.758	0.932			
Innovation performance	EIP1	0.749	0.905	0.917	0.918	0.614

	EIP2	0.77	0.902			
	EIP3	0.738	0.906			
	EIP4	0.713	0.908			
	EIP5	0.755	0.904			
	EIP6	0.729	0.907			
	EIP7	0.763	0.903			
Network embedding	NE1	0.771	0.93	0.937	0.937	0.652
	NE2	0.786	0.929			
	NE3	0.768	0.93			
	NE4	0.766	0.93			
	NE5	0.788	0.928			
	NE6	0.784	0.929			
	NE7	0.793	0.928			
	NE8	0.77	0.93			

4.2. The direct effect

This paper constructs a structural equation model（SEM) of digital capabilities and EIP, which is used to test the causal relationship between the variables (Hoe, 2008a), as shown in Figure 3. Thec2/df is 1.095< 3, indicating a good model fit (Kline, 1998). The GFI, NFI, TLI, and CFI are all above 0.9, and the RMSEA is 0.012<0.05 (Kelly & Walton, 2021). All the fitting indexes are per the research standard （Table 5), so it can be assumed that this model is a good fit. Path analysis shows that DP has a significant positive effect on EIP (β =0.149, P<0.05), so H1a is supported. DC significantly affects EIP (β =0.209, P<0.05), so H1b is supported. DA has a significant positive effect on EIP (β =0.228, P<0.05), so it supports H1c and the main causal effect is established.

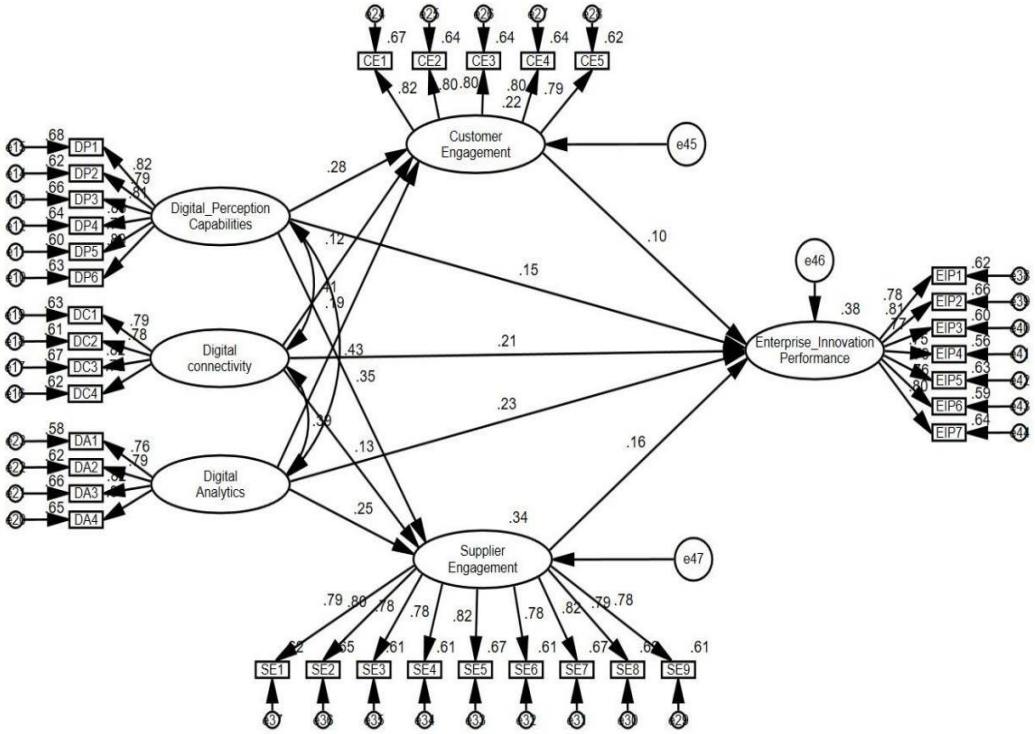


Fig 3. SEM of the study

Table 2. Model Fit Index

CMIN	df	CMIN/DF	NFI	IFI	TLI	CFI	GFI	RMSEA
597.767	546.000	1.095	0.959	0.996	0.996	0.996	0.949	0.012
Stata Criteria		<3	>0.8	>0.9	>0.8	>0.9	>0.8	<0.08

Table 5 Pearson Correlation

	Mean	Std. Deviation	Digital Perception Capabilities	Digital connectivity	Digital Analytics	Customer Engagement	Supplier Engagement	Network Embedding	Enterprise Innovation Performance
Digital Perception Capabilities	3.254	1.049	1						
Digital connectivity	3.312	1.044	0.370**	1					
Digital Analytics	3.333	1.054	0.387**	0.345**	1				
Customer Engagement	3.340	1.036	0.369**	0.274**	0.311**	1			
Supplier Engagement	3.305	1.022	0.470**	0.342**	0.407**	0.361**	1		
Network Embedding	3.298	1.039	0.391**	0.364**	0.412**	0.382**	0.398**	1	
Enterprise Innovation Performance	3.361	1.002	0.417**	0.404**	0.432**	0.335**	0.424**	0.448**	1

* $p<0.05$ ** $p<0.01$

4.3. Moderating effects

The results show that, in model 2, NE has a significant positive regulating effect (t=6,277, p=0.000<0.05) in the path of influence of DP on customer VCC, NE has a significant positive regulating effect (t=4.813, p=0.000<0.05) in the path of influence of DC on customer VCC as well. It also has a significant positive moderating effect on the influence path of DA on customer VCC (t=4.732, p=0.000<0.05). Network embedding has a significant positive moderating effect on the path of influence of DP on suppliers' participation VCC (t= 6.881, p=0.000<0.05). It has a significant positive moderating effect on the path of influence of DC on supplier engagement (t= 5.950, p=0.000<0.05), and NE has a significant positive moderating effect on the path of influence of DA on suppliers' participation VCC (t=6.021, p=0.000<0.05).

4.4. Moderated mediating effect

Based on 5000 Bootstrap replicated sampling, a Process program was used to test the mediating effect. VCC partially mediates between the dependent and independent variables, as CI does not include 0 at a 95% confidence interval. When the degree of network embedding is low, it contains 0 at the 95% confidence interval (Table 6). When the degree of network embedding is high, it does not include 0 (Liu, Songbo, et al., 2023; Zhou&Liu, 2023), indicating that when the degree of NE is higher, the mediation effect of customer VCC is more prominent. Thus, H5 is supported. H6 is proved in the same way; with the higher degree of NE, the more obvious mediation effect of supplier VCC.

Table 6 Conditional Indirect Effect

Mediating variables	Level	level value	Effect	BootSE	BootLLCI	BootULCI
Customer Engagement	Low level（-1SD）	2.259	-0.004	0.013	-0.032	0.02
	Average value	3.298	0.046	0.011	0.026	0.068
	High level（+1SD）	4.336	0.096	0.02	0.059	0.136
	Low level（-1SD）	2.259	-0.008	0.014	-0.034	0.02
	Average value	3.298	0.035	0.01	0.017	0.056
	High level（+1SD）	4.336	0.078	0.018	0.047	0.114
	Low level（-1SD）	2.259	-0.001	0.013	-0.025	0.024
	Average value	3.298	0.038	0.01	0.02	0.061
	High level（+1SD）	4.336	0.078	0.017	0.046	0.11
Supplier Engagement	Low level（-1SD）	2.259	0.021	0.016	-0.008	0.052
	Average value	3.298	0.092	0.015	0.066	0.126
	High level（+1SD）	4.336	0.163	0.024	0.12	0.217
	Low level（-1SD）	2.259	0	0.016	-0.035	0.031
	Average value	3.298	0.068	0.013	0.044	0.095
	High level（+1SD）	4.336	0.135	0.02	0.096	0.179
	Low level（-1SD）	2.259	0.016	0.016	-0.012	0.047
	Average value	3.298	0.079	0.014	0.055	0.108
	High level（+1SD）	4.336	0.143	0.022	0.104	0.185

Note: BootLLCI refers to the lower limit of the 95% interval, BootULCI refers to the upper limit of the 95% interval, Bootstrap type: percentile bootstrap method

5. Conclusion and Discussion

Based on Dynamic Capability Theory, this paper analyzes the influence and mechanism of digital capabilities on EIP and draws the following conclusions through empirical evidence: (1) Digital capability has a significant favorable influence on EIP; (2) Customer and supplier participation VCC play a partial mediating role between digital capabilities and EIP; (3) Network embedding positively regulates digital capabilities and VCC, which means when the degree of NE is higher, the effect of digital capabilities on VCC is more substantial, and the moderating effect will be reflected in the mediating effect of VCC.

5.1. Theoretical Contributions

First, it elaborates on the relationship between digital capabilities and CBEC's EIP. Although the existing literature analyzes the conceptual connotation of digital capabilities at the theoretical level, there is no systematic theory, a lack of uniform measurement scales, and a paucity of empirical research results (Jun et al., 2021; Li Shuwen et al., 2021). This paper explores the impact of the three dimensions of digital capabilities on EIP based on refining the standard dimensions, summarizes the general law of digital capabilities that gather digital technology and data resources, and is conducive to constructing the theory.

Second, it further explains the intrinsic mechanism of digitalization affecting EIP. The two dimensions of VCC both partially mediate the relationship between digital capabilities and EIP. Compared with other countries, the most significant advantage of the Chinese market is the number of users and suppliers. Digital capabilities can drive firms to utilize digital platforms, aggregate virtual resources, engage in strategic dialogues with domestic and foreign partners, establish trust, design risk-sharing, and increase relationship flexibility. Therefore, this paper conducts research through different dimensions of value co-creation subjects, which is conducive to promoting the evolution of the theory of VCC to a multi-subject perspective. It also reveals the underlying logic of enterprise innovation performance construction and enriches the multiple mediation paths.

Third, the boundary conditions for the role of digital capabilities are further clarified by introducing NE. Firms' position, status, and relationships in the network determine the quantity and quality of resources they aggregate, integrate, and allocate in the network, affecting their decision-making behavior in digital networks (Chi, R.Y.&Zhu, R., 2022). The structural differences in network embeddedness affect firms' access to and reconfiguration of resources, while structure and knowledge strengthen the interaction between network subjects and facilitate trust and cooperation among firms (Lavie, 2007; Soh, 2010). Therefore, CBEC should pay full attention to NE in local countries and destination countries, supplemented by platform integration capabilities driven by multi-directional synergies, to realize the organic collaboration of all subjects and the joint development of multiple subjects in VCC.

5.2. Management Implications

(1) Enterprises should increase the construction of digital infrastructure and use digital technology to realize digital transformation. CBEC should fully use data linking, information aggregation, and reconfiguration functions of digital platforms and maximize the value of data resources through digital platforms to meet various needs. The evaluation index system of platform selection for SMEs should be constructed with objective scoring evaluation (Wu Zhencai, 2019) and the platform selection at the right time according to the changes.

(2) Managers should encourage multi-body VCC. They should actively guide customers and suppliers to participate in the activities of value co-creation, to create an excellent interactive environment, and to establish a sound incentive mechanism to mobilize the enthusiasm and creativity of stakeholders through material and non-material incentives so that stakeholders participate in the product design,

production and service process, to increase the two sides of the interaction and cooperation.
(3) Enterprises should enhance the frequency and density of contact with partners in the network (suppliers, distributors, overseas customers, service organizations, etc.) and gain an advantageous position. CBEC should establish long-term and effective network relationships with their partners, focusing on the potential value and dependence of partners to stimulate creativity (Xie Xuemei&Wang Hongwei, 2020). Therefore, enterprises should build an exemplary network environment to improve the quality of relational and structural embedding so that digital capabilities can be fully utilized.

5.3. Limitations and Prospects

This paper argues that digital capabilities permeate the value chain of SMEs and affect EIP through VCC. It has specific theoretical and practical significance, but some limitations remain. Firstly, the number of samples, types of enterprises, and study areas are limited due to time and cost constraints; the samples can be further expanded by selecting regions or countries with different levels of economic development in the future to verify that the model is rationality in a multinational context. Second, this study only examines the impact of VCC at the enterprise level; it can be analyzed from the perspective of industry and organizational characteristics to improve the findings. Once again, this study adopts cross-sectional data, which can't reflect the dynamic changes in innovation performance while implementing digital capabilities. Future research can observe the growth of enterprises from a dynamic perspective and be conducted from the development indicators, such as collaborative innovation performance and green innovation performance, to examine the dynamic effects.

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