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The Digital Platform, Enterprise Digital Transformation, and Enterprise Performance of Cross-Border E-Commerce—From the Perspective of Digital Transformation and Data Elements

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Abstract: The digital trade ecosystem's development relies on the growth of cross-border e-commerce platforms. To ensure the continued growth of China's digital trade, it is crucial to consider the service capabilities of digital platforms and the digital transformation capabilities of cross-border e-commerce firms. This study explores the impact of these factors on the performance of cross-border e-commerce companies, with digital transformation capability acting as a mediator. Empirical research reveals that the service capability of digital platforms is composed of supply chain communication and cost control abilities, which partially mediate the relationship between digital platform serviceability and cross-border e-commerce enterprise performance. Moreover, both the service capabilities of digital platforms and the digital transformation capabilities of cross-border e-commerce companies have a positive and significant impact on enterprise performance.

Keywords: digital trade; cross-border e-commerce; digital platform; service capabilities; digital transformation; enterprise performance; data elements

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1. Introduction

Cross-border e-commerce represents a modern form of international trade in the era of digital commerce [1–4]. Cross-border e-commerce involves utilizing e-commerce platforms and digitalizing traditional trade links to facilitate transactions between entities located in different countries [5–10]. Cross-border e-commerce focuses on leveraging logistics, marketing, payment, public services, and other economic activities related to import and export trade to drive the growth of production and manufacturing [11–14]. The evolution of cross-border e-commerce in China has progressed from the initial stage where transaction entities and trading platforms were the primary participants to a more mature mid-stage [15–17]. During the mid-stage of cross-border e-commerce development, a cohesive ecosystem has emerged where manufacturing enterprises, public services platforms, logistics companies, payment companies, and other entities collaborate to drive growth [11,18–21]. Similar to the manufacturing industry, the service sector has become a critical driver for China to achieve its goal of becoming a global trade powerhouse [22]. The Fourteenth Five-Year Plan for National Economic and Social Development of the People's Republic of China and the Vision for 2035 have emphasized the need to facilitate the integrated development of the producer service industry, with a focus on enhancing the advantages of the entire industry chain. To achieve this, the development level of modern logistics, procurement, and distribution, and production control, operation management, and after-sales service must be improved [21,23–26]. There is a need to encourage the integration of modern service industries with advanced manufacturing and modern agriculture, along with the development of service enterprises that can compete globally [27–31]. The outlined approach provides a

clear direction and objective for utilizing cross-border e-commerce platforms to promote digital trade. It also presents a mechanism design path that facilitates the realization of China's goal to become a global trade powerhouse [32].

The digitization of trade links enables companies and policymakers to better understand the industry's strengths and weaknesses [33–36]. The key to enabling Chinese companies to expand globally lies in the development of a new foreign trade ecosystem that includes the digitization of all trade links and the growth of e-commerce platforms [37–39]. As a means of expediting the construction of a trustworthy cross-border data circulation system, and augmenting the legal regulations governing such circulation, the Central Committee of the Communist Party of China and the State Council have officially promulgated "Data 20": an "Opinion on Building a Data Basic System and Better Playing the Role of Data Elements." "Data 20" prioritizes the exploration of secure and standardized cross-border data flow methods, aimed specifically at common application scenarios including cross-border e-commerce, cross-border payment, supply chain management, and service outsourcing. This "Opinion" serves to clarify the particular scenarios for China's cross-border data circulation, while also providing direction and guidance for the application of digital technologies in relation to data transactions and circulation. Case studies have suggested that platform ecology forms the core of China's e-commerce development. Additionally, some scholars have created simulation models to study the transformation of four types of traditional retail enterprises into cross-border e-commerce [34,40,41]. The study's findings indicate that the optimal migration path for a traditional retail enterprise is either to develop with the assistance of a platform or to transition into a platform on its own [17,42–44]. The research findings align with the "Outline" that advocates for the coordinated development of producer services and the cultivation of service enterprises with global competitiveness [14,45,46]. This study aims to provide a comprehensive definition of cross-border e-commerce and digital trade based on their current developmental stage. Cross-border e-commerce is defined as a transactional entity that operates across different countries and relies on a platform-based enterprise to provide various services, facilitating international trade activities that involve the exchange of goods and related services [47–49]. Digital trade, on the other hand, represents the next phase in the evolution of the cross-border e-commerce ecosystem, incorporating advanced technological innovations and digital solutions to enhance trade activities [8,9,36].

The level of development of cross-border e-commerce platforms has a direct impact on the ability of trading companies to expand globally [38,39]. The service capabilities of digital platforms vary significantly when dealing with cross-border e-commerce companies at different stages of development [33,50–52]. The influence of e-commerce also needs to pay attention to the ability of cross-border e-commerce enterprises to transform and upgrade themselves [30,50,53]. Several rapidly developing provinces in China have initiated the development of digital trade, providing a benchmark for assessing the transformation and upgrading of cross-border e-commerce enterprises [54]. The enterprise digital transformation capability is one of the yardsticks for measuring cross-border e-commerce enterprises [40]. The platform plays a crucial role in the transformation of traditional foreign trade into a fundamental aspect of the digital trade development stage, which is primarily represented by cross-border e-commerce [7].

Currently, enterprise digitization is commonly equated with enterprise informatization, characterized by the digitization of enterprise infrastructure [29,55]. However, the process of applying digital technology is considered to be the digital transformation of enterprises [48,56]. While enterprise digitization often refers to the digitization of enterprise infrastructure, digital transformation entails much more than just the digitization of existing processes [57]. Hence, the digital transformation of enterprises should encompass not only the digitalization of infrastructure but also the integration of digital applications in various aspects, including R&D, production, finance, and talent [52]. In the future, China's high-level opening-up encompasses three key goals: shaping a new world trade order, building an open world economy, and fostering a community with a shared future for

humanity. The growth of China's international trade serves as a driving force for opening up in the new era, driving reform, development, and innovation through entrepreneurial activities. China's continued expansion into the global arena, bolstered by its dominant position in trade and discourse, signifies the establishment of a new global relationship framework built on the principles of solidarity, cooperation, and mutual benefits [58–60].

The global community is in urgent need of values that promote cooperation and mutual benefits. Scholars have generally recognized China's efforts in implementing the concept of a shared future for humanity. Nobel Economist Angus Deaton praised this idea as significant. Cross-border e-commerce platforms have brought about several positive effects, such as innovation in systems and mechanisms, improvement in the industrial value chain, support for national foreign trade strategies, and breakthroughs in trade protectionism [49]. These platforms have also played a significant role in promoting trade facilitation [61], effectively reducing management and transaction costs for enterprises [62], enhancing international competitiveness and voice [28,31], and transforming the position of emerging powers in the global system [63,64]. Cross-border e-commerce platforms have not only had positive effects on China's foreign trade, including innovation of systems and mechanisms, improvement of the industrial value chain, national foreign trade strategic support, and breakthroughs in trade protectionism, but also have had negative effects [65]. The negative effects can be mitigated by establishing a dispute resolution mechanism and actively participating in global trade governance. The increasing ecological trend of digital platforms has also drawn great attention to platform governance issues.

The growth of cross-border e-commerce has gained the support of significant free trade agreements, such as RCEP, and has also attracted the attention of scholars from various fields. Researchers have focused on various topics, such as the development models and status of cross-border e-commerce [66], factors influencing its growth, its relationship with traditional foreign trade, and evaluating its development [67,68]. Scholars have highlighted the crucial role of cross-border e-commerce in transforming and upgrading traditional foreign trade, as well as contributing to new economic growth from different angles [34,69,70]. With China being a leader in cross-border e-commerce development, forward-looking research on the evolution of the cross-border e-commerce ecosystem and its advanced forms has been conducted [21,71]. The Chinese government has also provided policy recommendations to encourage foreign trade enterprises to engage in cross-border e-commerce.

In conclusion, the evolution of cross-border e-commerce in China has entered an ecological development stage, with digital trade representing its next advanced form. The serviceability of cross-border e-commerce platforms and the digital transformation capabilities of cross-border e-commerce companies will significantly impact the future growth of China's digital trade [69,72]. Nonetheless, the impact mechanism of the interplay between digital and platform on cross-border e-commerce remains underexplored in the current literature. This study aims to investigate the serviceability of cross-border e-commerce platforms and the digital transformation capabilities of cross-border e-commerce companies, with a focus on identifying the positive impact mechanism of their interplay on cross-border e-commerce enterprises. The findings of this research hold great theoretical and practical value in facilitating the participation of Chinese cross-border e-commerce companies in digital trade activities.

2. Literature Review and Hypotheses

Cross-border e-commerce is a complex and multifaceted area of study, influenced by various factors such as digital transformation capabilities, platform empowerment capabilities, data elements, regulatory environment, and infrastructure [47–49]. Several key factors impact the success of cross-border e-commerce, including businesses' ability to embrace digital transformation and integrate it into their processes and operations. Investment in digital technologies such as cloud computing, artificial intelligence, and big data analytics can help businesses optimize their cross-border e-commerce strategies.

Additionally, access to accurate and up-to-date data, including customer demographics, purchasing behaviors, and preferences, is essential for developing targeted marketing strategies and optimizing product offerings. Reliable and efficient infrastructure, including internet connectivity and logistics networks, is also critical to success. Understanding and adapting to cultural differences, such as language and payment options, are also essential for businesses operating in different markets. Compliance with regulations related to data privacy, taxation, and cross-border trade is also crucial to avoid legal issues and financial penalties. Overall, businesses that effectively leverage digital transformation capabilities and data elements, while adapting to cultural differences and navigating the regulatory environment, are best positioned for success in cross-border e-commerce.

2.1. Digital Platform Service Capability and Enterprise Performance

There is a dearth of literature that has thoroughly examined the service capabilities of digital platform enterprises in a systematic manner. Nonetheless, a few studies have established that logistics, sales, and conflict coordination are three critical enterprise service capabilities that have a significant positive impact on the performance of cross-border B2C export enterprises [20,73,74]. Several scholars have investigated the impact of cross-border e-commerce platform service capabilities on enterprise performance. Their research indicates that service capabilities encompass a range of factors, including logistics, electronic payment systems, customs declaration and inspection procedures, and intellectual property protection [75,76]. Several studies have indicated that the performance of export enterprises can be impacted by various factors, such as logistics, marketing, opportunity identification, and conflict coordination [30,77].

Logistics, payment, marketing, and customs clearance are among the critical components examined in research investigating the factors that impact cross-border e-commerce [11–14]. Therefore, the current stage of the development of cross-border e-commerce ecology is characterized by various influencing factors, such as logistics, payment, marketing, and customs clearance, which are essential for the smooth development of cross-border e-commerce. Chinese scholars have identified these factors based on the actual development of cross-border e-commerce in China and summarized them into five categories: network marketing, international electronic payment, electronic customs clearance, international e-commerce logistics, and e-commerce law. Platform capabilities have been defined based on these factors, and studies have confirmed their positive impact on the performance of cross-border export e-commerce companies. Additionally, other factors, such as market resources [47,49], brand building [49], industry adoption and customs clearance and payment [21], logistics services [20], and government support, have also been found to significantly impact the growth of manufacturing cross-border e-commerce companies.

Academic research on cross-border e-commerce by international scholars typically emphasizes its technological aspects rather than its business model. Therefore, much of the international literature on this topic has investigated the factors that influence the diffusion of cross-border e-commerce technology. These factors are typically classified into four categories: the level of information technology infrastructure adoption [47], perceived benefits of cross-border e-commerce, government policies, and regulations [78,79], and readiness of business partners [80]. The factors hindering the development of cross-border e-commerce include electronic payment [67], market pressure, and customs clearance barriers [81].

Scholars have approached the research on cross-border e-commerce from different angles. Some have investigated the support that digital platforms lack in facilitating the development of enterprises, while others have focused on the capabilities that companies need in utilizing cross-border e-commerce technology. This study posits that examining the services offered by digital platforms is more pertinent to identifying the support that enterprises require. Hence, we adopt the former perspective and propose the following assumptions concerning the service capabilities of cross-border e-commerce platforms:

H1. *The service capabilities of cross-border e-commerce platforms significantly positively affect cross-border e-commerce enterprise performance.*

2.2. Enterprise Digital Transformation Capability and Enterprise Performance

Enterprise digital transformation is different from the informatization of enterprises [34,82]. Enterprise digital transformation includes applying digital technology in the enterprise production process [48], business process, business model innovation [47], and decision support [12,34]. There is a significant body of literature examining the impact of digital transformation on enterprise performance. For instance, Vial et al. conducted a study to investigate the effect of digital transformation capabilities on enterprise performance. They identified three key components of digital transformation capabilities: the application of digital technology, organizational change, and value chain changes. Several other scholars have also found evidence of a positive relationship between digital transformation and enterprise performance [50].

The digital capability of an enterprise is reflected in its ability to manage customers, processes, and performance. Yasa and other scholars have proposed that this capability can be demonstrated through the effective utilization of digital technology to identify market opportunities, make corporate decisions, innovate business models, and develop new products [83]. The digital capability of enterprises encompasses various aspects, such as production and manufacturing, design and management, product innovation, and marketing. In summary, this study proposes the following hypothesis:

H2. *The digital transformation capabilities significantly positively affect the performance of cross-border e-commerce enterprises.*

2.3. Digital Platform Service Capability and Enterprise Digital Transformation Capability

The digital transformation of enterprises is influenced by various factors, which are categorized into technical, organizational, and external environmental factors [32,48,49,56]. However, in the context of cross-border e-commerce ecosystem development, technical factors differ from the other two categories. Technical factors cannot be realized solely by the enterprise or external motivation [47]. It is essential to comprehend technical factors at two distinct levels. The first level pertains to the construction of enterprise informatization, which can facilitate digital transformation. The second level relates to the external environment, which offers digital technologies and their applications to enterprises. These technologies and applications are instrumental in advancing the digital transformation of cross-border e-commerce companies.

It is noteworthy that the cross-border e-commerce platform serves as the core of the entire e-commerce ecosystem [24,62]. Cross-border e-commerce platforms play a critical role in the digital transformation of enterprises by providing a robust information technology infrastructure and digital-based services that can address the shortcomings of different cross-border e-commerce companies. Moreover, these platforms offer a direct impetus for enterprises to achieve their digital transformation goals. Therefore, we propose the following hypothesis:

H3. *The service capabilities of cross-border e-commerce platforms have significant positive effects on the digital transformation capabilities of cross-border e-commerce companies.*

2.4. The Mediating Role of Enterprises' Digital Transformation Capabilities

The integration of resources through digital platforms empowers SMEs to enhance their enterprise efficiency. This "platform empowerment" plays a critical role in enabling cross-border e-commerce to adapt to dynamic market environments [84]. In the context of cross-border e-commerce, platform enterprises cannot operate in isolation and require coordination with other e-commerce enterprises to generate value [26]. Hence, there is a need for a mechanism that allows other cross-border e-commerce enterprises to participate in the process of empowering corporate performance through platform services [85].

Cross-border e-commerce represents a stage in the evolution of digital trade. Thus, enterprises engaged in cross-border e-commerce should possess and cultivate digital transformation capabilities [53,70]. Companies with stronger digital transformation capabilities

are more likely to use platform services to enhance their performance. Thus, it can be concluded that the digital transformation capabilities of cross-border e-commerce firms create a mechanism that links platform services to corporate performance. Therefore, we propose the following hypothesis:

H4. *The digital transformation capabilities play a mediating role between platform serviceability and enterprise performance.*

2.5. Research Framework

This study proposes a theoretical model that illustrates the relationship among platform service capability, enterprise digital transformation capability, and enterprise performance in cross-border e-commerce. The model posits that the service capabilities of digital platforms have a direct impact on enterprise performance. Additionally, enterprise digital transformation capability serves as a mediating variable, which influences the process of platform service capability affecting enterprise performance. The theoretical model is shown in Figure 1.

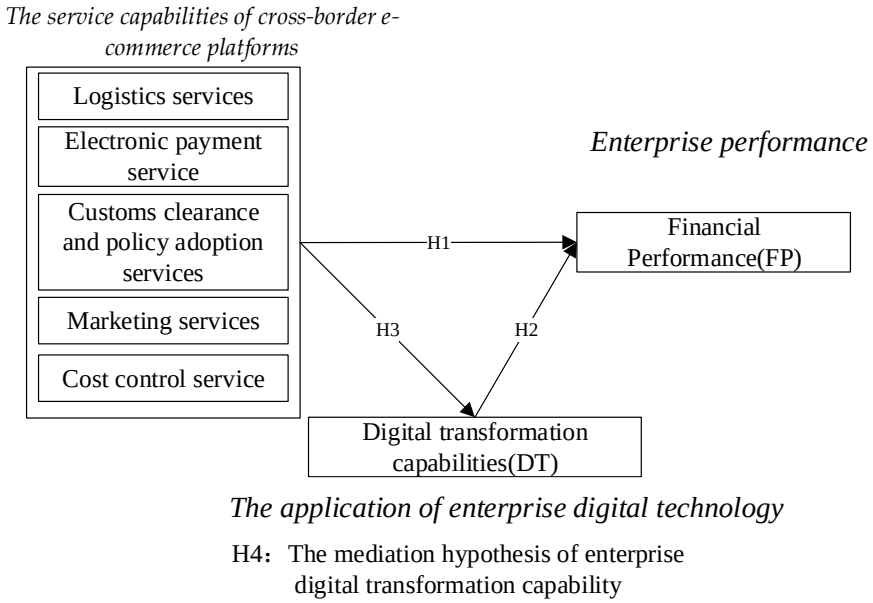

Figure 1. Theoretical model.

3. Methodology

This study employed a questionnaire scale adapted from the literature to measure the variables. The independent variable is the platform service capability of cross-border e-commerce [11–14], comprising 32 items across 5 components, namely electronic payment, logistics services, customs clearance, policy adoption, marketing, and cost control. The dependent variable is corporate performance, as defined by previous research such as Khin [52] and Yasa [83]. This component comprises five items, which compare whether the company has experienced a significant increase in operating income, market share, profit, sales, and customer satisfaction over the past three years. The mediating variable is the digital transformation capability of cross-border e-commerce companies. The scale used in this study is adapted from Yasa's research [83]. The scale for the component comprises 11 items that assess the usage of digital technologies such as big data for various purposes such as identifying market opportunities, innovating business models, improving business processes, managing financial internal controls, making corporate decisions, and developing new products. The measurement is carried out using a 7-point Likert scale ranging from 1 (strongly disagree) to 7 (strongly agree). The data collection and analysis for this study are divided into two stages.

In this study, we conducted the first round of pre-investigation using a questionnaire star sample service and distributing it among acquaintances. In the first round, we collected 109 valid questionnaires, and analysis results showed that the reliability of all seven components exceeded 0.6, indicating acceptable data reliability. Additionally, the validity of all seven components exceeded 0.7, indicating a more reasonable scale design. Through exploratory factor analysis, we discovered that the AVE value of the "enterprise digital transformation capability" and "enterprise performance" components was greater than 0.5, and their CR value was greater than 0.7, indicating good component validity. However, we excluded five items with standardization factor loadings less than 0.5, involving the use of artificial intelligence, digital technology for customer mining, new product development, marketing, and consumer satisfaction to improve corporate performance [86].

The discriminant validity of the five components of "platform service capability" was not met, prompting a re-examination of the factors using exploratory and confirmatory factor analyses. The results showed that "Platform service capability" was divided into two factors: supply chain communication capability and cost control capability, represented by 3 and 5 items, respectively. Finally, a formal survey questionnaire was developed, consisting of four latent variables and 19 measurement items. An improved pre-questionnaire was distributed from October 2021 to March 2022 using a network research company and an offline acquaintance network, with 540 questionnaires distributed and 433 valid questionnaires recovered, resulting in an effective recovery rate of 80%. The sample distribution is presented in Table 1.

The proportion of foreign trade enterprises choosing cross-border digital platforms is generally consistent with the current domestic selection of cross-border e-commerce B2B platforms [87]. The questionnaire data can to some extent reflect the primary export and import areas of China's foreign trade, making it representative and typical. Bentler and Chou (1987) as well as Jackson (2003) have recommended a sample to parameter ratio of 10:1 as appropriate, where the parameter refers to the total number of items in the questionnaire [88]. Given that our formal survey comprises 19 items, it is reasonable to collect more than 190 questionnaires. As we were able to obtain 433 effective responses, the sample size is considered adequate for conducting statistical analysis using structural equation modeling (SEM).

Table 1. Characteristics of the respondents (N = 433).

Characteristics	Category	Percentage
Enterprise attributes	Export	21.7%
	Import	3.7%
	Both	74.6%
Operating period	1 year and below	0.2%
	1–3 years	3.2%
	3–5 years (including 3 years)	10.2%
	5–8 years (including 5 years)	21.3%
	8 years and above	65.1%
Enterprise size	10 people or less	1.2%
	11–50 people	12%
	51–100 people	18.7%
	101–300 people	26.3%
	More than 300 people	41.8%
Chinese provinces	Guangdong	17.3%
	Shanghai	11.1%
	Jiangsu	7.6%
	Zhejiang	6.9%
	Beijing	6.7%
	Shandong	6.5%
	Hubei	5.3%
	Other	38.6%

Table 1. *Cont.*

Characteristics	Category	Percentage
Cooperative cross-border trade platform **(Multiple choice)**	Amazon	71.1%
	Chinese platforms (Dunhuang.com, Made-in-China.com, Alibaba International Station, Global Sources, etc.)	64.2%
	AliExpress	41.8%
	eBay	32.6%
	Shopee	12.7%
	Mercadolibre	10.6%
	Wish	9.7%
	Lazada	9.7%
	Jumia	5.54%
	Mercado Livre	5.3%
	Other	8.8%
Enterprise category	Manufacturing	57.7%
	Comprehensive platform	11.1%
	Logistics	6.7%
	Agency service provider	8.1%
	IT service provider	9.5%
	Financial service provider	5.1%
	Certification	1.2%
	Other	0.6%

4. Results

4.1. Reliability and Validity Analyses

SPSS 22 and Amos 21 are used to perform the empirical test. The measurement model passes the reliability and validity test after removing the measurement items whose factor loading is less than 0.6 [89]. The parameter values indicate a good fit for the data measurement model, as presented in Tables 2 and 3. All measurement items in Table 2 show factor loadings exceeding 0.6, suggesting high reliability of the measurement model. The Cronbach's α values for the four components are all above 0.7, the combined reliability CR values are all above 0.7, and the AVE falls within the acceptable range of 0.36, further indicating the model's validity [89].

Based on the correlation coefficient matrix shown in Table 3, it can be observed that the coefficient values on the diagonal are greater than the correlation coefficients between this component and other components. This result suggests that the measurement model has good internal consistency, convergent validity, and discriminant validity.

Table 2. Test results of reliability and validity (N = 433).

Construct	Item	Factor Loading	Cronbach's Alpha	Composite Reliability (*CR*)	Convergence Validity (*AVE*)
Supply Chain Communication Skills (SC)	SC1	0.635	0.711	0.71	0.45
	SC2	0.672			
	SC3	0.681			
Cost control Capability (CC)	CC1	0.681	0.82	0.82	0.48
	CC2	0.723			
	CC3	0.713			
	CC4	0.658			
	CC5	0.684			
Financial Performance (FP)	FP1	0.790	0.857	0.86	0.61
	FP2	0.681			
	FP3	0.821			
	FP4	0.817			

Table 2. *Cont.*

Construct	Item	Factor Loading	Cronbach's Alpha	Composite Reliability (*CR*)	Convergence Validity (*AVE*)
Digital Transformation Capability (DT)	DT1	0.736	0.869	0.87	0.5
	DT2	0.720			
	DT3	0.743			
	DT4	0.646			
	DT5	0.643			
	DT6	0.722			
	DT7	0.681			

Table 3. Discriminant validity test of the model.

Construct	DT	FP	SC	CC
DT	**0.700**			
FP	0.498	**0.779**		
SC	0.61	0.478	**0.672**	
CC	0.642	0.515	0.607	**0.692**

Note: The bold font on the diagonal is the square of AVE.

In addition, the main model fit index test results are as follows: χ^2/df =1.996, RMSEA (Root-Mean-Square Error of Approximation) = 0.048, GFI (Goodness-of-Fit Index) = 0.932, CFI (Comparative Fit Index) = 0.96, NFI (Normed Fit Index) = 0.923, TLI (Tucker–Lewis Index) = 0.953. The fit indices of the model are found to be higher than the recommended values, indicating that the model is suitable for further testing in the next structural model (see Table 4).

Table 4. Fit indices for CFA.

Fitting Index	χ^2/df	GFI	CFI	NFI	RMSEA	TLI
Recommended criteria	<3	>0.90	>0.90	>0.90	<0.08	>0.90
Actual value	1.996	0.932	0.96	0.923	0.048	0.953

4.2. Model Hypothesis Testing

In this study, hypothesis testing is conducted using Structural Equation Modeling. Specifically, path coefficient tests are performed to examine the impact of cross-border e-commerce platform service capabilities, such as supply chain communication and cost control, on the performance of cross-border e-commerce companies. Additionally, the study examines the impact of cross-border e-commerce companies' digital transformation capabilities on their performance, and tests the mediation effect through indirect effect testing. The results of these tests are presented in Tables 5 and 6 and Figure 2. The path coefficient, which represents the degree of explanation of the independent variable on the dependent variable, is considered ideal when greater than 0.3. The findings indicate that the actual degree of explanation assumed in this study is ideal and holds practical significance.

Table 5. Path coefficient test.

Path Relationship	Path Coefficient	S.E.	C.R.	*p*	Hypothesis Results
SC → FP	0.594	0.094	8.482	***	H1a Support
CC → FP	0.596	0.067	9.413	***	H1b Support
DT → FP	0.561	0.081	8.978	***	H2 Support
SC → DT	0.772	0.088	9.357	***	H3a Support
CC → DT	0.760	0.061	10.033	***	H3b Support

Note: *** $p < 0.001$, ** $p < 0.01$, * $p < 0.05$.

Table 6. The mediating effect test.

Path Relationship	Path Coefficient	S.E.	C.R.	*p*
SC → DT	0.769	0.087	9.367	***
SC → FP	0.411	0.147	3.772	***
CC → DT	0.761	0.060	10.130	***
CC → FP	0.405	0.095	4.423	* (0.014)
DT → FP	0.245	0.114	2.897	** (0.004)

Note: *** $p < 0.001$, ** $p < 0.01$, * $p < 0.05$.

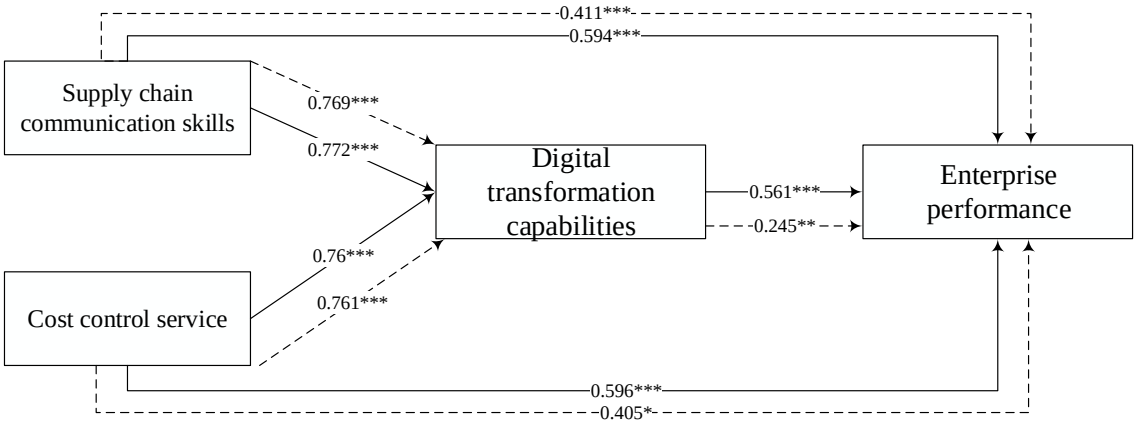

Figure 2. Model assessment results (path coefficients).

The results in Table 6 indicate that the relationships among the independent variable, dependent variable, mediating variable, and the structural model with the mediating variable are all statistically significant. This suggests that the digital transformation ability of the enterprise acts as a partial mediator between the platform's supply chain communication ability, cost control ability, and enterprise performance, supporting the acceptance of H4. Furthermore, in accordance with the literature by Shrout and Bolger, the mediating effect size is moderate, indicating that the mediating effect is significant and practically meaningful [90], and the ratio of the mediation effect to the total impact on the Amos report can be used as an evaluation index for the strength of the mediation effect.

In order to analyze the strength of the mediating effect of enterprise digital transformation capability, the total effect report and direct effect report output by Amos are examined. The strength of the mediating effect of DT (between SC and FP) = $(0.769 \times 0.245)/0.599 = 0.315$. The strength of the mediating effect of DT (between CC and FP) = $(0.761 \times 0.245)/0.598 = 0.312$.

5. Discussion

5.1. The Service Capabilities of Digital Platforms

This research initially designed a scale of "digital platform service capabilities" based on the services that cross-border e-commerce digital platforms can provide, including electronic payment, logistics services, customs clearance, policy adoption, marketing, cost control, and other factors. However, during the pre-investigation test, a high correlation between the five factors was found, indicating that they could not reflect the different aspects of a component. Therefore, two main factors, "supply chain communication ability" and "cost control ability," which can reflect "digital platform service ability," were obtained through confirmatory factor analysis and exploratory factors. In the formal investigation data analysis, all evaluation indicators met the standard. Notably, compared with the original scale, the formal scale's "cost control ability" has more use of digital platform services to reduce logistics and payment costs, which are two items originally belonging to "logistics service" and "electronic payment" components.

Although digital platform services are suitable for the early stage of cross-border e-commerce development by providing foreign trade links, China has entered the development stage of the cross-border e-commerce ecosystem where cross-border e-commerce enterprises and platforms jointly create value through integrated development. Therefore, the manifestation of the service capabilities of digital platforms needs to focus on the needs of the entire industry for symbiosis, expressed as "supply chain communication ability" and "cost control ability" under the constraints of this study's model. The symbiotic development trend of the manufacturing industry and the service industry has formed, and as enterprises' needs change, the required capability of "digital platform service capability" will change accordingly. Thus, the "Digital Platform Service Capability" scale developed and verified in this study can be used for verification analysis and scale expansion when discussing the various impacts of digital platform service capabilities on the management of cross-border e-commerce companies.

5.2. The Digital Transformation Capability of Enterprises

The digital transformation capacity of enterprises operating in the cross-border e-commerce market has a significantly positive effect on their overall performance. Additionally, the service capabilities of digital platforms exert a significant positive impact on both the digital transformation capacity and corporate performance of cross-border e-commerce companies. In the digital ecosystem, the service demand of cross-border e-commerce enterprises for digital platforms mainly stems from two factors: efficient communication with the supply chain's upstream and downstream and cost reduction in procurement, logistics, payment, software and hardware investment, testing, and certification.

First, all path coefficients in Figure 2 surpass 0.5, with the impact of digital platform service capabilities on enterprise performance slightly greater than that of enterprise digital transformation capabilities on its own business performance (0.594 > 0.561, 0.596 > 0.561). The data from Figure 2 highlight the current stage of China's cross-border e-commerce development, which has entered the ecosystem development phase, featuring the integrated development of manufacturing and service industries. Numerous digital platforms have offered comprehensive services with comparative advantages, building a certain level of corporate trust. Consequently, cross-border e-commerce firms receive greater recognition and develop a symbiotic relationship with the platform. As a result, cross-border e-commerce firms increasingly rely on platform service capabilities, which have a significant impact on them.

Secondly, the digital transformation capability of cross-border e-commerce companies has a relatively large impact on their corporate performance (0.561). This finding suggests that Chinese foreign trade companies recognize the importance of their digital transformation and are using digital technology to improve business processes, manage financial internal control, identify market opportunities, innovate business models, and formulate corporate strategic plans [52]. Cross-border e-commerce represents a stage in the development of digital trade, and entrepreneurs who recognize the arrival of the digital trade era actively choose to apply digital technology in their enterprise management. However, it can also be viewed as a passive choice driven by market developments, as businesses are compelled to adapt to environmental changes in order to sustain their competitiveness [91]. China's cross-border e-commerce companies are actively choosing digital transformation and upgrading to adapt to the development of digital trade, as shown by their positive impact on enterprise performance.

Finally, the significant impact of the platform's supply chain communication and cost control abilities on enterprise digital transformation capabilities (0.772 and 0.76, respectively) underscores the central role of cross-border e-commerce platforms in the entire digital trade ecosystem. These digital platforms provide information technology infrastructure and services based on digital technology that can improve communication efficiency in the supply chain and reduce costs throughout various trade links, enhancing the liquidity of enterprise commodity, capital, and information flows, and thereby improving business

performance. The development of China's cross-border e-commerce platform has entered a new stage of development, where digital platforms provide high-quality services such as modern logistics, procurement and distribution, production control, operation management, and after-sales service. With enterprise users increasingly demanding higher efficiency and lower cost input, this consideration can be integrated into the evaluation index system of cross-border e-commerce platforms.

5.3. Mediating Effect of the Digital Transformation Capabilities of Enterprises

The digital transformation capabilities of enterprises play a partial mediating role between the platform's supply chain communication capabilities, cost control capabilities, and enterprise performance, with a mediating effect strength of 0.315 and 0.312. This finding verifies that an enterprise's digital transformation capability is an important mechanism in the process of platform empowerment. In other words, the stronger an enterprise's digital transformation capability, the more effectively it can leverage platform service capabilities to enhance its own performance.

The conclusion drawn from the study suggests that platform service capabilities have a significant positive impact on the digital transformation capability of enterprises. The performance improvement of cross-border e-commerce enterprises relies on the support of both the cross-border e-commerce platform's services and the enterprise's transformation and upgrading abilities.

6. Conclusions

This study utilizes empirical analysis to investigate the interplay among digital platform service capabilities, digital transformation capabilities of cross-border e-commerce companies, and their performance. The results indicate that the platform service capability influences the enterprise performance process by mediating the digital transformation capability of the enterprise.

6.1. Summary of the Research

Currently, multilateral free trade agreements, such as RCEP and CPTPP, include provisions related to e-commerce. Research on cross-border e-commerce in the academic field is extensive, covering various aspects, such as the development status and models of cross-border e-commerce, influencing factors, the relationship with traditional foreign trade, and the evaluation and measurement of development status. From different perspectives, it is evident that cross-border e-commerce plays a crucial role in promoting the transformation and upgrading of traditional foreign trade and serves as an important new economic growth point. In China, the development of cross-border e-commerce has entered the ecological development stage, and cross-border e-commerce platforms have become the ecological center, positively promoting the development of other cross-border e-commerce enterprises. Therefore, this study aims to investigate the internal mechanism of cross-border e-commerce platforms in promoting enterprise development.

Based on the existing literature, this paper proposes that cross-border e-commerce platform services and enterprise digital transformation capabilities positively affect enterprise performance. The degree of "platform empowerment" depends on the enterprise's own capabilities. Consequently, this study examines the digital transformation capability of enterprises as an internal mechanism for cross-border e-commerce platform services to enhance enterprise performance. Through a Structural Equation Modeling (SEM) test, this study finds that the platform service capability consists of two main factors: supply chain communication capability and cost control capability. Furthermore, platform service capability and enterprise digital transformation capability have significant positive impacts on the company's digital transformation capabilities. Finally, the company's digital transformation capabilities play a partial intermediary role between the platform's supply chain communication capabilities, cost control capabilities, and corporate performance.

This study verifies that the company's digital transformation capabilities are an important mechanism in the process of "platform empowerment".

6.2. Limitations, Future Studies, and Recommendations

Cross-border e-commerce platforms have become a crucial component of digital trade, yet research in this area is constrained by several factors. This study proposes the digital transformation capability of cross-border e-commerce enterprises as an intermediary variable to investigate the mechanism by which platform service capabilities affect the performance of these enterprises. However, challenges remain regarding the digitalization of cross-border e-commerce platform enterprises and the impact of digital technology on digital trade.

One of the major limitations of cross-border e-commerce platform research is the lack of data accessibility. Cross-border e-commerce platform companies tend to maintain confidentiality about their business operations, and data privacy concerns and legal barriers impede researchers' access to crucial data. Another obstacle is the lack of standardization in data collection, as different platforms utilize different methods of data collection and presentation, hindering comparisons.

An emerging research direction is the ecological theory of cross-border e-commerce platforms, which focuses on comprehending the interactions between these platforms and their environment. Future research in this area can investigate the effects of external factors such as government regulations and cultural differences on the development of cross-border e-commerce platforms. Furthermore, the role of collaboration between different stakeholders, including platform companies, consumers, and suppliers, in creating a sustainable ecosystem for cross-border e-commerce can be examined.

In conclusion, cross-border e-commerce platform research is restricted by several factors, but new research directions are emerging that can advance our understanding of these platforms. Future research can explore the impact of digital technology, the ecological theory of cross-border e-commerce platforms, and collaboration among stakeholders. To overcome limitations and enhance research quality, researchers should cooperate with industry players and policymakers.

7. Implication

7.1. Theoretical Implication

In the current cross-border e-commerce market, it is important for both enterprises and governments to recognize the shift in core players. Traditional manufacturing enterprises are no longer the sole players, as they are now integrated with platform enterprises, and this integration is critical in creating higher value. The platform plays a central role in the development of the cross-border e-commerce ecosystem. Hence, when formulating industry standards, government policies, laws, and regulations (including regulations and guidelines related to platform anti-monopoly), policymakers must systematically consider the long-term benefits and potential risks for both companies and platforms. It is also essential to recognize the impact of data elements in this shift toward platform integration. With the rapid development and application of digital technology, data have become a new factor of production. As such, policymakers must consider the management and regulation of data flows within the cross-border e-commerce ecosystem in their policymaking efforts. The development of a reliable cross-border data circulation system and legal norms for cross-border data circulation is also critical to ensure the continued success and growth of the cross-border e-commerce industry [92]. It is necessary to avoid focusing solely on or disregarding the interests of one of the parties [44,93].

Currently, there is a lack of systematic literature studying the service capabilities of Chinese cross-border e-commerce platforms from the perspective of data elements and platform ecology. Third-party services such as logistics, payment, customs declaration, and marketing are often considered as part of the platform's service capabilities [24,53]. While this approach may hold true practically, the rapid promotion and application of

digital technology and data as a new factor of production have led to significant changes in cross-border e-commerce business processes, ecosystems, and partnerships in China [52]. Our research indicates that the validity of platform services classified by business links is insufficient due to their increasing integrations. After exploratory and confirmatory factor analyses, we found that the platform's supply chain communication and cost control abilities are the two constructions of platform service capabilities with reference value for future research.

Moreover, cross-border e-commerce in China has entered the ecological development stage, and our study examines the development of its ecosystem from the perspective of data elements and platform ecology. Our research offers two in-depth discussions on the digital application and platform ecological development of cross-border e-commerce enterprises in China. First, we propose exploring the internal mechanism of cross-border e-commerce platforms to improve enterprise performance, as platforms have become the core of cross-border e-commerce ecological development. Our findings confirm that cross-border e-commerce platform services have a significant positive impact on the development of cross-border e-commerce enterprises. Secondly, we propose that digital trade is the next advanced form of cross-border e-commerce development in China. While external platforms can assist enterprises to improve efficiency and reduce costs, companies can achieve the same effect by improving their own digital transformation capabilities. However, the implementation of platform services varies depending on the digital transformation capabilities of the companies. Therefore, we suggest that the digital transformation capabilities of enterprises are an internal mechanism for cross-border e-commerce platform services to affect enterprise performance. Our research confirms that enterprise digital transformation capabilities have a direct positive impact on enterprise performance and that the enterprise digital transformation capability is an internal mechanism for cross-border e-commerce platform services to positively affect corporate performance.

7.2. Managerial Implication

In the current digital age, data have emerged as a critical factor of production, driving economic growth in various countries worldwide. The significance of data in the global economy is becoming increasingly apparent, and cross-border data flows are serving as a key driver of global economic activities. However, this trend has also brought about severe security threats and privacy challenges, highlighting the need for a reliable cross-border data circulation system and stronger legal norms for data circulation. In response to these challenges, the Central Committee of the Communist Party of China and the State Council have issued "Data 20," officially known as the "Opinions on Building a Data Basic System and Better Playing the Role of Data Elements." The "Data 20" document emphasizes the importance of exploring safe and standardized methods for cross-border data flow, targeting specific application scenarios such as cross-border e-commerce, cross-border payment, supply chain management, and service outsourcing. By providing directional guidance for the application of related technologies in data transactions and circulation, "Data 20" not only clarifies the specific scenarios of China's cross-border data circulation but also lays the foundation for a robust and secure global data ecosystem. This initiative by the Chinese government is a step toward promoting a reliable and secure global data circulation system, which is critical for ensuring the continued growth and development of the global economy.

Cross-border e-commerce is one area that can benefit from a secure and reliable cross-border data circulation system. The development of cross-border e-commerce aims to support the survival and growth of small and medium-sized enterprises (SMEs) in China. In the current political landscape marked by heightened global political tensions, cross-border e-commerce can help alleviate the impact of trade disputes on China by aiding SMEs globally. This can result in the growth of competitive service companies in China, thereby promoting economic growth. To promote the development of China's cross-border e-commerce ecosystem, it is essential to adhere to multilateral tradeism and

actively participate in the formulation of international trade rules. Standardized rules can attract more countries to engage in mutually beneficial economic and trade exchanges. The completion of the Regional Comprehensive Economic Partnership (RCEP) standard approval by China sets higher-quality standards for Chinese digital platforms to provide services to international enterprises. This not only provides a better external environment for Chinese manufacturing and service enterprises to develop cross-border e-commerce but also paves the way for more countries to participate in mutually beneficial economic and trade exchanges.

The government and industry alliances can play a significant role in facilitating the growth of cross-border e-commerce. Establishing industry benchmarks, organizing public lectures, offering decision-making consultations, and promoting industry–university–research collaborations can assist cross-border e-commerce companies in understanding digital transformation and upgrading. This is especially beneficial for SMEs with limited resources, enabling them to leverage the digital platform to facilitate digital transformation and upgrading, with the support of the government and market. The digital age has brought about significant changes to the global economy, with data emerging as a critical factor of production. While cross-border data flows have provided a significant impetus to the world economy, they have also brought about severe security threats and privacy challenges. The Chinese government's "Data 20" initiative is a step toward promoting a reliable and secure global data circulation system, essential for ensuring the continued growth and development of the global economy. The development of cross-border e-commerce can aid SMEs globally and promote economic growth, and it is essential for China to continue participating in the development of international trade rules to ensure a friendlier external environment for cross-border e-commerce development. The government and industry alliances can play a crucial role in facilitating the growth of cross-border e-commerce by providing the necessary support and guidance to companies, especially SMEs, to facilitate digital transformation and upgrading.

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