Accounting and Corporate Management (2026)
Clausius Scientific Press, Canada

DOI: 10.23977/acccm.2026.080113
ISSN 2523-5788 Vol. 8 Num. 1

Research on the High-Quality Development of Cross-Border E-Commerce Platforms Empowered by Digital Technologies

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Keywords: Digital Technology; Cross-Border E-Commerce Platform; High-Quality Development; Empowerment Mechanism; Global Digital Trade

Abstract: With the accelerated evolution of the global digital economy and profound restructuring of international trade patterns, cross-border e-commerce platforms are undergoing a transformative shift from scale-oriented expansion to quality-driven development. Dominant digital technologies represented by big data, artificial intelligence, blockchain and cloud computing are profoundly reshaping the operational paradigms and competitive landscape of global cross-border e-commerce platforms. From a global research perspective, this paper firstly clarifies relevant basic concepts and theoretical foundations, summarizes the development status and prevailing dilemmas of cross-border e-commerce platforms, and further explores the internal logic and functional mechanism of digital technology empowerment. The research aims to provide theoretical references and practical implications for cross-border e-commerce platforms worldwide to achieve high-quality, sustainable and compliant development enabled by digital technologies.

1. Introduction

The in-depth integration of digital technologies and international trade has accelerated the transformation of the global trade pattern. Cross-border e-commerce has broken the geographical restrictions and procedural barriers of traditional trade, maintaining sustained growth in both mature markets such as Europe and America and emerging markets including Southeast Asia, Latin America, the Middle East and Africa[1]. At present, the global cross-border e-commerce industry is in a critical stage of transformation from extensive scale expansion to high-quality development. Traditional operation modes relying on low-price competition, manual management and a single profit model can no longer adapt to the increasingly fierce global market competition. Common bottlenecks restricting the long-term development of various platforms include homogenized platform operation, low supply chain operation efficiency, prominent compliance risks and insufficient brand influence. In this context, digital technologies have evolved from marginal auxiliary tools into the core driving force for industrial upgrading[2]. Countries and regions around the world have successively introduced supportive policies to encourage the application and

innovation of digital technologies in cross-border trade, and major platforms have also increased investment in digital transformation to seize market opportunities[3].

2. Literature Review

The integration of digital technologies with cross-border e-commerce (CBEC) has attracted extensive academic attention worldwide. Existing research in this field can be broadly classified into three major streams.

The first stream focuses on the application of digital technologies in CBEC operations. The convergence of big data and artificial intelligence has significantly improved demand forecasting and product selection decisions on cross-border platforms. Jiang (2022) developed a C-A-BP forecasting model based on a back-propagation neural network, using sales data from the Jollychic cross-border platform to verify the model's accuracy in procurement volume prediction[4]. The study highlights that algorithms and big-data analytics have become core technical enablers of supply chain management in CBEC. Guan (2022), from an "Internet + foreign trade" perspective, proposed a dynamic forecasting model based on controllable-correlation big data[5]. Empirical results show that the model outperforms traditional approaches in predicting export product sales and effectively captures the dynamic evolution of data series. In the area of intelligent customisation, Guo & Zhang (2022) developed a deep-learning-based framework for intelligent customisation in CBEC[6]. They argue that CBEC enterprises must possess a solid big-data foundation and leverage artificial intelligence to dynamically optimise data processing, thereby supporting product customisation and selection decisions and achieving full-chain resource integration from production to after-sales service.

The second research stream addresses regulatory compliance and cross-border data governance in the global CBEC industry. As data protection rules become increasingly stringent across jurisdictions, regional regulatory divergences have become a common challenge for international platforms. The existing literature generally agrees that the fragmentation of global regulatory systems significantly raises operational risks and compliance costs for cross-border e-commerce. Cross-border data flows are constrained by divergent political priorities, economic structures and technological capabilities across countries, resulting in a multi-centric regulatory landscape represented by the European Union, the United States, China and others. The EU's General Data Protection Regulation (GDPR), with its comprehensive protection provisions and adequacy determination system, has emerged as a key reference framework for global privacy governance. Its stringent rules on cross-border data transfers and restrictions on automated decision-making impose considerable compliance burdens on digital firms, but at the same time enhance trust in cross-border data exchanges through reinforced safeguards. However, this rights-based regulatory philosophy is in evident tension with the fragmented, sectoral model of the United States – which emphasises industry self-regulation and commercial freedom – and with China's data localisation approach centred on digital sovereignty. Scholars have pointed out that this fragmentation leads to persistent deadlock in international rule coordination, forcing globally operating enterprises to navigate multiple conflicting compliance frameworks, resulting in high compliance costs and enduring legal uncertainty.

The third stream explores digital transformation and ecosystem building in CBEC platforms. Researchers have noted a significant digital divide among platforms of different sizes and regions. The World Economic Forum (2022) observes that as trade becomes increasingly digital, the full recovery and success of small and medium-sized enterprises (SMEs) strongly depend on their ability to scale cross-border[7]. However, SMEs face urgent needs for digital infrastructure, training and processes, and the international barriers they encounter are more burdensome than those faced

by larger firms. From an industrial ecosystem perspective, Duan et al. (2021) integrate home-country and host-country entrepreneurial ecosystems with the digital ecosystem into a transnational digital entrepreneurship ecosystem framework[8]. They argue that CBEC platforms provide critical foundations for this ecosystem, not only by bridging home and host country ecosystems but also by supplying the entrepreneurial capital that the ecosystem promises. Their case study of twelve Chinese immigrant entrepreneurs reveals that cross-border entrepreneurs indeed rely on the supporting framework of a transnational digital ecosystem. This finding echoes the core insight of the industrial ecosystem perspective: high-quality development of cross-border e-commerce cannot rely on a single platform in isolation but requires data interconnection and business collaboration among upstream and downstream enterprises to build a coordinated industrial ecosystem.

Despite the rich body of existing research, several gaps remain to be addressed. On the one hand, most studies focus on a single digital technology or a single regional market, lacking a systematic analysis of the full-chain empowerment mechanism of multiple digital technologies on global CBEC platforms. On the other hand, the majority of the literature adopts operational efficiency as the sole evaluation criterion, rarely incorporating compliance development, brand building and ecosystem coordination into the research framework of high-quality CBEC development. Drawing on value chain theory and the TOE (Technology-Organisation-Environment) framework, this paper adopts a global perspective to analyse the internal logic and practical dilemmas of digital technology empowerment, aiming to provide practical references for the sustainable development of the global cross-border e-commerce industry.

3. Concept Definition and Theoretical Foundation

3.1. Definition of Core Concepts

The digital technology referred to in this paper is an integrated technical system mainly composed of big data, artificial intelligence, blockchain, cloud computing and the Internet of Things. Taking data as a new factor of production, the system realizes the collection, storage, analysis, transmission and intelligent application of information, and features intelligence, networking and transparency, serving as the fundamental technical support for the digital transformation of traditional industries[9]; A cross-border e-commerce platform is an online transaction hub that connects global suppliers, merchants, end consumers, as well as logistics, payment, customs clearance and other service participants. It covers multiple operational forms including B2B, B2C and social e-commerce, and undertakes core functions such as resource allocation, transaction guarantee and ecological collaboration in cross-border trade[10]; The high-quality development of cross-border e-commerce platforms abandons the extensive development model that merely pursues transaction volume and user scale. It takes innovation-driven development, efficiency improvement, standardized operation, risk prevention and control, brand cultivation and ecological coordination as core objectives, and emphasizes the comprehensive upgrading of operational quality, service capability, sustainable development and global compliance performance.

3.2. Theoretical Foundation

Three classical theories constitute the theoretical framework of this study. Value Chain Theory divides cross-border e-commerce operations into key links including product selection, marketing, supply chain management, payment and settlement, and after-sales service. Digital technologies can optimize each link of the value chain and facilitate the overall value appreciation of platforms[11]; Digital Economy Theory confirms that data has become a pivotal production factor in the digital era;

digital technologies can release the value of data resources, optimize the allocation of global trade resources, and break the efficiency bottlenecks of traditional cross-border trade[12]; The TOE Framework argues that the adoption and performance of technological innovation are jointly affected by technological characteristics, organizational operational capacity, and external market and regulatory environment[13]. The framework provides a complete analytical perspective for identifying application barriers of digital technologies in cross-border e-commerce and formulating targeted development strategies.

4. Development Status and Existing Problems of Cross-Border E-Commerce Platforms

4.1. Development Status

In recent years, the digital penetration of global cross-border e-commerce platforms has maintained a steady growth. Leading platforms in Europe and America have realized full-process digital layout with intelligent technologies widely applied in daily operation. Platforms in emerging markets such as Southeast Asia and Latin America are also accelerating digital transformation, with basic digital tools including intelligent customer service and data analysis gradually popularized. Major global economies have improved industrial supporting policies and promoted digital infrastructure construction, creating a favorable institutional environment for cross-border e-commerce development[14]. In terms of market layout, global platforms are reducing reliance on single markets, consolidating traditional mature markets while expanding emerging markets, forming a diversified and multi-polar market pattern. The expanding market scale and rising digital awareness have laid a solid foundation for the high-quality development of the industry.

4.2. Existing Problems

Nevertheless, the global cross-border e-commerce industry still faces prominent common dilemmas in the transition to high-quality development:

First, imbalanced digital technology application and prominent digital divide. Large international platforms possess sufficient capital and technological strength to deploy cutting-edge technologies, while most small and medium-sized platforms are constrained by cost and only adopt basic digital tools with shallow application depth. Moreover, most platforms prioritize digital transformation in front-end marketing, while the digital upgrading of core links such as supply chain and risk control lags seriously behind, resulting in severe data silos and insufficient exploitation of data value.

Second, increasingly complex cross-border data governance and compliance risks. Countries and regions differ greatly in regulations on data privacy protection, cross-border data flow and trade supervision. Strict regulatory regimes such as the EU General Data Protection Regulation (GDPR) impose huge compliance pressure on global platforms, accompanied by frequent security threats such as data leakage and cyber attacks.

Third, severe shortage of interdisciplinary talents. Digital cross-border e-commerce requires practitioners to master digital technologies, international trade expertise, foreign languages and regional regulatory rules simultaneously. The mismatch between the current talent training system and market demand has become a major constraint on the in-depth application of digital technologies.

Fourth, weak independent innovation capability and homogeneous market competition. Most platforms rely on mature commercial digital tools rather than investing in the R&D of underlying algorithms and core technologies. The lack of differentiated technological advantages leads to pervasive homogenized competition in the global market.

Fifth, fragmented global industrial ecosystem. Insufficient data interconnection and business

collaboration exist among upstream and downstream enterprises across borders. The digitalization level of supporting industries such as overseas warehouses and cross-border logistics varies greatly. The absence of a unified coordination mechanism significantly reduces the operational efficiency of the entire industrial chain.

5. Internal Logic and Functional Mechanism of Digital Technology Empowerment

5.1. Internal Logic

Digital technologies act as the core engine for the high-quality development of cross-border e-commerce platforms. The intrinsic empowerment logic lies in reshaping platforms' core competitiveness based on data factors. Different from the traditional development model relying on traffic dividend and low-price competition, digital technologies integrate scattered operational information into analyzable and applicable data resources, so as to realize accurate global supply-demand matching, intelligent decision-making, real-time risk control and personalized service provision. Enabled by the synergistic effect of multiple digital technologies, platforms can accomplish the transition from extensive scale expansion to intensive quality improvement, achieving coordinated growth in operational efficiency, service quality and comprehensive economic benefits.

5.2. Functional Mechanism

Combined with the Value Chain Theory and TOE Framework, the empowerment effect of digital technologies runs through front-end operation, mid-end supply chain, back-end support and global ecological collaboration, forming a multi-level and whole-chain functional mechanism.

In front-end operation links including product selection, marketing and customer service, big data and artificial intelligence collect global consumption trends, user portraits and competitor information to realize data-driven intelligent product selection, overcoming the limitations of traditional empirical judgment. Generative AI and multimodal technology can efficiently produce multilingual marketing content and advertising materials to support personalized content delivery and dynamic pricing for regional users. Natural Language Processing (NLP) enables multilingual intelligent customer service, eliminating language and time zone barriers and improving user experience and repurchase rate.

In mid-end supply chain links, AI forecasting models integrate sales data, logistics information and market trends to achieve precise demand forecasting and dynamic inventory allocation, effectively reducing inventory overstock and stockout risks. IoT technology realizes automatic management of warehousing, sorting and distribution. Blockchain technology records the full life-cycle information of commodities to support full-track traceability, curb the circulation of counterfeit goods, and improve the efficiency of cross-border customs clearance.

In back-end support links covering payment and risk control, blockchain simplifies cross-border payment procedures, shortens transaction cycles, reduces transaction costs and fraud risks; smart contracts can automatically complete fund settlement and performance supervision. Big data and AI construct an all-scenario intelligent risk control system to identify abnormal transactions, intellectual property infringement and irregular operations in real time. Cloud computing provides elastic computing power to cope with traffic peaks during promotional activities, ensuring system stability and cutting down infrastructure operation and maintenance costs.

Beyond individual platform operation, digital technologies facilitate the integration and coordination of the global industrial ecosystem, break information barriers among platforms, suppliers, logistics providers and regulatory authorities, spawn new business formats such as "cross-

border e-commerce + overseas warehouses", and build a mutually beneficial global digital trade ecosystem.

The mechanism diagram of the enabling effect of digital technology is shown in Figure 1 below.

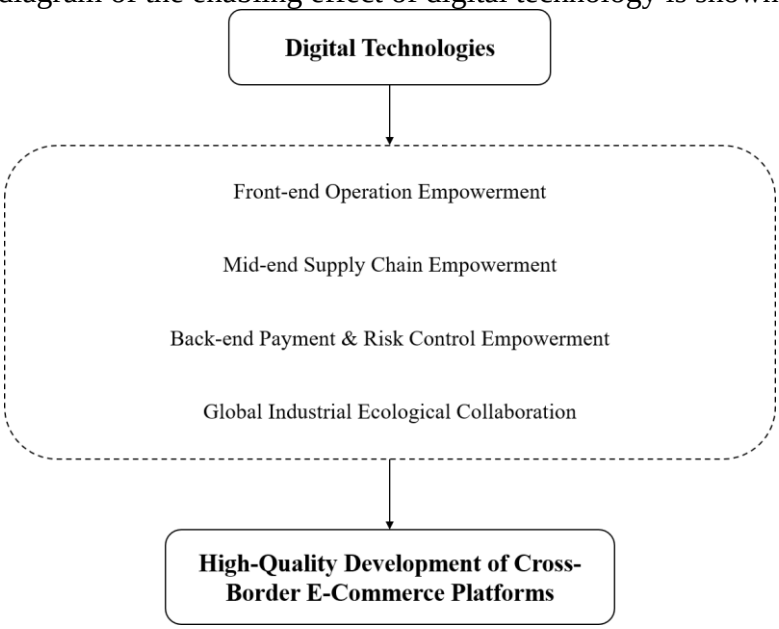

Figure 1: Mechanism diagram of the enabling effect of digital technology

6. Conclusions and Development Suggestions

6.1. Main Conclusions

This study systematically analyzed how digital technologies empower the high-quality development of cross-border e-commerce platforms from a global perspective, drawing three core conclusions. First, digital technologies, including big data, AI, blockchain, and cloud computing, act as a multi-dimensional empowerment engine, optimizing the entire value chain from demand matching to risk governance and ecosystem collaboration. Second, while digital penetration is increasing globally, platforms face persistent challenges, including uneven technology adoption, fragmented regulatory environments, and a shortage of interdisciplinary talent. Third, high-quality development requires not only technological innovation but also adaptive strategies to align with regional regulations and build inclusive global ecosystems.

The findings of this study have several important implications. For platform operators, the analysis highlights the need for tiered digital transformation strategies: large platforms should focus on developing cutting-edge, proprietary technologies to build competitive moats, while small and medium-sized platforms can prioritize low-cost, high-impact digital tools for core operations. For policymakers, the study underscores the importance of international regulatory coordination to reduce compliance burdens and facilitate cross-border data flows. For academia, the integrated framework proposed here provides a foundation for future quantitative studies to measure the causal effects of specific technologies on platform performance.

6.2. Development Suggestions

To promote the sustainable and high-quality development of global cross-border e-commerce platforms, market participants and regulatory authorities should jointly formulate the following targeted strategies:

(1) Adopt a categorized approach to digital transformation. Large-scale platforms should increase R&D investment in frontier technologies to establish robust technological moats, whereas small and medium-sized platforms should focus on their core businesses by adopting low-cost, pragmatic digital tools. All platforms, regardless of size, should establish unified data platforms to break down data silos and achieve full-chain data collaboration.

(2) Strengthen data security and compliance management. Platforms need to formulate standardized data governance frameworks, enhance information security protection, and establish local compliance teams to accommodate differentiated regulatory requirements across regions.

(3) Enhance the global interdisciplinary talent cultivation system. Universities and research institutions should design interdisciplinary programs tailored to industrial demands, while platforms should improve internal training and incentive mechanisms to attract and retain high-end interdisciplinary talent.

(4) Accelerate independent technological innovation. Market participants should engage in collaborative R&D and share technological outcomes, and develop innovative business models through the integration of multiple technologies to alleviate homogenized competition.

(5) Deepen international industrial cooperation. Countries and enterprises should promote cross-border data interconnection and business linkage, accelerate the digital upgrading of supporting infrastructure such as overseas warehouses and cross-border logistics, and jointly build a coordinated, efficient global cross-border e-commerce industrial ecosystem.

6.3. Research Prospects

Looking ahead, this research has some limitations that offer avenues for future work. First, the qualitative nature of the analysis means the findings cannot be generalized statistically; future studies could use panel data from global platforms to test the relationships proposed here. Second, the rapid evolution of technologies like generative AI and the metaverse calls for ongoing research into their emerging impacts on cross-border e-commerce. Third, comparative studies between mature and emerging markets could further illuminate how institutional contexts shape digital technology adoption and its outcomes. As the global digital trade landscape continues to evolve, continuous dialogue between practice and research will be essential to guide the sustainable development of cross-border e-commerce.

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