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Article

Cross-Border Live E-commerce Model Empowered by Digital Supply Chain

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Abstract: Cross-border live-streaming e-commerce faces significant challenges, including complex supply chain management and inefficient logistics. The digital supply chain, leveraging the Internet of Things, big data, and artificial intelligence, offers a solution for the challenges by digitizing and intelligentizing traditional supply chain processes. The digital supply chain facilitates real-time data sharing, automates business operations, and supports intelligent decision-making, which improves operational efficiency, reduces costs, and enhances customer satisfaction for cross-border live-streaming e-commerce companies. The digital supply chain is data-driven, highly collaborative, and transparent, making it an essential tool for companies to enhance their competitiveness. In this article, we explored the effects of the digital supply chain on cross-border live-streaming e-commerce by analyzing the challenges in its adoption. Based on the results, we proposed optimization strategies that contribute to the sustainable and healthy development of cross-border live-streaming e-commerce businesses.

Keywords: E-commerce, Cross-border commerce, Digital supply chain, Live-streaming commerce

1. Introduction

Cross-border live-streaming e-commerce utilizes live-streaming platforms to display and sell goods in real time, fostering interaction and transactions that directly connect brands with consumers. Despite its growth, the industry struggles with complex supply chain management and inefficient logistics, which are exacerbated by an expanding global market and diversifying consumer demands. The digital supply chain is becoming a key driver for development by transforming supply chain processes through advanced information technologies. The digital supply chain integrates technologies such as big data and cloud computing to enable real-time data sharing and intelligent decision support across all supply chain links. This approach allows companies to optimize their business processes, lower operating costs, and improve service quality and customer satisfaction, thus providing a competitive edge in the market (Jiang and Li, 2024). The digital supply chain integrates transaction data, logistics information, and inventory status to improve overall operational efficiency and enables seamless collaboration among suppliers, logistics providers, and payment platforms. This synergy enhances efficiency and reduces costs, helping e-commerce companies expand into new markets and achieve rapid business growth. In this study, we explored how to empower cross-border live-streaming e-commerce leveraging the digital supply chain. The results enable the development of countermeasures to meet the changing needs of the market to improve the efficiency and competitiveness of the supply chain and provide a reference for further development of e-commerce models and related research.

2. Digital Supply Chain Application

In this study, we reviewed the concept of the digital supply chain and its application in modern business (Fig. 1). A supply chain represents the complete production process of a product, and its management involves overseeing the flow of goods, capital, and information (Yang, 2024). The digital upgrade of this process involves the transformation of these three flows. The revenue from digital supply chain services was approximately 3.6 trillion yuan in 2023, reflecting an 11% year-on-year growth. High-tech manufacturing, cold chain, and cross-border logistics are becoming new drivers for this growth. In China, the scale of digital logistics services reached 2.9 trillion yuan in 2023, driven by the vigorous development of e-commerce and cross-border transportation (China's Digital Supply Chain Market Size and Development Trend Analysis Report, 2024).

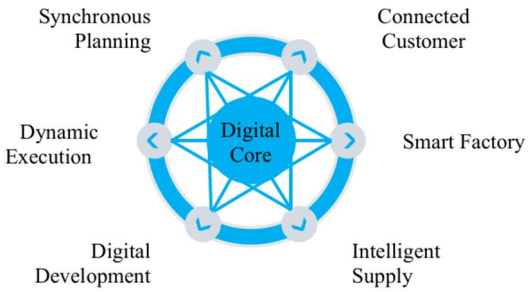

Fig. 1. Digital supply network.

An increasing number of enterprises are offering digital supply chain services tailored to cross-border live-streaming e-commerce. For instance, Yule Group employs a "four-in-one" supply chain middle platform system, integrating business and data middle platforms to establish a closed-loop data-driven operational framework. This system facilitates efficient business exploration and innovation. Cainiao Network leverages digital technologies to optimize and integrate logistics processes. Through big data analytics, intelligent warehouse management, and advanced distribution path planning, Cainiao enhances logistics speed and accuracy while reducing operational costs. As a result, it has emerged as one of the four largest cross-border logistics companies globally. Dolphin Supply Chain, a trading enterprise specializing in overseas shopping products, is dedicated to supplying authentic international goods to small and medium-sized overseas shopping businesses. It addresses key challenges in product sourcing and agent-based delivery. To support its operations, Dolphin has invested 170 million yuan in establishing five overseas warehouses, two Hong Kong warehouses, six bonded warehouses, and a comprehensive trunk transportation network. Additionally, it has developed four major procurement centers located in Europe, the United States, Australia, and Japan. Daystar provides end-to-end logistics services for domestic e-commerce platforms and merchants dealing in imported goods. Its offerings include overseas warehouse receipt, international transportation (via air and sea), bonded warehousing, customs data exchange, electronic customs clearance, and domestic delivery. Furthermore, companies such as Inspur Aigou Cloud Chain and Longdao, which specialize in digital supply chain solutions, offer full life-cycle growth services for large-scale chain enterprises. These services support digital transformation initiatives and enhance operational efficiency. Increasingly, leaders of large-scale chain enterprises recognize the strategic importance of digital supply chains in boosting competitiveness and driving industrial transformation and upgrading. Consequently, many have actively implemented digital supply chain systems within their organizations.

3. Effect of Digital Supply Chain

3.1 Enhanced Efficiency and Transparency

The digital supply chain significantly improves supply chain transparency and operational efficiency (Huang and Tan, 2025). By introducing technologies, such as blockchain, companies understand every stage of the supply chain, from the origin of raw materials to logistics and transportation. This transparency enhances compliance, reduces fraud, and builds consumer trust in the brand (Jin and Zhang, 2024). Therefore, the digital supply chain enhances overall operational efficiency by optimizing processes and reducing waste. Advanced information technologies, including the Internet of Things (IoT), big data analytics, and artificial intelligence (AI) enable real-time inventory monitoring, demand forecasting, and quick adjustments to production and logistics plans. This data-driven approach helps cross-border live-streaming e-commerce companies accurately predict market demand, minimize inventory overstock and stockouts, and improve overall operational efficiency (Yang et al., 2022). The system also quickly processes and ensures the accuracy of orders, leading to higher customer satisfaction.

3.2 Optimized Inventory and Reduced Costs

By leveraging big data analysis and intelligent prediction technology, digital supply chains enable cross-border live-streaming e-commerce companies to accurately forecast sales and manage inventory, which reduces overstocking, prevents shortages, and lowers operating costs. The increasing intelligence and automation of digital supply chains, through the use of robots and automated equipment, optimize warehouse management and reduce labor costs and safety risks. Additionally, real-time monitoring of logistics information enables companies to track goods, which reduces delays and transportation losses. The digital supply chain supports fast and flexible order processing and delivery, shortening delivery times and improving the customer shopping experience (Chung,

2021; Chu et al., 2024). Intelligent customer service and after-sales systems also allow for more timely problem resolution, which increases consumer satisfaction. The system collects and analyzes consumer data, such as shopping behavior and preferences, providing valuable market insights for personalized product recommendations and customized services. This personalization enhances consumer satisfaction and market competitiveness, and promotes sustainable development by optimizing logistics routes, reducing packaging waste, and using eco-friendly materials, which helps reduce the environmental impact and strengthens brand loyalty (Huang and Tan, 2025).

4. Challenges in Digital Supply Chain Adoption

The adoption of digital supply chains in cross-border live-streaming e-commerce faces challenges stemming from a volatile global environment, new technologies, and complex trade policies.

4.1. Technical Challenges

A primary technical challenge is system integration and data sharing, as different systems often use varied data formats and interface standards, which hinders information connectivity and affects supply chain responsiveness. Additionally, with the rapid advancement of communication technologies of 5G and 6G, AI, and big data, companies must continuously update their systems to stay current with market changes, which requires significant technical expertise and investment.

4.2. Operational Challenges

There are operational challenges, including logistics and inventory management, too. Cross-border logistics are characterized by long distances, numerous links, high costs, and unpredictable delivery times. The complexity and high cost of cross-border returns for end users present a significant challenge. Another major obstacle is collaboration in the supply chain. A digital supply chain requires close cooperation among all parties, but differing business interests complicate resource optimization. Unexpected emergencies such as natural disasters or political unrest also negatively affect collaborative operations.

4.3. Compliance Challenges

Compliance issues are also significant. Cross-border e-commerce must adhere to the international trade regulations of multiple countries, including tariff policies and data protection laws, to avoid legal and financial risks. Tax compliance, particularly with issues such as value-added taxes (VATs) and customs duties, is complex and requires accurate cost calculations to prevent financial losses and reputational damage. Table 1 shows a high degree of uncertainty of the cross-border live streaming e-commerce.

Table 1. Environmental analysis of uncertainty of cross-border live streaming e-commerce.

Stability / Complexity	Stable	Instable
Complexity	Low-medium uncertainty	High uncertainty
Easy	Low uncertainty	High-medium uncertainty

4.4. Market Challenges

The market is increasingly competitive, with more businesses entering the cross-border live-streaming e-commerce space. To stand out in the competitive market, companies must constantly innovate and optimize their digital supply chains to align with market trends and consumer demands. Changes in consumer behavior, such as the increase in omnichannel shopping, also require companies to optimize their operations across multiple platforms to provide a seamless customer experience. The industry suffers from a shortage of workforce. Despite the introduction of cross-border e-commerce courses in universities, the qualified workforce still falls short of market demand. Customs clearance also presents a challenge, as regulations and processes vary by country, which can lead to delays.

5. Optimization of Live-e-commerce E-commerce Model

To address these challenges, companies need to focus on technological innovation, operational optimization, compliance management, market insight, and talent training.

5.1. Technology Upgrades

Companies must establish unified data standards and interfaces with their partners to facilitate seamless information sharing and processing (Chen, 2024). By building a centralized information-sharing platform, data can be integrated from various sources to support decision-making while strengthening data security and privacy protection through encryption and access controls. Companies must also keep pace with new technologies, including 5G/6G, AI, and digital twin technology, by increasing investment in R&D and employee training, technological innovation, and applying new technologies to business models, such as AI for personalized recommendations and big data for consumer behavior analysis (Le et al., 2024).

5.2. Operational Optimization

By establishing or partnering with a global logistics network and using diversified transportation methods, costs and distribution efficiency are optimized. Advanced inventory management systems and IoT technology enable real-time inventory monitoring and intelligent scheduling to prevent overstock or shortages. Companies must establish an emergency logistics mechanism and optimize their warehousing layout to handle unexpected events and improve delivery efficiency. Collaboration through regular meetings must be ensured to share platforms and improve communication and resource allocation among supply chain partners.

Before entering new markets, companies need to thoroughly understand the local trade regulations, including tariffs and data protection laws, to ensure compliance and avoid legal risks. It is also required to establish a robust compliance management system, provide regular employee training, and keep updated on changes in the international trade environment (Mao, 2025). Companies must accurately calculate and manage tax costs, such as VAT and customs duties, using digital tools to automate tax data collection and analysis to improve accuracy and efficiency.

5.3. Market Situation

Companies need to keep updated on market trends and consumer demands to continuously innovate and enhance their brand image. Expanding into diversified markets and strengthening supply chain collaboration reduces reliance on a single market. Leveraging big data analytics is critical for precision marketing and optimizing the omnichannel customer experience. Localization efforts, including adapting products, logistics, language, and payment methods to specific markets, are also needed to improve consumer satisfaction and loyalty (Ma et al., 2024).

To address the workforce shortage, a school-enterprise cooperation system must be constructed by aligning with academic programs and market demands. Colleges and universities need to introduce lecturers with practical experience to strengthen students' ability and professional ability (Liu and Li, 2023). This includes developing joint courses and providing practical opportunities through internships. Additionally, companies must actively recruit experts and train employees, and provide competitive compensation and career development opportunities to create versatile professionals who understand both e-commerce and logistics.

Companies must understand and comply with the specific customs clearance regulations of each country. Using IoT and big data, companies must track goods in real-time and optimize customs clearance processes with intelligent algorithms. Close collaboration with logistics partners and establishing a professional customs clearance team also helps to reduce cargo detention times and respond quickly to policy changes.

6. Conclusions

With the rapid expansion of global cross-border live-streaming e-commerce, the digital supply chain plays an important role in enhancing operational efficiency and competitiveness. The digital supply chain improves transaction speed, optimizes resource allocation, enriches customer experiences, and enables industrial upgrading and brand globalizations. Moreover, it enables companies to adapt to fluctuations in the global supply chain. As a foundational element supporting the growth of cross-border live-streaming e-commerce, the digital supply chain is demonstrating its transformative potential. By facilitating supply chain collaboration, logistics and distribution can be streamlined, and personalized consumer demands are accommodated, which helps companies effectively respond to global market challenges and achieve sustainable development. Continuous technological advancement and diversification of digital supply chains further expand the impact of digital supply chain on cross-border live-streaming e-commerce.

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