

Construction and implementation of cross-border e-commerce supply chain system under the background of green and low-carbon

Cross-border
e-commerce
supply chain
system

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Abstract

Purpose – As China's e-commerce and cross-border e-commerce rapidly develop, the cross-border e-commerce supply chain exhibits characteristics of globalized development scale, collaborative multiparty participation, streamlined management processes, digitalized production and trade and flexible strategic choices. It tends toward data-driven intelligence, interoperable information collaboration, personalized order responses, sustainable supply chain management and secure blockchain technology. These characteristics and trends provide critical references for businesses, governments and investors.

Design/methodology/approach – In response to issues such as inconsistent legal regulations, imbalanced logistics and transportation, imperfect payment settlements and opaque supply chains.

Findings – It is recommended to take measures to strengthen cooperation and communication, optimize logistics, reduce customs clearance difficulties, reinforce safeguard measures and promote sustainable development, collectively fostering the healthy growth of cross-border e-commerce.

Originality/value – With the rapid development of cross-border e-commerce, green and low-carbon initiatives have become a significant trend in this sector. The cross-border e-commerce supply chain refers to the mechanism that reduces environmental impacts and enhances resource efficiency from manufacturers to consumers. It primarily involves manufacturers, e-commerce platforms, logistics companies and payment and settlement processes. The cross-border e-commerce supply chain is gradually becoming a highlight in China's foreign trade, supporting the concept of "buying globally and selling globally" and connecting the "world's factory" with the "world's market."

Keywords Cross-border e-commerce, Supply chain system, Construction

Paper type Research paper

The 2023 Central Economic Work Conference emphasized the active and prudent advancement of peak carbon emissions and carbon neutrality, accelerating the creation of a green and



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low-carbon supply chain [1]. With the rapid development of cross-border e-commerce, green and low-carbon initiatives have become a significant trend in this sector. The cross-border e-commerce supply chain refers to the mechanism that reduces environmental impacts and enhances resource efficiency from manufacturers to consumers. It primarily involves manufacturers, e-commerce platforms, logistics companies and payment and settlement processes. The cross-border e-commerce supply chain is gradually becoming a highlight in China's foreign trade, supporting the concept of "buying globally and selling globally" and connecting the "world's factory" with the "world's market." This makes it a crucial lever in driving the cross-border e-commerce industry toward more efficient, sustainable and intelligent development.

1. Development status of cross-border e-commerce

1.1 Continuous growth in the scale of cross-border e-commerce

China's cross-border e-commerce market is continually expanding. According to the statistics from China Customs, from January to June 2023, the scale of China's cross-border e-commerce imports and exports was about 1.1 tn yuan, an increase of 16.6% over the same period last year. The growth rate accelerated by 13.7% points, accounting for 5.5% of the total value of China's goods trade during the same period, up 0.7% points. Among them, exports were about 825.4bn yuan, up 20.6%, accounting for 7.2% of China's total exports in the same period; imports were about 277.1bn yuan, an increase of 6.2%, accounting for 3.2% of China's total imports [2].

1.2 Increased expansion into global markets

Cross-border e-commerce platforms such as Amazon, Alibaba and eBay have become major channels for global cross-border e-commerce. These platforms provide a convenient international trade environment, payment settlement services and logistics distribution networks, promoting the development of cross-border e-commerce. China, the United States of America and the UK are the major participants and consumer markets in the global cross-border e-commerce market. According to China Customs, in terms of export destinations, the United States of America accounts for 35.1% of China's cross-border e-commerce exports, followed by the UK, Germany and France with 9.2, 6.1 and 4.5%, respectively. Additionally, emerging markets like Vietnam, Malaysia and Brazil also play significant roles. In terms of import origins, Japan accounts for 21.9% of China's cross-border e-commerce imports, followed by the United States of America, Australia and France with 17.4, 9.4 and 8.2%, respectively. Goods from trading partners like Germany, South Korea and Italy also enter the Chinese market through cross-border e-commerce.

1.3 Diversification of cross-border e-commerce submarkets

In addition to the traditional B2C cross-border e-commerce, there is a growing number of submarkets such as B2B cross-border e-commerce, cross-border e-commerce platforms and cross-border e-commerce service providers. These submarkets, while meeting diverse business needs, also promote the diversified development of cross-border e-commerce. According to China Customs, over 90% of cross-border e-commerce goods are consumer products. Exports account for 95.9%, mainly including apparel, footwear, bags, home textiles, electronic products like mobile phones and household office appliances. Imports account for 95.3%, primarily comprising beauty and personal care products, food and fresh produce, pharmaceuticals and medical equipment and infant formula.

1.4 Significant trade advantages in coastal cities

With the advancement of technology and digital transformation, the supply chain of cross-border e-commerce is continuously innovating and developing. The application of

technologies like artificial intelligence, big data analysis and the Internet of Things has made the green supply chain of cross-border e-commerce more intelligent and efficient. According to China Customs, the main origins of cross-border e-commerce export goods are Guangdong, Zhejiang, Fujian and Jiangsu, accounting for nearly 80% combined. The primary consumption areas for imported goods are Guangdong, Jiangsu, Zhejiang, Shanghai and Beijing, accounting for over 40% in total.

1.5 Continuous enhancement of favorable cross-border policies

In 2023, the attention of various local governments in China toward cross-border e-commerce in the context of green and low-carbon development has continuously increased. Several related policies and regulations have been introduced to promote the healthy development of cross-border e-commerce. For instance, in December 2023, the Shanghai Municipal Commission of Commerce issued the “Shanghai Plan for Enhancing Capabilities, Improving Systems, Creating a Favorable Environment, and Introducing and Cultivating Traders.” This plan proposes support for the development of green technologies, the design of green products and the construction of green factories to create a green supply chain. In January 2023, the Shandong Provincial Party Committee and Provincial Government issued the “Three-Year Action Plan for Building a Green, Low-Carbon, High-Quality Development Pioneer Area in Shandong Province (2023–2025).” This plan proposes building a pioneer area for green, low-carbon and high-quality development, emphasizing the need to firmly follow the path of ecological priority and green development and accelerate the formation of an industrial structure, production mode, lifestyle and spatial pattern that saves resources and protects the environment.

2. Characteristic analysis

2.1 Globalization of development scale

The cross-border e-commerce supply chain involves various participants such as manufacturers, e-commerce platforms and logistics service providers from multiple countries and regions. This green supply chain network covers the globe, facilitating cross-border circulation of goods through the internet and logistics networks. For example, JD Logistics has built one of China’s largest warehousing networks and, through a trinity of logistics technology involving software, hardware and system integration, drives the whole supply chain to reduce costs and increase efficiency. Data show that as of the end of the third quarter of 2023, JD’s supply chain infrastructure assets increased by 17% year-over-year to 148.6bn yuan. As of September 30, JD Logistics operated over 1,600 warehouses nationwide, with a managed area exceeding 32m square meters including cloud warehouses (Zhang, 2023).

2.2 Collaboration among multiple parties

In the cross-border e-commerce supply chain system, each participant plays a different role, collaborating in the production, circulation and sales of goods. For example, the full-management model is becoming popular on cross-border e-commerce platforms. Implementing such a model requires a strong supply chain as a guarantee. In May 2023, TikTok Shop’s cross-border e-commerce officially announced the launch of a “full-management” operation model, with a small-scale pilot in the US market in August and a full-scale launch at the end of October. AliExpress began internal testing of the full-management model at the end of 2022 and promoted the full-management mode Choice channel in all categories in April 2023. Other cross-border e-commerce platforms like Lazada also started adopting the full-management model (Wenjun, 2023).

2.3 Streamlined management processes

Considering the differences in laws, customs policies and payment systems of different countries, the management process of the supply chain needs to take these factors into account. For relatively simple supply chain management processes, major companies in the cross-border e-commerce supply chain continuously simplify the sales order process through informatization; constantly monitor the storage of goods in warehouses; strengthen emotional management and brand loyalty of each consumer, increasing customer stickiness; for physical stores, form a standardized and normative management system to promote efficient store operation; use new technologies such as big data, artificial intelligence, cloud computing to enhance the data operation capabilities of merchants in the supply chain; adopt a series of business strategic models, innovate supply chain services, enhance the risk resistance of enterprises and endow enterprises with unique competitiveness.

2.4 Digitalization of production and trade

The cross-border e-commerce supply chain focuses on information technology and digital means, realizing information sharing and collaboration among various links through the internet and electronic data interchange. Supply chain participants can use e-commerce platforms, logistics tracking systems, supply chain management software and other tools to stay informed of order status, inventory and logistics information in real time, thus improving the efficiency and visibility of the supply chain. For instance, SHEIN spent a significant amount of money to transform factories for intelligence, making the factory's production operations mechanized, standard data digitalized, production visualized and information transparent. In terms of fabrics and sizes, there are quantified standards for their physical and chemical properties, which improve the circulation rate of production materials in a fully visualized manner. A series of warehousing management systems are fully intelligent and digitalized, and SHEIN has promoted its digital supply chain operation mode overseas, successfully launching the first locally produced product series in Brazil this year (Xiaomai, 2023).

2.5 Flexible strategic choices

The cross-border e-commerce supply chain needs to be highly flexible and adaptable due to factors such as policy changes between different countries and fluctuations in market demand. Supply chain participants need to be able to quickly adjust production plans, inventory management and logistics transportation to adapt to market and demand changes. For example, in addition to the convenience of transportation, overseas warehousing logistics in cross-border e-commerce also optimizes the entire supply chain system, reduces costs, improves customer satisfaction and provides opportunities to expand markets. In international markets, overseas warehousing is increasingly becoming an important strategy for e-commerce companies to gain competitive advantages [3].

3. Existing problems

Under the backdrop of green and low-carbon development, the cross-border e-commerce market holds immense potential, but the supply chain system faces several challenges, such as the diversity of laws and regulations, simplicity in logistics transportation, security of payment settlements and issues with supply chain visibility.

3.1 Non-uniformity of laws and regulations

Different countries and regions have varying customs policies and legal regulations, which the cross-border e-commerce supply chain must comply with. This includes issues related to

tax regulations, intellectual property protection, consumer protection laws, payment regulations and logistics regulations, posing challenges to the operation of the supply chain. In terms of tax regulations, different countries and regions have distinct tax laws and cross-border e-commerce entities need to understand and adhere to each destination's tax policies to ensure timely tax payments. Moreover, some countries may levy specific value-added taxes or tariffs on certain goods or services, which cross-border e-commerce entities must understand and address. Regarding intellectual property regulations, protecting intellectual property rights is a critical issue for cross-border e-commerce. Sellers need to ensure that their products do not infringe on any intellectual property rights while also guarding against counterfeit and inferior goods. The patent, trademark and copyright regulations may vary between countries and regions, requiring sellers to carefully study and comply with these regulations to avoid infringement disputes.

In terms of consumer protection laws, protecting consumer rights is a legal requirement that cross-border e-commerce cannot ignore. Sellers need to ensure the protection of consumer rights, including transparency in product descriptions, shipping notifications, return and exchange policies and dispute resolution mechanisms. Additionally, sellers must comply with personal information protection regulations at the destination to ensure proper handling of consumer data.

Regarding payment regulations, cross-border e-commerce needs to understand and comply with the payment regulations of different countries and regions to ensure the acceptance of payments from all over the world. Some countries and regions may require sellers to obtain specific payment licenses or permits and sellers need to understand and meet these requirements. Furthermore, sellers need to focus on the security and compliance of various payment methods to ensure consumer payment safety.

In terms of logistics regulations, cross-border e-commerce logistics involves aspects like customs, postal services and transportation and the logistics regulations vary between countries and regions. Sellers need to understand and comply with the logistics regulations of each destination to ensure smooth customs clearance and delivery to consumers. They also need to pay attention to environmental protection regulations during transportation to achieve green logistics.

3.2 Imbalance in logistics and transportation

Cross-border logistics, an essential part of the green supply chain, includes domestic transportation, international transportation and final delivery. Issues like delays, damages and losses in logistics can affect the efficiency of the supply chain and customer satisfaction. Moreover, geographical and cultural differences between countries can impact the operation of logistics. In general, logistics and transportation face issues like logistics efficiency, asymmetric logistics information, cross-border returns and after-sales services, theft and counterfeiting and mismatches between cross-border supply and demand. In terms of logistics efficiency, cross-border e-commerce logistics involves multiple stages, including international transportation, customs clearance and delivery. Each stage can affect the speed and efficiency of logistics. For example, international transportation can be lengthy, risking delays, losses or damage to goods. Customs procedures can be complex and time-consuming. The last-mile delivery may face restrictions from the postal systems of the destination country or region, leading to low delivery efficiency. Asymmetric logistics information means that logistics information cannot be tracked in real time. Customers may not be timely informed about the status, location or warehousing of the goods, affecting their satisfaction. Cross-border returns and after-sales services present challenges due to the shipping and receiving locations spanning different countries or regions. The return process is complex, involving cross-border logistics, tariff refunds, etc. adding to costs and time. Theft and

counterfeiting pose additional risks for cross-border e-commerce. During transportation, goods may be stolen or replaced. Due to the involvement of multiple countries or regions, a large number of counterfeit products and infringement issues exist, causing trust and purchase protection concerns for consumers. In terms of the mismatch between cross-border supply and demand, China's cross-border logistics infrastructure is still not fully developed and the system is not very rational, leading to a lack of coordination between cross-border logistics and e-commerce. The mismatched development levels of both aspects significantly restrict the growth of cross-border transactions.

3.3 Imperfections in payment settlement

Cross-border e-commerce involves the currencies and payment systems of different countries and regions. Differences in payment rules and procedures can lead to delays and inconveniences in payments. Additionally, cross-border payments face risks related to the diversity of payment methods, exchange rate fluctuations, payment security, settlement delays, cross-border taxation and the costs of cross-border payments. Regarding the diversity of payment methods, cross-border e-commerce must accept payments from various countries and regions, including credit cards, third-party payments, bank transfers, etc. This adds complexity to processing and may impact transaction efficiency. Exchange rate fluctuations, involving different currencies, can affect transaction costs and profits, adding uncertainty to transactions. Payment security is a crucial issue for cross-border e-commerce transactions involving sensitive consumer information, such as credit card numbers and bank accounts. Safeguarding payment security to prevent data breaches and fraudulent transactions is essential. Settlement delays can occur in cross-border payments involving the banking systems of multiple countries and regions, potentially delaying payment receipt by cross-border e-commerce and impacting cash flow and operational efficiency. Cross-border taxation involves understanding and complying with the tax laws of different countries and regions to ensure timely tax payments. Costs associated with cross-border payments include transaction fees, currency conversion fees, etc. which may affect the profits of cross-border e-commerce.

3.4 Lack of supply chain transparency

Due to the involvement of multiple parties and stages, the visibility and transparency of the cross-border e-commerce supply chain can be limited. Poor information flow and data silos hinder timely access to crucial information such as order status and inventory, leading to issues like lack of information sharing, compliance risks, product quality concerns and opacity in logistics information. In terms of lack of information sharing, the supply chain in cross-border e-commerce involves numerous stages, including manufacturers, logistics and customs. The inefficient flow of information between these stages results in an incomplete understanding of the entire supply chain and ineffective monitoring of each stage. Regarding compliance risks, due to the opacity of the supply chain, cross-border e-commerce may face compliance risks. For example, unfamiliarity with the import regulations and standards of certain countries or regions may lead to products not meeting requirements, resulting in returns and fines. In terms of product quality, the opacity of the supply chain means that cross-border e-commerce may not accurately understand the quality of products, potentially leading to products not meeting expectations or posing safety hazards. Regarding opacity in logistics information, logistics is a crucial stage in the cross-border e-commerce supply chain, but currently, there is an issue with opaque logistics information. Cross-border e-commerce cannot monitor the transportation of goods in real time, potentially leading to logistics delays and lost goods.

4. Suggested strategies

4.1 *Strengthen cooperation and communication*

Supply chain participants should enhance communication and cooperation by establishing effective mechanisms for sharing information. By sharing data on orders, inventory and logistics, real-time collaboration can be achieved across all segments of the supply chain, thereby improving its visibility. Nations should strengthen cooperation to jointly address issues like environmental protection and intellectual property rights, establish comprehensive international cooperation mechanisms and promote global green and low-carbon development. For instance, on August 7, 2023, the 13th BRICS Trade Ministers Meeting was held via video conference. The meeting resulted in documents like the “BRICS Framework for Strengthening Resilient and Sustainable Supply Chain Cooperation.” The international community should jointly develop unified cross-border e-commerce trade rules to reduce trade barriers between countries and enhance the transparency and efficiency of the supply chain.

4.2 *Optimize logistics and transportation*

Logistics and transportation are key components of the cross-border e-commerce supply chain. Supply chain participants should choose reliable logistics service providers and optimize logistics routes and delivery methods. Additionally, the use of logistics tracking technology can provide real-time information, allowing customers to stay informed about the status of their orders and the progress of logistics. According to survey data from the China Storage and Distribution Association on large-scale warehousing enterprises (defined as enterprises operating warehouses with an area of over 200,000 square meters), by the end of 2022, approximately 61.9% of enterprises achieved positive revenue growth and 38.1% experienced negative growth. Compared to 2021, the proportion of enterprises with reduced revenue increased. Among them, enterprises in the growth range of 0–10% accounted for the largest proportion at 31%, followed by those in the negative 10%–0 range at 17.3%. Adopting intelligent logistics technology, optimizing the global logistics network, improving logistics efficiency, reducing carbon emissions and promoting the green and low-carbon transformation of the supply chain can be effective. For example, Prolog released a new product at its 10th anniversary annual meeting – a comprehensive pick-and-place robot that provides a new solution for picking and handling on multitier shelving systems; Mecree launched the PS1500 series of intelligent pallet transporters in both ambient and refrigerated versions. They shared application cases of the “Magway River Map” platform for large-scale cluster scheduling in large-scale palletized four-way vehicle projects; JiZhiJia introduced a high-storage, high-throughput four-way vehicle picking solution, revolutionizing integrated warehousing and sorting scenarios; Hikon Robot launched a mechanical arm dismantling and stacking solution guided by machine vision, suitable for various box and bag packaging, effectively meeting diverse customer needs for warehouse sorting automation [4].

4.3 *Simplify customs clearance*

Supply chain participants should understand the customs policies and legal regulations of various countries and ensure that products meet relevant standards and certification requirements. They should stay informed about customs clearance measures in different countries and understand the clearance processes and required documentation in advance to reduce clearance time and risks. For example, in 2023, China Customs aims to promote foreign trade stability and quality improvement by focusing on market entities, market share and the safety and stability of industrial and supply chains. Efforts include relieving enterprises’ burdens to protect market entities, reducing customs clearance costs, continuously optimizing the business environment at ports, implementing special actions for cross-

border trade facilitation, preparing for the new round of World Bank assessments, advancing the construction of a “single window” for international trade, providing “one-stop” comprehensive services and creating intelligent ports [5].

4.4 Strengthen protective measures

Cross-border e-commerce supply chains should enhance preventive measures mainly in quality management, payment experience, intellectual property rights and talent training. In strengthening quality management, supply chains should ensure products meet quality standards and consumer expectations. Establish a manufacturer certification system and audit and evaluate manufacturers to ensure product quality reliability. Enhance the payment experience by offering diversified payment methods and ensuring payment security and convenience. Strengthen cooperation with payment institutions to provide a secure payment environment and guarantees. Support and promote green payment methods, including electronic payments and digital currencies, to reduce cash transactions, improve payment efficiency and lower environmental impact. In protecting intellectual property rights, supply chain participants should establish mechanisms for intellectual property protection, review and protect intellectual property within the supply chain and raise awareness through training and publicity. In terms of talent training, provide relevant training for enterprises to enhance the international operational capabilities of cross-border e-commerce professionals.

4.5 Promote sustainable development

Supply chain participants should focus on environmental protection and sustainable development, adopting green supply chain management measures such as reducing packaging waste, optimizing logistics routes and using renewable energy. Encourage enterprises to innovate and conduct research in the field of cross-border e-commerce, promoting the application of green technologies and enhancing the technological content of the supply chain. Implement sustainable practices in the supply chain to reduce environmental burdens, using green packaging, biodegradable materials, etc. to promote the greening of the supply chain. As of the end of 2022, there were 420 green warehouses (a 55.6% increase year-over-year) covering an area of 29.65 m square meters (a 48.3% increase year-over-year). Companies like Prologis and Vailog are exploring advanced green warehousing facilities, releasing “Zero Carbon Park” reports and summarizing and sharing practical solutions in planning, construction and operations [6]. Additionally, establish a monitoring and evaluation mechanism for the global cross-border e-commerce supply chain, regularly assess its level of green and low-carbon development and promote continuous improvement and higher standards.

5. Development trends

5.1 Data-driven intelligence

With the continuous development of big data and artificial intelligence technologies, the cross-border e-commerce supply chain will increasingly rely on the analysis and application of data. Through the mining and analysis of massive data, supply chain managers can more accurately predict market demand, optimize inventory management and improve logistics efficiency, thus achieving intelligence and optimization of the supply chain. For example, generative AI applications are in sync with the development elements of cross-border e-commerce. From the perspective of B2C cross-border e-commerce companies, they can effectively reduce the costs of optimizing processes and precision marketing and significantly enhance their effects. As for B2B platform-type enterprises, they can provide AI toolkit services and expand business revenue and profits [3].

5.2 Interoperable information collaboration

Visibility and transparency in the supply chain are key to improving efficiency and reducing risks. The future cross-border e-commerce supply chain will focus more on information sharing and collaboration, realizing real-time monitoring and data exchange in all links of the supply chain through technological means. Participants in the supply chain can more clearly understand order status, inventory, logistics information, etc. enhancing the visibility and transparency of the supply chain. For instance, Amazon's e-commerce operations place great importance on the significance of IT and AI intelligence. E-commerce operations have become more efficient, precise and automated due to the development of IT technology and more intelligent, predictive and personalized due to AI technology. Therefore, Amazon sellers should continuously develop IT technology and AI intelligence in e-commerce operations (Tanghui, 2023).

5.3 Personalization in order response

Cross-border e-commerce supply chains need to have rapid response and flexibility to adapt to market changes and shifts in consumer demand. Future supply chains will focus more on flexible design and rapid adjustment capabilities, including diverse manufacturing options, flexible production allocation and speedy logistics delivery, to meet consumers' demands for personalization and quick delivery. For instance, according to a report by Grand View Research, the customs products industry reached a market size of \$4.9bn in 2021 and is expected to reach \$39.87bn in 2023, with a compound annual growth rate (CAGR) of 26.1%, indicating broad market growth prospects. Overseas consumers have a strong demand for personalized products, with data from The Deloitte Consumer Review showing that over 50% of consumers are interested in purchasing personalized products for themselves, friends and family and one-fifth are willing to pay an additional 20% for personalized products [7].

5.4 Sustainability in supply chain management

The importance of environmental protection and sustainable development in cross-border e-commerce supply chains is increasingly prominent. Future supply chains will focus more on green supply chain management, including reducing packaging waste, optimizing logistics routes and using renewable energy, to minimize environmental impact and achieve sustainable development. For example, Lenovo Group's Global Supply Chain ESG Digital Platform and Lenovo Global Data Center Intelligent Operations Platform were selected as pioneer cases in the "Green Manufacturing/Supply Chain" and "Green Data Center" categories, respectively. Lenovo Group integrates the concept of ESG into every aspect of supply chain management, which helps enhance the supply chain's risk resistance. The intelligent transformation of ESG digital transformation will significantly improve the effectiveness of supply chain management [8].

5.5 Securitization with blockchain technology

Blockchain technology, characterized by decentralization, immutability and traceability, is expected to play a significant role in cross-border e-commerce supply chains. Through blockchain technology, supply chain participants can securely share and exchange data, enhancing the transparency and credibility of transactions and reducing the risks of fraud and counterfeit products. According to data from the China Electronics Information Industry Development Research Institute, the scale of China's blockchain industry (excluding cryptocurrencies, virtual currencies and enterprises with blockchain product input and output) in 2022 was about 6.7bn yuan, a year-on-year increase of 3.08%. In the past three

years, China's blockchain industry has grown from 5bn yuan in 2020 to 6.7bn yuan in 2022, with a three-year compound growth rate of about 77%. Although the growth rate has slowed, the cumulative industry scale over the past three years is nearly 20bn yuan. In 2022, China's blockchain investment and financing covered 18 fields, including finance, healthcare, energy, agriculture, logistics, automotive transportation, culture and entertainment, BaaS services, data services, real estate, social networking, retail and advanced manufacturing, continuing to expand compared to 2021 [9].

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