

Digital Transformation Path of Cross-border E-commerce Logistics Enterprises

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Abstract:

With the deep integration of global trade and the rapid development of cross-border e-commerce, the traditional operation mode of cross-border e-commerce logistics enterprises is facing unprecedented challenges such as information asymmetry, low operation efficiency and high cost. Digital transformation has become an inevitable choice for enterprises to enhance their core competitiveness. Based on the analysis of the current development status and existing pain points of cross-border e-commerce logistics industry, this paper explores the key technical supports for digital transformation, including artificial intelligence, big data, Internet of Things and blockchain. It also systematically studies the main challenges faced by enterprises in the transformation process, such as data security risks, high transformation costs, fragmented technical application scenarios and lack of industry standards. Finally, corresponding transformation paths are put forward from the aspects of strategic layout, technical application, organizational optimization, ecological coordination and policy support, so as to provide practical reference for cross-border e-commerce logistics enterprises to promote digital transformation and realize high-quality development.

Keywords:

Cross-border E-commerce Logistics, Digital Transformation, Technical Support, Transformation Path, Core Competitiveness

1. Introduction

In the context of the accelerating globalization of the world economy and the booming development of the digital economy, cross-border e-commerce has become a new engine driving the growth of international trade. As an important support for cross-border e-commerce, cross-border logistics undertakes the important task of connecting domestic and foreign markets, and its operation efficiency and service quality directly affect the development of cross-border e-commerce industry. In recent years, the scale of global cross-border e-commerce transactions has maintained a high growth rate. It is estimated that the global cross-border e-commerce transaction volume will exceed 8 trillion US dollars by 2026. The explosive growth of transaction volume has put forward higher requirements for the timeliness, transparency and controllability of cross-border logistics services.

However, the traditional cross-border logistics mode, which relies on manual operation and fragmented information management, has gradually been unable to meet the development needs of the current cross-border e-commerce industry. There are many pain points in the operation process, such as long customs clearance cycle caused by information asymmetry, difficult tracking of the whole logistics chain, high operation cost due to excessive dependence on manual work, and poor response ability to emergency events. These problems not only restrict the improvement of the core competitiveness of cross-border e-commerce logistics enterprises, but also affect the shopping experience of consumers and the healthy development of the entire cross-border e-commerce industry.

With the rapid development and wide application of digital technologies such as artificial intelligence, big data, Internet of Things and blockchain, digital transformation has become an inevitable trend in the development of cross-border e-commerce logistics enterprises. Digital transformation is not only the simple application of digital technologies, but also the comprehensive reconstruction of enterprise strategies, business processes, organizational structures and ecological cooperation models. By promoting digital transformation, cross-border e-commerce logistics enterprises can effectively solve the existing pain points in operation, improve operation efficiency, reduce operation costs, enhance service quality, and then gain a competitive advantage in the fierce market competition. Therefore, studying the digital transformation path of cross-border e-commerce logistics enterprises has important theoretical and practical significance for promoting the sustainable development of cross-border e-commerce logistics industry.

2. Current Development Status and Pain Points of Cross-border E-commerce Logistics Industry

2.1. Current Development Status

In recent years, driven by the rapid development of cross-border e-commerce, the global cross-border e-commerce logistics industry has shown a good development trend. On the one hand, the market scale has continued to expand. Taking China as an example, the import and export scale of cross-border e-commerce in China has exceeded 2 trillion yuan in 2023, with an average annual growth rate of more than 15%, which has directly driven the rapid growth of cross-border logistics demand [1]. On the other hand, the market competition pattern has become increasingly fierce. In addition to traditional large-scale logistics enterprises, a number of emerging logistics technology companies have entered the market, forming a competitive pattern of coexistence and competition between traditional enterprises and emerging enterprises.

At the same time, the regional development characteristics of the cross-border e-commerce logistics industry are obvious. The European and American markets have a mature logistics infrastructure and a sound regulatory system, and the digital level of logistics enterprises is relatively high. The emerging markets such as Southeast Asia and Latin America have a rapid growth in e-commerce penetration rate, and the demand for cross-border logistics services is increasing, but there are problems such as weak logistics infrastructure and imperfect regulatory systems. In addition, with the entry into force of free trade agreements such as RCEP, the trade barriers between regions have been gradually eliminated, which has provided a good policy environment for the development of cross-border e-commerce logistics industry, but

also put forward higher requirements for the cross-border coordination ability of logistics enterprises.

2.2. Main Industry Pain Points

Despite the good development trend of the cross-border e-commerce logistics industry, there are still many pain points in the operation process, which restrict the healthy development of the industry and the digital transformation of enterprises.

Firstly, information asymmetry and disconnection of the whole chain. Cross-border logistics involves multiple links such as warehousing, transportation, customs clearance and distribution, and involves multiple participants such as logistics enterprises, e-commerce platforms, customs and ports. Due to the lack of a unified information sharing platform and standard data interface, the information between various links and participants cannot be transmitted and shared in a timely and effective manner, forming an “information island” [1]. This leads to the difficulty of real-time tracking of goods in the whole logistics chain, the long customs clearance cycle caused by the inconsistency of declaration information, and the poor coordination between various links, which affects the operation efficiency of logistics enterprises.

Secondly, high operation cost and low efficiency. Traditional cross-border logistics enterprises rely heavily on manual operation in order processing, cargo sorting, transportation scheduling and other links, which not only has high labor cost (accounting for up to 40% of the total operation cost), but also is prone to errors, resulting in low operation efficiency [2]. For example, the manual entry of orders is not only time-consuming and laborious, but also easy to cause errors in order information, leading to the delay of goods delivery. In addition, the unreasonable allocation of logistics resources (such as empty driving of transport vehicles, low utilization rate of warehouses) also increases the operation cost of enterprises.

Thirdly, the lack of response capacity to risks and emergencies. Cross-border logistics is affected by many factors such as international trade policies, exchange rate fluctuations, natural disasters and public health events, and faces great operational risks [3]. However, traditional cross-border logistics enterprises lack effective risk early warning and response mechanisms, and cannot timely predict and deal with various risks and emergencies, resulting in serious losses. For example, the sudden change of customs policies in some countries will lead to the detention of goods, and the lack of timely response measures will affect the timeliness of goods delivery and damage the reputation of enterprises.

Fourthly, the mismatch between service quality and customer demand. With the continuous improvement of consumers' requirements for cross-border shopping experience, customers not only pay attention to the price of logistics services, but also put forward higher requirements for the timeliness, transparency and personalized service of logistics. However, traditional cross-border logistics enterprises are limited by the backward operation mode and technical level, and cannot provide personalized logistics services according to the needs of different customers, and the transparency of the logistics chain is low, which cannot meet the growing customer demand.

3. Key Technical Supports for Digital Transformation of Cross-border E-commerce Logistics Enterprises

The digital transformation of cross-border e-commerce logistics enterprises cannot be separated from the support of digital technologies. Artificial intelligence, big data, Internet of Things, blockchain and other digital technologies have unique advantages in solving the pain points of cross-border logistics operation, and have become the key technical supports for the digital transformation of enterprises [3].

3.1. Artificial Intelligence (AI)

Artificial intelligence technology plays an important role in optimizing the operation process and improving the decision-making level of cross-border e-commerce logistics enterprises[4]. On the one hand, AI can realize the automation and intelligence of logistics operations. For example, in the warehousing link, intelligent robots can complete the sorting, handling and storage of goods through visual recognition and grasping technology, which not only improves the efficiency of cargo sorting (by more than 80% compared with manual operation) but also reduces the error rate. In the transportation link, AI-based intelligent path planning algorithm can comprehensively consider factors such as road conditions, weather and customs clearance time, and formulate the optimal transportation path, so as to shorten the transportation time and reduce the transportation cost. On the other hand, AI can realize intelligent decision-making and risk early warning. By analyzing a large amount of logistics data, AI can predict the demand for cross-border logistics, help enterprises optimize the allocation of logistics resources, and avoid the waste of resources caused by overstocking or shortage of goods. At the same time, AI can identify potential risk factors (such as goods detention, damage and loss) in the logistics process in advance, and issue early warning signals to help enterprises take preventive measures in a timely manner.

3.2. Big Data

Big data technology is the core driving force for cross-border e-commerce logistics enterprises to realize data-driven operation. Cross-border logistics involves a large amount of data, including order data, cargo data, transportation data, customs data and customer data. Through big data analysis technology, enterprises can dig out the potential value of these data and provide support for business decision-making and service optimization. Firstly, big data can realize demand prediction and inventory optimization. By analyzing historical order data, customer consumption habits and market trend data, enterprises can accurately predict the demand for logistics in different regions and periods, and optimize inventory allocation to ensure that goods can be delivered to customers in a timely manner while reducing inventory costs. Secondly, big data can optimize the logistics path and improve the timeliness of delivery. By analyzing the transportation data of different routes (such as transportation time, cost and stability), enterprises can select the optimal transportation route and mode. Thirdly, big data can realize personalized customer service. By analyzing customer information such as purchase preferences, geographical location and delivery time requirements, enterprises can provide personalized logistics services for customers, improve customer satisfaction and loyalty. Finally, big data can help enterprises identify and control risks. By analyzing the data of customs clearance, transportation and other links, enterprises can find out the potential risk points and take corresponding control measures.

3.3. Internet of Things (IoT)

The Internet of Things technology provides technical support for the real-time monitoring and visualization of the whole cross-border logistics chain. By installing intelligent sensors, RFID tags and other IoT devices on goods, transport vehicles and warehouses, enterprises can collect real-time data such as the location, temperature, humidity and status of goods in the logistics process, and transmit these data to the background management system through the network. This enables enterprises and customers to real-time track the dynamics of goods, realize the visualization of the whole logistics chain, and solve the problem of difficult tracking of goods in traditional logistics mode. For example, in the transportation of perishable goods, IoT devices can real-time monitor the temperature of the carriage, and if the temperature exceeds the set range, the system will automatically issue an early warning, ensuring the quality of goods. In addition, IoT technology can also realize the intelligent management of warehouses. By installing IoT devices in warehouses, enterprises can real-time monitor the inventory status of goods, realize automatic inbound and outbound operations, and improve the efficiency of warehouse management.

3.4. Blockchain

Blockchain technology has the characteristics of decentralization, immutability and transparency, which can effectively solve the problems of trust shortage and information tampering in cross-border logistics[4]. Cross-border logistics involves multiple participants, and the information transmission between them is easy to be tampered with, resulting in trust problems. By using blockchain technology, enterprises can record the information of each link of the logistics chain (such as order information, cargo information, customs clearance information) on the blockchain, forming an immutable and transparent transaction record chain. This not only ensures the authenticity and reliability of information, but also realizes the sharing of information between multiple participants, reducing the information asymmetry between them. At the same time, blockchain technology can also realize the automatic execution of contracts through smart contracts. For example, when the goods arrive at the destination and are signed for, the smart contract can automatically complete the payment settlement, reducing the intermediate links and improving the efficiency of capital flow. In addition, blockchain technology can also help enterprises solve the problem of cross-border data security and compliance, ensuring that data transmission and sharing meet the relevant laws and regulations of various countries.

4. Main Challenges Faced by Digital Transformation of Cross-border E-commerce Logistics Enterprises

Although digital transformation can bring many benefits to cross-border e-commerce logistics enterprises, in the actual transformation process, enterprises still face many challenges, which affect the progress and effect of transformation [5].

4.1. Data Security and Cross-border Compliance Risks

Data is the core asset of the digital transformation of cross-border e-commerce logistics enterprises, but the problem of data security and cross-border compliance has become a major bottleneck restricting the transformation of enterprises [5]. On the one hand, cross-border logistics involves a large amount of sensitive data, including customer information, business data and trade secrets. The frequent occurrence of network attacks and data leakage incidents has brought great hidden dangers to the data security of enterprises. According to relevant data, the number of data leakage

incidents in the global logistics industry increased by 45% in 2023, and cross-border logistics enterprises have become the key targets of hackers due to their complex systems and scattered nodes. On the other hand, different countries and regions have formulated strict laws and regulations on data sovereignty and cross-border data flow, such as the EU's GDPR, the US's CLOUD Act and China's Data Security Law. These laws and regulations have strict requirements on the local storage, encrypted transmission and user authorization of data. Enterprises need to meet the compliance requirements of multiple countries and regions in the process of digital transformation, which increases the difficulty and cost of transformation. For example, a leading cross-border e-commerce logistics enterprise was at risk of a fine of up to 2 million US dollars in the Indonesian market because it failed to adjust its data storage scheme in a timely manner, which directly led to the suspension of its digital transformation process for half a year.

4.2. High Transformation Cost and Resource Bottleneck

The digital transformation of cross-border e-commerce logistics enterprises requires a lot of investment in hardware, software and talents, which brings great cost pressure to enterprises, especially small and medium-sized enterprises. In terms of hardware investment, enterprises need to purchase intelligent equipment such as intelligent sensors, automatic sorting machines and cloud computing servers, and the investment in these equipment is often tens of millions of yuan. In terms of software development, enterprises need to develop or customize professional logistics management systems (such as TMS, WMS) and information sharing platforms, and the development cost is usually between 5 million and 20 million yuan, and they also need to pay 5%-10% of the maintenance cost every year. In addition, the shortage of compound talents is also a major problem faced by enterprises. The digital transformation of cross-border logistics requires talents who are proficient in logistics business, IT technology and international trade regulations at the same time. However, such talents are in short supply in the market, and the salary level is relatively high, which increases the talent cost of enterprises. For example, a cross-border e-commerce logistics enterprise offered an annual salary of 1.2 million yuan to recruit a blockchain technology expert, but still no one applied. At the same time, the hidden costs in the transformation process (such as business interruption during system switching, employee retraining costs, data migration trial and error costs) are often underestimated, which further increases the transformation pressure of enterprises.

4.3. Fragmentation of Technical Application Scenarios and Coordination Difficulties

The cross-border logistics industry involves multiple links and multiple regions, and the complexity and diversity of scenarios lead to the fragmentation of digital technology application. On the one hand, there are great differences in the digital level of different links. For example, the air transport route has realized the whole-process IoT monitoring, while the coverage rate of cargo tracking in China-Europe Railway Express is still less than 40%. This “digital divide” between air, land and sea makes it difficult to realize the visualization of the whole logistics chain. On the other hand, the digital infrastructure in different regions is uneven. The digital infrastructure in emerging markets such as Southeast Asia and Africa is weak, and problems such as unstable power supply and poor network coverage often occur, which affects the normal operation of digital systems. In addition, the system interfaces between

logistics enterprises, e-commerce platforms, customs, banks and other participants are incompatible, and the lack of unified data standards makes it difficult to share data between various parties. For example, the system docking between a cross-border e-commerce platform and an international logistics company took as long as 6 months, and both parties needed to invest 20 engineers for customized development, which seriously restricted the release of digital value.

4.4. Lack of Industry Standards and Imperfect Ecological Construction

At present, the cross-border e-commerce logistics digital transformation industry lacks unified standards, including technical standards, data standards and service standards. The disunity of technical standards leads to the incompatibility of equipment and systems between different enterprises, which increases the cost of technical integration. The confusion of data standards makes it difficult to compare and share data between various parties, affecting the efficiency of data application. The lack of service standards leads to the uneven quality of digital logistics services in the market, and enterprises lack effective evaluation criteria. At the same time, the ecological construction of cross-border e-commerce logistics digital transformation is still in the initial stage. The cooperation between logistics enterprises, e-commerce platforms, technology companies, customs and other participants is not deep enough, and there is a lack of a coordinated and win-win ecological system. Most enterprises carry out digital transformation independently, which leads to the repetition of construction and the waste of resources, and cannot form the synergy of digital transformation.

5. Digital Transformation Path of Cross-border E-commerce Logistics Enterprises

In view of the main challenges faced by cross-border e-commerce logistics enterprises in the process of digital transformation, combined with the key technical supports, this paper puts forward the following transformation paths to help enterprises smoothly promote digital transformation and improve their core competitiveness [5].

5.1. Optimize Strategic Layout and Clarify Transformation Goals

The digital transformation of cross-border e-commerce logistics enterprises should first start with strategic layout, take digital transformation as a long-term development strategy of the enterprise, and clarify the transformation goals and direction [5]. Enterprises should combine their own business characteristics, market positioning and resource advantages to formulate a scientific and reasonable digital transformation plan, and avoid blind transformation. In terms of transformation goals, enterprises should focus on improving operation efficiency, reducing operation costs, enhancing service quality and strengthening risk control, and set phased transformation goals. For example, in the short term, realize the automation of order processing and the visualization of the main logistics links; in the medium term, build a unified data sharing platform and realize intelligent decision-making; in the long term, build a digital logistics ecological system and realize the integrated development of the whole industry chain. At the same time, enterprises should strengthen the top-level design of digital transformation, establish a special transformation leading group, coordinate the resources of various departments, and ensure the smooth progress of the transformation work.

5.2. Strengthen Technical Application and Promote Process Reconstruction

Enterprises should take digital technology as the core, strengthen the application of artificial intelligence, big data, Internet of Things, blockchain and other technologies, and promote the comprehensive reconstruction of business processes. Firstly, enterprises should promote the automation and intelligence of logistics operations. In the warehousing link, introduce intelligent robots and automatic sorting equipment to realize automatic inbound and outbound, sorting and storage of goods; in the transportation link, apply intelligent path planning and vehicle scheduling systems to optimize the allocation of transportation resources; in the customs clearance link, use AI and big data technology to realize automatic declaration and intelligent customs clearance, shorten the customs clearance cycle. Secondly, enterprises should build a unified data management platform, integrate the data of various links such as order, warehousing, transportation and customs clearance, eliminate "information islands", and realize the sharing and interaction of data. At the same time, strengthen the analysis and application of big data, realize demand prediction, inventory optimization, risk early warning and personalized customer service. Thirdly, enterprises should promote the application of blockchain technology in the aspects of cargo traceability, information verification and smart contracts, improve the transparency and trust of the logistics chain, and solve the problems of information tampering and trust shortage.

5.3. Promote Organizational Optimization and Strengthen Talent Training

The digital transformation of cross-border e-commerce logistics enterprises not only involves technical upgrading, but also requires the corresponding optimization of organizational structure and talent team. Firstly, enterprises should adjust their organizational structure, establish a flat and agile organizational model, reduce the level of management, and improve the efficiency of decision-making and execution. At the same time, set up a special digital technology department and data analysis department to be responsible for the research and application of digital technologies and the analysis and management of data. Secondly, enterprises should strengthen talent training and introduction, build a compound talent team that adapts to digital transformation. On the one hand, strengthen the training of existing employees, improve their digital literacy and technical level, and enable them to master the application of digital technologies and systems; on the other hand, actively introduce high-end talents in digital technology, data analysis, international trade and other fields, and improve the overall quality of the talent team. In addition, enterprises can strengthen cooperation with universities, vocational colleges and research institutions to carry out school-enterprise cooperation and talent customization training, and provide a steady stream of talents for digital transformation.

5.4. Strengthen Ecological Coordination and Build a Win-win Mechanism

The digital transformation of cross-border e-commerce logistics enterprises cannot be carried out independently, and needs the joint participation and cooperation of multiple subjects in the industry. Enterprises should strengthen ecological coordination, establish a win-win cooperation mechanism with e-commerce platforms, technology companies, customs, ports, banks and other participants, and build a digital logistics ecological system. Firstly, strengthen cooperation with e-commerce platforms, realize the docking and sharing of data and systems, and jointly optimize the logistics service process. For example, logistics enterprises can obtain real-time

order information from e-commerce platforms, and e-commerce platforms can obtain real-time logistics information from logistics enterprises, so as to improve the efficiency of order processing and goods delivery. Secondly, strengthen cooperation with technology companies, introduce advanced digital technologies and solutions, and accelerate the pace of technical upgrading. Thirdly, strengthen communication and cooperation with customs, ports and other regulatory authorities, promote the digitalization of regulatory services, and realize the intelligent customs clearance and inspection of goods. Finally, strengthen cooperation with other logistics enterprises, carry out resource sharing and business cooperation, avoid vicious competition and repeated construction, and form the synergy of digital transformation.

5.5. Rely on Policy Support and Standardize Transformation Process

The digital transformation of cross-border e-commerce logistics enterprises needs the support and guidance of government policies. Enterprises should actively rely on policy support, standardize the transformation process, and reduce transformation risks. Firstly, enterprises should pay close attention to the policy dynamics of various countries and regions on cross-border e-commerce and logistics digital transformation, and make full use of policy preferences such as financial subsidies and tax incentives to reduce transformation costs. Secondly, enterprises should abide by the relevant laws and regulations of various countries and regions on data security, cross-border data flow and other aspects, standardize the collection, storage, transmission and application of data, and avoid compliance risks. At the same time, enterprises should actively participate in the formulation of industry standards, promote the unification of technical standards, data standards and service standards in the industry, and create a good development environment for digital transformation.

6. Conclusions

In the context of the rapid development of the digital economy and cross-border e-commerce, digital transformation has become an inevitable choice for cross-border e-commerce logistics enterprises to enhance their core competitiveness and realize sustainable development. The digital transformation of cross-border e-commerce logistics enterprises is a complex systematic project, which involves strategic layout, technical application, organizational optimization, ecological coordination and other multiple aspects, and also faces many challenges such as data security risks, high transformation costs, fragmented technical application scenarios and lack of industry standards.

To promote the digital transformation of cross-border e-commerce logistics enterprises, it is necessary for enterprises to optimize their strategic layout and clarify their transformation goals; strengthen the application of digital technologies and promote the reconstruction of business processes; promote organizational optimization and strengthen talent training; strengthen ecological coordination and build a win-win cooperation mechanism; rely on policy support and standardize the transformation process. Only in this way can enterprises effectively solve the existing pain points in operation, improve operation efficiency, reduce operation costs, enhance service quality, and gain a competitive advantage in the fierce market competition.

In the future, with the continuous progress of digital technologies and the continuous improvement of the industry ecological environment, the digital

transformation of cross-border e-commerce logistics enterprises will develop in a deeper and more comprehensive direction. It is believed that through the joint efforts of enterprises, the government and the industry, the cross-border e-commerce logistics industry will realize high-quality development and make greater contributions to the development of global cross-border e-commerce and international trade.

Conflicts of Interest

The author declares that there is no conflict of interest regarding the publication of this article.

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