

Impact of Transportation Mode Selection on the Cost and Delivery Efficiency in Cross-Border E-Commerce Logistics

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Abstract

With the rapid development of cross-border e-commerce, logistics transportation has become an important factor affecting sellers' cost control and customer experience. Different transportation methods vary significantly in transportation costs, delivery timeliness, stability, and service quality. Therefore, choosing an appropriate transportation method is important for cross-border e-commerce enterprises. This article analyzes the impact of transportation mode selection in cross-border e-commerce logistics on costs and delivery efficiency. It compares the characteristics of sea freight, air freight, international express delivery, and dedicated logistics services, and discusses major factors including logistics costs, delivery efficiency, product characteristics, order size, and return risks. The study finds that different transportation methods have their own advantages and limitations, and no single method is suitable for all cross-border e-commerce orders. Therefore, enterprises should not simply pursue lower costs or faster delivery. Instead, they should make comprehensive decisions based on product value, order size, destination market, customer needs, and delivery requirements to achieve a better balance between cost control, delivery efficiency, and customer experience.

Key words

Cross-border e-commerce logistics; Mode of transportation selection; Logistics cost; Distribution efficiency; Order fulfillment

1. Introduction

Cross-border e-commerce has expanded rapidly in recent years and has become an increasingly important part of international trade. Data from the General Ad-

ministration of Customs show that China's cross-border e-commerce imports and exports reached 2.63 trillion yuan in 2024 [1]. As transaction volumes and overseas demand continue to increase, logistics has taken on a more critical role in cross-border e-commerce opera-

tions. For sellers, logistics performance influences not only whether products can reach customers efficiently, but also operating expenses, delivery reliability, customer evaluations, and repeat purchase intentions.

In actual operation, different transportation methods have significant differences in terms of cost, timeliness and stability. Sea freight has lower costs but longer transportation periods; international express services are faster but more expensive; dedicated logistics services are relatively balanced in terms of cost and efficiency. For small and medium-sized cross-border e-commerce sellers, if the transportation method is not chosen reasonably, it may result in excessive logistics costs, reduced profit margins, or longer delivery times and decreased customer experience. Therefore, how to strike a balance between logistics costs and delivery efficiency is an important issue in cross-border e-commerce logistics management.

Previous studies have mainly analyzed logistics efficiency issues from perspectives such as online retail fulfillment, delivery commitments, inventory layout, and end-point delivery. Online retail fulfillment decisions need to consider current costs and future fulfillment costs, and inventory layout and delivery commitments also affect delivery efficiency [2, 3]. However, existing studies still have relatively insufficient discussions on how small and medium-sized cross-border e-commerce sellers choose transportation methods. Therefore, this paper adopts the methods of literature analysis and comparative analysis to study the impact of different transportation methods on logistics costs and delivery efficiency, and proposes corresponding optimization suggestions.

2. The Current Development Status of Cross-Border E-Commerce Logistics Transportation Methods

The logistics transportation methods for cross-border e-commerce have formed a diversified pattern. Common methods include international express delivery, air transportation channels, sea transportation, dedicated logistics, and overseas warehouses. International express delivery and air transportation channels usually have

faster delivery times and are suitable for high-value, small-sized or time-sensitive goods; sea transportation has relatively lower unit transportation costs and is suitable for large quantities, large-sized goods with no strict time requirements; dedicated logistics strikes a balance between cost and delivery efficiency; and overseas warehouses prepare goods in advance near the target market, shortening the subsequent delivery distance and improving order processing and end delivery efficiency.

Cross-border e-commerce logistics has gradually developed beyond basic international transportation and now involves more integrated and platform-oriented services. Logistics providers and e-commerce platforms increasingly support multiple stages of the fulfillment process, including warehousing, order processing, customs clearance, last-mile delivery, and after-sales services. Research indicates that fulfillment capability can influence both delivery performance and business operations, while inventory allocation, delivery promises, and fulfillment decisions are also closely related to delivery efficiency in online retail [2,3]. As a result, transportation decisions in cross-border e-commerce are increasingly connected with warehouse planning, platform-based logistics services, and overall fulfillment management.

The current cross-border e-commerce logistics transportation methods are showing a trend of diversification, integration and platformization. Platform logistics, dedicated line logistics and overseas warehouses provide sellers with more options and enhance the flexibility of cross-border order fulfillment. Existing studies have focused on issues such as delivery commitments, inventory layout and consumers' delivery experience, and pointed out that consumers not only pay attention to delivery speed, but also to the accuracy and stability of delivery time [4]. However, the current research still lacks discussions on how small and medium-sized cross-border e-commerce sellers can select appropriate transportation methods by combining product characteristics, order size and target market.

3. Analysis of the Cost and Efficiency Dilemma in the Choice of Transportation Methods

3.1 The Profit Pressure Caused by the Differences in Cost Structure

The cost structures of different transportation methods vary significantly. Sea transportation is usually suitable for large quantities, large volumes, and goods with low time requirements. Its unit transportation cost is relatively low, but the transportation period is longer, which will increase inventory occupation and capital turnover pressure. Air transportation channels and international express services are faster, suitable for high-value, small-volume or goods with high time requirements. However, the transportation cost is higher, which may compress the profit of sellers. For small and medium-sized cross-border e-commerce sellers, logistics costs often directly affect the product pricing and profit margin. If the transportation cost accounts for a high proportion of the product price, even if the order volume increases, there may still be a problem of "sales but low profit".

Previous studies have shown that when online retail enterprises make order fulfillment decisions, they cannot only consider the lowest delivery cost for a single order, but also need to take into account the subsequent inventory distribution and changes in future fulfillment costs [2]. This indicates that cross-border e-commerce sellers should not simply choose the logistics channel with the lowest current price when selecting a transportation method, but should make a judgment from the perspective of overall costs.

3.2 The Risk of Non-Performance Resulting from Differences in Delivery Efficiency

Different transportation methods can lead to variations in delivery performance, particularly in transit time, on-time delivery, customs clearance, last-mile delivery, and tracking updates. A cross-border shipment normally passes through several stages, including origin collection, international transit, destination customs

procedures, and local distribution. Delays at any point in this process may slow down the entire order fulfillment process. Therefore, evaluating delivery efficiency requires more than simply comparing transportation speed. The reliability of transportation services and effective coordination between different logistics stages should also be considered.

From the perspective of transportation methods, air transportation channels and international express services have faster delivery times and are suitable for high-value, small-sized or time-sensitive goods. According to official information from FedEx, some of its international express services can deliver within 1, 2, or 3 working days, while economical international services usually take 2 to 5 working days [5]. In contrast, sea transportation is more suitable for large quantities, larger-sized goods, and those with less time requirements. Maersk's official data shows that the overall transportation time for sea shipping is typically 20 to 45 days, and it is affected by factors such as the starting point, destination, customs clearance procedures, and seasonal demand [6]. Thus, international express services have an advantage in speed but are more expensive; while sea shipping has a lower cost but a longer delivery period.

The evaluation of delivery services by consumers is not solely based on speed; the accuracy of delivery time, time scheduling, and service stability also affect the consumer experience [4]. Therefore, when choosing a transportation method, cross-border e-commerce sellers should comprehensively consider transportation stability, customs clearance efficiency, end delivery capabilities, and logistics information transparency in order to reduce the risk of fulfillment.

3.3 The Selection Dilemma Caused by Product Characteristics and Demand Fluctuations

The characteristics of the goods will further increase the complexity of the choice of transportation methods. Goods with low value, non-urgent nature, and large volume are more suitable for choosing the logistics method with lower cost; while goods with high value, fragile nature, small volume or high time requirements are more suitable for choosing logistics channels with higher stability and service quality. At the same time,

there are many types of cross-border e-commerce goods, and different goods vary in terms of weight, volume, value, packaging requirements and return risks, which makes it difficult for sellers to handle all orders with the same logistics method.

Relevant studies have shown that the product combinations and order structures in online retail can affect the performance of order fulfillment [7]. For cross-border e-commerce sellers, if there are a large variety of product types and significant fluctuations in orders, the logistics options will become more complex. For instance, common household storage items usually have lower prices. If international express delivery is chosen, the logistics cost may significantly reduce profits; while high-value products such as electronic products and precision components, if a slow or unstable logistics method is selected, it may affect the customer experience and after-sales evaluation.

3.4 The Additional Costs Incurred in the Return and After-Sales Processes

Cross-border e-commerce logistics also faces the problem of high costs for returns and after-sales services. Compared with local e-commerce, cross-border returns often involve international transportation, customs clearance, warehousing, and re-delivery, with longer processes and higher costs. If the initial transportation method is not chosen appropriately, resulting in delivery delays, package damage, or opaque logistics information, it may increase the likelihood of consumers returning items and making complaints. Research indicates that the delivery speed commitment not only affects sales and profits, but may also have an impact on returns and customer retention [8].

Meanwhile, the final delivery stage is also a crucial factor affecting the customer experience. Relevant studies suggest that the final delivery process holds significant value in online retail and can impact both the consumer experience and the service capabilities of the enterprises [9]. Therefore, even if the international transportation process is fast, if the final delivery capacity in the destination country is insufficient, the overall delivery efficiency will still be affected.

3.5 The Dilemma of Comprehensive

Decision-Making under Multi-Factor Consideration

Overall, choosing a transportation method for cross-border e-commerce requires sellers to balance several factors rather than focusing only on cost or delivery efficiency. Decisions may vary depending on delivery requirements, product features, customer expectations, and potential return risks. Although platform-based logistics, overseas warehousing, and third-party logistics can improve order fulfillment, they may also increase warehousing expenses, inventory burdens, and dependence on external platforms. Previous research indicates that picking failures in multi-channel order fulfillment may reduce fulfillment performance and generate additional operating costs [10]. Moreover, logistics decisions should take into account differences in product attributes, freight expenses, service reliability, and regional logistics conditions [11]. Therefore, sellers need to evaluate both their operational needs and market conditions when selecting an appropriate logistics solution.

Therefore, when choosing a shipping method for cross-border e-commerce sellers, they should avoid simply comparing shipping costs or delivery speeds. Instead, they should make a comprehensive judgment based on factors such as the value of the goods, the size of the order, the destination market, the customer's time requirements, and their own cost tolerance. Only by finding a relatively balanced trade-off between cost control, delivery efficiency, and customer experience can the quality of order fulfillment be improved and the long-term competitiveness of cross-border e-commerce sellers be enhanced.

4. Suggestion on Optimization

4.1 Select Differentiated Transportation Methods based on the Characteristics of the Goods and the Target Market

Cross-border e-commerce sellers should select different logistics methods based on the value, weight, volume, fragility and time requirements of the goods, rather than using the same transportation plan for all products. For low-value, large-volume and non-urgent goods, they

can prioritize choosing sea freight or cost-effective dedicated logistics; for high-value, small-volume, fragile or time-sensitive goods, they can choose international express or other air transportation channels to improve delivery stability and customer experience. At the same time, different countries and regions have differences in customs clearance efficiency, infrastructure and end delivery capabilities, and sellers should establish flexible logistics channel combinations based on the target market. The selection of cross-border e-commerce export logistics methods is affected by factors such as customs clearance procedures, transportation distance, import and export policies and logistics costs [12]. Therefore, sellers need to make a comprehensive judgment based on the product attributes and market environment, and avoid using a fixed single logistics method.

4.2 Establish a Comprehensive Evaluation Standard for Cost and Timeliness

When sellers choose the logistics method, they should not merely compare the freight costs, nor should they only pursue the fastest delivery. Instead, they should establish a comprehensive evaluation standard. This standard can include indicators such as transportation cost, estimated delivery time, on-time rate, customs clearance efficiency, end delivery capability, and logistics information transparency. Online retail fulfillment decisions need to comprehensively consider the current delivery cost and future fulfillment cost, rather than only focusing on the lowest cost of a single order [2]. Therefore, cross-border e-commerce sellers can choose a transportation method that is more suitable for their products and the target market thought of the freight, delivery time, and abnormal situations of different logistics channels, thereby achieving a balance between cost control and delivery efficiency.

4.3 Enhance the Transparency of Logistics Information and the Collaborative Capabilities in Contract Fulfillment

Cross-border logistics involves various stages, such as collection at the origin, international transportation, customs clearance, and final delivery. A lack of information transparency at any stage may increase consumer uncertainty and lead to after-sales issues. Therefore,

sellers should prioritize logistics service providers that offer timely tracking updates, strong customs clearance capabilities, and well-developed last-mile delivery networks. Consumers pay attention not only to delivery speed, but also to delivery accuracy and scheduling. In addition, inventory layout, delivery commitments, and order fulfillment arrangements can jointly affect the delivery efficiency of online retail [3,4]. Therefore, sellers should strengthen coordination among warehousing, shipping, customs clearance, and final delivery, reduce information gaps, and improve overall fulfillment stability.

4.4 Optimize Return and After-Sales Logistics Management

The cross-border e-commerce return process is lengthy and costly, so sellers need to consider the after-sales risks when choosing the transportation method. For fragile, size-unspecified or products with a high return rate, sellers can choose logistics channels with better packaging protection, more complete tracking information, and stronger after-sales handling capabilities. At the same time, sellers can also reduce returns by optimizing product descriptions, improving packaging quality, and setting reasonable return policies. The delivery speed commitment may affect sales, profits, returns, and customer retention [8]. Therefore, sellers should not blindly promise too fast delivery but should set a reasonable time limit based on their own logistics capabilities and reduce complaints and return risks caused by delivery delays or improper after-sales handling.

5. Conclusion

This article focuses on analyzing the impact of transportation mode selection in cross-border e-commerce logistics on costs and delivery efficiency. The research reveals that the core issue in choosing the transportation mode for cross-border e-commerce is not simply choosing a low-cost or high-speed logistics channel, but rather making a comprehensive trade-off among cost, timeliness, stability, product characteristics, and consumer experience. Sea transportation is suitable for large quantities of goods with low timeliness requirements, but the transportation period is longer; international express and air transportation channels are

suitable for high-value, small-sized or high-timeliness goods, but the logistics costs are higher; dedicated logistics, on the other hand, is relatively balanced between cost and efficiency, and is suitable for many ordinary cross-border orders.

From the perspective of the causes of the problem, cross-border e-commerce logistics involves various stages such as collection at the origin, international transportation, customs clearance, final delivery, and return handling. Any instability in any of these stages will affect the efficiency of fulfillment. Additionally, small and medium-sized sellers have a wide variety of product types, unstable order volumes, and limited profit margins. Therefore, when choosing logistics methods, they are more likely to face cost pressure and efficiency risks. Based on this, this article proposes that differentiated transportation methods should be selected based on product characteristics, a comprehensive cost and timeliness evaluation standard should be established, logistics information transparency should be enhanced, and return and after-sales logistics management should be optimized.

The significance of this article lies in analyzing the selection of logistics transportation methods from the perspective of small and medium-sized cross-border e-commerce sellers. This analysis is expected to help sellers make more reasonable decisions between cost control and customer experience. However, this article also has certain limitations. It mainly relies on literature and public data for analysis, lacking first-hand operational data from specific enterprises. Future research can combine cross-border e-commerce platform order data, seller interviews, or specific logistics enterprise cases to conduct more in-depth empirical analysis of the actual costs and delivery efficiency of different transportation methods.

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