



Location Model of Overseas Warehouses of Japanese Cross-Border E-Commerce Based on Ant Colony Algorithm

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Abstract. The rapid development of overseas warehouses has brought new opportunities for cross-border e-commerce. Taking Japan's cross-border e-commerce as the research object, this paper expounds the development model of cross-border e-commerce and the concept of cross-border logistics. Extracting the characteristics of Japan's cross-border e-commerce development model, improve the cross-border payment environment, obtain the influencing factors of overseas warehouse location, predict the demand according to the past transaction data and future development trend, take the warehouse location as the variable, and construct the location decision model by using ant colony algorithm.

Keywords: Ant colony algorithm · Cross border e-commerce in Japan · Overseas warehouse · Transaction mode · Cross border logistics · Location decision model

1 Introduction

With the rapid development of science and technology and the Internet, digitization and informatization are constantly changing our lives. The originally scattered links in commercial trade, such as products, capital flow, logistics and other information are integrated on the platform. Since then, the traditional trade mode has been deeply changed. In addition, the restrictions and challenges of information, policy environment and other aspects are becoming greater and greater [1, 2]. And more advanced and complete logistics facilities are needed. However, the e-commerce environment involves many factors, it is a complex project, so it is difficult to consider all influencing factors comprehensively [3, 4]. Cross border e-commerce overseas warehouse refers to the warehouse established by cross-border e-commerce in countries or regions other than their own countries to facilitate overseas trade. It is a cross-border logistics mode to achieve high efficiency, that is, cross-border e-commerce uses bulk cargo transportation to transport products to target countries or regions, and uniformly manages products by building or renting local warehouses locally, It also provides consumers with a series of logistics services, including one-stop services such as product warehousing, sorting, secondary packaging and local delivery. As a new way of logistics, overseas warehouses have gradually produced

many problems due to the complex international trade environment in recent years, and different development models also have different problems. Overseas warehouses under the self built mode require a lot of capital investment from cross-border e-commerce, and the construction cycle is long. The pursuit of minimum cost and maximum benefit has always been the pursuit of enterprises. Therefore, providing effective overseas warehouse location scheme for cross-border e-commerce enterprises is an important problem encountered by enterprises in planning and building warehouses. Among the existing site selection methods, there is no mature theoretical guidance for overseas warehouse construction, and there is also a lack of open overseas warehouse construction experience. At this time, a set of overseas warehouse location scheme for enterprises to refer to is particularly important for multinational e-commerce enterprises. At present, the academic literature on the combination of ant colony algorithm and Japanese cross-border e-commerce overseas warehouse location model is not very rich and needs to be further discussed.

2 Overview of Cross-Border E-Commerce and Logistics

2.1 Main Modes of Cross-Border E-Commerce

Under the Internet-based mode, the subjects of both parties complete the purchase and payment of one party and the collection and delivery of the other party through the electronic information platform of PC or mobile terminal. Compared with traditional trade, the development of cross-border e-commerce has become a new growth point in import and export trade [5, 6]. In order to better study this new trade mode, cross-border e-commerce is artificially divided according to different standards. The mainstream standard is divided according to the transaction subject, which can be divided into B2B mode, B2C mode, C2C mode and B2G mode. B2B mode is a cross-border business mode between enterprises on the network platform. On the other hand, through the B2B transaction mode, both parties can complete the whole transaction process on the network platform, from establishing the initial purchase and sale intention of both parties, to users' multi-directional comparison of products, to negotiating price, placing orders, signing orders and delivery, and finally to after-sales services. B2B mode enables enterprises to avoid many transactional workflow and personnel costs in the transaction process, speeds up the work efficiency between enterprises, makes enterprises cross the constraints of time and space through network technology, makes enterprise development more convenient and cheaper across regions and borders. B2C mode, that is, the cross-border e-commerce mode between enterprises and consumers on the network platform. The advantage of this model is that manufacturers often face consumers directly, eliminating many intermediate links and price differences. C2C mode, that is, the online transaction mode between consumers. The cross-border e-commerce platform provides an online mall for trading subjects at home and abroad. The seller can publish the products to be traded through the online mall, and the buyer can buy the products they need by browsing the online mall. With the popularity of mobile Internet and mobile payment, C2C transaction mode is more convenient, and the price is more competitive than the traditional transaction mode. More and more consumers choose online shopping. According to the data of iResearch, Taobao, eBay and paipai account for more

than 95% of the C2C market share in China. B2G mode, that is, the operation mode of transaction activities between enterprises and the government through the network. Its concept is that enterprises and government organs use the network platform to exchange trade information and conduct business with each other. This way is more concise and efficient than their usual offline office, and the whole transaction process is faster and more convenient. For example, through the informatization, networking and intelligence of network government affairs, the government office is more transparent and the government policy trend is more timely, so as to improve the service level of government affairs. For example, government departments publish bidding and procurement online and enterprises conduct online bidding.

2.2 Cross Border Logistics

The traditional cross-border logistics mode is mainly divided into postal parcel mode, international express mode and special line logistics mode [7]. Cross border logistics is very important for cross-border e-commerce. Cross border logistics determines whether the traded goods can be delivered to consumers accurately and safely. It is the final link of direct contact with customers and directly affects customers' consumption experience [1, 8]. Among them, the postal parcel channel is currently the mainstream mode of cross-border e-commerce delivery, and the overseas warehouse mode is a new cross-border logistics mode in recent years. The details of various cross-border logistics modes are shown in Table 1 below.

It can be seen from Table 1 that various market entities such as e-commerce enterprises, e-commerce platform enterprises and third-party logistics enterprises are also actively planning to build a cross-border logistics system to provide new development ways for cross-border logistics through "cross-border settlement" of overseas warehouses. And further integrate into the overseas circulation system by improving the level of logistics services, such as customs clearance efficiency of commodities, reducing logistics costs and improving distribution efficiency.

3 Location Model of Overseas Warehouses of Japanese Cross-Border E-Commerce Based on Ant Colony Algorithm

3.1 Extracting the Characteristics of Japan's Cross-Border E-Commerce Development Model

Japanese cross-border e-commerce enterprises choose online platforms to sell products and complete the steps of order processing. E-commerce enterprises will prepare goods in advance, first transport products from China to overseas warehouses, and store them in overseas warehouses for sale. Corresponding customs clearance business will be handled for products leaving the country. Corresponding customs entry business will also be handled when entering and leaving overseas warehouses. When the products enter the overseas warehouse, the customs clearance business will be completed according to the specified procedures of the location of the overseas warehouse, such as declaration and inspection, which can be said to be the "first customs clearance". When cross-border

Table 1. Main logistics modes of cross-border e-commerce

Cross border logistics model	Advantage	Disadvantage	Typical representative
Postal packet	Wide coverage and lowest cost	Poor timeliness, easy to lose parts and relatively imperfect service	China Post, Singapore Post, etc.
International express service	High timeliness, high reliability and safety, and can be tracked in the whole process	Higher cost	UPS, DHL, FEDEX, TNT etc.
Special line logistics	Effectively reduce the cost of trunk transportation, and the price is lower than that of international express	The timeliness is low. It usually needs to assemble goods with the goods of other shippers and sort them again	Russian special line, Middle East special line, American special line and European Special Line
Overseas warehouse	Reduce logistics costs, improve customer responsiveness and optimize after-sales service	There are some problems such as inventory backlog or shortage due to inaccurate sales forecast and market changes	FBA, SF overseas warehouse, China Post overseas warehouse, etc.

e-commerce enterprises receive orders, they guide overseas warehouse delivery through remote information management. When the goods are sent from overseas warehouses, the “second customs clearance” will be carried out, usually including taxation, inspection application, release, etc. As the “one-time customs clearance” has completed the reporting of some product information at the customs, the customs clearance time is relatively short during the “second customs clearance”. If the customer is satisfied with the product after receiving the product order, the online electronic transaction is completed. If you are not satisfied and need to return and exchange the goods, the products will be returned to the overseas warehouse to complete the return and exchange. In terms of cross-border logistics, there are mainly four different stages. One is the domestic head-on transportation stage, that is, the transportation stage of exporting the products of cross-border e-commerce enterprises from the supply point to the domestic logistics hub. Goods can be directly transported to overseas warehouses abroad through domestic ports, airports and other transportation hubs. If there are multiple supply places in China, the goods can be collected in the collection warehouse at the logistics hub and transported to the overseas warehouse. Under normal circumstances, the collection warehouse and overseas warehouse will be located at or near the transportation hub. Second, in the trunk transportation stage, products are transported from China to overseas warehouses. The third is the end distribution stage of products, in which products are delivered from

overseas warehouses to customers. On the other hand, export cross-border e-commerce enterprises sell products through online platforms. When receiving customer orders, goods are sent from overseas warehouses and distributed to customers [9, 10]. Generally speaking, most products have completed the whole logistics process of cross-border e-commerce logistics at this stage. For a few products, there is still a fourth stage, that is, the reverse logistics stage. When the customer needs to return and replace the goods, the goods are directly returned from the customer to the overseas warehouse for after-sales treatment. At this stage, Japanese payment enterprises have limited cooperation with foreign banks and financial institutions, covering less areas, and few foreign merchants adopt Japan's cross-border e-commerce payment platform. In addition, the Bank of Japan has not participated in many international third-party platform payment projects, resulting in less application in cross-border settlement, which has not been widely trusted and adopted by Japanese enterprises. We should actively guide the Bank of Japan's cross-border cooperation with international institutions, improve the cross-border payment environment, and spare no effort to support the upgrading and improvement of the cross-border payment and settlement system. For Japanese cross-border electricity the business enterprise, the first mock exam is that the long term logistics cost is low, the management autonomy is high, it is advantageous to control the quality of logistics service, and establish a good corporate image [11, 12]. The third-party overseas warehouse mode means that the overseas warehouse is constructed and operated by a third party other than in the process of cross-border e-commerce transactions. The third party here includes the third-party cross-border e-commerce platform, such as Amazon overseas warehouse, China Post overseas warehouse, etc. It also includes the main mode of non cross-border e-commerce transactions such as third-party cross-border logistics enterprises. The first mock exam is a high level of logistics professional standard. But the first mock exam is also difficult to provide personalized service. Japanese cross-border e-commerce enterprises lack autonomy in this mode. The fourth party overseas warehouse model can also be called one-stop overseas warehouse model. Its essence is the cross-border e-commerce logistics resource integration model with overseas warehouse as the core. It does not build overseas warehouses. It creates a one-stop cross-border logistics service platform for cross-border e-commerce enterprises by integrating resources such as third-party overseas warehouses, third-party logistics distribution enterprises, customs declaration enterprises, insurance enterprises and circulation processing enterprises. So as to realize resource co construction, sharing and win-win. The first mock exam can effectively integrate and optimize all kinds of resources, including information, capital and technology, which will help build a more perfect cross border logistics service system. Based on the above description, complete the steps of extracting the characteristics of Japan's cross-border e-commerce development model.

3.2 Obtaining Influencing Factors of Overseas Warehouse Location

Warehouse location is an important part of enterprise strategy. Therefore, location strategy plays an important role in enterprise operation. Unscientific location will bring long-term negative impact to enterprises. We must comprehensively consider various influencing factors in order to scientifically give correct analysis and decision-making methods for overseas warehouse location. The so-called warehouse location refers to

that a certain scale enterprise determines the location of warehouse,once completed, it will be difficult to make changes in the short term. Overseas warehouse mode is a new modern logistics service mode that takes into account management, warehousing and distribution. It aims to provide the seller with one-stop supporting services and warehouse management at the place of sale [13, 14]. From the process of the whole overseas warehouse, the overseas warehouse mode mainly includes the seller's businesses transporting goods to the overseas warehouse in large quantities by sea and air [13, 15]. The seller remotely operates the level of overseas stored goods through the information management platform and manages the real-time inventory. And the localized distribution that the local staff use the local logistics resources to distribute the goods to the customers according to the order information. The flow chart of the whole overseas warehouse logistics mode is shown in Fig. 1.

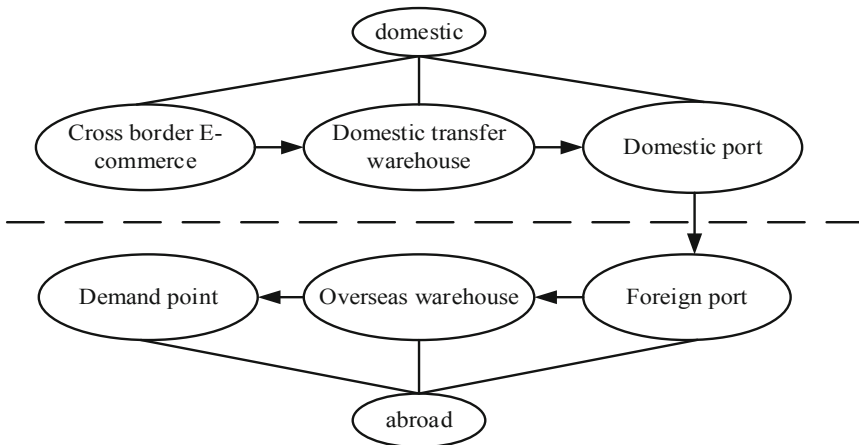


Fig. 1. Logistics service flow chart of cross-border e-commerce based on overseas warehouse mode

As can be seen from Fig. 1, the self built overseas warehouse mode refers to the way that cross-border e-commerce enterprises independently select, build and operate overseas warehouses. This mode has large investment and high threshold, and requires enterprises to have a certain level of logistics expertise. Therefore, it is not suitable for cross-border small and medium-sized enterprises, but only for cross-border e-commerce enterprises with large enterprise scale. Compared with the location of general storage facilities, the location of overseas warehouses should be considered in many aspects and all directions in the process of location selection because of its more complex logistics network system, wider scope and more diversified participants. Political factors, we need to focus on the policies and regulations implemented by domestic and foreign governments on overseas warehouses. On the one hand, the construction of overseas warehouses can be based in overseas countries and meet the requirements of local policies and regulations. On the other hand, the construction of overseas warehouses can make full use of all kinds of favorable support and preferential policies, such as tax reduction and exemption, in combination with the development needs of domestic and foreign

countries. On the other hand, the construction cost, labor cost, logistics cost and other cost elements of the area where the overseas warehouse location is located shall be fully considered. At the same time, the relevant factors such as local transportation conditions and the development level of logistics industry are investigated. Natural environmental factors, fully consider the climate conditions, terrain and other natural environmental factors of the area where the overseas warehouse is located, so that the construction and operation of the overseas warehouse can achieve long-term sustainable development and avoid the external environmental impact of force majeure. Meso factors mainly refer to the development level of the industry, which refers to the development level of the logistics industry. The logistics level of the region where the overseas warehouse is located represents the local logistics efficiency to a certain extent, and can also reflect the logistics cost from the side. In particular, the development status and trend of express industry in the region should be fully considered, because it involves the cost of tail transportation. Micro factors are mainly from the cost of each link process in the cross-border logistics network where the overseas warehouse is located. The transportation cost also includes head-on transportation cost, trunk transportation cost and end distribution cost. Tax cost includes relevant tax cost, import value-added tax cost, etc. As the logistics node closest to customers, the location of overseas warehouse should also consider its subsequent operation, which can improve customer satisfaction to a greater extent. Therefore, the distribution timeliness and the reverse logistics cost caused by return and exchange services should also be considered. The cross-border logistics system where overseas warehouses are located has a large space span and a long time, which is greatly affected by uncertain factors. For cross-border e-commerce enterprises, they can only predict the demand according to the past transaction data and future development trend, but they can not fully and accurately predict the local demand. For customers, different customers have different psychological expectations for products. In addition to product quality and price, the factors that measure customer satisfaction in cross-border e-commerce transactions, the receiving time of products is also very important, and the delivery time of products after receiving orders is affected by customs clearance and other links, so there is a certain degree of uncertainty. The time value of local satisfaction with product receipt is also affected by factors such as local logistics level, which is uncertain. Therefore, considering the influence of various factors in overseas warehouse location will be more practical. Based on this, complete the steps to obtain the influencing factors of overseas warehouse location.

3.3 Construction of Location Decision Model Based on Ant Colony Algorithm

Ant colony algorithm is a new bionic optimization algorithm, which comes from the foraging behavior of real ant colony. It is a heuristic optimization algorithm based on cluster intelligence [16–18]. According to the principle of ant colony algorithm, the location process of Japanese cross-border e-commerce overseas warehouse is designed.

1. Determine warehouse location objectives. Clarify the purpose and significance of establishing the warehouse, and take this as the premise to make preliminary preparations for site selection.
2. Analyze the constraints of warehouse location. During the selection of alternative warehouses, the geographical environment of the region shall be understood, and the man-made constraints shall be clarified in order to reduce the

number of alternative warehouses. Generally, the constraints of site selection include capital, traffic environment, distribution of demand points, government policies, etc. 3. Collect and sort out data. The location of warehouse is generally calculated by cost, that is, the construction cost, transportation cost and operation cost involved in the location are formulated, the mathematical model is established according to the target formula and constraints, and the effective algorithm is used to solve it. Therefore, the basic data of various expenses in the model should be investigated to ensure the smooth solution of the model. 4. Quantitative analysis. Select the appropriate warehouse location model and calculation method, calculate according to the survey data, and get the optimal solution of the scheme. 5. Site selection scheme evaluation. Combined with market adaptability, land use nature and customer satisfaction, the results are evaluated to verify the feasibility of the implementation of the scheme. 6. Review results. Firstly, other non cost factors affecting site selection are analyzed, each factor is given a certain weight, and the weighted method is used to recheck the results. If it passes the review, the calculation result is the final scheme; otherwise, it shall be screened again. 7. Determine the site selection results. After the review is passed, the optimal result of the final calculation is obtained. The continuous model assumes that the candidate range is regarded as a plane, and the warehouse can be set at any point of the plane as the best position. Through the two-dimensional coordinate system, the balance among time, distance and demand is displayed. Taking the warehouse location as the variable, the objective function is obtained, as shown in formula (1):

$$\min G = \sum_{m=1}^e l_m \left[(\beta_m - \beta_e)^2 + (\delta_m - \delta_e)^2 \right]^{\frac{1}{2}} \tag{1}$$

In formula (1), β represents the demand node, l represents the weight of the demand node, δ represents the total number of demand nodes, m represents the transportation cost, and e represents the variable slight partial score. Assuming that the center of gravity of the demand node is taken as the initial coordinate of the warehouse, the constraint conditions of the objective function are obtained, as shown in formula (2):

$$H = \begin{cases} \sum_{p=1}^D h_{pq} = 1, q \in K \\ \sum_{p=1}^D t_p = y \\ h_{pq} \leq t_p, q \in K, p \in D \end{cases} \tag{2}$$

In formula (2), D represents the maximum number of warehouses allowed to be built, K represents the set of candidate locations that can be used as warehouses in the plane, p represents the demand of the p demand point, q represents the set of demand points in the plane, and h represents the unit transportation cost from the warehouse to the demand point. According to the calculation result of formula (2), ensure that the requirements of each demand node are met by one warehouse, limit the number of alternative warehouses, and ensure that there are no requirements at demand points without warehouses. For Japanese cross-border e-commerce, enterprises have been pursuing profit maximization and cost minimization. In the decision-making of overseas warehouse construction, the

problem can be simplified to the problem of minimum cost. Then the overseas warehouse location decision model can be expressed as:

$$R = \sum_{i=1}^m s_i w_i + \sum_{i=1}^m \sum_{j=1}^n F V_{ij} \quad (3)$$

In formula (3), s represents the fixed cost required to build the overseas warehouse, w represents the decision variable, F represents the shipping distance from the overseas warehouse i to the demand node j , V represents the linear penalty coefficient of the time penalty cost exceeding the time threshold, m represents the set of candidate locations of the alternative overseas warehouse, and n represents the air transportation cost per unit cargo. The three-tier cross-border logistics network with supply points, overseas warehouses and demand points as nodes is relatively simple and intuitive in structure. Cross border e-commerce enterprises adopting this logistics network structure generally have the following characteristics: the product supply point is located at or close to a large transportation hub and has the geographical location conditions to complete cross-border transportation. Products can be easily transported to overseas areas by shipping, air transportation or cross-border trains. The business development of cross-border e-commerce enterprises has a certain foundation, and the supply of goods is concentrated, which is generally the location of cross-border e-commerce enterprises. Most of the overseas warehouses selected by Japanese cross-border e-commerce enterprises are self built overseas warehouses. The e-commerce enterprise shall establish or lease overseas warehouses by itself, and the operation and management of overseas warehouses shall be the responsibility of the cross-border e-commerce enterprise itself. Cross border e-commerce enterprises hope to realize cross-border logistics services by controlling the independent management authority of overseas warehouses. Based on this, the steps of constructing the location decision model are completed.

4 Conclusion

In order to fit the actual situation better, based on the multi-objective location model of overseas warehouse considering market value and transportation conditions under the determined environment, this paper further puts forward the multi-objective location model under the conditions of random demand and uncertain warehouse building cost, and constructs the location decision model according to the variable distribution form. Due to the limited research conditions, the parameters of freight discount in overseas warehouses are not deeply studied in this paper, and such problems will be optimized in the future research.

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