Study on Overseas Warehouse Location of Manufacturing Cross-border E-Commerce Enterprises Based on Multi-objective Optimization

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Abstract

As a new logistics mode, overseas warehouse can save transportation time for cross-border logistics and also solve the problem of customer return and exchange as soon as possible. This paper takes manufacturing cross-border e-commerce enterprise logistics as the starting point, considering cost, market, environment, society and other factors, establishes a multi-objective overseas warehouse location model to set up alternatives, analyzes the location model by analytic hierarchy process, selects the optimal solution of overseas warehouse location in the alternatives, and verifies the method by an example. Finally, it puts forward targeted suggestions for manufacturing cross-border e-commerce enterprises to establish overseas warehouses, and then promotes the new logistics mode of manufacturing cross-border e-commerce overseas warehouses to mature and standardize.

Keywords: Manufacturing, cross-border e-commerce enterprises, overseas warehouse location, multi-objective optimization, AHP

I. Introduction

In recent years, cross-border e-commerce as an emerging industry has developed rapidly, which has added a lot of color to the growth of national GDP. Cross-border e-commerce logistics is also accompanied by the development of cross-border e-commerce enterprises. However, the development and operation mode of cross-border e-commerce logistics is not perfect. In the process of operation, there are many problems such as slow delivery time, high packet loss rate and incomplete transportation lines. The emergence of these problems greatly reduces the shopping experience of overseas consumers, and the satisfaction of cargo inspection, resulting in a new model of overseas warehouse logistics. Compared with other special line logistics, overseas warehouse logistics can save time, delivery rate is fast, price is relatively cheap, and can be transported at home and abroad, which can better attract customers' purchase desire. However, overseas warehouses can solve the problem of traditional cross-border logistics, but freight prices and storage costs will also increase, so how to choose an economical and applicable location is particularly important.

By sorting out relevant literature, it is found that among many location methods, analytic hierarchy process and particle swarm optimization algorithm are widely used to solve the problem of overseas warehouse location. At this stage, some scholars have the following research on overseas warehouse location problem. Mei Baolini (2018) believes that the address selection of overseas warehouses should pay attention to the factors that affect the development of overseas warehouses, establish a combination of options, combine local cultural practices, focus on extensive thinking, in-depth research, and select the optimal address according to expert opinions[1]. Li Yangchunzi (2017) pointed out that the location of overseas warehouses should fully consider social background factors and economic cost factors. Among them, economic cost factors should cover warehousing costs and land operation costs, and social background factors are reflected in policy support, international environment, current international relations, local cultural customs and other aspects[2]. Qingqian Li (2020) believes that the main contradictions should be grasped when analyzing cross-border e-commerce issues, and only by analyzing layer by
layer can the key points be discovered. Chen Mengnan and Yang Bin(2017) broke through the previous single location model, established a dual-objective optimization model using integer programming method, namely the minimum cost and maximum customer satisfaction model, and designed a particle swarm optimization algorithm to solve the problem. Jun Chen(2020) from the distribution and transportation process, fully considering the uncertainty of demand and location in the data analysis process, established the distribution center location model, and obtained the optimal location scheme. Kong Hao(2020) fully considered the cost factor in establishing the overseas warehouse model, and introduced transport costs and infrastructure costs into the cost factor, focusing on the impact of this factor on the alternative target location. Zhu Jiatong, Zhang Bixi et al.(2017), from the perspective of customers' ability to accept prices and demand for local markets, proposed that the location of overseas warehouses is affected by factors such as construction cost, transportation mode, spatial distance and time cost. The single objective model of overseas warehouse location is established, and the specific location scheme is obtained by using genetic algorithm and particle swarm optimization algorithm. The location results are more realistic and reliable. Su Liyan(2017) first considered the specific factors affecting the development of overseas warehouses, and organized these factors into several options, which provided objective development data for the location of overseas warehouses. When analyzing the influencing factors of overseas warehouse location, Fu Zhengchuan(2019) mainly focuses on cost, such as time cost, storage cost and raw material cost. In addition, we also consider the unmarketable cost of commodities caused by force majeure and the risk cost of natural disasters, and derive the most suitable location scheme by calculating the risk cost and force majeure cost. Cao(2019) believed that the location of overseas warehouses should fully consider the uncertainty cost and formulate relevant location schemes according to the uncertainty of influencing factors. Wang Junqing(2018) established a hierarchical model of overseas warehouse location selection with hub factors and social policy factors as the main core factors in the article, using the analytic hierarchy process to analyze the given options, and according to the income weight of each program Draw the most optimal location plan.

Overseas warehouse is essentially a tertiary industry, so the degree of time control and service attitude are very important for cross-border e-commerce enterprises. Therefore, the overseas warehouse location problem in this paper considers four factors: cost, market, environment and society, and deeply excavates the decision objects contained in each factor. After comprehensive consideration, this paper uses the analytic hierarchy process to analyze the overseas warehouse location problem. Choosing analytic hierarchy process to solve the problem of overseas warehouse location of cross-border e-commerce enterprises in this paper can transform complex problems into hierarchical problems, set up multiple hierarchical objectives, combine qualitative and quantitative, consider all possible influencing factors, judge the importance of each influencing factor with the experience of decision makers combined with the actual situation of enterprises, reasonably give each standard weight of each decision scheme, and use the weight to calculate the advantages and disadvantages of each scheme, so the results are clear and clear, which is of practical significance to solve the problem of overseas warehouse location.

This paper is organized as follows. The first part describes the overseas warehouse location problem. The second part establishes the overseas warehouse location model, describes the analysis steps. The third part verifies the feasibility of the model and the analysis results through examples. The fourth part puts forward effective suggestions for the overseas warehouse location of cross-border e-commerce enterprises according to the scheme and influencing factors provided in this paper.

II. Description of Issues

The process of overseas warehouse location is generally divided into three steps: country selection, area determination and location selection. The overseas warehouse location problem of cross-border e-commerce enterprises can be described as an e-commerce enterprise that wants to develop overseas markets. After selecting the target country, considering the cost, transportation and other factors affecting the company's business development, the best location is selected, and the overseas warehouse is established to improve logistics efficiency and service quality, save transportation time, enhance the comprehensive competitiveness of enterprises, and successfully develop overseas markets.
Through investigation and query of relevant research data, this paper finally draws up cost factors that are subdivided into freight labor cost, land warehouse construction cost and energy fixed cost. Subdivided into technology upgrading, per capita income, new things acceptance market factors. Subdivided into natural environment, convenient transportation, offline store density of environmental factors. The social and environmental factors subdivided into policies and regulations, government support and the international trading market environment are the main influencing factors for the location of overseas warehouses of cross-border e-commerce, and the overseas warehouses with the least cost, the most suitable market for enterprise development, the best environment and the best policy are selected for cross-border e-commerce enterprises. The process is shown in Figure 1.

![Figure 1 Flow Chart of Overseas Warehouse Location of Cross-border E-commerce Enterprises](image)

### III. Model Establishment and Analysis Steps

3.1 Establish hierarchical structure model

According to the description of the above problems, this paper sets the target layer for the overseas warehouse location of cross-border e-commerce enterprises, and the first-level criterion layer is the cost factor, market factor, environmental factor and social factor. The first-level criterion layer is subdivided into the second-level criterion layer of freight labor cost, land warehouse cost, energy fixed cost, technology upgrading, per capita income, new things acceptance, natural environment, traffic convenience, offline store density, policies and regulations, government support, international trading market environment. The scheme layer is different alternative warehouse addresses.

On this basis, the hierarchical structure model of various factors is constructed, as shown in the following Figure 2.

![Figure 2 Hierarchical Model Structure](image)
3.2 Construction of judgment matrix

Establish the hierarchical structure model, then construct the judgment matrix. The judgment matrix is constructed by using the relative scale to compare the factors and evaluate the grade according to their importance. In this way, the difficulty in comparing the factors with different properties can be and the accuracy can be improved. Compare the importance of the guidelines to the objectives. \( a_{ij} \) is the comparison result of the importance of factor \( i \) and factor \( j \), which is called judgment matrix according to the matrix formed by pairwise comparison results. The judgment matrix has the following properties:

\[
a_{ij} = \frac{1}{a_{ji}}
\]  

(1)

The scaling method of judging matrix result \( a_{ij} \) is given, which is divided into nine grades. Table 1 shows:

| Scale | Implication                                      |
|-------|-------------------------------------------------|
| 1     | Represents the same importance of two factors    |
| 3     | That one factor is slightly more important than the other |
| 5     | That one factor is more important than the other |
| 7     | Represents that compared with two factors, one factor is more important than the other. |
| 9     | Represents that compared with two factors, one factor is extreme important than the other. |
| 2468  | Median of the above two adjacent judgements      |

3.3 Hierarchical single sorting and its consistency test

After the judgment matrix is constructed, the results are sorted by single level, and the judgment matrix will be consistent and inconsistent. For the consistent matrix, its normalized feature vector is taken as the weight vector. For the inconsistent (but within the allowable range) judgment matrix \( A \), corresponding to the eigenvector of the maximum eigenvalue \( \lambda_{\text{max}} \) of the judgment matrix, it is normalized and denoted as the weight vector \( W \). The element of \( W \) is the sorting weight of the relative importance of the same level element to a factor in the upper layer. Attainable

\[
Aw = \lambda_{\text{max}} w
\]  

(2)

Define consistency indicators as:

\[
 CI = \frac{\lambda_{\text{max}} - n}{n - 1}
\]  

(3)

\( CI = 0 \), with complete consistency;  
\( CI \) close to 0, with satisfactory consistency;  
The greater the \( CI \), the more serious the inconsistency.
The random consistency index RI is introduced to measure the size of CI. The method is to construct 500 pairwise comparison matrices \( A_1, A_2, \ldots, A_{500} \) randomly, then the consistency index \( CI_1, CI_2, \ldots, CI_{500} \) can be obtained.

\[
RI = \frac{CI_1 + CI_2 + \ldots + CI_{500}}{500} = \frac{\lambda_1 + \lambda_2 + \ldots + \lambda_{500} - n}{n - 1}
\] (4)

The random consistency index is as follows. Table 2 shows:

| Order of matrix | 1  | 2  | 3  | 4  | 5  | 6  | 7  | 8  | 9  | 10 |
|-----------------|----|----|----|----|----|----|----|----|----|----|
| RI              | 0  | 0  | 0.58 | 0.90 | 1.12 | 1.24 | 1.32 | 1.41 | 1.45 | 1.49 |

Define consistency ratios:

\[
CR = \frac{CI}{RI}
\] (5)

It is generally believed that when the consistency ratio \( CR < 0.1 \), the consistency of the judgment matrix is within the allowable range, and there is satisfactory consistency. Through the consistency test, the normalized feature vector can be used as the weight vector, otherwise the judgment matrix needs to be corrected.

3.4 Hierarchical total ranking and its consistency testing

After the single-level sorting and consistency checking are completed, the total-level sorting and consistency checking are carried out. Hierarchical ranking, as its name implies, is to calculate the weight of the relative importance of all factors at a certain level to the highest level (total goal). This process is carried out from high level to the lowest level.

In the middle layer (criterion layer), \( m \) factors \( A_1, A_2, \ldots, A_m \) are ranked as \( a_1, a_2, \ldots, a_m \) for the total target.

The bottom layer (scheme layer) \( n \) factors on the upper layer are \( A_j \) levels but sorted as \( b_{1j}, b_{2j}, \ldots, b_{nj} \).

The total ranking of the lowest level (scheme level) is:

\[
B_i = a_1b_{1i} + a_2b_{2i} + \ldots + a_nb_{ni}
\]

\[
B_2 = a_1b_{21} + a_2b_{22} + \ldots + a_nb_{2n}
\]

\[
\ldots
\]

\[
B_n = a_1b_{n1} + a_2b_{n2} + \ldots + a_nb_{nn}
\] (6)

That is, the weight of the bottom (programme level) factor \( i \) to the overall objective is:
Let $B_1$, $B_2$, ..., $B_n$ to the factor $A_j \ (j = 1, 2, ..., m)$ in the upper layer (A layer) is $C_{i_j}$, and the random consistency index is $R_{i_j}$, the consistency ratio of the total hierarchy is:

$$CR = \frac{a_1C_1 + a_2C_2 + \cdots + a_mC_m}{a_1R_1 + a_2R_2 + \cdots + a_mR_m}$$  \hspace{1cm} (8)$$

When $CR < 0.1$, it is considered that the hierarchical total ranking passes the consistency test, and the hierarchical total ranking has satisfactory consistency. Otherwise, the element values of the judgment matrix with high consistency ratio need to be readjusted.

At this point, the final decision is made according to the overall ranking of the lowest level (decision level).

**IV. Example Analysis**

A multinational company was established in 2011, and it is a well-known domestic overseas business brand with the largest scale effect of revenue. Its products mainly include three series: battery research and development and charging, multi-functional headphone audio, and intelligent innovation technology. Its revenue mainly comes from foreign markets, such as North America, Europe, Japan, the Middle East and other economically developed regions with strong consumption and standardized operation. The company had prepared to establish overseas warehouses in the United States, investigated several central cities in the United States, and finally chose the H Free Zone on the West Coast of the United States as the site after weighing the advantages and disadvantages. Taking this company as a case, this paper draws up City J, City X, City S, City F and City P as alternative addresses of overseas warehouses. After the above steps, the empirical analysis of the overseas warehouse location of this company is carried out to test the feasibility of the above overseas warehouse location scheme.

4.1 Establish hierarchical structure model

According to the influencing factors of overseas warehouse location of cross-border e-commerce enterprises mentioned in the third chapter, the hierarchical structure model of case enterprises is constructed as figure 3.
4.2 Construction of judgment matrix and hierarchical single ranking and consistency testing

Through interviews with employees in the relevant departments of the case company, on the basis of the factors considered in this paper are discussed, the results of the discussion will tell experts to use the experience and knowledge of experts to determine the weight of each index based on the method of industry expert scoring, the judgment matrix is shown in the following table, in order to save space, the eigenvalues and consistency test results of each judgment matrix are included in the table 3, table 4, table 5, table 6, table 7, table 8, table 9, table 10, table 11, table 12, table 13, table 14, table 15, table 16, table 17, table 18 and table 19.

Table 3 Decision Factor Judgement Matrix

| Cost factor       | Market factor | Environmental factor | Social factor | Weight (wi) |
|-------------------|---------------|----------------------|---------------|-------------|
| Cost factor       | 1             | 1/3                  | 1/3           | 0.1317      |
| Market factor     | 3             | 1                    | 1             | 0.395       |
| Environmental     | 1             | 1/3                  | 1             | 0.3001      |
| Social factor     | 3             | 1                    | 1             | 0.3001      |

Location target of overseas warehouse: $\lambda_{\text{max}} = 4.1533 \text{CR} = 0.0574 \text{CI} = 0.051$

Table 4 Cost Factor Judgement Matrix.

| Freight labor cost | Land construction cost | Fixed energy cost | Weight (wi) |
|--------------------|------------------------|------------------|-------------|
| 1                  | 3                      | 3                | 0.6         |
| 1/3                | 1                      | 1                | 0.2         |
| 1/3                | 1                      | 1                | 0.2         |

Target cost factors of overseas warehouse location: $\lambda_{\text{max}} = 3 \text{ CR} = 0 \text{ CI} = 0$

Table 5 Cost Judgement Matrix for Freight Labour

| City J | City X | City S | City F | City P | Weight (wi) |
|--------|--------|--------|--------|--------|-------------|

| City J | City X | City S | City F | City P | Weight (wi) |
|-------|-------|-------|-------|-------|-------------|
| 1     | 3     | 3     | 3     | 5     | 0.4339      |
| 1/3   | 1     | 1     | 1     | 3     | 0.1627      |
| 1/3   | 1     | 5     | 1/5   | 3     | 0.1179      |
| 1/3   | 1     | 5     | 1     | 3     | 0.2245      |
| 1/5   | 1/3   | 1/3   | 1/3   | 1     | 0.061       |

Target cost of overseas warehouse location factor freight labor cost:

raxm =5.3692 CR=0.0824 CI=0.0923

### Table 6 Land Construction Cost Judgment Matrix

| City J | City X | City S | City F | City P | Weight (wi) |
|-------|-------|-------|-------|-------|-------------|
| 1     | 3     | 5     | 3     | 3     | 0.4115      |
| 1/3   | 1     | 1     | 1/5   | 1     | 0.0898      |
| 1/5   | 1     | 1     | 1/7   | 1/3   | 0.0608      |
| 1/3   | 5     | 7     | 1     | 3     | 0.3141      |
| 1/3   | 1     | 3     | 1/3   | 1     | 0.1238      |

Target cost factors of overseas warehouse location land construction cost:

raxm =5.3344 CR=0.0746 CI=0.0836

### Table 7 Energy Fixed Cost Judgment Matrix

| City J | City X | City S | City F | City P | Weight (wi) |
|-------|-------|-------|-------|-------|-------------|
| 1     | 3     | 5     | 3     | 3     | 0.0652      |
| 1/3   | 1     | 1     | 1/5   | 1     | 0.3363      |
| 1/5   | 1     | 1     | 1     | 3     | 0.2699      |
| 1/3   | 3     | 1     | 1     | 1     | 0.1739      |
| 1/3   | 5     | 1/3   | 1/3   | 1     | 0.1547      |

Target cost factors of overseas warehouse location energy fixed cost:

raxm =5.3723 CR=0.0831 CI=0.0931

### Table 8 Market Factor Judgment Matrix

| Technology update | Per capita income | Acceptance of new things | Weight (wi) |
|-------------------|-------------------|--------------------------|-------------|
| 1                 | 1/3               | 1                        | 0.2         |
| 3                 | 1                 | 3                        | 0.6         |
| 1                 | 1/3               | 1                        | 0.2         |

Target market factors of overseas warehouse location:

raxm =3 CR=0 CI=0

### Table 9 Judgement Matrix of Technical Updating Factors

| City J | City X | City S | City F | City P | Weight (wi) |
|-------|-------|-------|-------|-------|-------------|
| 1     | 5     | 5     | 3     | 5     | 0.4922      |
| 1/5   | 1     | 1     | 1/3   | 3     | 0.109       |
| 1/5   | 1     | 1     | 1/3   | 3     | 0.109       |
| 1/3   | 3     | 3     | 1     | 3     | 0.2334      |
| 1/5   | 1/3   | 1/3   | 1/3   | 1     | 0.0564      |

Technical renewal of target market factors for overseas warehouse location:

raxm =5.2383 CR=0.0532 CI=0.0596
Table 10 Judgement Matrix of Per Capita Income Factor

|      | City J | City X | City S | City F | City P | Weight (wi) |
|------|--------|--------|--------|--------|--------|-------------|
| City J | 1      | 3      | 3      | 1      | 5      | 0.3536      |
| City X | 1/3    | 1      | 1      | 1/3    | 3      | 0.1326      |
| City S | 1/3    | 1      | 1      | 1/3    | 3      | 0.1326      |
| City F | 1      | 3      | 3      | 1      | 3      | 0.3193      |
| City P | 1/5    | 1/3    | 1/3    | 1/3    | 1      | 0.0619      |

Per capita income of overseas warehouse location target market factors:

\[ \lambda_{\text{max}} = 5.1366 \]  
\[ \text{CR} = 0.0305 \]  
\[ \text{CI} = 0.0342 \]

Table 11 New Things Acceptance Judgment Matrix

|      | City J | City X | City S | City F | City P | Weight (wi) |
|------|--------|--------|--------|--------|--------|-------------|
| City J | 1      | 3      | 3      | 1      | 5      | 0.3481      |
| City X | 1/3    | 1      | 1      | 1/3    | 3      | 0.1305      |
| City S | 1/3    | 1      | 1      | 1/3    | 3      | 0.1048      |
| City F | 1      | 3      | 3      | 1      | 5      | 0.3481      |
| City P | 1/5    | 1/3    | 1/3    | 1/5    | 1      | 0.0686      |

Acceptance of new things for overseas warehouse location target market factors:

\[ \lambda_{\text{max}} = 5.0981 \]  
\[ \text{CR} = 0.0219 \]  
\[ \text{CI} = 0.0245 \]

Table 12 Environmental Factors Judgment Matrix

|                  | Natural environment | Traffic condition | Offline store density | Weight (wi) |
|------------------|---------------------|-------------------|-----------------------|-------------|
| Natural environment | 1                  | 3                 | 3                     | 0.6         |
| Traffic condition  | 1/3                | 1                 | 1                     | 0.2         |
| Offline store density | 1/3            | 1                 | 1                     | 0.2         |

Target environmental factors of overseas warehouse location:

\[ \lambda_{\text{max}} = 3 \]  
\[ \text{CR} = 0 \]  
\[ \text{CI} = 0 \]

Table 13 Judgement Matrix of Natural Environmental Factors

|      | City J | City X | City S | City F | City P | Weight (wi) |
|------|--------|--------|--------|--------|--------|-------------|
| City J | 1      | 1      | 1      | 3      | 3      | 0.2878      |
| City X | 1      | 1      | 1      | 3      | 3      | 0.2598      |
| City S | 1      | 1      | 1      | 3      | 3      | 0.2878      |
| City F | 1/3    | 1/3    | 1/3    | 1      | 3      | 0.1079      |
| City P | 1/5    | 1/3    | 1/5    | 1/3    | 1      | 0.0567      |

Target environmental factors natural environment of overseas warehouse location:

\[ \lambda_{\text{max}} = 5.0981 \]  
\[ \text{CR} = 0.0219 \]  
\[ \text{CI} = 0.0245 \]

Table 14 Traffic Condition Factor Judgment Matrix

|      | City J | City X | City S | City F | City P | Weight (wi) |
|------|--------|--------|--------|--------|--------|-------------|

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| City | J | X | S | F | P | Weight (wi) |
|-----|---|---|---|---|---|-------------|
| City J | 1 | 1 | 1 | 3 | 5 | 0.2815 |
| City X | 1 | 1 | 1 | 3 | 5 | 0.2815 |
| City S | 1 | 1 | 1 | 3 | 5 | 0.2815 |
| City F | 1/3 | 1/3 | 1/3 | 1 | 3 | 0.1055 |
| City P | 1/5 | 1/5 | 1/5 | 1/3 | 1 | 0.0501 |

Target environmental factors traffic conditions of overseas warehouse location: $\lambda_{\text{max}} = 5.1366$
CR = 0.0305 CI = 0.0342

Table 15 Judgement Matrix of Offline Store Density

| City | J | X | S | F | P | Weight (wi) |
|-----|---|---|---|---|---|-------------|
| City J | 1 | 1 | 1 | 3 | 5 | 0.2815 |
| City X | 1 | 1 | 1 | 3 | 5 | 0.2815 |
| City S | 1 | 1 | 1 | 3 | 5 | 0.2815 |
| City F | 1/3 | 1/3 | 1/3 | 1 | 3 | 0.1055 |
| City P | 1/5 | 1/5 | 1/5 | 1/3 | 1 | 0.0501 |

Target environmental factors of overseas warehouse location offline store density: $\lambda_{\text{max}} = 5.0417$
CR = 0.0093 CI = 0.0104

Table 16 Social Factor Judgment Matrix

| Policies and regulations | Policy support | International trading market | Weight (wi) |
|--------------------------|----------------|-----------------------------|-------------|
| Policies and regulations | 1 | 1 | 1/3 | 0.2 |
| Policy support           | 1 | 1 | 1/3 | 0.2 |
| International trading market | 3 | 3 | 1 | 0.6 |

Target social factors of overseas warehouse location: $\lambda_{\text{max}} = 3$ CR = 0 CI = 0

Table 17 Judgement Matrix of Policy and Regulation Factors

| City | J | X | S | F | P | Weight (wi) |
|-----|---|---|---|---|---|-------------|
| City J | 1 | 1 | 1 | 3 | 5 | 0.2227 |
| City X | 1 | 1 | 1 | 3 | 5 | 0.1788 |
| City S | 1 | 1 | 1 | 3 | 5 | 0.1788 |
| City F | 1 | 3 | 3 | 1 | 3 | 0.3456 |
| City P | 1/3 | 1/3 | 1/3 | 1/3 | 1 | 0.0742 |

Policies and regulations on target social factors of overseas warehouse location: $\lambda_{\text{max}} = 5.1958$
CR = 0.0437 CI = 0.0489

Table 18 Factor Judgment Matrix of Policy Support

| City | J | X | S | F | P | Weight (wi) |
|-----|---|---|---|---|---|-------------|
| City J | 1 | 1 | 1 | 3 | 5 | 0.2308 |
| City X | 1 | 1 | 1 | 3 | 5 | 0.2308 |
| City S | 1 | 1 | 1 | 3 | 5 | 0.2308 |
| City F | 1 | 1 | 1 | 3 | 5 | 0.2308 |
| City P | 1/3 | 1/3 | 1/3 | 1/3 | 1 | 0.0769 |

Policy support for target social factors of overseas warehouse location: $\lambda_{\text{max}} = 5$ CR = 0 CI = 0

Table 19 Environmental Judgment Matrix of International Trading Market

| City | J | X | S | F | P | Weight (wi) |
|-----|---|---|---|---|---|-------------|
| City J | 1 | 1 | 1 | 3 | 5 | 0.2308 |
| City X | 1 | 1 | 1 | 3 | 5 | 0.2308 |
| City S | 1 | 1 | 1 | 3 | 5 | 0.2308 |
| City F | 1 | 1 | 1 | 3 | 5 | 0.2308 |
| City P | 1/3 | 1/3 | 1/3 | 1/3 | 1 | 0.0769 |

Policies and regulations on target environmental factors of overseas warehouse location: $\lambda_{\text{max}} = 5.1958$
CR = 0.0437 CI = 0.0489

Table 18 Factor Judgment Matrix of Policy Support

| City | J | X | S | F | P | Weight (wi) |
|-----|---|---|---|---|---|-------------|
| City J | 1 | 1 | 1 | 3 | 5 | 0.2308 |
| City X | 1 | 1 | 1 | 3 | 5 | 0.2308 |
| City S | 1 | 1 | 1 | 3 | 5 | 0.2308 |
| City F | 1 | 1 | 1 | 3 | 5 | 0.2308 |
| City P | 1/3 | 1/3 | 1/3 | 1/3 | 1 | 0.0769 |

Policy support for target social factors of overseas warehouse location: $\lambda_{\text{max}} = 5$ CR = 0 CI = 0

Table 19 Environmental Judgment Matrix of International Trading Market

| City | J | X | S | F | P | Weight (wi) |
|-----|---|---|---|---|---|-------------|
| City J | 1 | 1 | 1 | 3 | 5 | 0.2308 |
| City X | 1 | 1 | 1 | 3 | 5 | 0.2308 |
| City S | 1 | 1 | 1 | 3 | 5 | 0.2308 |
| City F | 1 | 1 | 1 | 3 | 5 | 0.2308 |
| City P | 1/3 | 1/3 | 1/3 | 1/3 | 1 | 0.0769 |
Target social factors of overseas warehouse location international trading market environment:

\[ \lambda_{\text{max}} = 5.1366 \quad \text{CR}=0.0305 \quad \text{CI}=0.0342 \]

The CI values of each judgment matrix are equal to or close to 0, and the CR values are less than 0.1, indicating that the consistency of each judgment matrix is acceptable.

4.3 Hierarchical Total Ranking and Consistency Test

After calculation, the weight table of the middle layer of group decision and the bottom conclusion (weight) table of group decision are obtained as shown in Table 20 and Table 21.

| Nodal point                        | Global weight | Same level weights | Superior                      |
|------------------------------------|---------------|--------------------|--------------------------------|
| Cost factor                        | 0.1317        | 0.1317             | Location target of overseas warehouse |
| Market factor                      | 0.395         | 0.395              |                                |
| Environmental factor               | 0.1733        | 0.1733             |                                |
| Social factor                      | 0.3001        | 0.3001             |                                |
| Freight labor cost                 | 0.079         | 0.6                | Cost factor                    |
| Land construction cost             | 0.0263        | 0.2                |                                |
| Fixed energy cost                  | 0.0263        | 0.2                |                                |
| Technology update                  | 0.079         | 0.2                | Market factor                  |
| Per capita income                  | 0.237         | 0.6                |                                |
| Acceptance of new things           | 0.079         | 0.2                |                                |
| Natural environment                | 0.104         | 0.6                | Environmental factor           |
| Traffic condition                  | 0.0347        | 0.2                |                                |
| Offline store density              | 0.0347        | 0.2                |                                |
| Policies and regulations           | 0.06          | 0.2                | Social factor                  |
| Policy support                     | 0.06          | 0.2                |                                |
| International trading market       | 0.1801        | 0.6                |                                |

As shown in table 21, the bottom data of group decision shows that the highest value of City J is 0.3379, the second weight of City F is 0.266, and the lowest weight of City P is 0.0662 compared with other cities. This data shows that the development of City P is lagging behind in many alternative addresses, and it is necessary to further improve the comprehensive quality of the city, and the best address for comprehensive analysis is City J.

It can be seen that the case company can choose the best location after the analysis of various factors, which proves that the location scheme proposed in this paper has certain stability.
V. Suggestions on Overseas Warehouse Location of Cross-border E-commerce Enterprises

5.1 Experience sharing meeting on overseas warehouse construction

As an emerging model, overseas warehouse is not mature and should learn from the development experience of other enterprises. According to the development planning and operation mode of other similar enterprises, specific operation strategies can be formulated according to their own situation, and cooperate with other excellent enterprises to promote better and faster development of enterprises.

5.2 Integration into the warehouse environment, first shot at work

In the process of overseas warehouse construction, we should investigate the local economic conditions, experience the local customs and habits. On the one hand, it improves customer satisfaction and increases the order rate and turnover rate of goods. On the other hand, it is conducive to the familiarity of overseas warehouse employees with future work and lays a solid foundation for the subsequent operation of overseas warehouses. Enterprises can recruit local excellent staff in advance, do a good job of staff training in advance, save the follow-up overseas warehouse operation time, improve the overall quality of overseas warehouse staff.

5.3 Actively Participating in the Symposium on Political and Commercial Exchanges and Exchanging New Ideas

For small and medium-sized or in the financing stage, cross-border e-commerce enterprises with loans should actively coordinate with local governments and listen to their opinions and suggestions when establishing overseas warehouses, which is conducive to the subsequent project operation and long-term development of enterprises. With guidance from the government and relevant departments. When the overseas warehouse model developed to a mature transition phase can apply for government cooperation, or policy funding support, mutual benefit, harmonious development, better promote enterprise and regional development.

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