Study on Location Selection of Import and Export Trade Logistics Park Based on Analytic Hierarchy Process

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Abstract. In order to build a modern industrial system, accelerate the development of China's import and export trade industry, reduce the operating costs of enterprises, increase the economic benefits of enterprises. Logistics park in the new era background,how to build efficient, convenient, unimpeded circulation system, is the inevitable requirements of the construction of modern logistics park. At present,"Internet +" and smart logistics have been widely used in all aspects of the city, which has a profound impact on people's production and life. As the main carrier of logistics activities, logistics parks should also change their development concept and change the traditional development mode, which ignores carbon emission, operation efficiency and low degree of informatization. This project intends to use AHP method to study the location selection of logistics parks in southern Xinjiang, and then use matlab software to conduct quantitative evaluation on the location index of selected logistics centers by taking the import and export trade logistics Park in Kezhou, Xinjiang as an example. The research results of this project will provide new ideas and methods for the development of logistics industry in southern Xinjiang, and will be extended to Xinjiang.

Keywords: Logistics park, analytic hierarchy process, location selection, matlab

1 Introduction

In recent years, with the in-depth implementation of the Belt and Road Initiative, the logistics industry has gradually risen and become one of the core drivers of high-quality economic growth, which plays an indispensable role in promoting economic growth. In particular, the construction of logistics parks in China is still in a relatively backward stage of development, and it is urgent to strengthen the strategic layout and construction process of logistics parks in accordance with the actual situation of various places and the development trend. At present, the Turkah port and Irkeshtan Port in Kezhou, Xinjiang are busy with vehicles coming and going and freight. The flood of vehicles gathering is running continuously, connecting the pulse of the development of Kezhou and the world. In 2023, the total import and export

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value of Kezhou is 10.75 billion yuan, an increase of 111.3% compared with the same period in 2022 (the same below), 59.9 percentage points higher than the growth rate of foreign trade import and export in Xinjiang. However, with the increase of orders and the increase of transport vehicles, road congestion, no centralized parking places for vehicles, and random parking oftrucks on both sides of the road affect traffic safety and are not conducive to the efficiency of import and export trade. In order to promote a high level of opening to the outside world, facilitate customs clearance and speed up import and export trade, this paper will adopt the analytic hierarchy process, select a suitable location, build a logistics park, and make every effort to improve the speed of port clearance and escort high-quality economic development[2].

2 Overview of Import and Export Trade Logistics Park

"Port logistics" means "import and export trade logistics", which refers to the use of the advantages of port cargo distribution, relying on cutting-edge logistics facilities and equipment, relying on import and export and transit trade as the cornerstone, using modern information technology as an operating tool, committed to the deep integration and optimization of logistics resources, so as to enhance the diffusion effect of logistics around the port, forming a comprehensive logistics system. Import and export trade logistics park is essentially a set of economic regional logistics command, scheduling and information processing inone of the core hub, it brings together logistics activities, and is located in a variety of transportation mode intersection of the key node. Here, all kinds of logistics facilities and logistics companies of different natures can be compact distributed in geographical space, forming a logistics enterprise cluster with considerable scale and diversified services[3]. The operation of the park not only realizes the optimal integration and efficient use of regional resources, but also promotes the rapid development of other industries by promoting the efficiency of production and circulation links, and enhances the overall competitiveness of the local market.

3 A Brief Introduction of the Analytic Hierarchy Process

The Analytic Hierarchy Process (AHP) was first put forward by the American operations research professor Satie of the University of Pittsburgh in the early 1970s. The method divides the factors related to decision into target layer, criterion layer, measure layer and scheme layer. It is an evaluation and decision method applied in system engineering. Have the ability to deal with multi-objective, multi-criteria, multi-level complex decision-making problems. The analytic hierarchy process is used to classify many influential factors in the logistics system, divide these factors into different groups, and then build a hierarchical architecture model[4]. Then, the judgment matrix is built to show the relative importance of each factor at each level, and the ranking and consistency check of a single level are carried out. On this basis, complete the whole hierarchy sorting and consistency check. Through the sorting result, the relative importance of each decision factor to the overall goal is calculated, so as to determine the best choice.[1] The specific steps are as follows:

(1) Establish a hierarchical structure model. After the in-depth analysis of the decision-making problem, the factors contained in the problem are divided into different levels, such as target layer, criterion layer, index layer, scheme layer, etc., and the hierarchical structure of the hierarchy and the dependency relationship of factors are explained in the form of block diagram[5].

(2) Construct the judgment matrix. The value of the elements of the judgment matrix reflects the relative importance of each factor. The scale method of 1-9 and its reciprocal is generally adopted. See Table 1 for details.

Table 1. Scale of the judgment matrix

Scale	Meaning
1	Indicates that two factors are of equal importance when compared
3	Indicates that one is slightly more important than the other compared to two factors
5	Indicates that when two factors are compared, one is significantly more important than the other
7	Indicates that when two factors are compared, one is strongly more important than the other
9	Means that one is extremely more important than the other when comparing two factors
2,4,6	Represents the median of two adjacent judgments on appeal
8 Count backwards	If factor i is compared to j to give backwards judgment Bij, then the judgment of factor j and i is Bij=1/B

(3) Single hierarchical ranking and its consistency test. The so-called hierarchical single sort refers to the importance order of each factor on the upper layer of a factor, the essence of its calculation is to calculate the largest feature root of the judgment matrix and the corresponding feature vector, that is, for the judgment matrix B, BW=λmax the calculation meets, where is the largest feature root of B, W is the corresponding normalized feature vector, then the component of W is the weight corresponding to the single sort. λ λ W max max i In order to ensure the credibility of single hierarchical ranking, it is necessary to test the consistency of the judgment matrix, that is, to calculate the random rmax −n consistency ratio.CR=RI(n- 1) Where n is the order of the judgment matrix and RI is the average random consistency index, which can usually be seen in Table 2. Only when CR<0.1, the result of single hierarchical sorting is considered to be satisfactory, otherwise, the value of the judgment matrix elements needs to be adjusted[6].

Table 2. Comparison table of mean random consistency index

Judge order the of matrix	1	2	3	4	5	6	7	8	9	10
RI	0	0	0.58	0.9	1.12	1.24	1.32	1.41	1.45	1.49

(4) Hierarchy total sort calculation. The ranking weight of the relative importance of all factors at the same level to the top level (the overall goal) is called the total ranking of the hierarchy. This process is carried out from the highest level to the lowest level. If the previous level Aj contains m factors A1, A2,...,Am, the total ranking weights of the level are a1, a2,...,am, respectively, and the next level Bj contains n factors B1 and B2,... Bn, and their hierarchical single-order weights for factor Aj are b1j, b2j,...,bnj, respectively. (bkj=0 when bk is not linked to Aj).

4 Case Study of the Location of Import and Export Trade Logistics Parks

It is located in Turgate Port, Tuoyun Township, Wuqia County, Kizilsu Kirgiz Autonomous Prefecture, Xinjiang, China, adjacent to Narun Oblast of Kyrgyzstan, and close to Upper Artush Town. This port is not only the cargo transit hub of Artush City, but also undertakes the important distribution function of import and export trade in Kashgar, is an important channel for commercial exchanges between China and Kyrgyzstan, and is a key channel to Central Asia, South Asia, West Asia and even Europe. However, despite the gradual relaxation of policies and the rising demand for logistics, the current level of logistics services still needs to be improved. Due to the lack of close inter-regional cooperation, the logistics system is not perfect, the degree of resource integration needs to be improved, and the lack of a comprehensive import and export trade logistics park and logistics information platform[7], these factors have had an adverse impact on the allocation of resources and the flow of production factors, and then restrict the further development of the economy. The town of Upper Artush is strategically located, with a relatively dense concentration of people, vehicles and goods, and a large area of open space, which is particularly fierce in the competition. In this paper, the above four typical regions were selected as the research objects, which were recorded as F1, F2, F3 and F4 respectively[8][9], and a number of industry experts were invited to score the results, and the results were ranked by analytic hierarchy process to rank the weights of the indicators affecting the location of regional logistics centres, and the comprehensive scores of the four regions were sorted to select the optimal scheme.

(1)Establish a hierarchical structure model, and through the analysis of the logistics development of the Bohai Economic Circle, determine the location of the regional logistics centre A as the target layer, and the criterion layer as the five main factors affecting the target layer: logistics status B1, economic and cost advantage B2, sustainable development capacity B3, policy support B4, and social performance B5; The indicator layer is the factor that affects the criterion layer; The scheme layer is the 4 cities to be selected; The hierarchical model is shown in Figure 1.

(2) Construct the judgment matrix, hierarchical single sorting and consistency check.

① Construct the judgment matrix Bi-A (i=1,2,3,4,5) based on the results of the expert scoring method, and use MATLAB software to obtain the maximum eigenvalue and eigenvector (weights) of the matrix, which are: λmax=5.187, ω=(0.50, 0.12, 0.16, 0.07, 0.15), CR=0.0417<0.1, passing the consistency check.

②The judgment matrix of Bij-Bi(i=1,2,3,4,5; j=1,2,3) was constructed, and the maximum eigenvalues and eigenvectors (weights) of each matrix were calculated by MATLAB software, which were λ1=3.0246, λ2=3.1078, λ3=3.0536, λ4=3.0356, λ5=3.0385, ω1=(0.2, 0.12, 0.68), ω2=(0.52, 0.12, 0.36), ω3=(0.52, 0.12, 0.36), ω4=(0.17, 0.35, 0.48), ω5=(0.64, 0.26, 0.10), CR1=0.0212<0.1, CR2=0.0929<0.1, CR3=0.0462<0.1, CR4=0.0306<0.1, CR5=0.0332<0.1, all passed the consistency test.

③ The judgment matrix of Fm-Bij (m=1,2,3,4) was constructed, and the maximum eigenvalues and eigenvectors (weights) were calculated by MATLAB software: λ11=4.0283, λ12=4.0283, λ13=4.0731, λ21=4.0458, λ22=4.0458, λ23=4.0875, λ31=4.111, λ32=4.0875, λ33=4.0511, λ41=4.0875, λ42=4.0894, λ43=4.1169, λ51=4.1725, λ52=4.144, λ53=4.144.

All of them passed the consistency test after calculation.

(3) The total order of the hierarchy. By calculating the scores of the four regions, F2>F1> F3>F4, it can be judged that the import and export trade logistics park should be selected in the town of Upper Artush.The hierarchical model is shown in Table 3.

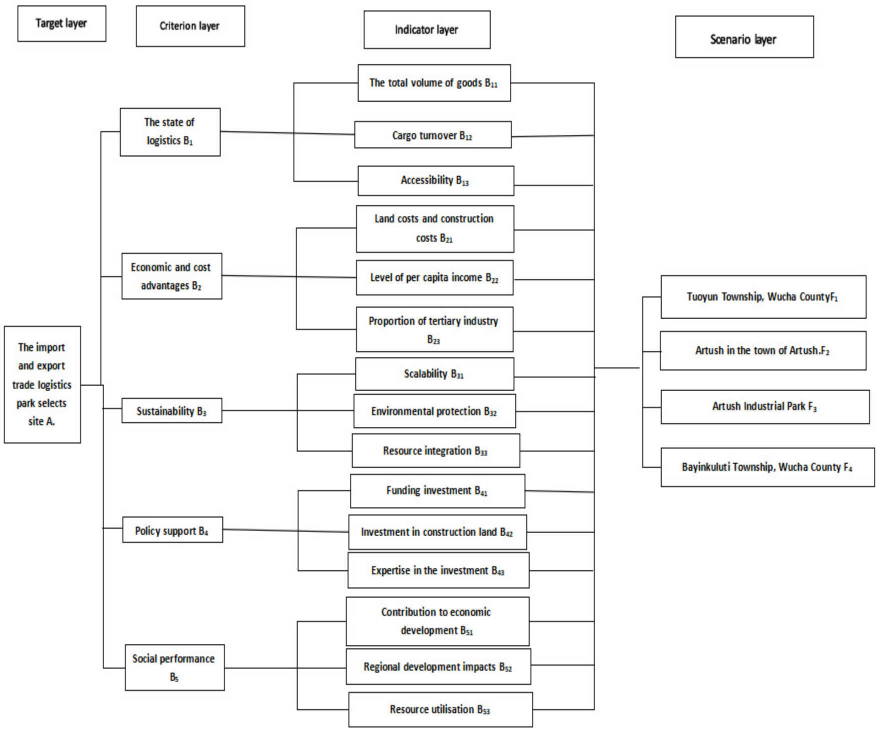

Fig. 1. Hierarchical model of the import and export trade logistics park

Table 3. Indicator (weight) value

Data		Evaluate data at the solution level			
Indicators (Weights)					
Guideline layer	Guideline layer	F_1	F_2	F_3	F_4
The state of logisticsB1 (0.5)	The total volume of goods B11 (0.2)	0.58	0.23	0.07	0.12
	Cargo turnover B_{12} (0.12)	0.58	0.23	0.07	0.12
	Accessibility B_{13} (0.68)	0.58	0.22	0.14	0.06
Economic and cost advantagesB_2 (0.12)	Land costs and construction costs B_{21} (0.52)	0.46	0.29	0.16	0.09
	Level of per capita income B_{22} (0.12)	0.46	0.29	0.16	0.09
	Proportion of tertiary industry B_{23} (0.36)	0.46	0.29	0.17	0.08
SustainabilityB_3 (0.16)	Scalability B_{31} (0.53)	0.54	0.23	0.15	0.08
	Environmental protection B_{32} (0.14)	0.46	0.29	0.17	0.08
	Resource integration B_{33} (0.33)	0.47	0.28	0.18	0.07
Policy supportB_4 (0.07)	Funding investment B_{41} (0.17)	0.46	0.29	0.17	0.08
	Investment in construction land B_{42} (0.35)	0.53	0.28	0.13	0.06
	Expertise in the investment B_{43} (0.48)	0.62	0.26	0.09	0.03
Social performanceB_5 (0.15)	Contribution to economic development B_{51} (0.64)	0.55	0.29	0.11	0.05
	Regional development impacts B_{52} (0.26)	0.45	0.32	0.16	0.07
	Resource utilisation B_{53} (0.10)	0.45	0.32	0.16	0.07

5 Conclusion

remarks Based on the comprehensive analysis, this paper uses the analytic hierarchy process (AHP) and the calculation function of MATLAB software to quantify the location of the import and export trade logistics park, which makes full use of the advantages of the analytic hierarchy process in dealing with multi-criteria and multi-index problems, and makes the results more objective and referential by extensively soliciting the opinions of relevant experts.

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