Research on the location of S express logistics terminal delivery network in Haizhou District of Lianyungang

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Abstract. With the development of Internet technology, consumption on the internet has become an indispensable way of consumption in our life, and the logistics industry driven by network consumption is also rising rapidly. Logistics terminal distribution is a kind of logistics activity that logistics service providers deliver express packages directly to consumers from the last distribution network. It is the last link of logistics service to meet the needs of customers. The purpose of this paper is to analyze the distribution of a certain express terminal network in Haizhou District of Lianyungang, put forward the proposal of increasing the distribution network, and study the location of the network through AHP, and determine the final location and the establishment of the network has a certain significance to improve customer satisfaction and other aspects.

1 Introduction

In recent years, more and more express delivery industry has sprung up. One of the key points to stand out among many logistics enterprises is to determine the address of logistics distribution center. The location of logistics distribution center determines the operation cost and benefit of the enterprise. A good location decision of logistics distribution network can bring benefits to the enterprise. On the contrary, the logistics center will face risks because of the wrong location.

In this field, many scholars have conducted in-depth research. Weltevreden.J.J., based on the data statistics of distribution enterprise operation and customer behavior, this paper makes an objective analysis of the collection and delivery point, but mainly qualitative research.^[1] Yang PJ, Hu Hao etc. established a location model with the minimum distance of door-to-door delivery right and the closest distance between customers and outlets. He transformed the multi-objective optimization problem into a single objective model by using constraint method and solved it by using genetic algorithm.^[2] Yin XQ, Mo YD, Dong CC, etc. based on the complex network theory, a location method of urban cold chain terminal distribution station is proposed. The simulation results show that the proposed method is accurate and effective, and can fully ensure the timeliness of distribution.^[3] Liu JC etc. in order to determine the optimal location of the logistics center, the hybrid multi-attribute decision-making method is used to determine the candidate area of the logistics center, and the constraint conditions are added to optimize the established model. Finally, the operability and superiority of the proposed optimization model are verified through the analysis of an example.^[4] Xiao YW, Lou ZK study that

the heuristic algorithm based on triangle centroid and bisection points optimizes the initial solution. The algorithm allows to accept a suboptimal solution to avoid falling into local optimum, and tracks the search process through memory array, and finally outputs the optimal solution of the process. Finally, an example is given to show that the proposed algorithm is superior to the mean clustering and point density clustering algorithms.^[5]

Therefore, if logistics companies want to develop better, they have to pay more attention to the terminal location, and invest a certain amount of human and material resources in this research, which is conducive to the steady development of enterprises.

2 Materials and methods

2.1 Materials

2.1.1 Factors affecting site selection

The main factors affecting the location of distribution network are population distribution, regional economic development level, traffic situation and market efficiency. The distribution of population mainly refers to the number of population and the characteristics of population distribution in the region; one of the factors that determine the level of logistics service is the economic level of the region. As we all know, only after the economy meets the basic physiological security needs will there be further demand. With the improvement of economic level, there will be more consumption demand, and then greater logistics demand. In order to bring greater economic benefits for enterprises, logistics enterprises have the ability to update equipment and build intelligent and

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intelligent logistics system and distribution system; the traffic condition of the road includes the amount of traffic flow at a certain time, the degree of congestion caused by the maximum traffic flow, and so on. The radiation capacity of traffic refers to the farthest distance that a certain distribution network can deliver and the size of the area that can be delivered within this distance in a certain time; the radiation range of terminal distribution network and the quantity of goods that may need to be distributed in this range are the important reasons to consider whether to build this distribution network.

2.1.2 Distribution network layout in Haizhou District of Lianyungang

According to the current network survey and the actual situation of stampede, there are 21 distribution outlets in Haizhou S express. Terminal distribution network, also known as terminal distribution center, takes the final consumers as the service object and aims to improve the satisfaction of consumers. For the areas with large flow of people, large daily delivery of packages and easy to burst warehouse, the research thinks that we can increase the distribution network to improve the distribution efficiency of the area and achieve higher customer satisfaction. This paper puts forward three alternative websites, and selects the optimal address through the AHP model.

Plan 1: set up a network in Longhe South Road, Haizhou District;

Plan 2: set up a network in Yanhe South Road Street, Haizhou District;

Plan 3: set up a network in Qindongmen street, Haizhou District;

2.2 Methods

The location problem of terminal network is a comprehensive and complex decision-making problem. Both qualitative factors and quantitative factors should be considered. Only when the two factors are combined can a higher effect be achieved. The problems that people are facing in the fields of economy, society management are complex systems that restrict and interact with each other. AHP is a new, concise and practical decision-making method that combines various factors for quantitative and qualitative analysis.

2.2.1 Modeling steps of AHP

The judgment matrix of pairwise comparison is established. The pairwise matrix represents the comparison of the relative importance between this level and other related units for a certain element in the upper level. At this time, the relative comparison is used to reduce the difficulty of comparison between different factors as far as possible, so as to improve the accuracy.

2.2.2 Hierarchical analysis of terminal distribution network

Through expert advice, search for relevant literature and other methods to find out the factors that affect the terminal network site selection, analyze and summarize them into three categories. This paper is divided into three categories: social impact, infrastructure and business environment. The social impact includes: policies and regulations, environmental pollution, human resources; infrastructure is divided into: traffic distance, communication network, road facilities; business environment is divided into: price level, human demand, service level, and establish a hierarchy diagram, as shown in Figure 1.

Fig.1. Analytic hierarchy process

2.2.3 Model solving

The judgment matrix of pairwise comparison is established. The pairwise matrix represents the comparison of the relative importance between this level and other related units for a certain element in the upper level. At this time, the relative comparison is used to reduce the difficulty of comparison between different factors as far as possible, so as to improve the accuracy.

The judgment matrix and relative weight of the intermediate factor layer to the target layer show in β .

$$\beta = \begin{bmatrix} 1 & 1/3 & 2/3 \\ 3 & 1 & 2 \\ 2/3 & 1/2 & 1 \end{bmatrix}$$

The maximum eigenvalue of judgment matrix B is 3.001, and its approximate, Then the consistency test was carried out. The consistency index is eigenvector is obtained by:

$$CI = \frac{\lambda - n}{n - 1} \quad (1)$$

$$CR = \frac{CI}{RI} \quad (2)$$

The closer the CI is to 0, the stronger the consistency is. In order to measure the consistency, the random consistency index RI is introduced.

Table 1. the consistency index

n	1	2	3
RI	0	0	0.58
n	4	5	6
RI	0.90	1.12	1.24

When the consistency ratio $CR < 0.1$, the consistency was satisfied and passed the consistency test. The eigenvectors: $V^{(2)} = (0.182, 0.545, 0.273)^T$, $CI=0.005$, $RI=0$, those are obtained from the comparison between factor layer and target layer, which meet the consistency index.

Similarly, the weight of the sub factor layer to the factor layer is calculated and the feature vector is obtained. The weight and eigenvector of the scheme layer to the sub factor layer are obtained. The final results are shown in table2 and table3.

Table 2. Calculation results of sub factor layer to factor layer

$V^{(2)}$	0.182	0.545	0.273
$v_k^{(3)}$	0.1692 0.3874 0.4434	0.2500 0.2500 0.5000	0.5584 0.3196 0.1219
λ_k	3.0180	3.0000	3.0020
CI_k	0.0090	0.0000	0.0010

Table 3. Calculation results of scheme layer to target layer

$V^{(3)}$	0.031	0.070	0.081	0.136	0.136	0.276	0.152	0.087	0.033
$v_k^{(4)}$	0.595 0.277 0.129	0.082 0.236 0.682	0.429 0.429 0.429	0.633 0.193 0.174	0.429 0.166 0.688	0.571 0.286 0.143	0.429 0.429 0.142	0.250 0.250 0.500	0.595 0.276 0.129
λ_k	3.163	3.001	3.889	3.009	3.647	3.001	3.000	3.000	3.003
CI_k	0.082	0.0005	0.445	0.005	0.3235	0.0005	0.000	0.000	0.002

$RI=0.58$ ($n=3$) meets the consistency test, CI_k passes the consistency test, so the relative weight of scheme layer to target layer can be calculated. Through the above calculation, matrix $v^{(4)}$ of 3×9 composed of v_j can be obtained and show in table 3. Then the combined weight of the fourth layer to the first layer is:

$$v^{(4)} = V^{(4)} \times v^{(3)} \quad (3)$$

$$V^{(4)} = \begin{bmatrix} 0.595 & 0.082 & 0.429 & 0.633 & 0.166 & 0.571 & 0.429 & 0.250 & 0.595 \\ 0.277 & 0.236 & 0.429 & 0.193 & 0.166 & 0.286 & 0.429 & 0.250 & 0.277 \\ 0.129 & 0.682 & 0.142 & 0.175 & 0.686 & 0.143 & 0.142 & 0.500 & 0.129 \end{bmatrix}$$

The combination weight of plan 1 is as follows, the combination weight of other site calculation similarly.

$$0.595 \times 0.031 + \dots + 0.595 \times 0.033 = 0.468 \quad (4)$$

With the same calculation method, the combination weight of plan 2 and plan 3 can be obtained. Finally, the combination weight of scheme layer to target layer is:

$$v^{(4)} = (0.468, 0.401, 0.279)^T$$

The score of each alternative point is calculated by the proportion of weight. The scores of the three plans are as follows: 84.364, 83.504, 82.592, the plan 1 is the highest

score. The location is located at site of plan 1, which indicates that it is most appropriate for S express to establish a network here. The comprehensive score of social impact, infrastructure and operating environment of this location is the best, which has relative advantages. It can bring better benefits to add new outlets in this location.

3 Conclusion

The plan of resource saving can be obtained the highest benefit by selecting a network. In other words, the establishment of the network is to achieve the best effect of leasing cost and radiation range in the selected location. In order to ensure the distribution efficiency of the network, this paper does not consider the choice of the lowest cost business place. By further calculating the distance between distribution outlets and demand points, the optimization scheme can be obtained. Cooperation among all distribution outlets will reduce the repeated delivery, and the logistics cost will be further reduced when the logistics center distributes.

In this paper, the use of analytic hierarchy process for

analytic hierarchy process, the factors of the factor layer only consider three aspects of the impact and shortcomings, but the distribution network location environment may be more complex, in the future researches can add more factors, using other methods to improve the feasibility of the research results.

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