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Research on Location Selection of Distribution Center in New Urban Area of Jiuzhou Tong Based on Hierarchical Analysis Method

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Abstract. With the rapid development of the logistics industry, the site selection of distribution centers is increasingly highlighting its importance. The purpose of this paper is to study the site selection problem of the distribution center in the new urban area of Jiuzhou Tong using the hierarchical analysis method (AHP). By constructing a site selection evaluation model, combined with field research and data analysis, the key factors affecting site selection are identified, and the optimal site selection scheme is given. The results of the study show that the AHP-based site selection method can effectively improve the scientificity and rationality of site selection, and provides strong support for the planning and development of the distribution center in the new urban area of Jiuzhou Tong.

Keywords: distribution center; site selection; hierarchical analysis.

1 INTRODUCTION

In foreign countries about the problem of site selection as early as 1909 by the scholar Weber first proposed. At that time, the problem studied was simply the distribution distance of a single warehouse location to the customer. The purpose of the study is to plan the location to minimize the distance and the cost of distribution. Since then, as the scale of the siting problem has been expanding and the complexity of the problem has been increasing, scholars have conducted more in-depth studies to further improve the siting method on Weber's research and select the optimal solution to minimize the logistics cost[1]. Among them, some scholars have proposed the center of gravity method[2], Baumol-Wolfe mixed-integer planning method[3], and so on. Merakl utilized the minimum-maximum criterion of linear mixed integers for the siting problem of hub stations. HuX, HuaX used the improved particle swarm algorithm to establish a mathematical model for the distribution center siting problem, solved the model by the time acceleration factor, and determined the final siting scheme, which provides a reference significance for the siting of logistics and distribution centers.

As a benchmark in the pharmaceutical logistics industry, Jiuzhou Tong, with its modern integrated logistics center and advanced logistics technology, has made

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significant contributions to the construction of logistics networks for private pharmaceutical enterprises and the national pharmaceutical industry. With the strengthening of the national policy to support the pharmaceutical industry and the rapid growth of medical institutions in Hohhot, the new city's demand for medical supplies is increasing. However, the existing distribution centers of Jiuzhou Tong are located in remote areas, with high cost and poor timeliness, which can't meet the distribution needs of the new urban areas, affecting the economic benefits and development speed of the enterprise. Therefore, in order to meet the huge demand for medical resources and commodity distribution in the new city, JZT decided to set up a small logistics and distribution center in the new city to improve the distribution efficiency, reduce cost and time, and enhance the economic efficiency of the enterprise[4].

2 INTRODUCTION TO HIERARCHICAL ANALYSIS (AHP)

The hierarchical analysis method (AHP) is a multi-objective decision analysis method combining qualitative and quantitative, which decomposes a complex decision problem into a number of interrelated factors by constructing a hierarchical structural model[5], and assigns weights according to the importance of each factor, and ultimately arrives at the optimal decision-making solution. AHP has the advantages of systematicity, flexibility and practicality, and therefore has a wide range of applications in site selection problems.

3 CONSTRUCTION OF THE EVALUATION MODEL FOR THE SITE SELECTION OF THE DISTRIBUTION CENTER IN THE NEW URBAN AREA OF JIUZHOU TONG

3.1 Introduction of Alternative Projects

Due to the number of medical institutions in the new city, retail pharmacies covering a wide area, and with the establishment of Jiuzhou Tong obligation to deal with a large base, in order to meet the distribution needs and enhance the economic benefits of the Jiuzhou Tong Company, it is proposed to build a small logistics and distribution center in the new city, through field visits, data research on the feasibility of the project of the logistics and distribution center site selection and necessity of the project after the screening of the three alternative addresses, respectively: Alternative Project A Alternative project A, alternative project B, alternative project C.

3.2 Overview of the Site Selection Program:

Hohhot Jiuzhoutong Company is faced with a site selection decision to establish a distribution center in the new city. Each of the three alternatives, A, B, and C, has its own strengths, and a combination of factors such as transportation, demand, cost, infrastructure, and development potential need to be considered. Project A is conveniently located in the northern part of the new city, close to demand-intensive areas, with low transportation costs, and surrounded by well-developed infrastructure and medical facilities. The price of the land is moderate and suitable for quick return of capital; Project B is located in the transportation hub area of the new city, close to the airport and the railway station, with excellent accessibility, which is conducive to the reduction of transportation costs. It also radiates to a number of universities and residential areas, with high potential demand for pharmaceutical distribution, but high land costs;

Project C is located in the northwestern part of the new city, with convenient transportation, excellent natural environment and stable labor force. It is far from the center of demand, but the low cost of land makes it suitable for long term planning.

In order to avoid the one-sidedness of qualitative analysis, it is proposed to use hierarchical analysis for quantitative decision-making to determine the optimal siting plan by constructing a hierarchical structure, assigning weights and consistency test.

4 MODELING AND SOLVING

4.1 Building a Progressive Hierarchy

Through the detailed introduction of the alternative project, the analysis of the many factors affecting the location of the small distribution center established by Jiuzhou Tong in the new city, and after summarizing them to quantify the location problem, the use of hierarchical analysis will be the location of logistics distribution centers constructed into the following hierarchical hierarchical structure, This is shown in Figure 1:

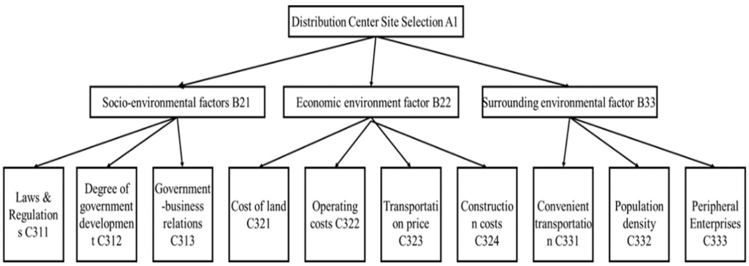

Fig. 1. Site Selection Evaluation Indicator Model

4.2 Ordering of Judgment Matrices

By consulting with the relevant departments of Jiuzhou Tong, we obtained the judgment and opinions of the relevant persons in charge on the importance of the impact indicators, and then, on this basis, we applied the nine-level scoring method, assigned weights to each level, and constructed a judgment matrix.

(1) Target level judgment matrix, This is shown in Table 1:

Table 1. Judgment matrix for the target layer

A1	Socio-environmental factors B21	Economic environment factor B22	Neighborhood factor B23
Socio-environmental factors B21	1	1/3	1/5
Economic environment factor B22	3	1	4
Neighborhood factor B23	5	1/4	1
weights	0.6194	0.2842	0.0964
λ_{max}= 3.0867; consistency ratio: 0.0834 < 0.1; consistency requirements met			

As in Table 1 there are a total of three indicators at the target level: social environmental factors B21, economic environmental factors B22, and neighborhood environmental factors B23, and two-by-two comparisons are given weights based on importance to calculate the number of consistency tests and specific results

(2) Criterion level judgment matrix

There are a total of three indicators in the normative layer: social environmental factors B21, economic environmental factors B22, and peripheral environmental factors B23, which in turn form the target layer. Three judgment matrices were created according to the importance of each factor to the previous layer of factors, as follows:

① The judgment matrix for socio-environmental factors is shown in Table 2:

Table 2. Criterion Level Judgment Matrix

B21	Laws and regulations C311	Degree of government development C312	Business-Government Relations C313
Laws and regulations C311	1	1/2	1/4
Degree of government development C312	2	1	1
Business-Government Relations C313	4	1	1
weights	0.5794	0.2341	0.1865
λ_{max}= 3.0539; consistency ratio: 0.0518 < 0.1; consistency requirements met			

② The judgment matrix of economic environment factors is shown in Table 3:

Table 3. Criterion Level Judgment Matrix

B22	Cost of land C321	Operating costs 322	Transportation price C323	Construction costs C324
Cost of land C321	1	7	5	8
Operating costs 322	1/7	1	2	3
Transportation price C323	1/5	1/2	1	4
Construction costs C324	1/8	1/3	1/4	1
weights	0.6449	0.1601	0.1410	0.0539
λ_{max}= 4.2494; Consistency ratio: 0.0934 < 0.1; Consistency requirements met				

③ The judgment matrix of peripheral environmental factors is shown in Table 4:

Table 4. Criterion Level Judgment Matrix

B23	Convenient transportation C331	Population density C332	Peripheral Enterprises C333
Convenient transportation C331	1	3	6
Population density C332	1/3	1	5
Peripheral Enterprises C333	1/6	1/5	1
weights	0.6270	0.2923	0.0807
λ_{max}= 3.0952; Consistency ratio: 0.0915 < 0.1; Consistency requirements met			

4.3 Program Comparison and Analysis of Results

Based on the conclusions of the above table and the findings of the research on the operations of KCRC, the data and final scores for the three site schemes are shown in Table 5, Table 6 and Table 7:

Table 5. Scores for each level of Scenario A

Tertiary indicators				Secondary indicators			Level 1 indicators
norm	weights	estimation	mark	norm	weights	mark	aggregate score
C311	0.3588	9	3.2292	B21	0.6194	5.31	3.72
C312	0.1450	8	1.1600				
C313	0.1155	8	0.9240				
C321	0.1833	3	0.5499	B22	0.2842	1.26	
C322	0.0455	8	0.3640				
C323	0.0401	6	0.2406				
C324	0.0153	7	0.1071				
C331	0.0605	8	0.4840	B23	0.0964	0.77	
C332	0.0282	8	0.2256				
C333	0.0078	8	0.0624				

Table 6. Scores for each level of Scenario B

Tertiary indicators				Secondary indicators			Level 1 indicators
norm	weights	estimation	mark	norm	weights	mark	aggregate score
C311	0.3588	8	2.8704	B21	0.6194	4.49	3.40
C312	0.1450	8	1.1600				
C313	0.1155	4	0.4620				
C321	0.1833	8	1.4664	B22	0.2842	1.96	
C322	0.0455	5	0.2275				
C323	0.0401	4	0.1604				
C324	0.0153	7	0.1071				
C331	0.0605	8	0.4840	B23	0.0964	0.63	
C332	0.0282	4	0.1128				
C333	0.0078	4	0.0312				

Table 7. Scores by Level for Scenario C

Tertiary indicators				Secondary indicators			Level 1 indicators
norm	weights	estimation	mark	norm	weights	mark	aggregate score
C311	0.3588	4	1.4352	B21	0.6194	2.82	2.21
C312	0.1450	4	0.5800				
C313	0.1155	7	0.8085				
C321	0.1833	5	0.9165	B22	0.2842	1.39	
C322	0.0455	6	0.2730				
C323	0.0401	5	0.2005				
C324	0.0153	7	0.1071				
C331	0.0605	8	0.4840	B23	0.0964	0.71	
C332	0.0282	6	0.1692				
C333	0.0078	7	0.0546				

After comprehensively comparing the various factors affecting site selection through hierarchical analysis, the above table is obtained and it is concluded that among the three alternative addresses A, B and C, alternative address A has the highest score, i.e., it is the optimal site. Alternative addresses B and C are listed second and third.

5 CONCLUSION

This paper discusses the importance of establishing distribution centers in new urban areas based on the pharmaceutical logistics of Jiuzhou Tong. The right distribution center is critical to logistics timeliness and economic efficiency. Through fieldwork and needs analysis, the site selection problem is transformed into a mathematical model using the hierarchical analysis method for quantitative assessment to support corporate decision-making. However, the logistics and distribution system is complex and dynamic, with many influencing factors that are difficult to quantify. Therefore, in-depth study of system factors is needed to improve the judgment matrix and reduce subjective influence. In the future, a combination of decision-making methods should be used to select sites more scientifically and improve the efficiency of logistics and distribution.

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