Analytic Hierarchy Process (ahp) in the Application of Logistics Center Location Selection Process

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ABSTRACT: Under the background of increasingly standardized logistics market and more intense market competition, there are more needs to establish logistics centers with sound logistics functions and improved information network. Choosing a reasonable location is particularly important to build the logistics center. Logistics park location is an important aspect of logistics network as a whole. Introducing the analytic hierarchy process (ahp) in the logistics area, analizing the main factors affecting it first, and then establish alternative evaluation index system, the factors affecting the importance weights, as the basis of the specific scheme selection of evaluation.
KEYWORD: logistics center; The location; Analytic hierarchy process (ahp); Class hierarchy model

1 INTRODUCTION

Logistics center, also known as circulation center, is the stronghold of the organization, cohesion, management, logistics activity. Logistics center is mainly social service oriented, with sound logistics function, perfect information network, large range of radiation, storage and capacity. Reasonable logistics center location is advantageous for the centralized layout and construction of logistics infrastructure, prompting intensive transport and producing scale effect; but also avoiding the result of the development of logistics to bring bad effects to the urban environment, which also can give relief to traffic of the city. Logistics center location selection firstly has to clear the necessity of establishing logistics center, purpose and meaning. Its program includes collecting data, analyzing main volume cost and other influence factors on the results of the calculation, which finally balance from the overall (Ben-Tal A et al, 2004).

2 THE SELECTION OF LOGISTICS CENTER LOCATION

2.1 *The principle of logistics center location selection.*

The selection of logistics center location has a variety of methods, including two categories, qualitative analysis and quantitative calculation. No matter what method, first of all, it has to obey four principles: the adaptability, coordination, economy and strategic. Perishable product requires and rapid transport for many times, should have more better to sex, so need to near market distribution, it is to some extent in the distribution of the product distribution center; Next to the railway arteries; Logistics area gathered in consumption. How to choose the logistics center address, lies in the construction of logistics center USES and purposes. The demand of the market as the basis, the construction of local logistics center according to the actual situation of logistics demand, so as not to no one in, after the completion of the field without the city.

2.2 *The influence factors of logistics center location.*

Along with the development of modern logistics and mature, people have got consensus about that there are many factors when people choose the logistics center location. According to the purpose and the function of the logistics center site and evaluation of the scientific, practicability, effectiveness along with the combination of the quantitative and qualitative analysis, the factors can be summarized as the following four main aspects: the social benefit, economic benefit, technical benefit and environment benefit (Xu Jie et al, 2010).

2.3 *The overview of the method of logistics center location selection.*

Considering the fundamental principles of logistics center location and influence factors, you can select a location in the following ways.

(1) the method of coordinate analysis. (2) to solve the transport model. (3) the scheme of comparison.

3 APPLICATION OF ANALYTIC HIERARCHY PROCESS IN LOGISTICS CENTER LOCATION

3.1 *Overview of the analytic hierarchy process (ahp).*

Many evaluation problems of evaluation object properties are diversity, complex and difficult to use quantitative methods to evaluate, besides, it is hard to do evaluation projects with a single hierarchy. Then you need to first establish a multi-factor and multi-level evaluation system, use the combination of qualitative and quantitative methods, and make the evaluation of complex question. In such cases, the operations researcher, a professor at the university of Pittsburgh t. l. saadi (t. l. Satty) puts forward the famous idea of AHP method in the 1970 s (Wang Yingluo, 2008).

3.2 *The basic ideas of the analytic hierarchy process and implementation steps.*

The Analytic hierarchy process (AHP) break down the complex problems into individual elements and group these factors according to the dominance so that they can form a hierarchical structure. Through comparing the two ways to determine the relative importance of various factors in the hierarchy, and then integrated relevant personnel judgments. Thus, the alternative options can be sorted by their importance.

The application of analytic hierarchy process can be generally divided into four steps.

(1) Analyze the relationship between the basic factors and establish the hierarchical structure of the system.

(2) About each element of the same level on a hierarchy of the importance of a certain criterion are compared, and two constructs two comparative judgment matrix, consistency.

(3) Calculated by the judgment matrix elements being compared to the relative weights of the rule.

(4) Calculate each layer element relative system synthesis weights of overall goal, and sort all the alternatives.

3.3 *The program as a model of hierarchy analysis method of logistics center location*

3.3.1 *Build hierarchy mode.*

AHP evaluation of logistics center location in the hierarchical model, target layer as "choose the optimal logistics center address" criterion as "factors determining the effect of logistics center location", the content in this article to social, economic, technical and environmental benefits are in four aspects: Residents in the city and ease the traffic pressure, influence of degree of saturation, access roads, public equipment; close to the consumer market, low transport costs, low price location; fully functional level, functional reliability, and close to the freight hub; atmospheric pollution and the effects on the ecological landscape. These factors can be constructed as independent of the elements of the rule layer guidelines, criterion elements and guidelines can be passed between the various elements and functional dependencies. Address selection limited to P1, P2, and P3 3 programmer, through anarchically hierarchy process to get the best program.

In selection of the logistics center location, target layer is infected by four decision-making factors. Besides, the influence of the social benefit, economic benefit, technical benefit and environment benefit are respectively impacted by their own decision-making factors. By comparing the relative importance between the last level's factors and this level's factor, people can construct the judgment matrix. In

Four aspects of the criteria levels for target Fcan obtain judgement matrix:

Similarly, we know that next-level criterion M and the related factors of guidelines S between the judgment matrixes is:

$$A_{S_1-M}=\begin{bmatrix}1&\frac{1}{7}&\frac{1}{3}&\frac{1}{5}\\7&1&5&2\\3&\frac{1}{5}&1&\frac{1}{3}\\5&\frac{1}{2}&3&1\end{bmatrix}\quad A_{S_2-M}=\begin{bmatrix}1&\frac{1}{5}&\frac{1}{3}\\5&1&3\\3&\frac{1}{3}&1\end{bmatrix}\quad A_{S_3-M}=\begin{bmatrix}1&\frac{1}{3}&2\\3&1&5\\\frac{1}{2}&\frac{1}{5}&1\end{bmatrix}\quad A_{S_4-M}=\begin{bmatrix}1&3\\\frac{1}{3}&1\end{bmatrix}$$

The comparison matrix between Program p and the criterion M's factors are:

$$A_{M_1-P}=\begin{bmatrix}1&\frac{1}{3}&\frac{1}{5}\\3&1&\frac{1}{3}\\5&3&1\end{bmatrix}\quad A_{M_2-P}=\begin{bmatrix}1&5&8\\\frac{1}{5}&1&5\\\frac{1}{8}&\frac{1}{5}&1\end{bmatrix}\quad A_{M_3-P}=\begin{bmatrix}1&2&7\\\frac{1}{2}&1&5\\\frac{1}{7}&\frac{1}{5}&1\end{bmatrix}\quad A_{M_4-P}=\begin{bmatrix}1&1&5\\1&1&5\\\frac{1}{5}&\frac{1}{5}&1\end{bmatrix}$$

$$A_{M_5-P}=\begin{bmatrix}1&3&\frac{1}{7}\\\frac{1}{3}&1&\frac{1}{9}\\7&9&1\end{bmatrix}\quad A_{M_6-P}=\begin{bmatrix}1&2&7\\\frac{1}{2}&1&6\\\frac{1}{7}&\frac{1}{6}&1\end{bmatrix}\quad A_{M_7-P}=\begin{bmatrix}1&\frac{1}{4}&\frac{1}{2}\\4&1&3\\2&\frac{1}{3}&1\end{bmatrix}\quad A_{M_8-P}=\begin{bmatrix}1&\frac{1}{3}&5\\3&1&7\\\frac{1}{5}&\frac{1}{7}&1\end{bmatrix}$$

$$A_{M_9-P}=\begin{bmatrix}1&\frac{1}{4}&\frac{1}{5}\\4&1&\frac{1}{2}\\5&2&1\end{bmatrix}\quad A_{M_{10}-P}=\begin{bmatrix}1&7&9\\\frac{1}{7}&1&5\\\frac{1}{9}&\frac{1}{5}&1\end{bmatrix}\quad A_{M_{11}-P}=\begin{bmatrix}1&1&7\\1&1&7\\\frac{1}{7}&\frac{1}{7}&1\end{bmatrix}\quad A_{M_{12}-P}=\begin{bmatrix}1&3&\frac{1}{5}\\\frac{1}{3}&1&1\\5&1&1\end{bmatrix}$$

3.3.2 *Calculation of weights.*

According to matrix A_{F-S}, then according to formula $\omega_i=\sum_{j=1}^{n}a_{ij}/\sum_{i=1}^{n}\sum_{j=1}^{n}a_{ij}$, calculate the normal-

ized eigenvectors which is $\lambda\max = \frac{1}{n}\sum_{i=1}^{n}\frac{\sum_{j=1}^{n} a_{ij}\omega_j}{\omega_i} = 4.175$ corresponded $\omega = [0.577, 0.115, 0.193, 0.115]^T$, then calculate the largest eigenvalue. Similarly, conclude each of the four judgment matrix of eigenvectors and the maximum eigenvalue: A_{S_1-M}、A_{S_2-M}、A_{S_3-M}、A_{S_4-M} Four eigenvectors of matrix and maximum eigenvalue:

$\omega = [0.057, 0.523, 0.121, 0.299]^T$ $\lambda\max = 4.068$ $\omega = [0.105, 0.637, 0.258]^T$ $\lambda\max = 3.039$
$\omega = [0.230, 0.648, 0.122]^T$ $\lambda\max = 3.004$ $\omega = [0.750, 0.250]^T$ $\lambda\max = 2$

Similarly, A_{M_1-P}、A_{M_2-P}、A_{M_3-P}、A_{M_4-P}、A_{M_5-P}、A_{M_6-P}、A_{M_7-P}、A_{M_8-P}、A_{M_9-P}、$A_{M_{10}-P}$、$A_{M_{11}-P}$、$A_{M_{12}-P}$ 12 to determine the eigenvectors of the matrix is:

$\omega = [0.105, 0.258, 0.637]^T$ $\omega = [0.73, 0.21, 0.06]^T$ $\omega = [0.592, 0.333, 0.075]^T$ $\omega = [0.46, 0.46, 0.09]^T$
$\omega = [0.149, 0.066, 0.785]^T$ $\omega = [0.69, 0.25, 0.06]^T$ $\omega = [0.14, 0.62, 0.24]^T$ $\omega = [0.28, 0.65, 0.07]^T$
$\omega = [0.10, 0.32, 0.58]^T$ $\omega = [0.80, 0.15, 0.05]^T$ $\omega = [0.47, 047, 0.06]^T$ $\omega = [0.14, 0.62, 0.24]^T$

Relative significance of the factor weights once or is the element relative to the top of the class on the class of an element in a degree of normalization after the dominant, more weight, more dominant (Wang Jian et al, 2007).

3.3.3 *Consistency check*

(1) After getting the maximum characteristic value and the characteristic vector, people also need to check the consistency of the judgment matrix.

(2) Consistency index $C.I.$

$$C.I. = \frac{\lambda\max - n}{n-1}$$

(3) The mean random consistency index $R.I.$ The mean random consistency index shown in the table 1.

Table 1 from 1 to 12 of a positive reciprocal matrix mean random consistency index

n	1	2	3	4	5	6	7	8	9	10	11	12
R. I.	0	0	0. 52	0. 89	1. 12	1. 36	1. 41	1. 41	1. 46	1. 49	1. 52	1. 54

(4) Calculate the consistency

$C.R. = \frac{C.I.}{R.I.}$ ($C.R. < 0.1$, the consistency of the judgment matrix is acceptable, otherwise modify the matrix so that it meets the requirement for consistency.)

A_{F-M} $C.I. = \frac{\lambda\max - n}{n-1} = \frac{4.175-4}{4-1} = 0.058$ $C.R. = \frac{C.I.}{R.I.} = \frac{0.058}{0.89} = 0.066$ A_{S_1-M} $C.I. = 0.023$ $C.R. = 0.026$
A_{S_2-M} $C.I. = 0.019$ $C.R. = 0.033$ A_{S_3-M} $C.I. = 0.002$ $C.R. = 0.003$ A_{S_4-M} $C.I. = 0$ $C.R. = 0$

According to A_{F-S} and the eigenvectors of A_{S_1-M}、A_{S_2-M}、A_{S_3-M}、A_{S_4-M} can get guidelines on the target layer of synthetic priority vector of f is:

$\omega = [0.033, 0.302, 0.070, 0.173, 0.012, 0.073, 0.030, 0.044, 0.125, 0.024, 0.086, 0.030]T$

According to and the eigenvectors of A_{F-M}, Programme-p can be obtained on the A_{M_1-P}、A_{M_2-P}、A_{M_3-P}、A_{M_4-P}、A_{M_5-P}、A_{M_6-P}、A_{M_7-P}、A_{M_8-P}、A_{M_9-P}、$A_{M_{10}-P}$、$A_{M_{11}-P}$、$A_{M_{12}-P}$ target layer of synthetic priority vector of f is: $\omega = [0.490, 0.344, 0.170]^T$

Based on eigenvector can be on the objectives of the programme the ranking vector of f is: Test result: the proportion of three minimum, programme the largest proportion, followed by programme II. Logistics Center location selection is better.

4 CONCLUSION

Choosing the address of Logistics Park, people should measure and analysis things on the whole. They should not only consider the macroscopic aspect, but also considerate the microscopic aspect. Then they can make the decision. To some places, the services of the local logistics park should be considered with other logistics nodes so that people can achieve good coordination to form a whole. Regarding the short of transportation or low cost factors as the basic principle, people adopt the method of quantitative analysis of the selected address. It can make the complex decision problems clear, and can also evaluate and choose the best location decision more easily and accurately. Thus, people can make a good foundation to play the efficiency of Logistics Park better and faster.

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