Research on Logistics Distribution Center Location Model and Evaluation Under Electronic Commerce

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Abstract

Modern logistics combines transportation, storage, loading and unloading, handling, carrying, packaging, processing, distribution, freight forwarders, information industry and socialized production of new services together, the development of economies scale and the reduction of transportation cost makes people pay attention to logistics distribution center gradually. Location of logistics distribution center plays a very important position in the logistics system, belongs to the logistics management strategy layer. In this paper, we investigate the multiple attribute decision making problems for evaluating the logistics distribution center location model with 2-tuple linguistic information. We extended the TOPSIS model to solve the evaluation problems of the logistics distribution center location model with 2-tuple linguistic information. Finally, a numerical example for evaluating the logistics distribution center location model with 2-tuple linguistic information is used to illustrate the applicability and effectiveness of the proposed model.

Keywords: Multiple Attribute Decision Making, TOPSIS, Linguistic Information, Logistics Distribution Center Location

1. Introduction

In the recent years, With the development of economics, science and technology, logistics becomes more and more important place and it takes our attention gradually, so that a country physical logistics integrated development level became judges one of its national synthesis strength symbols. With the developments of the social economic, the rhythm of people’s work is hastened. People’s demands for fresh frozen foods are growing. The retail merchant in order to raise its service level, increasingly also have high requests to the city cold chain logistics centre business, logistics centre development becomes restricts Our country logistics Enterprise how to design and reconstruct enterprise’s distribution system and enhance the distribution efficiency. The critical question is the problem of logistics distribution center location. The logistics distribution center location decided the entire distribution system pattern and the structure, defined the distribution system operation, selected method and related cost. Therefore the research construction of minimum-cost mathematics model has the important theory and practice significance. The existed paper summarizes the related research theory of the location of logistics center. The paper are planned to analyze the developmental situation in the cold chain and point out the problems in the development of China’s cold chain in theoretical and practical way. The paper established the model of cold chain distribution center location in a qualitative and quantitative way according to the commodity distributed. This existed paper summarized and reviews the literature of location of distribution centre, introduced the domestic and foreign development present situation and the method which used; analyzes the system of cold chain, summarized the basic theory, the basic method and the basic model on location of distribution centre and discuses the influence factor of the cold chain logistics distribution centre location. Then, discusses the procedure model of the cold chain location of distribution centre master the process and procedure of the cold chain logistics distribution centre location Then establishes a comprehensive cost optimization model for this distribution system under the restriction of service levels about cold chain and bring forward the arithmetic, mixed genetic algorithm to the model established. Finally through the analysis and the computation of the concrete example has proven the rationality and the feasibility of the model. The research conclusion of this paper may provide the cold chain logistics enterprise the reference of the pursuit of the minimum allocation overall cost on the basis of selecting location for the cold chain distribution, which has the good application value.
economic globalization, logistics modernization is developing rapidly. Modern logistics is generally paid close attention to as "the third profit source", and becomes the new point of growth of modern economy. During the process of moving towards the economic globalization and informationization, our country make developing logistics economy as the important insurance factor of accelerating economic development, adjusting the industrial structure, improving quality and benefit of economic running. Rational selection of the distribution center location not only can shorten the distribution distance, improve the distribution speed, reduce the distribution cost, but also can promote the organic coordination and cooperate of two kinds of flow of production and consumption and make the overall logistics system in the balance state. Because distribution center is in the important position of logistics system, a lot of scientific research personnel have carried on work to this problem and built a series of models and arithmetic in the recent years. However this arithmetic has its limitation. In allusion to this situation, this existed papers studies this problem deeply by using spatial analysis method of WebGIS. Firstly, this paper illustrates the basic problem: the conceptions of logistics; function and operational system of distribution center; principle, influence factors, procedure, steps of the selection of distribution center, and analyses the existed method of distribution center location selection. The introduction of these problems establishes the research basis of the study in this paper. Secondly, on the basis of analyzing the current research situation both at home and abroad this paper proposes the method based on the spatial analysis method of WebGIS[11-14]. According to the difference of the nature of influence factors, this existed paper divides the influence factors into spatial character and non-spatial character, and accordingly divides the procedure of distribution center location selection into two steps to deal with these two kinds of influence factors respectively, that to say, overlap analysis is used to deal with spatial influence factors, and network analysis is used to deal with non-spatial influence factors. Through building mathematic model this paper determine the quantity and location of distribution center, as well as relationship between supplying and demand, and meanwhile real data is used to validate this model, in order to prove its correctness and feasibility. Thirdly, the optimized allocation for single logistics center is the central study of this existed thesis. Based on the analysis and evaluation of general allocation approaches, the means of integrating continuous and discrete methods is brought forward. The allocation model covers factors such as land price, traffic resistance and competition ingredient. Finally, the maximum benefit is the objective function of the model that is solved by genetic algorithm. Then, the spare spots are determined, and the actual spot for building is determined by using the theory of grid cell plus analysis. Using the method of the logistics distribution center site, this paper illustrates the operating flow of the way by the example of WEIFANG Merchandise Corporations, Ltd. There is not any difference between the reality and the result of the method of the existed paper. So, our method is right and feasible[15-16].

The aim of this paper is to investigate the multiple attribute decision making problems for logistics distribution center location with 2-tuple linguistic information[17-20]. We extended the TOPSIS model to solve the logistics distribution center location with 2-tuple linguistic information. According to the traditional ideas of TOPSIS, the optimal alternative(s) is determined by calculating the shortest distance from the 2-tuple linguistic positive ideal solution (TLPIS) and on the other side the farthest distance of the 2-tuple linguistic negative ideal solution (TLNIS). Finally, a numerical example for logistics distribution center location model with 2-tuple linguistic information is used to illustrate the applicability and effectiveness of the proposed model.

2. Research on Logistics Distribution Center Location Model and Evaluation Under Electronic Commerce

With the agricultural production and the circulation increasing year by year, our society has putting forward higher request safety and quality of agricultural products after national agricultural structure adjustment. According to the national development policy of agricultural products, it’s extremely important to speed up the development of agricultural logistics and promote sustained increase in rural incomes and safeguard consumer safety. The location of logistics distribution center plays a crucial role in improving logistics status and controlling the logistics distribution cost in the modern logistics theory. It is to say, the reasonable location is one of the main reasons that could reduce the distribution’s costs. With the optimization of logistics distribution center, it’s easier to improve the efficiency and make the cycle of equipment operation short. During operation in distribution system of
agricultural products, optimized logistics distribution center plays a decisive role in completing
governmental outbound and inbounding, replenishment joint operations. Let \( A = \{ A_1, A_2, \cdots, A_m \} \) be
a discrete set of alternatives, and \( G = \{ G_1, G_2, \cdots, G_n \} \) be the set of attributes, \( w = (w_1, w_2, \cdots, w_n) \)
is the weighting vector of the attributes \( G_j \) \( (j = 1, 2, \cdots, n) \), where \( w_j \in [0, 1] \), \( \sum_{j=1}^{n} w_j = 1 \). Suppose
that \( \tilde{R} = (\tilde{r}_{ij})_{mn} \) is the decision matrix, where \( \tilde{r}_{ij} \in \tilde{S} \) is a preference value, which takes the form
of linguistic variables, for the alternative \( A_i \in A \) with respect to the attribute \( G_j \in G \).

In the following, we will extend the TOPSIS method to solve multiple attribute decision making
problems for the logistics distribution center location with 2-tuple linguistic information.

Step 1. Transforming linguistic decision matrix \( \tilde{R} = (\tilde{r}_{ij})_{mn} \) into 2-tuple linguistic decision matrix
\( \tilde{R} = (\tilde{r}_{ij}, 0)_{mn} \).

Step 2. Defining the TLPIS and TLNIS as
\[
\left( r^+, a^+ \right) = \left( (s_1, 0), (s_2, 0), \cdots, (s_j, 0) \right) \quad (1)
\]
\[
\left( r^-, a^- \right) = \left( (s_p, 0), (s_q, 0), \cdots, (s_s, 0) \right) \quad (2)
\]

Step 3. Calculating the distances of each power supply control system design from TLPIS and TLNIS
using the following equation, respectively:
\[
\left( \xi^+_i, \eta^+_i \right) = \Delta \left( w_j \sum_{j=1}^{n} \frac{\Delta^{-1}(r_{ij}, a_j) - \Delta^{-1}(r^+_j, a^+_j)}{t} \right) \quad (3)
\]
\[
\left( \xi^-_i, \eta^-_i \right) = \Delta \left( w_j \sum_{j=1}^{n} \frac{\Delta^{-1}(r_{ij}, a_j) - \Delta^{-1}(r^-_j, a^-_j)}{t} \right) \quad (4)
\]

Step 4. Calculating the relative closeness degree of each power supply control system design from
TLPIS using the following equation
\[
\left( \xi_i, \eta_i \right) = \Delta \left( \Delta^{-1}\left( \xi^+_i, \eta^+_i \right) \right) / \left( \Delta^{-1}\left( \xi^-_i, \eta^-_i \right) + \Delta^{-1}\left( \xi^+_i, \eta^+_i \right) \right), i = 1, 2, \cdots, m. \quad (5)
\]

Step 5. According to the relative closeness degree \( \left( \xi_i, \eta_i \right) \), the ranking order of all alternatives can be
determined. If any alternative has the highest \( \left( \xi_i, \eta_i \right) \) value, then, it is the most desirable alternative.
3. Illustrative example

Modern logistics combines transportation, storage, loading and unloading, handling, carrying, packaging, processing, distribution, freight forwarders, information industry and socialized production of new services together, the development of economies scale and the reduction of transportation cost makes people pay attention to logistics distribution center gradually. Location of logistics distribution center plays a very important position in the logistics system, belongs to the logistics management strategy layer. Through referring to the references and the actual research, we select the factors from the qualitative and quantitative two aspects influenced the location of logistics distribution center, constructs the model of location of logistics distribution center, and expounds the basic process of combing structure model. Finally using the basic process of applied example to verify the above process, and verifies the validity and scientific process, prospects the location of logistics distribution center of future research and development. In this section, we present an empirical case study of logistics distribution center location with linguistic information. There is a panel with five possible logistics distribution centers \( A_i (i = 1, 2, 3, 4, 5) \) to select. The team of experts must take a decision according to the following four attributes: 

1. \( G_1 \) is the functionality and reliability;
2. \( G_2 \) is the regulation period length;
3. \( G_3 \) is the complementarities of quality of power supply attributes;
4. \( G_4 \) is the maintainability and transferability.

The five possible logistics distribution centers \( A_i (i = 1, 2, \cdots, 5) \) are to be evaluated using the linguistic term set

\[
S = \{ s_0 = \text{extremely poor}, s_1 = \text{very poor}, s_2 = \text{poor}, s_3 = \text{medium},
    s_4 = \text{good}, s_5 = \text{very good}, s_6 = \text{extremely good} \}
\]

by the decision maker under the above four attributes, as listed in the following matrix.

\[
R = \begin{bmatrix}
A_1 & s_4 & s_5 & s_4 & s_5 \\
A_2 & s_2 & s_3 & s_5 & s_3 \\
A_3 & s_6 & s_2 & s_6 & s_1 \\
A_4 & s_1 & s_4 & s_3 & s_6 \\
A_5 & s_4 & s_6 & s_4 & s_5 \\
\end{bmatrix}
\]

and \( w = (0.2, 0.4, 0.25, 0.15) \) is the weighting vector of the attributes \( G_j (j = 1, 2, 3, 4) \).

In the following, in order to get the most desirable logistics distribution centers, we shall extend the TOPSIS method to solve multiple attribute decision making problems for logistics distribution center with 2-tuple linguistic information.

**Step 1.** Transforming linguistic decision matrix \( \tilde{R} = (r_{ij})_{m \times n} \) into 2-tuple linguistic decision matrix \( \tilde{R} = (r_{ij}, 0)_{m \times n} \).
Step 2. Defining the TLPIS and TLNIS as

\[
\begin{align*}
T^+ &= (s_1,0),(s_6,0),(s_0,0),(s_0,0) \\
T^- &= (s_0,0),(s_0,0),(s_6,0),(s_0,0)
\end{align*}
\]

Step 3. Calculating the distances of each logistics distribution centers from TLPIS and TLNIS

\[
\begin{align*}
(\xi_1, \eta_1) &= (s_1, -0.12), (\xi_2, \eta_2) = (s_1, -0.25) \\
(\xi_3, \eta_3) &= (s_1, -0.33), (\xi_4, \eta_4) = (s_1, 0.36) \\
(\xi_5, \eta_5) &= (s_0, 0.36), (\xi_6, \eta_6) = (s_1, -0.18) \\
(\xi_7, \eta_7) &= (s_1, -0.35), (\xi_8, \eta_8) = (s_1, -0.32) \\
(\xi_9, \eta_9) &= (s_0, 0.48), (\xi_{10}, \eta_{10}) = (s_0, 0.41)
\end{align*}
\]

Step 4. Calculating the relative closeness degree of logistics distribution centers from TLPIS

\[
\begin{align*}
(\bar{\xi}_1, \bar{\eta}_1) &= (s_1, -0.34), (\bar{\xi}_2, \bar{\eta}_2) = (s_1, -0.31) \\
(\bar{\xi}_3, \bar{\eta}_3) &= (s_1, -0.42), (\bar{\xi}_4, \bar{\eta}_4) = (s_1, 0.20) \\
(\bar{\xi}_5, \bar{\eta}_5) &= (s_1, -0.36)
\end{align*}
\]

Step 5. Ranking all the logistics distribution centers \(A_i (i = 1, 2, \cdots, 5)\) in accordance with the relative closeness degree \((\bar{\xi}_i, \bar{\eta}_i): A_4 > A_2 > A_1 > A_5 > A_3\), and thus the most desirable logistics distribution centers is \(A_4\).

4. Conclusions

Modern logistics combines transportation, storage, loading and unloading, handling, carrying, packaging, processing, distribution, freight forwarders, information industry and socialized production of new services together, the development of economies scale and the reduction of transportation cost makes people pay attention to logistics distribution center gradually. Location of logistics distribution center plays a very important position in the logistics system, belongs to the logistics management strategy layer. At the end of the 20th century, with the development of science and enhancement of the trend of economic globalization, logistics modernization is developing rapidly. Modern logistics is generally paid close attention to as "the third profit source", and becomes the new point of growth of
modern economy. During the process of moving towards the economic globalization and informationization, our country make developing logistics economy as the important insurance factor of accelerating economic development, adjusting the industrial structure, improving quality and benefit of economic running. In this paper, we investigate the multiple attribute decision making problems for evaluating the logistics distribution center location model with 2-tuple linguistic information. We extended the TOPSIS model to solve the evaluation problems of the logistics distribution center location model with 2-tuple linguistic information. Finally, a numerical example for evaluating the logistics distribution center location model with 2-tuple linguistic information is used to illustrate the applicability and effectiveness of the proposed model.

5. References


