Container Multimodal Transport Channel In Shandong District Path Evaluation and Optimization

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Abstract. In order to optimize the container multimodal transport in Shandong district, researching for the development of container multimodal transport channel in Shandong district is starting from the model method of reasonable selection of transport path, it used hierarchy analysis method to evaluate the container multimodal transport channel in Shandong district, it studied to determine the optimal path of container multimodal transportation, it is establishing path evaluation and system of container multimodal transport channel in Shandong district.

Introduction

Container multimodal transport channel is gradually formed on the premise of the development of container intermodal transportation, container multimodal transport channel is in a certain geographical area where a variety of modes of transportation is available. How to choose the suitable way to determine the optimal path of container intermodal transportation and set up the path evaluation and system in Shandong district of container multimodal transport channel become the key of the research.

To Establish Evaluation Index System of Container Multimodal Transport Channel Path

It evaluates the channel conditions in the perspective of macroscopic. Setting up the index system is considering both social satisfaction and the owner satisfaction. The index are goods freight level, the duration of cargo transportation, the flexibility of the cargo transport, the security of the cargo transport, the owner preference, the rational use of resources, environmental protection degree of the path, opportunities to increase employment, the influence of impact on the comprehensive transportation system. Through the investigation and study, a large number of facts in the nine indicators of the index system, the first five indicators is most concerned problems in the process of container transport for the owner of the goods, it is the direct impact on the owner to choose path. The remaining four indicators from the state's overall interests as a starting point, to constraints of path selection, which can achieve the best environmental protection container transport, the most effective resource utilization, it needs relevant policies to achieve two indicators of container cargo for owners to choose path constraint.

The Model and Steps of Channel Routing Method

The AHP is used to calculate each index weight.AHP to calculate the index weight method is as follows: Structure judgment matrix. This is the key step in the AHP.

It uses three scale judgment instead of the original judgment which is difficult to give exactly nine scale to construct comparison matrix C.

$$Cij \begin{cases} 0 = i \text{ more important than } j \\ 1 = i, j \text{ are equally important} \\ 2 = j \text{ more important than } i \end{cases} \tag{1}$$

Calculate the importance ranking index of each element:

$$ri = \sum_{i=1}^{n} cij, (i = 1,2,3,...n)$$, take $r\max = \max\{ri\}$, $r\min = \min\{ri\}$ $\tag{2}$

Calculate the elements of the judgement matrix

$$b_{ij} = \begin{cases} \dfrac{r_i - r_j}{r_{\max} - r_{\min}}(b_m - 1) + 1, \text{when } r_i \le r_j \\ 1, \text{when } r_{\max} = r_{\min} \\ \left[\dfrac{r_i - r_j}{r\max - r\min}(b_m - 1) + 1\right]^{-1}, \text{when } r_i > r_j \end{cases} \tag{3}$$

take $b_m = r_{\max} / r_{\min}$

Calculating the characteristic vector of judgment matrix

It uses the root mean square method to calculated the approximate results:

$$\overline{wi} = \sqrt[n]{\sum_{j=1}^{n} bij}, i = 1,2,......,n \tag{4}$$

Take $\overline{wi}$ normalization:

$$\overline{w} = \frac{\overline{wi}}{\sum_{i=1}^{n} \overline{wi}}, i = 1,2,......,n \tag{5}$$

Obtain $\overline{w} = (w1, w2, ..., wn)^T$, that is the approximate value of the eigenvector, which is the relative weight of each factor.

Calculate the maximum eigenvalue of a matrix $\lambda_{\max}$:

$$\lambda_{\max} = \sum_{i=1}^{n} \frac{(A\overline{w})_i}{n\overline{w_i}} \tag{6}$$

$(A\overline{w})_i$ is the first i elements for vector Aw. Consistency test of judgment matrix

$$C.I = \frac{\lambda_{\max} - n}{n - 1} \tag{7}$$

The consistency of judgement matrix of n, the greater the judgment is the worse, so bring in modification value $R.I$, and taking

$$C.R = \frac{C.I}{R.I}$$

(8)

Container Multimodal Transport Channel Path Evaluation in Shandong District

Shandong regional economic development is rapid, in the process of container transportation, international container transportation proportion is larger, and the exit channel is varied, this article selects several channel as evaluation objects, including Yangtze sea route, the pearl river delta sea route, the northern gulf sea route, and the new Eurasian continental bridge. Due to Rotterdam is another terminal of the new Eurasian continental bridge, it is considering the direction of channel and the principle of load and water balance, it selects the Rotterdam port of final points for each path.

Multimodal Transport Route Choice Analysis of Shandong and Surrounding Areas to Rotterdam Which in Europe

Path one: Shandong around---Shandong---Shanghai~~~Rotterdam
Path two: Shandong around---Shandong===Shanghai~~~Rotterdam
Path three: Shandong around---Shandong≈ ≈ ≈Shanghai~~~Rotterdam
Path four: Shandong around---Shandong---Shenzhen~~~Rotterdam
Path five: Shandong around----Shandong= = =Shenzhen~~~Rotterdam
Path six: Shandong around---Shandong ---The bohai sea~~~ Rotterdam
Path seven: Shandong around---Shandong=== The bohai sea~~~Rotterdam
Path eight: Shandong around ---Shandong = = =Alataw Pass ~ ~ ~ Rotterdam

   Among them:~ ~ ~ for overseas shipping, ≈ ≈ ≈ for inland water transport , = = = for railway transportation, --- for road transport.

The Path Condition Basic Data

It considering 1 TEU container the path optimization from Shandong to Rotterdam, each road are including inland transportation stage (including port and dock stagnation, loading and unloading cost and time) and the phase of maritime transport.

   Take the yuan against the dollar to 6.8, total freight and total time of the path as shown in table 1.

Table1 Route total transport costs, time

	Cost (RMB)	Total shipping time(days)
Path one	17366	29.5
Path two	16627	30.2
Path three	15780	32
Path four	16871	27.3
Path five	16010	27.9
Path six	15476	30.4
Path seven	15143	30.6
Path eight	34826	19.5

Calculation Process and Results

Quantifies the Qualitative Indexes

Based on the data rate method, combined with the specific situation in shandong, please industry experts scoring for the convenience of each path, security, resource reasonable degree, and environmental protection, the scores as shown in table 2.

Table 2 Evaluation of qualitative indicators

	Flexibility	Security	The owner preference	The rational use of resources	Environmental protection degree	Employment opportunities	The impact on the traffic
Path one	9	6	8	7	8	8	6
Path two	7	9	7	8	7	9	7
Path three	8	8	9	9	9	7	8
Path four	8	6	6	7	7	6	7
Path five	7	7	5	7	7	6	8
Path six	8	7	6	9	7	5	6
Path seven	7	9	8	8	8	6	7
Path eight	9	9	7	9	6	5	8

Calculate Each Index Weight

AHP is used to calculate transportation cost, shipping time, convenience, security, and owner's preference for the weight of the owner's satisfaction, for consistency check. According to the formula (1) the following comparison matrix table 3.

Table 3 Comparison matrix owner satisfaction qualitative index weight

	Transportation costs	Transportation time	Flexibility	Security	The owner preference
Transportation costs	1	2	2	2	2
Transportation time	0	1	2	2	2
Flexibility	0	0	1	1	2
Security	0	0	1	1	2
The owner preference	0	0	0	0	1

Using the formula (2) (3), the judgment matrix table 4 below.

Table 4 The owner satisfaction qualitative index weight judgment matrix

	Transportation costs	Transportation time	Flexibility	Security	The owner preference
Transportation costs	1	3	6	6	9
Transportation time	1/3	1	4	4	7
Flexibility	1/6	1/4	1	1	4
Security	1/6	1/4	1	1	4
he owner preference	1/9	1/9	1/4	1/4	1

According to the formula (4) (5), we can calculate(0.248, 0.228, 0.248, 0.228, 0.146) is the feature vector approximation, this also is transportation cost, transportation time, convenience and safety for the relative weight of customer satisfaction.

Remember to A1 = (0.248, 0.28, 0.248, 0.28, 0.1460), according to the formula(6), $\lambda_{max} = 5.059$

According to the formula (7) (8) and table 4.1 to CR = 0.013 < 0.1, satisfy the consistency check.

In the same way, to calculate the impact of rational use of resources, environmental protection, employment opportunities, integrated transport system on social satisfaction. Using the comparison matrix, judgment matrix is calculated (0.30, 0.30, 0.23, 0.30) for feature vector approximation, this also is the degree of reasonable utilization of resources, environmental protection, employment opportunities, the influence of the comprehensive transportation system to the weight of social satisfaction. Remember to A2 = (0.30, 0.30, 0.23, 0.30)

$\lambda_{max} = 4.026$ CR = 0.009 < 0.009, satisfy consistency check.

Assuming that the owner's satisfaction and social satisfaction are weights of the total target (0.7, 0.3) , record as A = (0.7, 0.7)

The fuzzy synthesis is carried out by using the formula (2.3). The calculation results are as follows:

$$B1 = A1 \times R1 = |0.590 \quad 0.540 \quad 0.559 \quad 0.517 \quad 0.508 \quad 0.545 \quad 0.579 \quad 0.525|$$

$$B2 = A2 \times R2 = |0.537 \quad 0.538 \quad 0.554 \quad 0.470 \quad 0.457 \quad 0.504 \quad 0.510 \quad 0.457|$$

$$B = A \times R = |0.574 \quad 0.540 \quad 0.557 \quad 0.503 \quad 0.493 \quad 0.533 \quad 0.558 \quad 0.504|$$

As can be seen from the results, the comprehensive evaluation of the eight paths are arranged as follows: the path one, path seven, path three, path two, path six , path eight, path four, path five. The optimal path is path one. From the territory of the various directions of the path to sum up the evaluation, each rank path and advantages as shown in table 5.

Table 5 Analysis of the advantages of each path

Evaluation rank	Path	Path to the prominent advantages	Path to the main disadvantages
1	Path one	Time is short, and high sensitivity	Cost is a bit high, poor safety
2	Path two	Time is short, safety coefficient is big, cost is low	Poor flexibility, low degree of environmental protection
3	Path three	Low cost, large capacity, high degree of environmental protection, reasonable utilization of resources	Flexibility is poor, provide employment will be less
4	Path four	High safety coefficient, provide more employment opportunities	Poor flexibility, low degree of environmental protection
5	Path five	Relatively short time	Provide employment will be less, low safety factor
6	Path six	The shortest time and high safety	High cost, provide employment will be less
7	Path seven	The flexibility is relatively good	Poor safety
8	Path eight	The cost is relatively low, high safety	The low degree of environmental protection

Summary

Using AHP to get the optimal path for a, can be seen from the path advantage analysis, the path is a major advantage of time is short, high sensitivity, main disadvantage, slightly high cost, poor safety. Disadvantages relative to other path, a relatively optimal, can satisfy the two aspects of social satisfaction and the owner satisfaction of requirements, so the optimal path.

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