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Selection of Logistics Outsourcing Service Suppliers Based on AHP

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Abstract

The good choice of service suppliers is the key to success in logistics outsourcing. Based on the analysis of the characteristics of logistics outsourcing industry, the evaluation index system including logistics cost, the logistics operation efficiency, the basic qualities of service suppliers and logistics technology level has more targeted and practicability. In this paper the evaluation and selection of logistics outsourcing service suppliers carried out based on AHP and studied an actual case. It provides a reference for an enterprise to choose logistics outsourcing service suppliers.

1. Introduction

Along with the rapid development of economic globalization, the further refinement of social division and the rapid development of information technology, the competition between enterprises is becoming increasingly fierce. And logistics outsourcing has become the development trend of enterprise logistics operation. The good choice of service suppliers is the key to success in logistics outsourcing. Logistics outsourcing can bring great benefits for the enterprise. But at the current more difficulties exist in the choice of enterprise logistics outsourcing service suppliers and even cause failure of logistics outsourcing, a main reason is lack of effective method, how to choose the logistics outsourcing suppliers suitable for the enterprise development.

The main research results about the choice of third party logistics suppliers are as follow. Kasilingamr (1998) thought that four factors for the third party logistics service supplier to choose: the perceived performance of logistics suppliers, the perception ability, the price, the strategy and external environment using the factor analysis method [1]. Yahya and Kingsman (1999) set up evaluation index system including quality, response delivery and performance of financial management technical ability and facilities through the investigation and AHP [2]. Yaohuang Guo (1999) established an AHP judgment matrix of supplier evaluation with quality, price, technical ability and distribution reliability [3]. Hongwei Jiang and Wenxiu Han (2001) set up evaluation index system including quality, price, delivery, service, product development and production, external environment, and other (sales and marketing staff in general) on the comprehensive analysis of the service [4]. Lijuan Ma (2002) proposed 9 indexes on supplier selection standards: the product quality, the price, the post-sale service, the technical level, the geographical position, supply capacity, economic benefit, delivery and market effect [5]. Weiqing Zhong etc. (2003) said that the specific vendor selection indexes should consider four aspects such as technical level, management ability, and service level and management environment to make the supply chain performance maximization according to the design principle [6]. Jinghua Zhou etc (2005) set up a customer satisfaction index system from the customer's point of view to evaluate the third party logistics enterprise, and use SPSS11.0 to analyze 66 sample data. It is proved that the system has the high homogeneity, the reliability and validity of the structures [7]. Ying Sun (2006) construct a third-party logistics operation efficiency evaluation index system including four aspects, such as the input-output efficiency, the equipment utilization efficiency, quality assurance, efficiency, market competition efficiency [8]. Xianhua Wu etc. (1998) proposed to choose partners based on ANP [9]. Pengju Ma etc (1999) used fuzzy analytic hierarchy process (F-AHP) to choose partners [10]. Shihua Ma etc (2002) chose three common indexes, such as quality, cost and delivery time, and set up a weight correlation analysis model of supplier selection and evaluation [11].

Through the above analysis, in actual work, analytic hierarchy process (AHP) is used more mature evaluation model; therefore it is feasible to use AHP as the evaluation model of logistics outsourcing services. Based on the evaluation index system including logistics cost, the logistics operation efficiency, the basic qualities of service suppliers and logistics technology level has more targeted and practicability. In this paper the evaluation and selection of logistics outsourcing service suppliers carried out based on AHP and studied the actual case of a frozen food enterprise. It provides a reference for an enterprise to choose logistics outsourcing service suppliers.
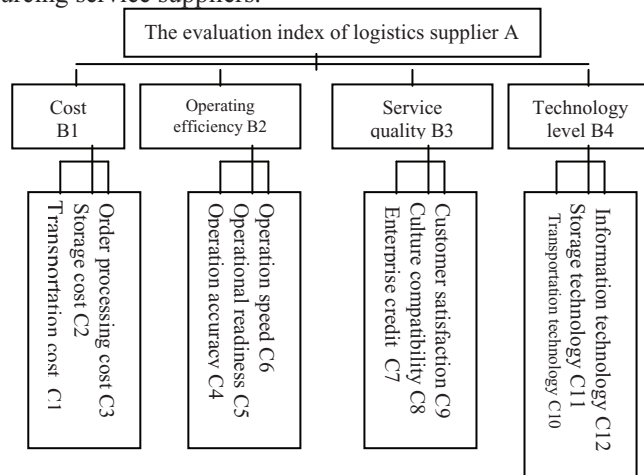

Fig. 1 The hierarchical analysis model of logistics service supplier evaluation

2. The hierarchical analysis model of logistics service supplier evaluation

In the evaluation index system of logistics supplier, the top layer is the target to choice logistics outsourcing service suppliers, namely the first level evaluation index. The intermediate layer is the criterion, and depends on the four secondary indexes: the logistics cost, logistics operating efficiency, fundamental service quality and logistic technology level.

To establish the three-level index by further subdivision index of the intermediate layer, show in figure 1.

3. Empirical case of the choice of logistics outsourcing suppliers based on AHP

3.1 Basic situation of the case

A company belongs to the frozen food industry, specially established a team of experts who are responsible to research and evaluate the feasibility of logistics outsourcing by comprehensive analysis. They finally decided to measure from following A, B and C third-party logistics services in three preferred choice to solve the problem of logistics operation.

Third party logistics company A as a state-owned enterprise logistics supplier, provides the all directional logistics solutions to customers all over the country to delivery to the terminal or clients with the logistics branches in 24 hours. Its business scope involves transportation, warehousing, distribution and overall logistics packaging and design. Company A is the lowest logistics cost in 3 candidates' enterprises, but the assignment speed is slower, and the prestige and transportation technology are relatively backward.

Logistics Company B owns many professional companies in refrigeration, hotel, real estate, logistics and distribution, import and export trade. The transportation and warehousing logistics cost of Company B is the highest in three candidates' enterprises, but the operation accuracy is general, the compatibility of enterprise is poor culture, and the information technology is relatively backward.

As one of modern refrigeration logistics enterprises, Logistics Company C is an integrated modern logistics enterprise specialized in the cold storage, distribution and information processing integration. Using modern information and network tools, the company provides goods transportation, storage, fresh goods and logistics distribution, etc. in a scientific and orderly logistics flow. The operation accuracy and readiness are the highest. And its logistics information technology is the most advanced.

3.2 Establishment of the judgment matrix of goals layer

The judgment matrix of goals layer shows in table 1.

TABLE I The judgment matrix of goals layer

A	B1	B2	B3	B4
B1	1.000	2.000	3.000	2.000
B2	0.500	1.000	2.000	1.000
B3	0.333	0.500	1.000	0.500
B4	0.500	1.000	2.000	1.000

Table 2 shows the result of each column element normalized processing of the judgment matrix.

TABLE II. The result of each column element normalized processing of the judgment matrix

A	B1	B2	B3	B4
B1	0.429	0.444	0.375	0.444
B2	0.214	0.222	0.250	0.222
B3	0.143	0.111	0.125	0.111
B4	0.214	0.222	0.250	0.222

Calculate W_i and normally process, the result shows in table 3.

TABLE III The result normally processed for W_i

W1	W2	W3	W4
0.423	0.227	0.123	0.227

That is the approximate solution of the feature vector $W =$ （0.423，0.227，0.123，0.227）

Calculate λ max, then take two matrix multiplied, the result shows in Table 4.

TABLE IV The result of two matrix multiplication

1.699	0.911	0.491	0.911

According to table 3 and table 4, the result is: $\lambda_{max} = 4.010$.

Test the consistency and the result is: CI=0.003.

At the same time by checking on the table and the result is: RI=0.89；CR=0.004.

3.3 Establishment of the judgment matrix of criterion layer

Based on the above steps to determine the criterion layer judgment matrix, and calculated the eigenvector, secondary index (logistics cost) judgment matrix shows in table 5.

TABLE V The judgment matrix of logistics cost

B1	C1	C2	C3
C1	1.000	0.500	0.333
C2	2.000	1.000	0.667
C3	3.000	1.500	1.000

Similarly available: $W =$ (0.550，0.210，0.240).

Calculation can get: $\lambda_{max} = 3.000$

At the same time by checking on the table and the result is: RI=0.58; CI=0.000.

Because of CR<0.1, therefore this judgment matrix has good uniformity.

Using the formula and steps, the judgment matrix and consistency test results of secondary indexes including the logistics operation efficiency, the basic service qualities and logistics technology level show in table 6, table 7, table 8.

TABLE VI The judgment matrix and consistency test results of logistics operation efficiency

B2	C4	C5	C6	W
C4	1.000	0.500	0.333	0.167
C5	2.000	1.000	0.666	0.333
C6	3.000	1.500	1.000	0.500
Test	$\lambda_{max} = 3, CR = 0 < 0.1$; CI=0			

TABLE VII The judgment matrix and consistency test results of the basic service qualities

B3	C7	C8	C9	W
C7	1.000	0.666	2.000	0. 333
C8	1.500	1.000	3.000	0. 500
C9	0.500	0.333	1.000	0. 167
Test	$\lambda_{max} = 3, CR = 0 < 0.1$; CI=0			

TABLE Ⅷ The judgment matrix and consistency test results of logistics technology level

B3	C7	C8	C9	W
C7	1.000	0.666	2.000	0. 333
C8	1.500	1.000	3.000	0. 500
C9	0.500	0.333	1.000	0. 167
Test	$\lambda_{max} = 3, CR = 0 < 0.1$; CI=0			

Can see, CR < 0.1 for all single sort of secondary index, therefore each of the consistency of the judgment matrix is acceptable.

3.4 Total hierarchical sorting

Total sorting means the same level of all factors for target layer (top) the relative weight in order of importance. Total sorting weight synthesis the weight in single criterion under from top to down.

For the total sorting of the matrix, CW is the product between the weight matrix of target layer and the weight matrix of criterion layer. Calculation results shows in table 9.

Comparison with other indexes, the transportation cost is the most important; the total weight is 23.3%. In addition, the storage technology and operation speed is more important, their weights are 11.4%.

3.5 Comprehensive appraisal result

Considering the influence factors, according to the actual situation of three logistics outsourcing suppliers A, B and C, scored 12 sub-functions index(score 10 points) and weighted average. According to the evaluation index system in this paper, the indices of logistics outsourcing suppliers A, B and C show in table 10.

TABLE Ⅸ Total sorting of the judgment matrix

Criterion layer / Scheme layer	B1	B2	B3	B4	CW
	0.424	0.227	0.122	0.227	
C1	0.550				0.233
C2	0.210				0.089
C3	0.240				0.102
C4		0.167			0.038
C5		0.333			0.076
C6		0.500			0.114
C7			0.333		0.041
C8			0.500		0.061
C9			0.167		0.020
C10				0.333	0.076
C11				0.500	0.114
C12				0.167	0.038

TABLE Ⅹ The indices of logistics outsourcing suppliers A, B and C

suppliers / indexes	supplier A	supplier B	supplier C
X1	8	6	7
X2	7	5	6
X3	8	7	8
X4	9	6	9
X5	8	8	9
X6	6	9	8
X7	6	8	9
X8	8	6	8
X9	7	7	9
X10	6	8	9
X11	8	8	9
X12	8	6	8

Combined with the calculation result of weight CW, according to formula: $y = \sum c_w x_i$, the synthesis scores of logistics outsourcing suppliers A, B and C are 7.483, 7.001 and 7.97 respectively. Obviously, supplier C is the highest scores in three logistics outsourcing service suppliers and is the best choice.

4. Conclusions

Based on the analysis of the characteristics of logistics outsourcing industry, the evaluation index system including logistics cost, the logistics operation efficiency, the basic qualities of service suppliers and logistics technology level has more targeted and practicability. In this paper the evaluation and selection of logistics outsourcing service suppliers carried out based on AHP and studied an actual case. It provides a reference for an enterprise to choose logistics outsourcing service suppliers.

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