The Logistics Operation Mode Selection for e-Commerce Enterprises

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Abstract. Choosing an appropriate logistics operation mode will help enterprises achieve the pursuit of low cost and high profit of logistics. In this paper, the logistics operation mode used by e-commerce enterprises is divided into three forms: completely self-supporting, completely outsourcing, and logistics alliance. Starting from the logistics characteristics of e-commerce enterprises, the evaluation index system of three logistics operation mode is constructed. Finally, a comprehensive evaluation model based on the combination of set-value statistics and multi-level grey evaluation method is proposed, and the model is tested by an example analysis.

Keywords: Logistics operation mode · set-valued statistics · multi-level grey evaluation method

1 Introduction

For a long time, logistics has always been the bottleneck restricting the development of e-commerce enterprises. To break through this bottleneck, scholars have proposed methods, including the traditional decision-making method, the two-dimensional decision-making method proposed by Ballow and the analytic hierarchy process (AHP) proposed by Satty [1]. Kent N. Gourdin (2001) proposed the selection model of e-commerce logistics cost and service quality [2]. Oliver Williamson (1979) constructed the transaction cost theory to select the logistics operation mode, and established a matching relationship between the transaction and the regulatory structure [3]. Yang (2017) proposed B2C e-commerce enterprise reverse logistics operation mode selection method [4]. In comparison, scholars have studied more about the selection method of non-e-commerce enterprises. For example, Wei (2017) proposed a reverse logistics operation mode selection method for iron and steel enterprises [5], Yao et al. (2016) proposed an evaluation and selection method based on the operation mode of small and medium-sized logistics enterprises [6]. Zhang (2006) proposed to establish a selection model from three perspectives: the ownership, the dominance and the span of logistics business [7].

In this paper, the logistics operation mode of e-commerce enterprises is divided into the following three types: completely self-supporting, completely outsourcing, logistics alliance. A comprehensive evaluation model based on the combination of set-value

J. Yen et al. (Eds.): ICBIS 2023, AHCS 14, pp. 588–596, 2023.
https://doi.org/10.2991/978-94-6463-198-2_60

statistics and multi-level grey method is proposed to study how to choose the mode. The model application test is carried out through a case, and the selection decision is made according to the comprehensive evaluation results.

2 Model Building

The construction process of comprehensive evaluation model based on set-valued statistics [8] and multi-level grey evaluation method [9, 10] includes three parts:

(1) The grading standard of multi-level grey evaluation index is determined by using the grading standard of index interval estimation value of set-valued statistics, and the organic combination of set-valued statistics and multi-level grey evaluation model is realized.
(2) According to the reliability analysis of index weight and the influence analysis of comprehensive evaluation results, the sample matrix of index evaluation is made.
(3) The weight and its reliability of each evaluation index are calculated and applied to the subsequent calculation of multi-level grey evaluation method. Finally, the comprehensive evaluation value is obtained, and the best is selected as the selection decision according to the size of the evaluation results. The construction process of comprehensive evaluation model is shown in Fig. 1.

This paper analyzes the influencing factors of e-commerce enterprises choosing logistics operation mode from seven aspects. These seven aspects include logistics cost, logistics service ability, logistics management ability, strategic position of logistics subsystem, strength and characteristics of e-commerce enterprises, strength and characteristics of logistics alliance, scale and technical level of logistics agent enterprises. Then three operating mode index systems were established.

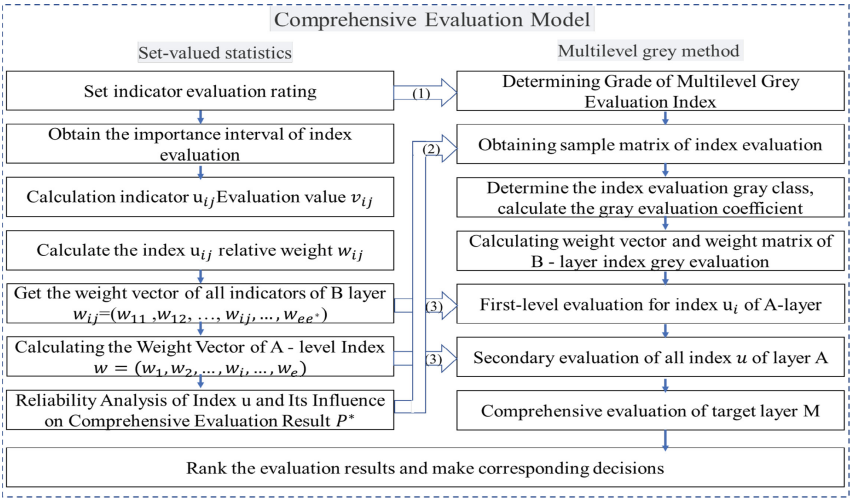


Fig. 1. Comprehensive evaluation model building process

3 Example Analysis

3.1 Example Background

In this paper, the example object is a new private B2C e-commerce enterprise G in China. Its basic situation is as follows:

At the beginning of 2006, the enterprise was transformed from a physical sales enterprise to a B2C e-commerce enterprise. Since entering the field of e-commerce, the company has maintained rapid growth, whose growth rate more than 200% for four consecutive years. The company specializes in smaller 3C electronic products. Its business scope throughout the country, which is mainly concentrated in the Beijing area. The logistics can not meet the needs of rapid development of enterprises. It is urgent to find a suitable logistics operation mode under the opportunity of rapid development of enterprises.

3.2 Computational Process

Using the comprehensive evaluation model for example calculation, and the specific steps are as follows:

(1) Interval estimation of evaluation indicators and Weight calculation

Scoring the importance of each index, and the index importance estimation interval of the three modes is obtained. Using Matlab programming to calculate the weight of all indicators and reliability, the results are shown in Tables 1, 2 and 3.

Table 1. Index weight and reliability of completely self-supporting

Target layer	Criterion layer	Index layer	w_{ij}^s	g_{ij}^s
Evaluation Index System of completely Self-supporting Logistics Operation Mode	Strength and Characteristics of Enterprises $w_1^s = 0.268$	Investment Scale	0.0475	0.0565
		Logistics Equipment Perfect Level	0.0456	0.0664
		Logistics Information Technology Level	0.0568	0.092
		External Financing Capacity of Enterprises	0.0492	0.0741
		Characteristics of Trading Area	0.0541	0.0772
		Product Characteristics	0.0579	0.0935

(*continued*)

Table 1. (*continued*)

Target layer	Criterion layer	Index layer	w_{ij}^s	g_{ij}^s
	Strategic Position of Logistics Subsystem $w_2^s = 0.146$	The Criticality of Logistics to Business Success	0.0577	0.0949
		Requirements For Logistics Control	0.056	0.0855
		External Opportunities for Developing Logistics Subsystem	0.059	0.0927
	Management Ability of Enterprise Logistics $w_3^s = 0.1347$	Quality of Managers	0.0587	0.0985
		Ability of Coordination and Communication	0.0383	0.0719
		Efficiency of Logistics Management Process	0.067	0.1282
	Logistics cost $w_4^s = 0.185$	Logistics Business Management Costs	0.0451	0.0535
		Logistics Distribution Operation Cost	0.0455	0.0537
		Degree of Investment Risk	0.0479	0.0595
	Logistics Service Capability of Enterprises $w_5^s = 0.2156$	Timeliness of Logistics Services	0.06	0.0802
		Security of Logistics Services	0.0465	0.0585
		Flexibility of Logistics Services	0.0594	0.0841
		Breadth of Logistics Service Area	0.0417	0.0904

(2) Analysis of the impact of weights on evaluation

1) Reliability analysis of weights
g represents the degree of dispersion of the evaluation value of the importance of the index. Indicators are generally considered available when g is less than 0.3. Reliability analysis is shown in Fig. 2-(a) (where blue represents completely self-operation, green represents completely outsourcing, and red represents logistics alliance). All the value of indicators are less than 0.3. It can be considered that the reliability of each indicator weight is also high.

Table 2. Index weight and reliability of completely outsourcing

Target layer	Criterion layer	Index layer	w_{ij}^{o}	g_{ij}^{o}
Evaluation Index System of Completely Outsourcing Logistics Operation Mode	Strength and Characteristics of Enterprises $w_1^o = 0.2264$	Investment Scale	0.0415	0.1486
		Logistics Information Technology Level	0.0547	0.102
		Coordinated Control Ability for Logistics Agent Enterprises	0.0617	0.0766
		Characteristics of Trading Area	0.057	0.0517
		Product Characteristics	0.0529	0.0787
	Scale and Technical Level of Logistics Agent Enterprises $w_2^o = 0.1777$	Status of Funds	0.0569	0.1202
		Perfect Level of Logistics Facilities	0.0657	0.0682
		Logistics Information Technology	0.0551	0.0833
	Management Ability of Logistics Agent Enterprises $w_3^o = 0.1907$	Quality of Managers	0.0506	0.0884
		Ability of Coordination and Communication	0.05538	0.0881
		Efficiency of Logistics Management Process	0.0553	0.0793
		Information Confidentiality Level	0.031	0.0881
		Business Philosophy	0.025	0.1235
	Logistics cost $w_4^o = 0.1769$	Logistics Business Management Costs	0.0564	0.0718
		Logistics Distribution Operation Cost	0.0688	0.0543
		Degree of Investment Risk	0.0517	0.0655
	Logistics Service Capability of Enterprises $w_5^o = 0.2284$	Timeliness of Logistics Services	0.0657	0.0611
		Security of Logistics Services	0.0679	0.0289

(*continued*)

Table 2. (*continued*)

Target layer	Criterion layer	Index layer	w_{ij}^{o}	g_{ij}^{o}
		Flexibility of Logistics Services	0.0285	0.1284
		Breadth of Logistics Service Area	0.0663	0.0419

Table 3. Index weight and reliability of logistics alliance

Target layer	Criterion layer	Index layer	w_{ij}^{a}	g_{ij}^{a}
Evaluation Index System of Logistics Alliance Logistics Operation Mode	The scale and technical level of the enterprise $w_1^a = 0.2538$	Investment Scale	0.048	0.0485
		Logistics Equipment Perfect Level	0.0248	0.0695
		Logistics Information Technology Level	0.0264	0.0882
		The Breadth of Corporate Partners	0.0424	0.0817
		Coordinated Control Ability of the Alliance	0.0442	0.0791
		Characteristics of Trading Area	0.0451	0.0745
		Product Characteristics	0.0229	0.1065
	Strength and Characteristics of Logistics Alliance $w_2^a = 0.2299$	Status of Funds	0.0444	0.1029
		Logistics Equipment Perfect Level	0.0474	0.0515
		Logistics Information Technology Level	0.0437	0.1011
		Stability of the Alliance	0.0487	0.0669
		Resource and Technology Sharing Capability of Alliance	0.0457	0.0607

(*continued*)

Table 3. (*continued*)

Target layer	Criterion layer	Index layer	w_{ij}^a	g_{ij}^a
	Management Ability of Logistics Alliance $w_3^a = 0.2052$	Quality of Managers	0.0441	0.0763
		Alliance collaboration capabilities	0.0396	0.0882
		Efficiency of Logistics Management Process	0.0481	0.0532
		Information confidentiality level	0.0487	0.0564
		Consistency of business philosophy	0.0247	0.1295
	Logistics cost $w_4^a = 0.1445$	Logistics Business Management Costs	0.0515	0.0372
		Logistics Distribution Operation Cost	0.0533	0.0531
		Degree of Investment Risk	0.0397	0.093
	Logistics Service Capability of Enterprises $w_5^a = 0.1665$	Timeliness of Logistics Services	0.0503	0.1295
		Security of Logistics Services	0.0503	0.0372
		Flexibility of Logistics Services	0.024	0.0531
		Breadth of Logistics Service Area	0.0419	0.086

2) Analysis of the impact of comprehensive evaluation results
The greater the weight, the higher. Index weight size distribution is shown in Fig. 2-(b), (c), (d).

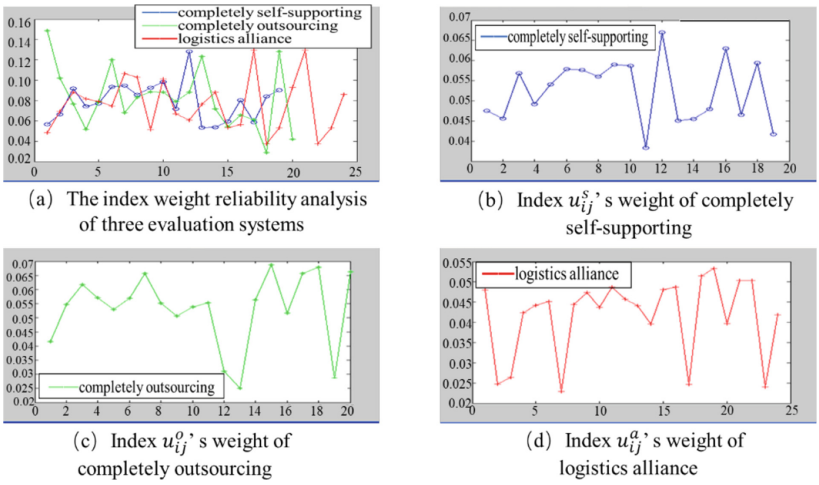
(3) Determining the sample matrix of evaluation indicators
According to the importance score of set-valued statistical indicators, the multi-level grey evaluation index score level is set to the nine-level scoring standard, and the sample matrix is determined for the index score.

(4) Results of comprehensive evaluation
According to the above calculation steps, the comprehensive evaluation results P_s^*, P_o^* and P_a^* of three logistics operation mode are obtained in turn:

$$P_s^* = Y^s \cdot X^T = (0.0620, 0.0692, 0.0523, 0.0212) \cdot (9, 7, 5, 3, 1)^T = 1.3693$$

$$P_o^* = Y^o \cdot X^T = (0.0583, 0.0688, 0.0581, 0.0299, 0.0017) \cdot (9, 7, 5, 3, 1)^T = 1.3884$$

$$P_a^* = Y^a \cdot X^T = (0.0655, 0.0755, 0.0581, 0.0880, 0) \cdot (9, 7, 5, 3, 1)^T = 1.4354$$



(a) The index weight reliability analysis of three evaluation systems

(b) Index u_{ij}^{s}' s weight of completely self-supporting

(c) Index u_{ij}^{o}' s weight of completely outsourcing

(d) Index u_{ij}^{a}' s weight of logistics alliance

Fig. 2. Influence analysis chart of weight on evaluation

(5) Result analysis

Rank the comprehensive evaluation results, $P_a^* > P_o^* > P_s^*$. The enterprise has strong capital investment scale and external financing ability, which can meet the higher capital investment in the early stage of logistics alliance construction, and has relatively good partners. Therefore, the enterprise adopts the logistics alliance operation mode is indeed the best choice.

4 Conclusion

In this paper, a comprehensive evaluation model based on set-valued statistics and multi-level grey evaluation method are used. From the comprehensive evaluation results obtained from examples, the selection decision is reasonable and effective. This can also illustrate the effectiveness of the model application. But it still needs to be applied in the real e-commerce enterprises. Then this paper will make further improvement and research.

Acknowledgment. This research was funded by the Fundamental Research Funds for the Central Universities 2022JBZY042.

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