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The Optimal Solution based on TOPSIS and Grey Relation Analysis

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Abstract

The order data and supply data of the raw material suppliers of the production enterprises are very interesting. According to the historical data of the enterprises, we can observe that the importance of the material suppliers to the enterprises is different. Therefore, it is necessary to quantitatively analyze the supply characteristics of different suppliers, establish a mathematical model reflecting the importance of ensuring the production of enterprises, and determine the most important suppliers for the future business dealings of enterprises. This article uses a special evaluation method to help companies determine the importance of material vendors.

Keywords

Entropy Method; TOPSIS; Grey Relation Analysis.

1. Introduction

The raw materials used by a company that produces construction and decorative panels can be divided into three categories. The company only pre-orders one type of material from a supplier. To meet their own production needs, companies always purchase all the supplies from suppliers. However, the actual supply of material suppliers is always different from the company's order supply. Now we have a company's order and supply data for 402 raw material suppliers in the past five years. We hope to find a way to evaluate it and determine the importance of each material supplier to the company. Based on the data of the past five years, this paper has dug out several indicators to measure and evaluate suppliers and establishes a comprehensive evaluation index system for suppliers to solve this problem.

2. Organization of the Text

2.1. Selection of Evaluation Indicators

Principles for selecting indicators

The importance of choosing a supplier is related to internal factors such as the supplier's scale, supply potential, and reputation status. At the same time, the company's choice of supplier will also be affected by the company's dependence on the supplier, willingness for long-term cooperation, and cooperation. And the other influence of factors such as changes in tendencies and the company's benefits. To evaluate the importance of suppliers more scientifically, when selecting important evaluation indicators, it is necessary to uphold the principles of objectivity, comprehensiveness, and independence, and comprehensively consider the impact of various factors on the importance of suppliers.

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2.2. Refined Index Screening and Quantification

Based on the above-mentioned principle of selecting indicators, we select the supplier's importance to the enterprise Y_j as the dependent variable and try to select the indicator that has the greatest impact on the evaluation of the supplier's importance as the independent variable for research.

Based on the known data, we mainly select detailed indicators from these three aspects. In terms of the strength of suppliers, we select two detailed indicators of 402 suppliers' supply scale x_1 and supply potential index x_2 in the past five years; in terms of reputation status, we select reputation index x_3 and time variation coefficient of supply-to-order ratio x_4 These two refined indicators; in terms of the company's dependence on suppliers and the trend of cooperation, we select the two refined indicators of long-term cooperation x_5 and weekly order quantity ratio x_6; in terms of the company's benefits, we directly select The benefit factor x_7 is a refined index. These seven detailed indicators (as shown in Figure [1]) measure the importance of suppliers to the enterprise from different perspectives.

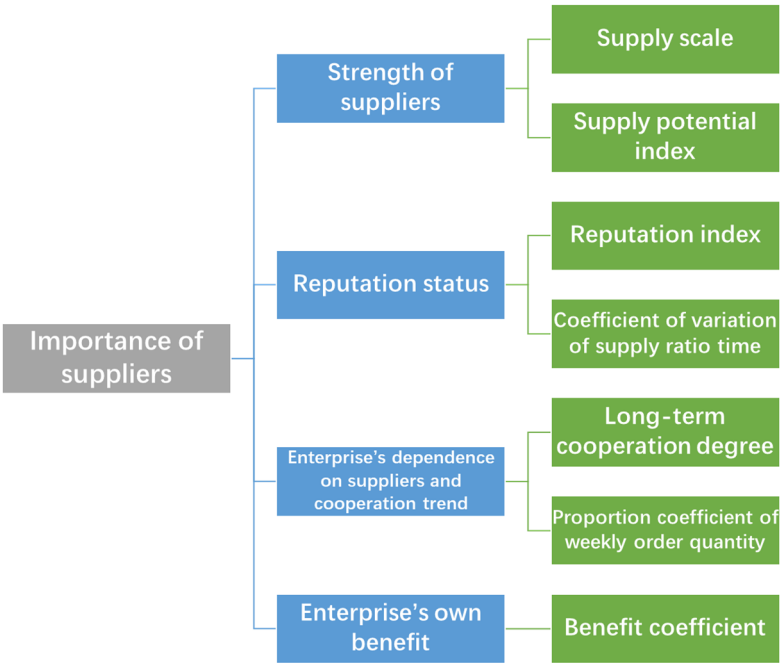

Figure 1. Detailed indicator screening chart

✹The supplier scale x1 is an independent variable. Here, the supplier scale is replaced by the average level of its weekly (with orders) supply to measure the supplier's strength. The formula for calculating the average weekly supply in the past five years:

$$x_1 = \frac{\sum_{week=1}^{240} g}{\sum_{week=1}^{240} s} \tag{1}$$

Among them: g represents the supply quantity, s represents the number of weeks in which there is an order.

We divide the average weekly (ordered) supply into four levels according to the size: (Table 1)

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Table 1. Supplier scale grade

Average weekly (with orders) supply		grade
>500		4
100~500		3
10~100		2
0~10		1

✷The supply potential index x2 is an independent variable. Here, the supply potential index is replaced by the weekly maximum supply level to measure the supplier's strength. The maximum weekly supply is divided into four levels according to the size: (Table 2)

Table 2. Supply potential grade

Maximum weekly supply		grade
>1000		4
500~1000		3
100~500		2
0~100		1

✷The reputation index x3 is an independent variable. Here, the reputation index is replaced by the average weekly supply-to-order ratio to measure the supplier's reputation status. The formula for calculating the average weekly supply-to-order ratio in the past five years:

$$x_3 = \frac{\sum_{week=1}^{240} \frac{m}{n}}{\sum_{week=1}^{240} s} \tag{2}$$

Among them: m represents the supply quantity during the ordering week, n represents the order quantity during the ordering week, and s represents the number of the ordering week.

✷The time coefficient of variation of the supply-to-order ratio x4 is an independent variable. Here, the time coefficient of variation of the supply-to-order ratio is replaced by the slope of the supplier's supply-to-order ratio change curve in the past five years to measure the supplier's reputation. If the time coefficient of variation of the supply-to-order ratio is greater than 0, it means that the supplier's reputation status has a trend of getting better in the past five years, and the larger the time variation coefficient, it means that the supplier's reputation status has been significantly improved, and vice versa NS. The time coefficient of variation of the supply-to-order ratio is convenient for us to judge the importance of the supplier by inferring the development trend of the supplier's reputation status.

✷The degree of long-term cooperation x5 is an independent variable. Here, the degree of long-term cooperation is replaced by the total proportion of suppliers selected for supply weeks in the past five years to measure the degree of dependence of the company on suppliers and the

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trend of cooperation. The formula for calculating the total proportion of suppliers selected for the supply week in the past five years:

$$x_5 = \frac{\sum_{week=1}^{240} s}{240} \tag{3}$$

Among them: s represents the number of weeks in which there is an order.

✷The weekly order quantity ratio coefficient x6 is an independent variable. Here, the weekly order quantity ratio coefficient is replaced by the ratio of the weekly order quantity to the total weekly order quantity of similar raw materials to measure the company's dependence on suppliers and the trend of cooperation. The formula for calculating the ratio of weekly order quantity to the total weekly order quantity of similar raw materials:

$$x_6 = \frac{z}{\sum t} \tag{4}$$

Among them: z represents the weekly order quantity, t represents the weekly order total of similar raw materials.✷The benefit coefficient x7 is an independent variable. Here, the benefit coefficient is replaced by the different purchasing propensity coefficients for A, B, and C after the company comprehensively considers the purchase cost, storage, and transportation costs of the three raw materials, to measure the company's purchase of raw materials Impact on self-benefit.

2.3. Entropy Method to Calculate Weight

The entropy weight method is an objective weight calculation method driven by data. The data itself can tell us the index weight, which largely avoids the influence of subjective judgment on the result. The higher the degree of variation of the index, the more information reflected and the higher the corresponding weight.

In the end, we get the weights of 7 indicators(table 3):

Table 3. Index weight

index	Long-term cooperation degree	Proportion coefficient of weekly order quantity	Benefit coefficient	Reputation index	Supply scale	Supply potential index	Coefficient of variation of supply ratio time
weight	0.230	0.014	0.063	0.164	0.247	0.248	0.034

2.4. The TOPSIS Solution Distance Method Quantifies the Importance of Suppliers

The TOPSIS method(Technique for Order Preference by Similarity to an Ideal Solution) is an effective multi-index evaluation method. It constructs the positive ideal solution and negative ideal solution of the evaluation problem, that is, the optimal solution and the worst solution of each index, and calculates the relative closeness of each plan to the ideal plan. , That is, close to the degree of the positive ideal solution and the principle negative ideal solution to sort the solutions. In this example, it is to construct a supplier whose importance index of all aspects of the supplier reaches the rightmost, and then measure the actual supplier The degree of proximity to this idealized supplier, the closer it is to the enterprise, the more important it is.

Obviously, Si lies between [0,1]. When Si is closer to 1, it means that the closer the supplier i is to the idealized target, the more important the supplier is. Conversely, when Si is closer to 0, it means that supplier i is farther away from the idealized target, and the importance of this supplier is lower.

Finally, 402 suppliers are ranked by importance according to the size of Si.

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2.5. Grey Relational Analysis Method to Quantify the Importance of Suppliers

The basic idea of the gray correlation analysis method is to judge whether the connection is close according to the similarity of the geometric shape of the sequence curve. It can combine qualitative and quantitative methods for a large number of uncertain factors and their mutual relations, so that the originally complicated problem becomes Be clear and simple, avoid subjectivity and draw correct conclusions.

The greater the gray-weighted correlation degree, the higher the importance of supplier i; the smaller the gray-weighted correlation degree, the lower the importance of supplier i. Finally, the importance of 402 suppliers is ranked according to the degree of gray-weighted relevance.

Comprehensive TOPSIS and GRA ranking to determine the final supplier.

Under the premise that the weight of each indicator is determined by the entropy weight method, by comparing the ranking results of the importance of the two suppliers obtained by the TOPSIS superior and inferior solution distance method and the GRA gray correlation analysis method, we found that the importance of the two different methods The sex ranking is very consistent. Figure [2] is the score curve of the most important suppliers obtained by the two methods. The changing trends of the two curves in the figure are the same, which illustrates the ranking results obtained by different methods. With high accuracy and objectivity, we finally adopted it.

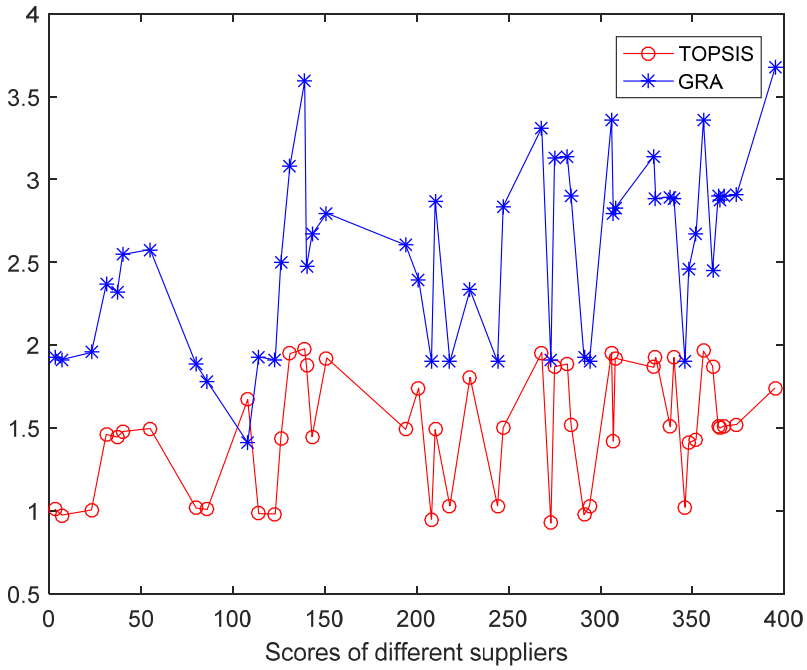

Figure 2. Curves of suppliers obtained by two methods

3. Conclusion

This paper firstly determines the weight of each indicator by the entropy weight method, and then uses two different methods: TOPSIS and GRA to score and rank the importance of suppliers, that is, the two methods are mutually verified, and the two obtained are ranked the comparison found that the degree of overlap in the importance ranking of suppliers is very high, which fully demonstrates the reliability of the evaluation index system and the objective accuracy of the model.

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References

[1] Chen Xiaode. Study on dynamic quantitative analysis method of plant population and community structure [J]. Acta Ecologica Sinica, 1998, 18(002):214-217.

[2] Zou Zhihong, Sun Jingnan, Ren Guangping. Weighting fuzzy evaluation factors by entropy method and its application in water quality evaluation [J]. Journal of Environmental Sciences, 2005, 25 (4): 552-556.

[3] Lu chunyang, Wen feng, yang Qingyuan, et al. performance evaluation and obstacle factor diagnosis of urban land use based on improved TOPSIS method-taking Chongqing as an example [J]. resources science, 2011(03):535-541.

[4] Luo yi, Li Yulong. comprehensive decision of transmission network planning scheme based on entropy weight method and grey relational analysis method [J]. power grid technology, 2013 (01): 77-81.