

Research on Supplier Evaluation Based on TOPSIS

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Abstract: This paper mainly studies the ordering and transshipment of raw materials in production enterprises, standardizes the relevant data, establishes an evaluation model based on TOPSIS, and finally solves the quantitative analysis of supplier supply reliability and determines the supplier selection scheme. Firstly, this paper quantitatively analyzes the supply characteristics of suppliers and sorts them. Eliminate the data. A TOPSIS evaluation model is established by using five indicators, namely supply intensity, supply compliance rate, difference supply ratio, fluctuation range and progress degree. Combined with the economic benefits of suppliers' supply of raw materials, economic benefit factors are introduced, and the final total importance score is obtained by normalization.

1. Introduction

Nowadays, with the continuous progress of science and technology and the rapid development of economy, the market competition faced by production enterprises is increasingly fierce, the life cycle of products is constantly shortened, and the uncertainty of users' needs is constantly increasing, which makes the competition among enterprises gradually change to the competition among supply chains where enterprises are located. This means that the overall performance of the supply chain where the enterprise is located will have a direct impact on the competitiveness of the enterprise itself. Therefore, the coordination of industrial supply chain has become one of the key issues in the research of competitiveness of production enterprises. [1]

2. Supplier Evaluation Model.

Firstly, we divide the supplier's supply characteristics into three categories: supply risk, supply balance and supplier's economy.

The supply strength S is defined as follows: Each supplier has a total supply capacity and total order number of orders (when the order is 0, the calculation of the number of orders is not included):

$$S_j = \frac{\sum_{i=1}^{240} P_{ij}}{n_j}$$

The supply compliance rate Q is defined as follows: the percentage of each supplier's compliance times in the total order times within five years:

$$Q_j = \frac{\sum m_{ij}}{n_j} \times 100\%$$

Differential ratio β is defined as follows: Five years When suppliers do not meet corporate demand, when $O_{ij} - P_{ij} > 0$, the supply amount is added to the quantity, then divided by the total order in five years.

$$\beta_j = \frac{\sum_{i=1}^{n_j - \sum^{m_y}} (O_{ij} - P_{ij})}{\sum_{k=1}^{n_j} O_{ij}}$$

The fluctuation range F of supply is defined as follows: the variance of the supply quantity of each supplier within five years:

$$F_j = \frac{\sum_{k=1}^{n_j} (P_{ij} - \bar{P}_j)^2}{n_j}$$

The improvement degree γ of supply capacity is defined as follows: the average value of the weekly supply growth rate of each supplier to the enterprise:

$$\gamma_j = \frac{\sum I_{ij}}{m_1}$$

The supply benefit factor α of each raw material is defined as follows: the quotient of the cost of each raw material and the quantity of the raw material that needs to be consumed to produce a unit cubic meter of product.

$$\alpha_m = \frac{x_m}{U_m}$$

In this paper, the order of relative importance of the first five indicators is determined as follows: supply compliance rate > supply balance ratio > supply intensity > supply fluctuation range > supply progress factor, and the TOPSIS method is used for comprehensive evaluation [2].

- Positiveization processing of indicator data.

First of all, we know that the maximum index (benefit index) means that the greater the value, the better, such as the supply compliance rate; Minimal index (cost index) means that the smaller the value, the better, such as the ratio of supply difference. In the analysis, we need to unify the indicators into one type, which is generally converted into maximum indicators. [3] Therefore, we transformed the five indicators representing the reliability of each supplier's supply into maximum indicators.

- Standardized processing of index data.

Standardized formula of maximum index is as follows:

$$\tilde{S}_j = \frac{S_j - S_j^{min}}{S_j^{max} - S_j^{min}}$$

Set the positive ideal solution C^+ of the u-th indicator value c_u^+ is:

$$c_u^+ = \max_{1 \leq j \leq 402} \tilde{b}_{ju}$$

Set the negative ideal solution C^- of the u-th indicator value c_u^- is:

$$c_u^- = \max_{1 \leq j \leq 402} \tilde{b}_{ju}$$

- Calculation of the distance from each evaluation object to each ideal solution.

For the u-th indicator, the distance d_j^+ from the j-th supplier to the positive ideal solution is:

$$d_j^+ = \sqrt{\sum_{u=1}^5 (\tilde{b}_{ju} - c_u^+)^2}, u = 1, 2, \dots, 5$$

For the u-th indicator, the distance d_j^- from the j-th supplier to the negative ideal solution is:

$$d_j^- = \sqrt{\sum_{n=1}^5 (\tilde{b}_{ju} - c_u^-)^2}, u = 1, 2, \dots, 5$$

• Order of importance of each supplier.

The comprehensive evaluation value of each indicator of each supplier is defined as follows:

$$A_j = \sum_{u=1}^5 w_u \frac{d_j^-}{d_j^- + d_j^+}$$

Among them, w_u is the weight corresponding to u-th index and A_j is reliability evaluation score of j-th supplier.

Considering the influence of different kinds of raw materials supplied by 402 suppliers on supply reliability, the final supply reliability score of suppliers is recorded as:

$$R_j = \alpha_m \times A_j$$

Obviously, R_j is located between [0, 1]. The closer the R_j is close to 1, the closer the supplier j is the idealization target, the higher the supply reliability of the supplier. Conversely, when R_j is closer to 0, the further supplier j is far from the idealization target, the lower the supply reliability of the supplier.

3. Model Solving.

The scores of each supplier can be obtained by programming with Matlab software, and then the importance of each supplier can be sorted. The scores of the top 5 suppliers are shown in the following table.

Table 1: Scores of the top 5 suppliers.

Supplier ID	S140	S201	S229	S361	S395
Materials classification	B	A	A	C	A
Evaluation score	0.0944	0.0750	0.0689	0.0443	0.0432

4. Conclusion

In order to reasonably select the most important supplier from suppliers, we need to score the reliability of each supplier. Based on the analysis of reliability indicators, it can be seen that there are many evaluation indicators and the relationships among them are complex, which is a process of multiple factors and one result. We use TOPSIS comprehensive evaluation method to sort the proximity between limited suppliers and ideal targets, so as to obtain the scoring results of supply reliability of each supplier through comprehensive evaluation. Finally, we can choose a supplier that

is more suitable for enterprise production.

References

- [1] Huang Weilai, Zhang Zigang, Liu Yunzhe. *Optimal production batch and raw material ordering decision model under yield flexibility [J]. Systems Engineering, 1998(01): 44-50.*
- [2] Xie ruijun, Wang Kexin, Chen Siyu, Guo yuxin, Chen shuaijie. *Study on the emergency management ability of Anhui urban public health based on AHP-TOPSIS model [J]. Journal of Shanxi Datong university (natural science edition), 2021, 37(04): 43-50+55.*
- [3] Jin Lu, He Wei, Yan Huaguang, He Guixiong. *Comprehensive evaluation method of benefits of township comprehensive energy system based on improved TOPSIS [J/OL]. Electrical Measurement and Instrument: 1-9 [2021-09-12].*