Agricultural & Forestry Economics and Management (2021) Vol. 4: 55-59
Clausius Scientific Press, Canada
DOI: 10.23977/agrfem.2021.040110
ISSN 2616-2202

Research on Supplier Based on Dynamic Weighted Comprehensive Evaluation

Mingquan Xian, Juguang Ren, Tianjun Li, Haibing Liu, Chong Liu

Institute of Engineering and Technology, Chengdu University of Technology, Leshan, Sichuan, 614000

Keywords: dynamic weighting, supplier evaluation, supply chain analysis.

Abstract: In this paper, a comprehensive evaluation model based on dynamic weighting is proposed, which can evaluate suppliers in real time and efficiently. The research of this problem can provide more effective suggestions for enterprise management, help enterprises to reduce costs and obtain higher benefits. Firstly, this paper preprocesses, analyzes and mines the given data, and selects the evaluation index from the perspective of the supplier's supply characteristics. This paper uses the average enterprise response, market share, cooperation density, and standard deviation. As the supply characteristic indicator, calculate the score of 402 suppliers, considering that the weight of the evaluation indicator changes with the actual situation, this paper establishes based on Dynamic weighted comprehensive evaluation model.

1. Introduction

China's economy is developing rapidly, its economy continues to develop and its technology continues to advance. With the increasingly fierce market competition and the increasing demand for products, the competition of supply chain has gradually become the leading role of competition among enterprises. Supplier is an important part of supply chain management, and it is becoming a key factor to determine the development of enterprises. Whether to choose suppliers scientifically is of great significance to the development of enterprises.

2. Dynamic Weighted Comprehensive Evaluation Model

Combined with the order quantity of enterprises and the supply quantity of suppliers in five years, the data are analyzed quantitatively. In this paper, market share, enterprise demand responsiveness, cooperation density and stability are selected as the evaluation indexes of suppliers to establish an evaluation model.

Enterprise demand responsiveness: the supplier's ability to respond to the urgent needs of enterprises, including the production and supply capacity of raw materials [1].

$$R_n = \sum_{y=1}^{240} \left(1 - \frac{\left|p_{oij} - p_{sij}\right|}{p_{oij}}\right), n = 1,2,3,\cdots,402$$

Market share: Refers to the proportion of sales or sales volume of a product produced by an enterprise in sales or sales volume of similar products in a certain production cycle [2].

$$F_j = \frac{\sum_{y=1}^{240} w_{ij}}{W}$$

Cooperation density: refers to the ratio of times and time of cooperation between two individuals in a certain time period.

$$\Phi_{ij} = \frac{\sum_{y=1}^{240} m_{ij}}{M}$$

Stability: Also called standard deviation, it is an index used to study the degree of sample dispersion, which is expressed by. The smaller the stability, the smaller the distance between the sample and the average value, and the greater the distance between the sample and the average value.

$$S = \sqrt{\frac{1}{D}\sum_{i=1}^{D}(x_i - \mu)^2}$$

Because the value of each evaluation index needs to be obtained in the actual production of the enterprise, and changes with the change of market demand, the traditional evaluation system cannot make an accurate evaluation of the index, so this paper puts forward a dynamic weighted comprehensive evaluation model.

According to the data of enterprise's order quantity and supplier's supply quantity in the past five years, according to the enterprise's own production characteristics, the evaluation index is selected, the correlation test is carried out, the weight distribution of each evaluation index is determined, the static weight is calculated for the price, and a dynamic weighted comprehensive evaluation model is established to grade and rank suppliers. Establish a comprehensive evaluation model based on dynamic weight;

·Determination of dynamic weight of indicators.

There are 402 evaluated objects in this article, recorded as $S_1, S_2, S_3, \cdots, S_{402}$, with 4 indicators for each evaluation object, record x_1, x_2, x_3, x_4, each indicator x_i it can be divided into K levels, recorded as $p_1, p_2, \cdots, p_K$. There is a range in each level, remember to $\left[a_k^{(i)}, b_k^{(i)}\right)$ and $a_k^{(i)} < b_k^{(i)} (i = 1,2, \cdots, m;\ k = 1,2, \cdots, K)$, When the indicator $x_i \in \left[a_k^{(i)}, b_k^{(i)}\right)$, belongs to the k-class indicator $p_k (1 \le k \le K)$. Therefore, the dynamic weighted method has scientific, and if the TOPSIS evaluation method cannot meet the rationality of this question [3].

Standardized treatment:

$$x_i' = \frac{x_i - m_i}{M_i - m_i} (1 \le i \le m)$$

Where m_i is the minimum value of the indicator x_i, M_i is the maximum value of the indicator x_i. x_i is a dimensionless indicator. In this paper, the company's actual production situation is the starting point, and the dynamic weighting function of the characteristics is analyzed.

S-type distribution function dynamic weight calculation formula: Evaluation index x_i affects the impact of comprehensive evaluation results increase with the increase of category $p_k (k = 1,2,3 \cdots, K)$, showing an S-shaped curve, at this time The x_i's change function can be set to the S-type distribution function [4].

$$w_i(x) = \begin{cases} 2\left(\dfrac{x - a_1^{(i)}}{b_K^{(i)} - a_1^{(i)}}\right)^2, & a_1^{(i)} \le x \le c \\ 1 - 2\left(\dfrac{x - b_K^{(i)}}{b_K^{(i)} - a_1^{(i)}}\right)^2, & c < x \ge b_K^{(i)} \end{cases}$$

Among them, $c = \frac{1}{2}\left(a_1^{(i)} + b_K^{(i)}\right)$, $a_1^{(i)}$ means the minimum value of the i-th indicator, $b_1^{(i)}$ represents the maximum value of the i-th indicator.

For each standardized evaluation index value, the corresponding dynamic weight function is brought in $\omega_{ij}(x)(i = 1,2,3\cdots,m)(j = 1,2,3\cdots,n)$

$$\omega = \begin{pmatrix} w_{1,1} & w_{1,2} & \cdots & w_{1,n} \\ w_{2,1} & w_{2,2} & \cdots & w_{2,n} \\ \vdots & \vdots & \vdots & \vdots \\ w_{m,1} & w_{m,2} & \cdots & w_{m,n} \end{pmatrix}$$

Dynamic weighted score for indicators of the i-th supplier:

$$Z = x_{ij} \cdot \omega_{ij}\left(x_{ij}\right)$$

Dynamic weighted score matrix:

$$Z = \begin{pmatrix} x_{1,1}w_{1,1} & x_{1,2}w_{1,2} & \cdots & x_{1,n}w_{1,n} \\ x_{2,1}w_{2,1} & x_{2,2}w_{2,2} & \cdots & x_{2,n}w_{2,n} \\ \vdots & \vdots & \vdots & \vdots \\ x_{m,1}w_{m,1} & x_{m,2}w_{m,2} & \cdots & x_{m,n}w_{m,n} \end{pmatrix}_{m,n}$$

Sum the index dynamic weighted score matrix by column to obtain the dynamic weighted score of the comprehensive index of the merchant:

$$D = \sum_{n=1}^{4} \left(x_{m,n} \cdot \omega_{m,n}\left(x_{m,n}\right)\right)$$

·Determination of price static weight.

Calculate its own price weight according to the price of three kinds of materials, and then use the material unit price to calculate the material price weight;A, B, CA, B, C

$$G_i = \frac{\varepsilon_i}{\varepsilon_A + \varepsilon_B + \varepsilon_C}$$

·Build a comprehensive scoring system.

After obtaining the dynamic weights of the four indexes and the static weights of prices, we can construct a comprehensive scoring function.

$$y_k = G_t D_k$$

Among them, y_k is the first score of the k family, $t = 1,2,3, k = 1,2,3\cdots\cdots 402$. D_k is the integrated dynamic indicator score of the k-th supplier, and G_t is the price weight of the material type supplied by the k-th supplier.

3. Model Solving.

Firstly, the data were analyzed quantitatively, and the evaluation index scores of 402 suppliers were obtained. Bringing the indicators into the S-shaped distribution function gets the supplier index scores with weights, which changes compared with the index scores without weights. In the face of changes in market demand, due to the existence of dynamic weights of indicators, enterprises can adjust suppliers' supply plans in time and reduce cost input. Among them, the stability score of the merchant S010 is 0.9995, the cooperation density score of the merchant S007 is 0.9999, and the enterprise demand response score of the merchant S003 is 0.91716422. The market share score of the merchant S003 is 0.00176 at the maximum.

The static weights of the three raw materials are obtained from their prices:

$$G_A = 0.363636$$
$$G_B = 0.333333$$
$$G_C = 0.303031$$

After obtaining the dynamic weight of indicators and the static weight of materials, they are brought into the comprehensive scoring function to obtain the comprehensive score of suppliers. Using the established dynamic weight comprehensive evaluation model, the list of the 50 most important suppliers is determined. The supplier list reflects the supplier's ability to meet the needs of the enterprise, the supplier's own market share, and the close cooperation with the enterprise. For example, the comprehensive score of supplier S229 is 1.144281, ranking first.

After determining the list of the 50 most important suppliers, this paper tests the stability of the model.

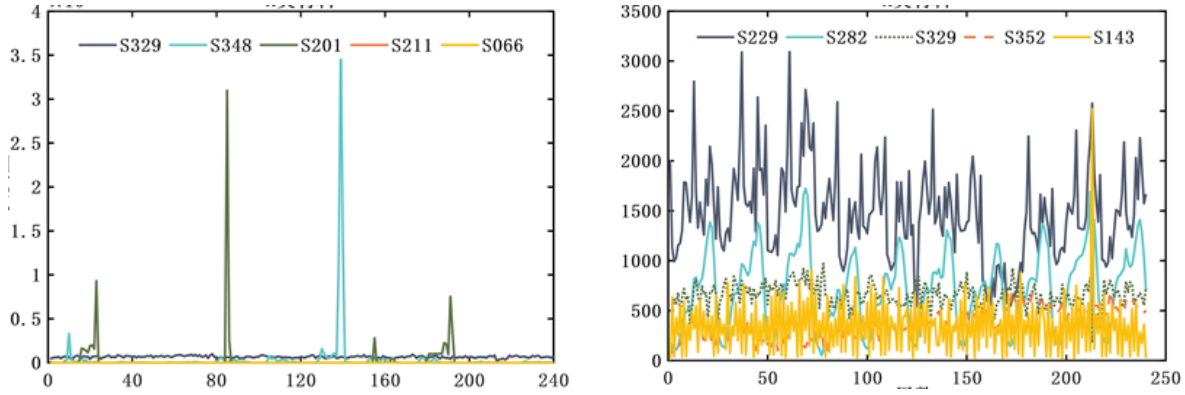

Figure 1: inspection of supply quantity of class a raw materials.

The figure on the left shows that five suppliers are randomly selected from the material suppliers to check their supply quantity, and it is found that the supply quantity of some suppliers in a certain period is obviously higher than that in other periods, and the change range of supply quantity is much larger than that of the five material suppliers randomly selected on the right.

4. Conclusion

In this paper, a dynamic weighted comprehensive evaluation model is established, and the evaluation indexes are dynamically weighted by the dynamic weighting method, so as to obtain the evaluation ranking of suppliers. Considering the influence of supply unit price on raw materials purchased by enterprises, the price of materials is statically weighted, and the evaluation index after dynamic weighting is given static weight, and finally the list of the 50 most important suppliers for enterprises is obtained.

References

[1] Tao Yunhai. Research and application of supplier evaluation in manufacturing supply chain. [D]. Master's thesis .2015.05.
[2] Fang Zhongmin, Han Fuyi, Ma Rong, Application of Fuzzy Classification in Enterprise Inventory Management, Logistics Technology, Vol. 38, No.1, 2019.
[3] Han Zhonggeng. Comprehensive evaluation model of water quality based on dynamic weighting method. Proceedings of the 8th Academic Exchange Meeting of China Operational Planning Society. Shenzhen, Guangdong. June 30, 2006; 649-654
[4] Liu Ke. Optimization of cold chain logistics service provider selection based on bi-level multi-objective programming. [D]. Master's thesis .2018.05.