

Research on Ordering and Transportation Strategy of Raw Materials in Manufacturing Enterprises

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Abstract: This paper mainly studies the impact of upstream suppliers on downstream manufacturing enterprises. Firstly, this paper makes an abstract qualitative analysis on the supply characteristics of suppliers from the four aspects of supplier quality, supplier scale, supply stability and supply continuity, and then quantifies these four qualitative aspects layer by layer into five indicators: supply and demand matching degree, weekly average supply, supply weeks, supply law and the longest continuous supply weeks, The quantitative evaluation index is constructed, the weight is given by entropy weight method, and the supply characteristic measurement index system based on TOPSIS evaluation model is established by Python software to compare the advantages and disadvantages of different suppliers, and the 5 most important suppliers are sorted by scoring.

1. Introduction

With the continuous progress of science and technology, the continuous development of information technology and the further deepening of global economic integration, the competition between enterprises has changed from product competition to supply chain competition. The supplier team at the upstream of the supply chain plays a very key role in the competition. Therefore, the scientific selection of suppliers has become the focus of the business community. How to build an effective supplier evaluation index system and how to reasonably use the evaluation method of supplier selection has become an urgent problem to be solved in enterprise competition. [1]

For the supplied enterprises, stable and sustainable supply plays a vital role in their production and operation. Through the quantitative analysis of supplier characteristics, a specific supplier index system and evaluation model are established, which is conducive to enterprises to better select upstream suppliers and produce synergy among enterprises.

2. Supplier supply characteristics measurement index system

2.1 Construction of system

Firstly, the five indicators to measure supplier supply characteristics are defined, and finally the supplier supply characteristics measurement index system is constructed.

(1) Supply and demand matching degree MD

Definition: supply and demand matching degree is the score obtained according to the

consistency between order quantity and supply quantity.

$$\begin{cases} MD = 1 - p_i^*k \\ p_i = \left| \frac{s_i - d_i}{d_i} \right| \end{cases} \quad (1)$$

$$\begin{cases} k = 0.3, l_i \geq 0 \\ k = 1, l_i < 0 \end{cases} \quad (2)$$

$$l_i = s_i - d_i \quad (3)$$

Where p_i represents the proportion of the deviation between the supplier's supply quantity and order quantity in week i , k represents the weight given to the deviation between the supply quantity and order quantity in different degrees, s_i represents the supplier's supply quantity in week i , d_i represents the order quantity received by the supplier in week i , and l_i represents the difference between the supplier's supply quantity and order quantity in week i .

The matching degree of supply and demand represents the consistency between the manufacturer's order quantity and the supplier's supply quantity. When the order quantity and supply quantity are completely consistent, MD has the highest score, which is the most ideal case, with a score of 1. When the order quantity is inconsistent with the supply quantity, we will discuss it in two cases. On the basis of score 1, points will be deducted in varying degrees.

In the first case, when the supply quantity is less than the order quantity, it will have a great impact on the production enterprise of this building and decorative plate, which is likely to cause the production enterprise to fail to deliver on time, so that the enterprise faces the risk of default, or for the purpose of delivering on time and maintaining the enterprise's reputation, purchase high priced finished products in the temporary market for delivery, increasing the production cost of the enterprise, The adverse impact and possible loss to the enterprise are large, so the score deduction weight will be set to 1. In the second case, when the supply quantity is greater than the order quantity, although it may lead to inventory accumulation in the production enterprise and increase the storage cost of the enterprise, the enterprise can reduce the impact of this situation through a series of adjustment measures such as flexible production planning and reducing the order quantity of the next batch. Therefore, the impact on the production enterprise is smaller than that in the first case, therefore, when setting the score deduction weight, k is set to 0.3.

The calculated supply-demand matching degree can well reflect the supplier's quality. The higher the supply-demand matching degree, the closer the order quantity issued by the enterprise is to the supplier's actual supply quantity, the higher the supplier's quality, and the smaller the supply-demand matching degree, the greater the difference between the order quantities issued by the enterprise and the supplier's actual supply quantity, and the worse the supplier's quality.

(2) Weekly average supply AS

Definition: the weekly average supply is the average value of the supplier's supply in the week with supply.

$$AS = \frac{\sum_{i=1}^W s_i}{W} \quad (4)$$

Where s_i represents the quantity supplied by the supplier in the week; W represents the number of weeks the supplier actually has supply.

The weekly average supply does not divide the total supply by the total number of weeks, but only represents the supply level in the weeks with supply, which can fully reflect the supplier's ability to supply raw materials and effectively measure the size of the supplier.

(3) Supply weeks W

Definition: supply weeks W is the total supply weeks of the supplier, that is, the total number of times that the manufacturer of the building and decorative plate successfully receives the supplier's supply in a specific time period.

The more total supply weeks, the more frequent business transactions between the manufacturer and the supplier. It can be judged whether the two sides of the cooperative enterprise have strong cooperation ability. At the same time, the number of successful deliveries can also measure the stability of suppliers' supply.

(4) Supply law L

Definition: the supply regularity index is the amplitude spectral variance after Fourier transform of the quantity of raw materials provided by each supplier to the building and plate manufacturer every week.

$$L = \frac{\sum_{i=1}^n (amp_i - \overline{amp})^2}{n} \quad (5)$$

Where amp_i is the Fourier transform amplitude of the quantity of raw materials provided by the supplier to the construction and plate production enterprise in week i , \overline{amp} is its average value, and n is the total number of weeks of the given data, i.e. $n = 240$.

As the upstream part of an industry, the supply stability of suppliers also plays a very important role in ensuring the long-term development of the whole industry. An important indicator to measure the stability of suppliers is their supply law. Our team believes that this law is mainly reflected in the time periodicity of upstream and downstream enterprises in weeks and the regularity of supply amount. The stronger the regularity, the higher the supplier's supply stability, the more we can ensure the production of the building and plate production enterprise.

Moreover, we note that the amplitude after Fourier transform can very accurately measure the concentration of a group of data after change, which is a very good reflection of the regularity of the original data.

(5) Maximum continuous supply weeks C

Definition: the longest continuous supply weeks C is the maximum continuous supply weeks of the supplier.

In order to measure the continuity of suppliers' supply, we count the longest consecutive supply weeks of each supplier in the attached data. In practice, the longer the longest continuous supply weeks C , the more dependent the manufacturer of the building and decorative plate on the supplier's goods in a specific period of time, and can reflect the higher service quality and strong supply continuity of the corresponding supplier.

2.2 Measurement index system of supply characteristics based on TOPSIS evaluation model

It can be seen from the above supplier supply characteristic measurement index system that the quantitative evaluation of supply characteristics is a process of seeking multiple factors, there are many indicators that affect the final results, and the relationship between indicators is quite complex.

TOPSIS method is a common decision-making method in multi-objective decision-making. It sorts according to the proximity between a limited number of evaluation objects and the idealized goal, and evaluates the relative advantages and disadvantages among the existing objects. The basic principle of TOPSIS method is to sort by detecting the distance between the evaluation object and the optimal solution and the worst solution. The evaluation object is the most ideal sample when it is closest to the optimal solution and away from the worst solution. The optimal solution is when all index values reach the optimal value of each evaluation index, and the worst solution is when all index values reach the worst value of each evaluation index. We compare the optimal solution and the worst solution of each scheme, and find the scheme closest to the optimal solution and far away

from the worst solution, which is the best scheme to be selected.

According to these characteristics, we decided to use five indicators to build a supplier supply characteristic measurement index system based on TOPSIS evaluation method. The specific process is as follows [2]:

- (1) The normalized initial matrix is constructed according to the data.
- (2) Standardize the original data.
- (3) Determine the weight of each indicator.
- (4) Determine the optimal solution and the worst solution.
- (5) Calculate the proximity of each evaluation object to the best scheme and the worst scheme.
- (6) Calculate the similarity C_i between each evaluation object and the optimal scheme.
- (7) Results determined by comprehensive evaluation

The comprehensive evaluation value of the evaluation object is the proximity in the formula, which is sorted by the relative proximity. The greater the relative proximity of the evaluation object, the better, and vice versa.

3. Model solving

3.1 Solution of supplier supply characteristic evaluation model

Firstly, the five indicators to measure supplier supply characteristics are defined, and finally the supplier supply characteristics measurement index system is constructed.

- ① The weight of each evaluation index is solved by entropy weight method.

According to the basic process of entropy weight method, the five evaluation indexes are weighted by Python software. The result matrix is as follows:

$$[0.0338824, 0.48991986, 0.11440919, 0.00058025, 0.3612083] \quad (6)$$

3.2 Model solving

According to the basic process of TOPSIS method introduced above, it is necessary to select the maximum and minimum values in each column of indicators to form the best and worst scheme. We use Python software programming to determine the best scheme and the worst scheme. The results are as follows:

Table 1: Statistics of the best scheme and the worst scheme

	MD	AS	W	L	C
Negative ideal solution	-6.76247E-05	0.000208061	0.000514751	-0.930713011	0.00068813
Positive ideal solution	0.084552562	0.6094479	0.124057124	1.44416E-05	0.165842266

Finally, the proximity between each evaluation object and the optimal scheme and the final score are calculated and sorted. The information of the top 5 suppliers is as follows:

Table 2: Statistical table of results.

ID	Material Science	Negative ideal solution	Positive ideal solution	Score	Sort
S201	A	0.1016	0.4271	0.8079	1
S229	A	0.2112	0.2420	0.5340	2
S361	C	0.2274	0.2277	0.5002	3
S140	B	0.2441	0.2050	0.4565	4
S108	B	0.2803	0.1832	0.3952	5

4. Model Evaluation

4.1 Advantages of the model

1. This paper preprocesses the data before modeling, which makes the data more suitable for the model and the results more real.

2. This is the innovation of this model: the introduction of a series of original indicators, including supply-demand matching degree and supply law, is of great significance to measure the characteristics of suppliers and build a series of evaluation system.

4.2 Disadvantages of the model

We assume that suppliers and forwarders are independent of each other and have no preference. In real life, the situation is often more complex.

References

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