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Solution of Enterprise Ordering and Transportation Scheme Based on Planning Decision Model

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Abstract: This paper mainly studies the ordering and transportation of raw materials in production enterprises.In order to improve production efficiency and meet the production needs of enterprises,it is necessary to formulate a scientific and reasonable ordering and transportation scheme.Firstly,this paper analyzes the data and arranges the total supply of 402 suppliers from large to small. It is found that the supply of the first 60 suppliers accounts for 99%of the total supply,and the other suppliers accounting for only 1% of the supply are of low importance to the enterprise.Then,this paper establishes the TOPSIS comprehensive evaluation model,formulates the three indicators of total supply,stability and dishonesty,objectively weights the evaluation model by using the entropy weight method,and finally selects the top 10 suppliers.

Keywords:TOPSIS comprehensive evaluation model; Entropy weight method

1. Introduction

A manufacturing enterprise mainly engaged in building and decorative plates mainly takes lignocellulosic and other vegetable fiber materials as raw materials.The raw materials can be divided into three categories:A,B and C.The number of production weeks arranged by the enterprise every year is 48 weeks,and a 24 week material ordering and transportation plan needs to be formulated in advance,that is,the supplier,ordering quantity and transporter need to be determined according to the production capacity,so as to complete the ordering and transportation of raw materials of the production enterprise.Qian Zhuo once pointed out:"Whoever can survive in the competition will get greater development space and more opportunities."[1]It can be seen that the transportation and ordering of raw materials are very important to the development of enterprises.

The production enterprise has a weekly capacity of 28200 cubic meters,and does not produce a cubic meter of products[2].It needs 0.6 cubic meters of class a raw materials,0.66 cubic meters of class B raw materials or 0.72 cubic meters of class C raw materials.Due to various conditions,the raw material suppliers required by the production enterprise cannot supply goods strictly according to the order quantity,that is,the actual supply quantity may not be equal to the order quantity.In order to maintain the raw material inventory that meets the production demand for no less than two weeks as far as possible,so as to ensure the normal production needs,enterprises often purchase all the raw materials of suppliers.The upper limit of each transporter is 6000 cubic meters per week,which is often transported by one transporter.

At the same time,in the process of actual transportation,the loss of raw materials is also one of the influencing factors[3].The ratio of loss quantity to supply quantity is defined as the loss rate,and the number of raw materials actually transported by the forwarder to the production enterprise is defined as the receiving quantity.

As we all know,the cost will affect the benefit of the enterprise.The unit price of class a raw materials and class B raw materials are 20%and 10%higher than that of class C raw materials respectively.The unit transportation cost and storage cost of class A,B and C are equal.

2. Model Pretreatment

2.1 Indicators reflecting the importance of production

Set some indicators that can reflect the importance of production.From the perspective of ensuring enterprise production,through data mining[4],we set three indicators:total supply,stability and dishonesty.

Total supply refers to the sum of the quantity of raw materials supplied by each supplier within five years(240 weeks).

The stability index is reflected by the standard deviation.Fill all the data with supply equal to 0 in 240 weeks with the average value of other non-zero weeks,and then calculate the standard deviation.

Dishonesty refers to the value obtained by comparing the difference between the number of orders for raw materials required by the manufacturer and the number of raw materials provided by the supplier with the number of orders for raw materials required.When this ratio is greater than 0,the number of orders required is greater than the supply

The supplier's supply quantity is defined as dishonesty;After mining the data,it is found that the enterprises are listed in the table

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of enterprise order quantity in Annex 1

The total order quantity of 402 suppliers is converted into production capacity of 8909859 cubic meters.However,in the table of supplier supply quantity,the total supply quantity is converted into production capacity of 6703971 cubic meters,which is about 24.76%less than the order quantity converted into production capacity,and is still less than 28200 cubic meters multiplied by 6768000 cubic meters in 240 weeks.Therefore,if the supplier's supply is greater than the enterprise's order

Quantity,that is,when the ratio is less than or equal to 0,it is beneficial to the benefit of the enterprise,which is defined as not breaking faith.

After summing up the ratio of supplier's dishonesty and dividing it by its dishonesty times,the average dishonesty degree of the supplier is obtained.

2.2 Data simplification

Through further data mining,we found that the supply volume of the top 60 suppliers accounted for 99%of the total supply volume of all 402,and the total supply volume of the remaining 342 accounted for 1%of the total supply volume.Therefore,it is reasonable to believe that we should select the 50 suppliers that are most important to ensure the production of the enterprise from the top 60 suppliers.

3. TOPSIS evaluation model

3.1 TOPSIS evaluation model is established according to the selected indicators

(1)The analysis of the three indicators shows that the total supply is benefit indicators(the higher the index value,the better the index),and the stability and credibility are cost indicators(the lower the index value,the better).

Therefore,the first step is to forward the two indicators of stability and dishonesty:

X_{ij} forms a matrix with 60 rows and 3 columns(the row represents the supplier and the column represents the selected three indicators),which is recorded as matrix X;

Now forward the two indicators of stability and dishonesty corresponding to columns 2 and 3.The processing formula is $maxX_{ij} - X_{ij}$.

(2)Dimensionless matrix X with formula $Z_{ij} = X_{ij} / \sqrt{\sum_{i=1}^{60} X_{ij}^2}$ to obtain matrix Z with 60 rows and 3 columns;

3.2 There are 60 objects to be evaluated and the standardized matrix of 3 evaluation indicators.

$$Z = \begin{bmatrix} Z_{11} & \cdots & Z_{13} \\ \vdots & \ddots & \vdots \\ Z_{601} & \cdots & Z_{603} \end{bmatrix} \tag{1}$$

Define maximum:

$$Z^+ = (max\{z_{11}, z_{21}, ..., z_{601}\}, max\{z_{12}, z_{22}, ..., z_{602}\}, max\{z_{13}, z_{23}, ..., z_{603}\}) \tag{2}$$

Define minimum:

$$Z^- = (min\{z_{11}, z_{21}, ..., z_{601}\}, min\{z_{12}, z_{22}, ..., z_{602}\}, min\{z_{13}, z_{23}, ..., z_{603}\}) \tag{3}$$

Define the distance between the ith evaluation object and the maximum value

$$D_i^+ = \sqrt{\sum_{i=1}^{3} \omega_j (Z_j^+ - z_{ij})^2}. \tag{4}$$

Define the distance between the ith evaluation object and the minimum value

$$D_i^- = \sqrt{\sum_{i=1}^{3} \omega_j (Z_j^- - z_{ij})^2}. \tag{5}$$

To sum up,we can calculate the score of the I(I is matrix 2...Matrix 6)evaluation object without normalization treatment:

$$S_i = D_i^- / (D_i^+ + D_i^-) \tag{6}$$

3.3 Solution of TOPSIS evaluation model

(1)Data forward.

(2)Dimensionless treatment.

(3)Calculate distance.

The top 10 most important suppliers can be solved by Python as shown in the table below:

Tab1 Top 50 most important suppliers.

business	raw material	dishonesty	stability	total supply	score	rank
S229	A	0.001404835	780.8170124	591478.3333	0.088344	1
S140	B	0.024041505	6607.421782	457646.9697	0.068378	2
S361	C	0.001411585	559.3990277	455666.6667	0.068131	3
S108	B	0.006280917	1856.677227	365075.7576	0.054524	4
S282	A	5.0846E-05	644.6309235	282233.3333	0.042092	5

S151	C	0.009152599	2534.498368	270136.1111	0.040267	6
S275	A	0.000141681	192.5077797	264255	0.039396	7
S329	A	0.000187124	198.7770017	260863.3333	0.038887	8
S340	B	0.000376159	241.7978358	259736.3636	0.038718	9
S139	B	0.004998809	3201.647143	230093.9394	0.034253	10

4. Entropy weight method

4.1 Solution of information entropy

After simplifying the data as a whole,the original data of 60 groups of suppliers selected are standardized,and the effect indicators and cost indicators are obtained as follows:

$$\left(S_{ij}\right)_{n} = (x_{ij} - x_{jmin})/(x_{jmax} - x_{jmin}) \tag{7}$$

$$\left(S_{ij}\right)_{h} = (x_{jmax} - x_{ij})/(x_{jmax} - x_{jmin}) \tag{8}$$

Then the obtained indexes are standardized to obtain the index standardization matrix:

$$S = \begin{bmatrix} S_{11} & \cdots & S_{13} \\ \vdots & \ddots & \vdots \\ S_{601} & \cdots & S_{603} \end{bmatrix} \tag{9}$$

Calculate the probability matrix P from the probability calculation formula $p_{ij} = s_{ij}/\sum_{i=1}^{60} s_{ij}$.

Calculated information entropy $e_j = \sum_{i=1}^{60} p_{ij} \cdot \ln p_{ij}$.

4.2 Solution of information utility value

Defined by the information utility value:

$$d_j = 1 - e_j \tag{10}$$

4.3 Solution of weight coefficient

After normalizing the information utility value,the entropy weight of each index is:

$$\omega_j = (1 - e_j)/(\Sigma 1 - e_j) \tag{11}$$

The calculated indicators are shown in the table below:

Tab2 Indicators.

Term	Information entropy e	Information utility value d	Weight coefficient w
MMS-total supply	0.8705	0.1295	91.90%
NMMS-dishonesty	0.9959	0.0041	2.89%
NMMS-stability	0.9927	0.0073	5.20%

References:

[1] Qian Zhuo,Fu Zhaoming(2021).Construction cost management and control of construction engineering[J].Construction enterprise management,(09):57-58.

[2] Wang Yu,Peng Libin,Long Jie(2019).Application of entropy weight method in independent evaluation index weight of resettlement[J]. Yunnan hydropower,35(05):26-28.

[3] Li Juan,Zhang Di,Shen Houcai(2014).Research on Retailer ordering decision with a sense of fairness[J].China management science,22(08):90-99.

[4] Xu Bing,Xiong Zhijian(2015).Supply Chain Pricing and ordering decision based on customer strategic behavior and shortage loss[J].China management science,23(05):48-55.