Research on Supplier Evaluation System Based on AHP and Gray Relational Analysis

Yangjun Liu

North China Electric Power University (Baoding), Baoding, Hebei, 071000, China

Abstract: The construction industry is an important pillar economic industry. By managing the material procurement, the procurement cost can be reduced, which is helpful to expand the profit margin of enterprises and improve the economic benefits. This paper quantitatively analyzes the supply characteristics of 402 suppliers, and analyzes the data from the following four aspects: analyzing the order quantity of enterprises, analyzing the supply of suppliers, analyzing the supply rate of suppliers, and setting evaluation criteria to analyze the satisfaction of enterprises with each supplier. After the weight is determined by AHP, the data of 402 suppliers for 240 weeks are integrated by grey relational analysis, and the corresponding correlation degree is obtained and sorted. The higher the correlation degree, the more satisfying the set evaluation index and the more satisfying the production demand of the enterprise. Finally, 50 most important suppliers were selected.

1. Introduction

As we all know, the construction industry is an important pillar economic industry and a barometer of economic development. Under the background of rapid economic growth and the promotion of urbanization policy, the development scale of the construction industry has gradually increased, which also increases the competition within the construction market. For construction enterprises, in order to cope with the market competition and gain advantages in the competition, in addition to improving their own technical strength, they also need to "take part in internal work" to do a good job in enterprise internal management, among which material procurement management is the key point that needs special attention. Through the management of material procurement, the procurement cost can be reduced, which is helpful to expand the profit margin of enterprises and improve economic benefits. [1]

2. Supplier Index Selection Based on AHP

Analytic hierarchy process (AHP) refers to a complex multi-objective decision-making problem as a system, in which the objective is decomposed into multiple objectives or criteria, and then into several levels of multiple indicators (or criteria and constraints), and the single ranking (weights) and total ranking of the levels are calculated by qualitative index fuzzy quantification method, which can be used as a systematic method to optimize the decision-making of objectives (multiple indicators) and multiple schemes. [2]

In this question, aiming at how to choose a more suitable supplier, we will decompose the problem into four components according to the nature of the problem, and gather and combine the factors at different levels according to their interrelation and affiliation, so as to form a multi-level analysis structure model, and finally the problem will be attributed to the determination of the relative important weights of the lowest level (scheme level) relative to the highest level (target level) or the arrangement of relative advantages and disadvantages.

Step 1: Establish a hierarchical structure model. Firstly, there are four factors that influence the selection of suppliers: the order quantity of enterprises, the supply quantity of suppliers, the supply rate of suppliers (that is, the ratio of supply quantity to order quantity), and the satisfaction of enterprises with each supplier. By solving the eigenvector of the judgment matrix, the influence degree of these four factors on how to select suppliers, namely priority weight, is obtained, so that it can be applied in the grey relational analysis.

Step 2: Four influencing factors process data separately. Through centralized processing of the data in the above four aspects, each supplier corresponds to four data: supply rate, satisfaction degree, order quantity and supply quantity. The supply rate refers to the ratio of weekly supply to order quantity, and the data of 240 weeks are added to get the average value. Order quantity refers to the sum of the order quantities put forward by the enterprise for each supplier. Supply quantity refers to the sum of the supply quantity that each supplier can supply in 240 weeks. Set detailed criteria for evaluating satisfaction.

Step 3: Set the satisfaction evaluation standard. Due to the influence of different situations on satisfaction, the evaluation satisfaction standards are set as follows: ① Set the highest satisfaction to 1 and the lowest to 0, and the corresponding satisfaction should be between 0 and 1. ②If the order quantity is 0 and the supply quantity is 0, that is, the enterprise has no order demand for a certain supplier, and a certain supplier has not provided the goods to the enterprise. In this case, the satisfaction degree is 0. ③ Let the supply quantity be X and the order quantity be Y. If x/y is greater than 0 and less than 1, the number in the range of 0 to 1 is the satisfaction degree. If x/y is greater than 1, that is, the supply quantity of a supplier is greater than the order quantity required by the enterprise, the satisfaction degree is 1. ④ If the supply quantity is 0 and the order quantity is not 0, that is, a supplier does not provide the supply quantity required by the enterprise, the satisfaction degree is 0.

Step 4: Construct a judgment matrix. According to the objective discussion, the degree of influence of these four factors on the final result (that is, the weight of each factor) is set as follows:

Table 1: Judgment Matrix

	Supply quantity	Supply rate	Satisfaction	Order
Supply quantity	1	1/3	1/4	2
Supply rate	3	1	1/2	4
Satisfaction	4	2	1	5
Order quantities	1/2	1/4	1/5	1

Step 5: Check the consistency. Because CR < 0.10, the consistency of the judgment matrix A is acceptable.

Step 6: Use eigenvalue method to calculate the weight. A matrix has an eigenvalue of n and other eigenvalues of 0. In addition, we can easily find that when the eigenvalue is n, the corresponding eigenvector is, and this eigenvector is just the first column of the consistent matrix. Because the consistency of our judgment matrix is acceptable, we can follow the method of finding the weight of the consistent matrix.

Step 1: Find the maximum eigenvalue of matrix A and its corresponding eigenvector.

Step 2: normalize the obtained feature vectors to get our weights.
The resulting weights are as follows:

Table 2: Index weight

index	weight
Supply quantity	0.1248
Supply rate	0.3056
Satisfaction	0.4918
Order	0.0778

3. Evaluation of Supplier Based on Grey Relational Analysis

For the factors between two systems, the degree of correlation is a measure of the degree of correlation that changes with time or different objects. In the process of system development, if the changing trends of the two factors are consistent, that is, the degree of synchronous change is higher, that is, the degree of correlation between the two factors is higher; Otherwise, it is lower. Therefore, the grey relational analysis method is a method to measure the degree of correlation between factors according to the degree of similarity or dissimilarity of development trends among factors, that is, "grey relational degree".[3]

In order to apply this method, first of all, determine the reference series, that is, the data series reflecting the behavior characteristics of the system, also known as the evaluation standard. Let the supply quantity be X and the order quantity be Y. Because the model we established takes x/y as the formula, when the result is closest to 1, it can be considered that the supply quantity can meet the order quantity, so set 1 as the best evaluation standard, that is, the reference series value. Then, determine the comparison object, that is, the data sequence composed of factors that affect the system behavior.

Find the grey correlation coefficient between reference series and comparison series. The degree of correlation is essentially the degree of geometric difference between curves. Therefore, the difference between curves can be used as a measure of the degree of correlation.

Find the correlation degree. Because the correlation coefficient is the correlation degree value between the comparison series and the reference series at each moment, it has more than one number, and the information is too scattered to make overall comparison. Therefore, it is necessary to concentrate the correlation coefficient of each moment (that is, each point in the curve) into one value, that is, to find its average value, which is used as the quantitative expression of the correlation degree between the comparison series and the reference series. The correlation degree formula is as follows:

Identify the 50 most important suppliers. According to the obtained correlation degree ri, the satisfaction degree of 402 suppliers is ranked from big to small, and the most important 50 suppliers can be obtained.

4. Conclusion

In a word, for construction enterprises, the procurement of engineering materials needs to focus on the development of the times, integrate various supply schemes with characteristics, and promote the construction of procurement process. In practice, we should do a good job in supplier evaluation and selection, strengthen construction, improve the supply chain system, and do a good job in supply chain management, so as to comprehensively improve the procurement level of engineering materials in construction enterprises.

References

[1] Zou Hongjian. Analysis of procurement management of building engineering materials from the perspective of supply chain [J]. Green building materials, 2021 (06): 1-2. DOI: 10.16767/J.cnki.10-1213/Tu.2021.06.001.

[2] Zhao Shuangjun, Xu Mingliang. Research on the evaluation index weight of green suppliers in textile enterprises based on AHP [J]. Progress of Textile Science and Technology, 2021 (11): 45-47+60. DOI: 10.19507/J. CNKI.1673-0356.2021.11.011

[3] Wang Jianhao, Wang Long, Sean, Cui Lijie. Grey group clustering and multi-attribute decision-making of supplier selection based on improved CRITIC [J/OL]. Systems engineering and electronics: 1-12 [2021-12-03]. http://kns.cnki.net/kcms/detail/11.2422