Expert analytical method for evaluating suppliers of material resources for an industrial enterprise

Método analítico experto para evaluar proveedores de recursos materiales para una empresa industrial

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Abstract
The article offers an expert-analytical method for evaluating the choice of a resource supplier for an industrial enterprise. It is based on combining the expert evaluation method and the index method and calculating the criteria for evaluating the quality of the supplier. This makes it possible to increase the efficiency and accuracy of selection by combining subjective and objective approaches. The number of criteria to be evaluated may vary depending on the specifics of the company's activities. The method contributes to the development of the theory and practice of management of supply and production activities of the enterprise.
key words: supplier, rating, evaluation indicators, industrial enterprise

Resumen
El artículo propone un método analítico experto para evaluar la elección de un proveedor de recursos para una empresa industrial. Se basa en una combinación del método de evaluaciones de expertos y el método de índice y el cálculo de los criterios para evaluar la calidad del proveedor. Esto le permite aumentar la eficiencia y la precisión de la elección combinando enfoques subjetivos y objetivos. El número de criterios evaluados puede variar según los detalles de la empresa. El método contribuye al desarrollo de la teoría y la práctica de la gestión de las actividades de suministro y producción de la empresa.
Palabras clave: proveedor, calificación, indicadores de evaluación, empresa industrial

1. Introduction

Nowadays, there is no unified method for evaluating a supplier selection in the field of logistics research. This issue is topical, as it affects the results of the company's activities, providing it with necessary material resources. The number of estimated indicators can amount to several tens. It is important to choose the most important indicators correctly. The method proposed by the authors will help simplify the procedure for selecting the optimal supplier. This work is based on the study of the experience of domestic and foreign researchers.

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2. Methodology

The goal is to justify theoretically the development of a method containing indicators for evaluating the choice of a supplier that is optimal for an industrial enterprise in modern economic conditions.

The main goals of the study are:

1. To conduct a theoretical research of existing methods of supplier selection;

2. To highlight the main evaluation indicators;

3. To show the calculation of the proposed indicators;

4. To Output the criteria for evaluating the supplier's quality.

An expert-analytical method combining the method of expert assessments and the index method was used to solve this problem.

The method of expert assessments is based on a subjective assessment of both indicators and the significance of indicators. Therefore, the quality of such a rating of suppliers depends on the knowledge, practical experience and intuition of experts. The second method is based on the calculation of objective indicators, which ensures accuracy and mathematical validity. Combining these methods allows to eliminate the disadvantages of each of them, focusing on their advantages.

3. Results

Several Russian and foreign scientists have contributed to the study of the supplier rating calculation methodology, such as: Gadzhinsky (2017), Kobrinsky (2001), Anikin (2019), Kolobov (2012), Sergeev (2012), Firon (2006), Kuznetsova (2012).

The procedure for evaluating suppliers in their work is usually as follows:

- a list of indicators is defined, based on which a decision will be made on the preference of a particular supplier;

- the supplier is evaluated according to the planned indicators by the method of point expert assessments;

- the share of each indicator in the total set of indicators is estimated using expert assessments;

- the rating of each supplier is calculated using the formula:

$$A_k = \sum_{i=1}^{n} B_i * O_i,$$

Where Ak is the rating of k-supplier; Bi –the share of i-indicator; Oi – the assessment of i-indicator.

- the results are compared and the best partner is determined.

Thus, an array is formed from the entire set of suppliers. All the elements in itare ranked in a descending order. The first supplier is the most profitable partner for production and supply operations.

This algorithm is based on a subjective assessment of both indicators and the share of indicators. Therefore, the quality of such a rating of suppliers depends on the knowledge, practical experience and intuition of experts.

In their research Dybskaya and Kolobov (2012) provides an approximate scheme for rating suppliers, offers a description of each indicator and its score. However, there is no justification for gradation based on such indicators as price, quantity, and time to transport resources.

Gordon and Karnaukhov (2001) suggests using a matrix model when choosing a supplier. The order volumes and delivery terms are specified in the rows; suppliers - in the columns. The purchase prices and tariffs can be found at the intersections of the rows and columns. By defining the lowest costs by columns, it is possible to select a potential supplier. The final selection is made taking into account the quality characteristics of the service level (reliability of deliveries, readiness to respond to changes in delivery conditions, the duration of relationships with suppliers), which can be evaluated using a point system. The described approach involves the synthesis of qualitative and quantitative indicators in the rating of suppliers.

A similar method of evaluating and selecting suppliers is used by Tyapukhin (2020). The researcher suggests building a matrix. The factors are the range of resources and the list of suppliers. The intersection of rows and columns indicates the total cost of purchasing resources (prices and transport costs). The proposed method excludes such important indicators as the quality of resources and reliability of supplies, which may prevail when choosing a supplier over the cost of purchasing resources.

Kobrinsky (2001) based the calculation of the supplier rating on the definition of the following indicators: the supplier's product quality coefficient, the coefficient of fulfillment of contractual obligations, prices and transport costs. The proposed algorithm does not explain how to determine the product quality coefficient. The positive aspect is that there is no subjective assessment of indicators. The supplier selection criteria are based on the minimum total cost of purchasing resources, adjusted for the two proposed correction factors.

Sawik (2019) proposes a scenario-based supplier selection method to reduce supply disruptions.

Chan and Man (2020) evaluate the supplier based on a model of coordination between the seller and the buyer with synchronized cycles, taking into account the costs of manufacturing, transporting and storing inventory.

After analyzing the existing approaches to evaluating the rating of suppliers, the authors of this research propose to use an expert analytical method. Its main difference is the synthesis of the index method and the method of expert evaluations.

The indicators of evaluation of suppliers are calculated by the analytical method. It is based on the growth rate of prices, the growth rate of supply of material resources of poor quality (quality indicator), the growth rate of average delay (reliability indicator of delivery), the growth rate of saleprofitability and the liquidity ratio of the supplier (indicators of financial condition). In addition to the indicators of price, quality and reliability of delivery, it is necessary to take into account the remoteness of suppliers and the degree of satisfaction of consumer needs in the range. Table 1 shows formulas for calculating indicators using the objective method.

The significance of indicators is determined by the method of expert assessments. For this purpose, specialists with practical experience in supply and production activities are involved. Experts can use any of the known methods of assessment (questionnaires, interviews, brainstorming, round table, etc.).

Table 1
Methods of calculating indicators

Index	Formula	Comment
1. Weighted average price growth rate, T_p	$$T_p = (\sum_{i=1}^{n} T_{pi} * d_i) * 100$$	T_{pi} - the rate of price growth for the i type of material resource supplied; d_i - the share of the i type of material resource in the total volume of deliveries for the current period
2. The growth rate of supply of materials of poor quality, T_q	$$T_q = \frac{d_1}{d_0} * 100$$	d_1, d_0 - the share of materials of poor quality in the total volume of deliveries for the current and previous periods
3. The growth rate of the average delay, T_t	$$T_t = \frac{O_1}{O_0} * 100$$	$O_1 O_0$- the average delay per delivery in the current and previous periods, days
4. The ratio of the remoteness of the provider, T_l	$$T_l = \frac{L_1}{L_0} * 100$$	L_1 - the distance to the supplier, km; L_0- the distance to the nearest supplier, km
5. The degree of satisfaction of consumer's needs in the product range, C'_y	$$C_y = \frac{N_n}{N_H} * 100$$ $$C'_y = 100 - C_y$$	N_n - the number of inventory items supplied by the supplier; N_H - the required number of inventory items for the production of final products; C'_y–adjusted degree of customer satisfaction by product range
6.1. The growth rate of the profitability sales of the supplier, T_r 6.2. The growth rate of the supplier's liquidity ratio, T_m	$$T_r = \frac{R_1}{R_0}; \; T_m = \frac{K_1}{K_0}$$ $$T'_r = \frac{100}{T_r}; \; T'_m = \frac{100}{T_m}$$	R_1, R_0 –the supplier's profitability sales in the current and previous periods; K_1, K_0 - the supplier's liquidity ratio in the current and previous periods; T'_r, T'_m –adjusted growth rates of indicators T_r, T_m

In conclusion, the degree of correctness of the supplier selection is determined by the formula:

$$I = \frac{A_k}{A_1},$$

Where I is the criteria for evaluating the quality of suppliers; Ak - the rating of k-supplier; A1 - the rating of the supplier with the best position.

The rating of k-supplier with whom economic relations are established is correlated with the rating of the supplier with the best position. In practical application, the gap between these values is important. This criterion characterizes the degree of correctness of supplier selection and the degree of efficiency of the purchasing subsystem.

The peculiarity of this method is that a higher rating indicates a higher level of negative qualities of the supplier. It is necessary to adjust the growth rate of the supplier's profitability and liquidity indicators, which characterize positive qualities of the supplier.

In this case, preference should be given to the supplier that has the lowest rating. According to this system, the supplier's quality assessment criteria will vary from 1 to higher. Thus, the proposed method allows you to calculate the supplier's rating and make the right choice among possible partners.

4. Conclusions

The proposed expert-analytical method makes a positive contribution to the development of the rating assessment of a resource supplier for an industrial enterprise.

The method combines subjective and objective approaches. This allows to improve the quality of the selection of potential suppliers. Combining the knowledge and practical experience of experts with the calculation of quantitative indicators, a comprehensive rating assessment is achieved.

The method considers not only the values based on the requirements of the procurement (low price, high quality and reliability of supply, the minimum remoteness of the provider, maximum degree of satisfying consumers needs on the product range), but takes into account the interests of the subsystem "production". This suggests a systematic (logistics) approach to rating suppliers.

Bibliographic references

Anikin, B., Anikin, O. (2019). Trends in the development of modern logistics. Logistics. 12 (157), 34-39. Retrieved from:

https://www.elibrary.ru/item.asp?id=41567579

Chan, C., Man, N., Fang, F., Campbell, J.(2020). Supply chain coordination with reverse logistics: A vendor/recycler-buyer synchronized cycles model.Omega (United Kingdom)Volume 95, September 2020. 102090.Retrieved from:

https://www.sciencedirect.com/science/article/pii/S0305048318302925?via%3Dihub

Dybskaya, V., Kolobov, A., Sergeev, V. (2012). Logistics. Tutorial. 3rd edition. Moscow. Scientific Publishing Center INFRA-M. 368. Retrieved from:

https://www.elibrary.ru/item.asp?id=29795448

Firon, H, Linders, M. (2006). Supply and inventory management. Logistics. St. Petersburg. Publisher Victoria Plus. 768. Retrieved from:

https://www.labirint.ru/books/68113/

Gadzhinsky, A. (2017). Logistics. The textbook. 21st edition. Moscow. Dashkov & K Publishing House. 420. Retrieved from:

https://znanium.com/catalog/document?pid=414962

Gordon, M. Karnaukhov S. (2001). Logistics of goods distribution. 2nd edition. Moscow. Center for Economics and Marketing. 200. Retrieved from:

https://www.logistics-gr.com/index.php?option=com_content&id=12763&c-72&Itemid=99

Kobrinsky, G. (2001). Calculation of supply and sales parameters. Risk. 1, 23-28. Retrieved from:
http://opac.ntbminprom.ru:8080/opac/index.php?url=/notices/index/IdNotice:458772

Kuznetsova, M. (2015). Analysis of logistics procurement management. Economic analysis: theory and practice. 43 (442), 43-52. Retrieved from:

https://www.elibrary.ru/item.asp?id=24623636

Kuznetsova, M. (2012). Methodology of analysis and evaluation of resource providers. Economic analysis: theory and practice. 43 (298), 57-61. Retrieved from:

https://www.elibrary.ru/item.asp?id=18078166

Sawik, T. (2019). Disruption mitigation and recovery in supply chains using portfolio approach. Omega (United Kingdom). Volume 84, April 2019, 232-248. Retrieved from: https://www.sciencedirect.com/science/article/pii/S0305048316309665?via%3Dihub

Tyapukhin, A. Logistics (2020). Textbook. 2nd edition. Moscow. Publishing house Yurayt. 568. Retrieved from: https://urait.ru/index.php/bcode/448056