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A COMPARISON OF SUPPLIERS AND THEIR LEVELS WITHIN THE PURCHASING PROCESS

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Abstract: Due to the effects of the global economic crisis, manufacturing companies have been forced to look for savings in all areas. Many manufacturing entities in recent years have not sufficiently optimized their purchasing processes. Effective and cost-optimised purchasing, however, is a crucial factor in a company's success. Assessing the quality of suppliers and their services therefore appears to be a key aspect. Deciding on which supplier to use is not easy, because there are multiple criteria that concern the complete marketing purchasing mix and other inner and outer factors that need to be taken into account. The final decision may have a significant impact not only on the entire manufacturing process, but also on the competitiveness of the respective product or the company as a whole.

1. Introduction

Purchasing is one of a company's key activities that in essence begins the transformation process. By the term purchasing, we mean all company business activities that aim to gain both tangible and intangible assets for a respective company. In a broader sense, purchasing can be characterised as a set of company activities related to establishment of the given company's need for material sources to perform its business functions and those activities associated with obtaining these sources, their transport, payment, distribution (such as stock management), inventory management and possible wear before their handover to production as well as inspections and lodging complaints about poor quality goods. [1]

2. The importance of purchasing within a company

This set of activities thus secures the materials required to initiate the manufacturing process within a given quantity, time and quality. The pivotal bearer of the purchasing function in every company is in most cases the purchasing department. As in every other area, the proper functioning of such department depends on suitably chosen and precisely defined assigned tasks, on the delegation of powers and on defining how to manage internal and external relationships. Economic stimulation of the whole department as well as individual workers remains a key aspect here. [2, 3]

Purchasing in its essence provides all feedstock for the manufacturing process. When the feedstock is acquired under poor (high) prices or a failure in shipment occurs, the entire manufacturing process can be adversely affected. Ultimately, this could lead to a danger of not meeting the needs of the customer or even losing them. The purchasing process can thus significantly affect a company's competitiveness.

3. Supplier Evaluation

Selecting and evaluating suppliers can occur in different ways. Most of them, however, are based on monitoring pre-defined criteria. These may be related to price, quality, delivery times, delivery conditions and many other factors. However, only those criteria that are significant to the respective company are mostly looked at in these evaluations. Businesses prefer those that are related to the company's economic and business results (price, cost and quality). The volume of a purchase from a respective supplier (the actual size of the purchase) is naturally significant. Previous experience with the given supplier is thus often incorporated into the evaluations. In general, we can classify all potential criteria into the following four groups:

- criteria related to the product,
- criteria related to provided services,
- criteria concerning the price and contractual terms,
- criteria that evaluate the supplier's attitude and behaviour [4].

It is often better to secure a purchase from multiple sources in order to eliminate the dependence on a single supplier, which in addition allows for the possibility to conduct a comparison. This possibility is also used by companies operating in automotive production and related processes. Organisations always work with a number of long-term proven suppliers. In the case of repeated purchases, it is recommended to re-evaluate the selection

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of a supplier based on updated information, supplemented by a comparison of new purchase options and experiences. During the purchase decision-making, it is useful to distinguish between two groups of suppliers. The first group consists of smaller, regional suppliers. Even smaller contracts could be useful for these subjects. These suppliers try with the utmost effort to meet the agreed-upon orders because they do not want to lose a customer or to lose credit with the other potential partners. The second group consists of major suppliers that are able to deliver, often promptly, a fairly wide range of products. These suppliers, however, sometimes expect a higher level of activity from the buyer or concessions in qualitative parameters.

When deciding upon a supplier, companies should proceed so that the (according the availability of information and the severity of purchasing decision-making) final decision will be the result of:

- an expert assessment by a team or an individual,
- a rating evaluation (simple or with valuation - weighing - of the significance of individual criteria),
- a consideration of the results of calculating factors that can be directly quantified and an indirect quantification of quantitative characteristics (through a rating or an expert assessment),
- a combination of previous approaches [5, 6].

We often encounter difficulties when selecting and evaluating suppliers [7]. This may be due to the number of possible criteria. The actual evaluation can be based on the use of dozens of different criteria, such as in the automotive industry. [8] In the case of evaluating several suppliers, the process is even more complex (Figure 1).

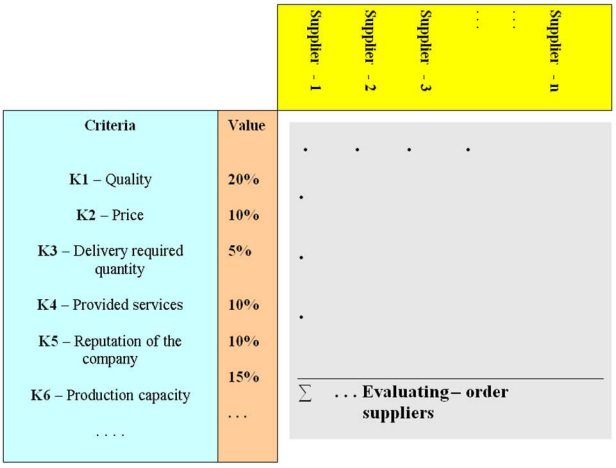

Figure 1 The multi-criterion character of supplier evaluation

Businesses often use a number of criteria when evaluating supplier subjects. Individual criteria then naturally have different meanings and significance. It is necessary to evaluate the significance and importance of the individual criteria. Many subjects have these weights adjusted rather intuitively. Applying methods that help to reduce the intuitive character of the importance of evaluating individual criteria seems to be very appropriate here. An interesting option is the pairwise comparison method. This method uses a binomial comparison of all the monitored criteria. The criterion that is most important to the respondent is always identified with using this comparison.

Overall, the most important criterion is thus the criterion with the highest number of preferences. Preferences are considered non-normed weights which must be subsequently converted into normed weights. However, it can occur that a particular criterion has zero preference, which would mean it has zero importance. The nature of deciding on criteria, however, clearly shows that each selected criterion has a certain amount of importance. In this case, an additional consideration of obtained preferences is performed.

Calculating weights (1) is carried out using the following equation:

$$v_i = \frac{n+1-p_i}{n(n+1)/2} \qquad (1)$$

n – the total number of criteria,

p_i – the order of each criteria by number of gained preferences.

An example of the pairwise comparison method can be demonstrated on weight assigning for five selected criteria for an industrial company. The purchasing department has set the following five criteria for which it wants to use of the supplier evaluation:

Criterion No.1 – The amount of material placed in a consignment warehouse.

Criterion No. 2 – Discounts.

Criterion No. 3 - The speed of stock replenishing in the consignment warehouse.

Criterion No. 4 - The reliability of communication with the supplier.

Criterion No. 5 - The quality of raw materials and services.

The goal is to assess the weight and importance of each individual criterion. One hundred points must be distributed between the five monitored criteria, according to their importance for the company. During the first step, all the criteria are compared against each other (the left part of Table 1). In this way, all the possible criteria combinations are compared. The results of each evaluation are tabulated. The investigator always decides between two criteria and writes in the table the one that he/she considers more important (e.g. comparing K1 and K2). Using this procedure, he/she is able to compare all pairs of individual criteria (Table 1).

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Table 1. Weight assessment using the pairwise comparison method

K1	K2	K3	K4	K5	K_i	P_{pi}	P_i	V_i
	1	1	1	1	K1	4	1	0.33
		2	2	2	K2	3	2	0.27
			3	3	K3	2	3	0.20
				5	K4	1	4	0.07
					K5	0	5	0.13

The number of preferences P_{pi} is set for each criterion. This number represents the number of obtained votes. According to obtained preferences, the individual criteria are ranked (P_i). Using equation No. 2, the weights for individual criteria are identified (V_i).

$$V_i = \frac{n+1-p_i}{n(n+1)/2} \qquad (2)$$

$$V_{i2} = \frac{5+1-2}{5(5+1)/2} = \underline{\underline{0,27}} \qquad (3)$$

The calculation example for weight determination for criterion 2 is shown in equation (3). Weights for the other criteria were identified in the same way. Weights for all criteria were as follows:

K1 – The amount of raw material placed in the consignation warehouse – 0,33 - 33%.
K2 – Discounts – 0,27 - 27%.
K3 – The speed of stock replenishing in the consignment warehouse – 0,20 - 20%.
K4 - The reliability of communication with the supplier – 0,07 - 7%.
K5 - The quality of materials and services – 0,13 – 13 %.

The number of criteria can be arbitrary and the procedure for determining their weight is similar. The greatest advantage of this method is the fact that determined weights are based on a pairwise decision. The respondent determines the weights using his/her preferences. Determined weights can be thus used during the supplier evaluation.

Let's assume a company uses the criteria mentioned above when making their evaluation. These then have the following units and minimal and maximal boundaries:

K1 – The amount of raw material placed in the consignation warehouse (tons).
K2 – Discounts (1 to 5; 1 – Significant, 5 – None).
K3 – The speed of stock replenishing in the consignment warehouse (hours).
K4 – The reliability of communication with the supplier (1 to 5; 1 – Excellent, 5 – Poor).
K5 - The quality of materials and services (1 to 5; 1 – Excellent, 5 – Poor).

The following values are set for the above criteria (Table 2) for four model suppliers (D1 – D4). Each supplier is evaluated with regard to their level of quality based on all five monitored criteria. To determine which supplier is the best according to the current values, we can use the distance from fictive variant method.

Table 2. Values of individual criteria for monitored suppliers

Criteria	EVALUATED SUPPLIERS			
	D1	**D2**	**D3**	**D4**
K1	90,000	50,000	22,000	49,000
K2	2	3	4	1
K3	50	60	15	40
K4	3	2	1	4
K5	1	2	3	4

The principle of this method consists of quantifying the potential distance from the optimal variant. This method allows decision makers to also take into account criteria values, not just the ranking of suppliers in the respective area. Calculating the distance of fictive variant is shown in equation 4.

$$D_j = \sqrt{\sum_{i=1}^{n} v_i \times \left(\frac{x_i^* - x_{ij}}{x_i^* - x_i^0} \right)^2} \qquad (4)$$

n . . . the total number of criteria
x_{ij} . . . the value of each criterion in terms of individual variants
x^*i . . . the best consequence due to criterion i
x^0i . . . the worst consequence due to criterion i

The equation for calculating the distance from fictive variant takes into account the weight of the individual criterion and the best and worst values. Calculating individual distances is performed for all variants. The total sum of the distances of each criterion determines the value of the distance from the fictive variant. The smaller this value, the more profitable the given variant (supplier).

Table 3. Determining the distance from the fictive variant

				d_{ij}			
Criterion	v_i	x_i^*	x_i^0	D1	D2	D3	D4
K1	0.27	90,0	22,0	0	0.053	0.270	0.056
K2	0.33	1	4	0.037	0.147	0.330	0

K3	0.20	15	60	0.121	0.200	0	0.061
K4	0.07	1	4	0.058	0.014	0	0.13
K5	0.13	1	4	0	0.008	0.031	0.07
			∑	0.216	0.422	0.631	0.317
			D_j	0.465	0.650	0.794	0.563
			Rank	1	3	4	2

Table 3 shows the results of the supplier evaluation according to the monitored criteria. An example of the calculation (Criterion No. 1 / Supplier No. 2) follows:

$$d_i = v_i\left(\frac{x_i^* - x_{ij}}{x_i^* - x_i^0}\right)^2 = 0{,}27\times\left(\frac{80.000-50.000}{90.000-22.000}\right)^2 = \underline{\underline{0{,}053}} \quad (5)$$

The d_{ij} value within Table 3 shows the distance from the optimal variant that can be considered fictive. According to the obtained results, it is evident that the best supplier is the one marked D1. For this supplier, the determined distance from the ideal variant is the shortest (0.465). The order of the other suppliers is as follows: D4, D2, and D3. With regard to the last place supplier (D3), it is shown that the determined distance from the optimal variant is almost twice as far as the distance identified with the first place supplier, D1. The determined distance from the fictive variant generally describes the "value" of the supplier and according to this value we can also quantify the actual differences between individual suppliers. The resulting order is therefore based on a quantification of all evaluated criteria.

4. Conclusions

The purchasing process can significantly affect a company's competitiveness. A key role is played here by the supplier evaluation. This can serve not only as an instrument for developing successful cooperation with suppliers, but can also be used a metric for evaluating them. When evaluating many potential suppliers according to a number of criteria, a company cannot simply rely on intuitive evaluations. The multi-criterion decision-making method that allows a company to evaluate their suppliers based on an exact set of factors is a very versatile instrument that can be used in any industry. The applied method of distance from fictive variant allows a user to assess any number of suppliers using a wide range of criteria. The method simultaneously also allows the user to quantify individual differences. A quality purchasing process can be a crucial factor in helping a company gain a competitive edge in the current challenging market conditions where even small differences influence the success of companies.

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