METABK 55(2) 237-240 (2016)
UDC – UDK 669.71.058.7:658.73.001.8:629.113.338.45=111

ALUMINIUM SUPPLIER SELECTION FOR THE AUTOMOTIVE PARTS MANUFACTURER

Received – Primljeno: 2015-05-01
Accepted – Prihvaćeno: 2015-10-11
Preliminary Note – Prethodno priopćenje

This paper presents a methodology for selection of the optimal sources of supply, which is also known as the problem of supplier selection. Theoretical considerations are expanded with research related to aluminium supplier selection for a hypothetical manufacturer of aluminium parts for transportation equipment located in Poland. Evaluation of five suppliers of aluminium from Poland, Germany and Slovenia has been conducted using a weighted scoring method, a strengths and weaknesses method and a graphical method. Choosing the best offer and prioritizing suppliers allows not only the most rational decision in the field of supply logistics to be taken but also the quality of service in the metallurgical industry to be improved.

Key words: aluminium supplier, methodology, supplier selection, automotive industry, sources of supply selection.

INTRODUCTION

Great progress in the automotive industry in body, chassis and power train construction of is supported by the introduction of new materials with high strength [1], resistance to vibration [2] and resistance to weather conditions that have a direct effect on weight, performance and fuel consumption.

Modern material technology in automotive engineering is recognized with the highest growth rates. Light, high-strength and corrosion-resistant materials such as aluminium are commonly used. Bearing in mind the fact that approx. 85 % of the cost of logistics procurement processes due to materials and the fact that the quality of the raw material is uniquely associated with the quality of the final product, the decision to choose a supplier in the metallurgical industry is classified as strategic.

The problem of the ultimate source of supply selection is a very complex, multi-step task. This is due largely to the fact that not all decisions are made with the help of measurable parameters that can be indisputably economically justified.

In such a situation, alongside quantitative methods, qualitative methods are simultaneously commonly used [3], with expert methods belonging to the group of heuristic methods, involving the use of opinions and assessments of people deliberately selected to quantify the problem. It is believed that the expert methods should be included, especially in those decisions by an enterprise that significantly affect the provision of high-quality finished products.

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When choosing a new supplier many factors are taken into account, including the following:
- delivery time,
- quality and price of the supply material,
- readiness for delivery,
- quality of delivery,
- elasticity of supply [4 - 5].

There are many publications analysing the methodology and assessment methods used for supplier selection [6 - 10]. Usually, regardless of the assessment method, supplier selection methodology consists of the following basic steps [11]:
1. Defining the supply material
2. Defining criteria for suppliers' evaluation
3. Characteristics of suppliers
4. Evaluation and selection of suppliers.

EXAMPLE OF SUPPLIER SELECTION FOR ALUMINIUM PARTS AUTOMOTIVE INDUSTRY MANUFACTURER

Defining the supply material

Our example analysis is based on a case study of a supply problem for a company producing aluminium parts, the LEIBER company. Full automation of mass production enabled the research subject to produce a very diverse range of vehicle parts made of lightweight and very durable aluminium, used by metallurgical manufacturers from many industries, including the automotive industry.

The research object is high-quality [12] aluminium rods used in metallurgical manufacturing for various kinds of vehicles, both in in-house and outsourced [13] production.

Aluminium is used primarily as an alloy with other metals. This is due to its properties. Aluminium alloy material is plastic, but with an average strength comparable to nearly 3 times greater than cast iron, including molybdenum, but about 2 - 2,5 times less than high-strength steels. It is usually mixed with Si, Cu, Mg and Mn additions for better forming. For various reasons, aluminium alloys are more expensive for manufacturing than steel, but if we consider the advantages and disadvantages, aluminium is preferable. In one passenger car the total mass of all parts made of light alloys based on aluminium is now approx. 130 kg, which makes problems regarding its rational purchase very significant.

Aluminium is transported in the form of beams, and, depending on the diameter of the rods, there is a different number of rods in each bundle. For the purpose of analysis, bundles with 40 rods of 50 mm in diameter and 5 m in length will be described as a supply material.

In addition to the basic parameters listed below, aluminium rods must meet a few requirements: a smooth and clean surface, no pores or follicles, resistance to salt water.

Supply material parameters:
- flexural strength: $\geq$ 200 MPa,
- yield strength: Rp 0,2 $\geq$ 430 MPa,
- tensile stress: Rm $\geq$ 510 MPa,
- hardness: HB $\geq$ 135,
- elongation: $A_5 \geq 7$ %,
- dimensions (length x diameter): 500 /mm x Φ 50
- weight: 5,40 kg / m
- quantity: 40 rods (1 bundle)

Free movement must be prevented when transporting aluminium rods. Connected bundles of bars are placed on a wooden base to prevent slipping. After positioning one layer, the next layer can be installed using coasters.

Characteristics of suppliers

The aluminium supplier market in Poland is a competitive market, but due to the very high expectations of the LEIBER company the suppliers are limited. Among the already existing suppliers of the Polish factory there are German and Slovenian partners.

For the purposes of evaluation and selection of all available manufacturers of aluminium rods, five companies from Germany, Slovenia and Poland (Table 1) were identified.

Table 1 **List of suppliers of aluminium rods**

Company name	Country
(AWW) Aluminium-Werke Wutöschingen AG & Co.KG	Germany
Grupa Kęty S.A.	Poland
Impol, d.o.o.	Slovenia
Hydro Aluminium Chrzanów	Poland
Eurometal S.A.	Poland

Analysing the location of five potential manufacturers of aluminium parts can provide attractive transport conditions for suppliers located in the immediate vicinity of the enterprise. Close location of material supply flows is extremely important when there is the need for just-in-time or even just-in-sequence production, which is already becoming a standard in the automotive industry.

Qualitative evaluation of suppliers

After analysing what was available in the market, an analysis summarizing the offers of potential suppliers of aluminium was prepared (Table 2).

Table 2 **Summary of aluminium rods suppliers' offers**

Parameter	AWW	Grupa Kęty	Impol	Hydro	Euro-metal
Price (EUR / kg)	3	2	2,5	1,5	2
Delivery costs (EUR / km)	1	2	1	2	2
Completion terms	up to 7 days	up to 3 days	up to 7 days	up to 2 days	up to 2 days
Payment terms (days)	30	14	30	14	14

The first method used was a qualitative variables method (categorical method), which is the simplest method for evaluating and selecting suppliers.

Supplier evaluation was based on a qualitative method using the strengths and weaknesses model. The method includes a five-point scale based on the following criteria: price, location, market position, date of payment, completion terms, availability on the market, quality (e.g. ISO certificate). Each criterion was evaluated by a panel of experts on a five-point scale, where the following abbreviations were used: U - unsatisfactory (0 points), W - weak (1 point), S - sufficient (2 points), G - good (3 points) and E - excellent (4 points). All five suppliers were evaluated based on the offers received. An example of an assessment with the strengths and weaknesses model qualitative method is shown in Table 3 for the Grupa Kety (PL) supplier, which received the highest average score (2,85) of all the suppliers rated.

Table 3 **Qualitative evaluation method with strengths and weaknesses model for Kęty (PL) supplier**

Grupa Kęty (PL)	Average rating				
	U(0)	W(1)	S(2)	G(3)	E(4)
Price				X	
Location					X
Quality				X	
Market position			X		
Payment terms			X		
Completion terms				X	
Availability				X	
Total score: 3+4+3+2+2+3+3=20					
Average score: 20/7=2,85					

Table 4 presents a summary of the results of the qualitative evaluation of all the analysed suppliers.

Table 4 **Summary of qualitative evaluation of suppliers**

Supplier	AWW	Grupa Kęty	Impol	Hydro	Eurometal
Average score	2,71	2,85	2,57	2,43	2,75

Quantitative evaluation of suppliers

Another possibility for supplier selection may be using one of the quantitative methods. For the research analysis the weighted evaluation method was selected. This method should be initiated by preparing a diagram containing the selection criteria, i.e. the characteristics of suppliers, the established scores for these features (using a 0 - 100 scale), and the introduction of weights for those features whose sum is equal to 1. The next step involves calculating points for a given criterion. The results of aluminium supplier evaluation are shown in Table 5.

Table 5 **Summary of quantitative evaluation of suppliers**

Supplier		AWW	Grupa Kęty	Impol	Hydro	Eurometal
Criterion	Weight					
Price (EUR)	0,07	5,6	6,3	5,9	6,7	6,3
Location	0,08	5,6	7,6	6,0	7,6	7,6
Quality	0,23	20,7	19,6	21,9	20,7	21,8
Market position	0,08	7,6	6,4	7,6	6,8	6,0
Payment terms	0,09	8,1	7,6	8,1	7,2	7,7
Completion terms	0,17	13,6	15,3	13,6	14,4	15,3
Availability	0,19	18,0	18,1	16,1	12,4	15,2
Delivery costs	0,09	7,6	7,6	8,1	8,5	8,1
TOTAL	1,00	86,9	88,5	87,3	84,3	88,0

Graphical evaluation of suppliers

Rating metallurgical industry suppliers using a graphical method is carried out in a similar way to the quantitative assessment, because the assessment is made on a scale of 1 - 5 for all the selected key parameters. The tool is so convenient that it easily enables quick selection of the best supplier of all, who fills the assessment radar chart shown in Figure 1 in the fullest possible way.

Selection of aluminium supplier

Depending on the company sourcing strategy (single sourcing, dual sourcing, multi-sourcing), a decision is made on the selection of one or more suppliers, with whom partnership relations are maintained.

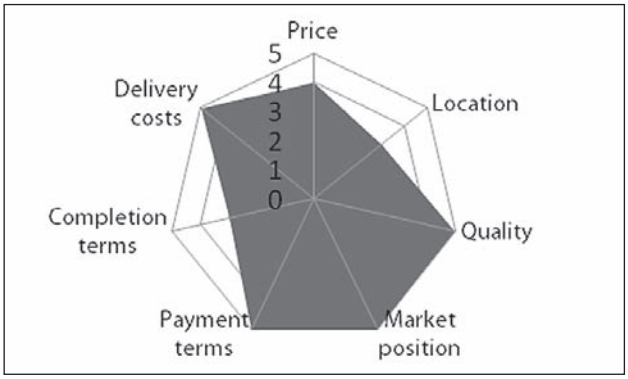

Figure 1 Visualization of the Grupa Kęty supplier evaluation with graphical method

The results of the case study showed that metallurgical industry suppliers, in spite of many differences, exhibit similar values. It is therefore important to focus on the company's key supplier selection criteria for the manufacturer. Only because the quality is so important to the LEIBER company when choosing a supplier of aluminium are companies from Germany and Slovakia considered, which are less competitive than Polish companies mainly because of their unsatisfactory location. However, they are leaders in other factors, such as the very important issue of quality. From the analysis it can be seen that the differences in the price of the material are small, but in general a large proportion of the logistics cost is the cost of delivery, which in the case of AWW and Impol will be highest due to the distance. Although the best Polish suppliers were evaluated with the highest scores, Grupa Kety and Eurometal (average score respectively: 88,5 and 88,0), despite losing out in the European market, are at the forefront in Poland, and therefore should be regular suppliers to companies located in Poland producing automotive parts.

It is worth noting that methods mentioned above not always help to identify a single supplier, sometimes alternately showing a different supplier or even excluding suppliers in different methods.

CONCLUSIONS

The problem of metallurgical materials supplier selection is a problem of strategic importance. In a competitive market such as the aluminium market, qualitative and quantitative methods help companies to make rational decisions on supplier selection.

The problem of selecting an aluminium supplier of automotive parts for the manufacturer LEIBER, presented in the article, confirmed in all the methods used that the best provider company was Grupa Kety (rating: 88,5), mainly because of a satisfactory price/quality ratio for aluminium and other key evaluation parameters: location, market position, payment terms, completion terms and delivery costs.

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