

The Supplier Selection Process in Regional Terms – Case Study Analysis

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The article presents a supplier selection procedure, which is one of the key elements of the whole procurement process, carried out in each business entity. Particular attention was paid to the regional aspect of the issue. It has also been presumed that in the case study, only local suppliers will be taken into account. Such assumptions (including close distance between potential supplier and a company) foster e.g. reduction of costs and delivery time, enhance all supply chain and enable implementation of modern management concepts. In times of strong competition, all these aspects have become particularly important. In the phase of computational experiments, which aimed at ranking and selection of the most desired supplier in the case study, multiple criteria ranking methods - Electre III/IV and Promethee II have been applied.

Keywords: logistics, supplier, multiple criteria ranking, Electre III/IV, Promethee II.

1. INTRODUCTION

Each business entity carries out its own supply process regardless of one's operating industry. As suppliers are responsible for delivery of raw materials, components, finished products or services, their selection plays a key role in all procurement process and determines a future success of the parent company on the market. Therefore, it should be well-thought and based on the set of criteria relevant from the company's /decision maker's point of view.

In the described case study, the owner of the company, operating in the furniture industry (acting as a decision maker DM), clearly indicates that only regional suppliers can be taken into consideration. Attention is drawn to the fact that close distance between the supplier and manufacturers contributes to reduction of delivery period and enables shipments of small but frequent batches of materials, which form the manufacturing process. This kind of local supply policy has also other advantages, for example: introduces modern management concepts, reduces storage costs, improves logistics process and provides calculable economic benefits. Furthermore, the regional market supply concept is

recommended in particular to small businesses as it enables direct contact and close cooperation with their supplier (which may be impeded in case of international or global supply).

The overall research goal of this paper is to indicate and emphasize regional aspects in supplier selection process and all its advantages. All those qualities have been also highlighted in the proposed methodology, based on the multiple criteria decision making. Only local suppliers have been taken into consideration (sawmills, coniferous wood suppliers) for the business operating in the furniture industry in Łódź Province (central Poland). The key evaluation criteria have been selected with respect to their effectiveness in procurement process on the regional market. In the computational phase, two multiple criteria ranking methods have been applied i.e. Electre III/IV and Promethee II.

2. REGIONAL MARKET SUPPLY

Market is being defined as a gathering of people or institutions who want to purchase particular goods or services with the sellers of those goods or services. It is a place where supply and demand meet. As a result of discussions and negotiations,

the price of a particular good or service is being established and finalized by purchase/sale transaction. In terms of geographical scope, different kinds of market can be distinguished, those are in particular: local, regional, national, international or global market. The scope of regional market encompasses a specific area of the country such as commune, district or province. In most cases it also depends on the profile of the companies operating on the given area and their investments capacities.

Due to these constraints, the dominant form of communication between clients and suppliers is a direct contact. It also enables rapid flow of information, providing opinions about products and services offered by the companies, quality of their customer service, company and its employees culture, as well as individual approach toward potential client. If the company operating on the regional market shapes its negative image, they will have great difficulties to reverse it and gain the trust of the customers. As a consequence, it is particularly necessary for the companies operating regionally to take care of employees' competences in order to establish long-term relations between the company and its business external environment, including its clients and suppliers.

Operating on the regional market also requires precise market research about its business operators, obtaining information about its potential clients, suppliers and main competition. Besides, local companies are characterised by a firm commitment to their ongoing suppliers, which is a result of non-business interests developed for many years and based on a very good and close relations. In this context it has to be taken into account, that some of the companies' owners do not even consider any possible changes. Another ones, who allow for that possibility, may have difficulties in negotiations of more favourable conditions, not to mention about the termination of cooperation with the present suppliers and starting cooperation with the new ones. Accordingly, the company strategy or operational decisions should be well thought and based on the strict rules, in order not to disrupt and at the same time to maintain a good market position.

Moreover, within the concept of regional market occurs the strategy of local supply which is an intended action aiming at searching for suppliers and other operators in the closest surrounding of the company. Its main objective is cooperation with companies operating regionally or spatially, what reduces the risk of deficiencies

or failures in transportation process by shorter routes and delivery periods. It also contributes to the safety of delivery, its timeliness, lower cost and better transparency of purchasing process (Grzybowska 2011, p. 63). Furthermore, local suppliers provide an access to the qualified labour force (Camuffo et al. 2006, pp. 135-147; Porter 1990, p. 3; Porter 1998, pp. 77-90). Such cooperation may allow for an exchange of knowledge concerning innovations for business (and places local suppliers in a favourable position which enhances the quality of products and innovations), it may determine the positive reputation of the company (for example by safeguarding workplaces) and it supports innovations (the development of local crafts) (Breschi and Malerba 2001, pp. 817-833; Maskell 2001, pp. 921-943; Salazar and Holbrook 2007, pp. 1129-1141).

Finally, such cooperation encourages different kinds of logistic concepts such as Just in Time, fair competition and continuous improvement. Also, the quality of social relations is gradually deteriorating along with the growing distance from the suppliers. It is another reason why some companies may be willing to protect local suppliers who are able to provide assistance in case of various distractions (Sorenson and Baum 2003, p. 20). Finally, in the local market clients and suppliers are subjected to the same legal rules, they have common culture, they speak the same language without having to worry about paying customs duty or the exchange rate (Arnold 1997, p. 73; Arnold 2007, pp. 13-46; Voigt 2008, p. 3). Some researchers also claim that because of fluctuations in demand at times of crisis, it is better to have an efficient local supply chain (Jin 2004, pp. 1292-1305).

It all means that close relations between clients and suppliers according to their geographic location are mostly beneficial, however some situations may also bring negative results. These include in particular: the impossibility to make use of international contacts and know-how, the risk of purchase costs increase due to the limited number of possible procurement variants - suppliers who sustain their prices do not allow for any prices negotiations or may simply have restricted production capabilities. A supplier change may be also constricted by the number of suppliers operating on one's local/regional market (Beer 2012, p. 34; Arnold 1997, p. 111; Arnold 2007, p. 29; Voigt 2008, p. 196). All these aspects may impede the potentially new cooperation with

the supplier and affect any negotiations concerning its conditions.

Thus, the supplier evaluation and selection process should be carried out carefully, taking into account all the criteria important from the manufacturing company's perspective. It is possible to achieve by application of Multiple Criteria Decision Making/Aiding which supports decision makers (people who define decision problems) with rules, tools and methods in solving complex decision problems, considering several - often contradictory - points of view (Figueira et al. 2005, p. 17; Vincke 1992, pp. 5-14). As many researchers prove (Arnold 1995, pp. 8-22; Janker 2004, p. 17; Kocój 1997; Żak and Galińska 2017, pp. 121-155) the suppliers evaluation and selection process has a multiple character. Selected methods of methodology will be applied in order to solve the problem (selection of wooden boards regional supplier for the company operating in the furniture industry) in the case study described.

3. METHODOLOGICAL BACKGROUND OF THE RESEARCH IN THE CASE STUDY

Both in theory and practice of decision making, many various tools (methods, techniques, rules) which support selection process have been discovered. Multiple Criteria Decision Making is one of those tools, as it strongly facilitates decision making process and selection adequacy. The field of multi criteria decision aid (MCDA) is devoted to the study of problems that fit the above context. Among others, MCDA focuses on the development and implementation of decision support tools and methodologies to confront complex decision problems involving multiple criteria, goals or objectives of conflicting nature. It has to be emphasized though, that MCDA techniques and methodologies are not just some mathematical models aggregating criteria that enable one to make optimal decisions in an automatic manner. Instead, MCDA has a strong decision support focus. In this context the decision maker has an active role in the decision-modelling process, which is implemented interactively and iteratively until a satisfactory recommendation is obtained that fits the preferences and policy of a particular DM or a group of DMs (Doumpos and Evangelos, 2013, pp. 3-4). Evaluation and selection process is a multidimensional analysis of all the variants, based on the criteria which are hardly comparable. Multiple criteria analysis provides not only the

most desired solutions but at the same time takes into account all criteria important from the decision maker's perspective (Roy 1990ab).

To solve multiple decision problems various tools, procedures or methods can be used. They can be generally divided into two groups: (Figueira et al. 2005, pp. 33-49; Vincke 1992, p. 11; Żak 2005, pp. 22-53)

- the methods of American inspiration based on the utility function (Keeney and Raiffa 1993), referred to as the unique criterion of synthesis methods e.g. UTA (Figueira et al. 2005), AHP (Saaty 1980; Saaty 1995, pp. 81-126);
- the methods of the European/French origin, based on the outranking relation, also known as outranking synthesis methods, considering incomparability relation e.g. Electre I-IV (Roy 1990a, pp. 324-331), Promethee and Oreste.

Electre III/IV method is the multiple criteria method of ranking the finite set of variants which are evaluated with the application of the set of criteria. The method is one of the universal multiple criteria ranking methods based upon the outranking relation (Figueira et al. 2005; Roy 1990ab; Vincke 1992). The procedures carried out with the application of Electre III/IV method aims at the construction of preference model on the basis of pairwise comparisons of all decision variants, taking into account the thresholds which define the relation between these variants (Stachowiak 2002, p. 132). Computational algorithm of Electre III/IV comprises of three stages (Galińska et al. 2015, p. 140-144):

- I – matrix evaluation construction and definition of the DM's preference model,
- II – outranking relation construction,
- III – outranking relation implementation.

The final stage of Electre III/IV algorithm gives the final ranking which ranks the variants from the best to the worst. Relations between variants are expressed in the following form: indifference (I); preference (greater than – „>”); non-preference or inverse of preference (less than – „<”) and incomparability (R).

Promethee method was introduced by Brans (Brans et al. 1984, pp. 470-490; Brans et al. 1986, pp. 228-238) to preference rank a set of decision alternatives, based on their values over a number of different criteria. Put simply, a ranking of alternatives is established based on the

accumulative preference comparisons of pairs of alternatives' values over the different criteria (using generalised preference functions) (Kun-Huang 2014, p. 452). The acronym Promethee stands for 'Preference Ranking Organization Method for Enriched Evaluation'. Thus, the Promethee method will provide decision maker with a ranking of actions (choices or alternatives) based on preference degrees. The method falls into three main steps:

- I – the computation of preference degrees for every ordered pair of actions on each criterion,
- II – the computation of uni criterion flows,
- III – the computation of global flows.

Based on the global flows, a ranking of the actions will be obtained as well as a graphical representation of the decision problem (Alessio and Nemery 2013, p. 137). The Promethee II ranking is based on the net flows only and leads to a complete ranking of the actions (i.e. the incomparable status does not exist). The actions can thus be ordered from the best to the worst. Both of the described methods solve the ranking/choice problems (table 1).

4. DESCRIPTION OF DECISION SITUATION IN THE CASE STUDY

The issue considered in this paper is evaluation and ranking of the suppliers for the company operating in the furniture industry. The company specializes in manufacturing garden furniture, distinguished by wide range of patterns, colours and fabrics. The furniture is mainly dedicated to florists and exhibitors at flower fairs, both from the country and abroad: the furniture is exported to the Netherlands. In 2016 the company reported sales of 1.2 million PLN (0.3 million EUR) with the average employment of 4 workers. It belongs to the group of small businesses sector. The company also belongs to the furniture business operators which is currently holding the fourth position within all Polish business industry sectors.

However, this industry also deals with two main problems - lack of workforce and instantly growing labour costs. Such situation forced companies to raise salaries in order to keep employees and stop the outflow of workers. The same applies to the respondent company, whose owner was forced to double the salaries only in the period of 2016/2017. Nonetheless, this situation did not affect the final price of the product, as the

Table 1. Required inputs for MCDA ranking or choice method.

Ranking/ choice problems	MCDM/A method	Input	Output
	Electre	indifference, preference and veto thresholds	partial and complete ranking (pairwise outranking degrees)
	Promethee	indifference and preference thresholds	partial and complete ranking (pairwise preference degrees and scores)

Source: (Alessio and Nemery, 2013, p. 7).

The difference between these two methods are their key parameters. Promethee only requires indifference and preference thresholds, whilst Electre requires indifference, preference and veto thresholds. The most popular methods implementing the outranking relations framework are the Electre methods, as well as the Promethee methods, with different variants for addressing choice, ranking and classification problems (Doumpos and Evangelos 2013, p. 8). Therefore, they will be applied in practical part of this paper in order to indicate the best variant in the decision situation.

main buyer (the Dutch Wholesale Market) did not accept any potential increase in price. It all forced the company to look for savings in different business segments e.g. looking for cheaper raw materials. The company's owner (acting as a decision maker in the case study described) decided to carry out a detailed analysis of the sawmills i.e. trimmed timber of dry wood (especially from coniferous wood) as it is the basic and the most important raw material in the furniture manufacturing. Any potential failures in deliveries of this material may lead to a very detrimental manufacturing stoppages.

Next, it has been presumed that only regional manufacturers will be taken into consideration - the ones located in Łódź Province (central Poland). Local supplies are mainly dedicated to small

enterprises as they bring various benefits, including:

- reduction of delivery period,
- reduction of delivery costs,
- ability to provide small, but frequent parts of raw materials forming the manufacturing process,
- reduction of storage costs,
- recovery of the value frozen in the stored raw materials,
- direct contact with the supplier,
- ability to straightforward reaction over delivery of bad quality of raw material; possibility of fast replacement,
- ability to straightforward reaction in unpredictable situations, e.g. delivery delays,
- ability to introduce modern management concepts including, among others Just in Time.

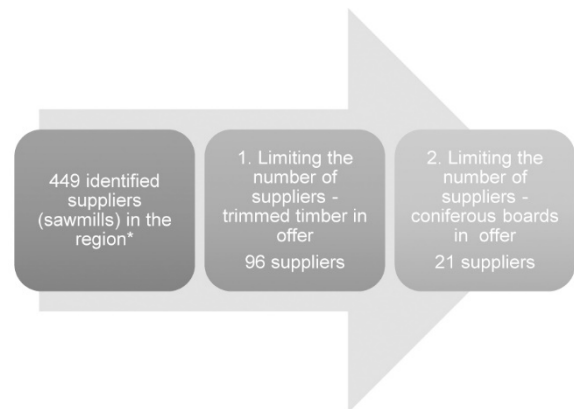
The location of the company contributes to regional cooperation as in Łódź Province there are a lot of dynamic enterprises operating in wood sector, having coniferous boards in their offer. The ongoing wood source selection was based on the habit i.e. the previous owner of the company was accustomed to his long standing supplier. The decision to look for alternative supply sources was the result of cost reduction necessity while still trying to maintain high quality of manufactured furniture. The selection process was divided into four main stages:

- I – Suppliers identification,
- II – Limiting the number of suppliers,
- III – Suppliers evaluation,
- IV – Suppliers selection.

Firstly, all manufacturers of trimmed timber which corresponded to the profile of the company were selected. Central Statistical Office served here as a rich source of data as it provided all sawmills in Łódź Province in accordance with the established regional supply strategy. Secondly, number of suppliers has been limited. This stage was divided in two parts:

- 1) elimination of suppliers who do not have trimmed timber in offer,
- 2) elimination of suppliers who do not have coniferous boards in offer.

As a result of a second step, the number of suppliers was limited to 21 (Fig. 1).



* condition on November 30, 2017

Fig. 1. Diagram of the second stage 'limiting the number of suppliers'.

Source: the authors' study.

Suppliers chosen at the second stage of selection have undergone the third stage which was a detailed suppliers evaluation with an application of multiple criteria decision making methodology and Electre III/IV and Promethee II ranking methods. The evaluation's criteria have been constructed according to the model proposed by B. Galińska and J. Żak (Żak and Galińska 2017, pp. 121-155) which distinguishes 9 main evaluation criteria. The importance weights of the criteria were formulated on the basis of the interview with the DM, his preferences and aspirations. Due to research limitations, criteria K1 - K9 and their sub-criteria have been only enumerated, without any detailed descriptions (table 2).

Some evaluation criteria were indicated as invalid for the decision maker (weight 0). They were omitted in the computational procedures as the goal was to indicate the most desired supplier in the case study. At the same time, the most significant criteria were the ones connected with the local supply strategy. The results based on the Electre III/IV and Promethee II methods are presented in the next section of this paper.

Table 2. Suppliers evaluation criteria in the case study.

Criterion	Sub-criterion	Weight of Criterion- Electre method	Weight of Criterion- Promethee method
K1: Product price and payment conditions	K1.1: Unit cost of the product delivered	10	0.2
	K1.2: Payment conditions	7	0.11
K2: Timeliness of delivery/ supplier		5	0.06
K3: Reliability of delivery	K3.1: Share of deliveries of products in appropriate quantity and conditions (undamaged)	0	0
	K3.2: Share of deliveries carried out as agreed	0	0
	K3.3: Quality of the product delivered	9	0.17
K4: Cost of delivery		8	0.14
K5: Accessibility of supplier	K5.1: Time-oriented accessibility	4	0.05
	K5.2: Geographical accessibility	10	0.2
K6: Customer Service Quality (during the supply process)	K6.1: Level of customer support (info, monitoring, problem solving, reaction)	0	0
	K6.2: Flexibility of the supplier (in changing the order)	0	0
K7: Market position of the supplier	K7.1: Market experience of the supplier	3	0.04
	K7.2: Market share	0	0
K8: Performance of the supplier	K8.1: Efficiency of Human Resources (sales/employee)	0	0
	K8.2: Assets turnover	0	0
K9: Modernity of the supplier		2	0.03

Source: the authors' study.

5. COMPUTATIONAL EXPERIMENTS WITH AN APPLICATION OF SELECTED MULTIPLE CRITERIA METHODS

Due to study limitations, the results of computational experiments have been restricted to final rankings, placing particular supplier's position. In accordance with the Electre III/IV method algorithm, the evaluation matrix has been constructed and the DM's preference model has been defined in the process of naming the wages of criteria and thresholds: indifference threshold q , preference threshold p and veto threshold v , which are the mode of expression the DM's sensitivity to the changing value of criteria. In the second stage of the algorithm, the outranking relation has been constructed. In the third stage of the algorithm, the outranking relation has been applied and on the basis on the indexes of the variants (suppliers D1-D21), the ascending and descending distillations have been performed, formulating the structure of complete preorders. Then, they have been averaged into the median ranking and the intersection of preorders resulted in the final ranking. The results of these suppliers selection calculations are presented in the Fig. 2.

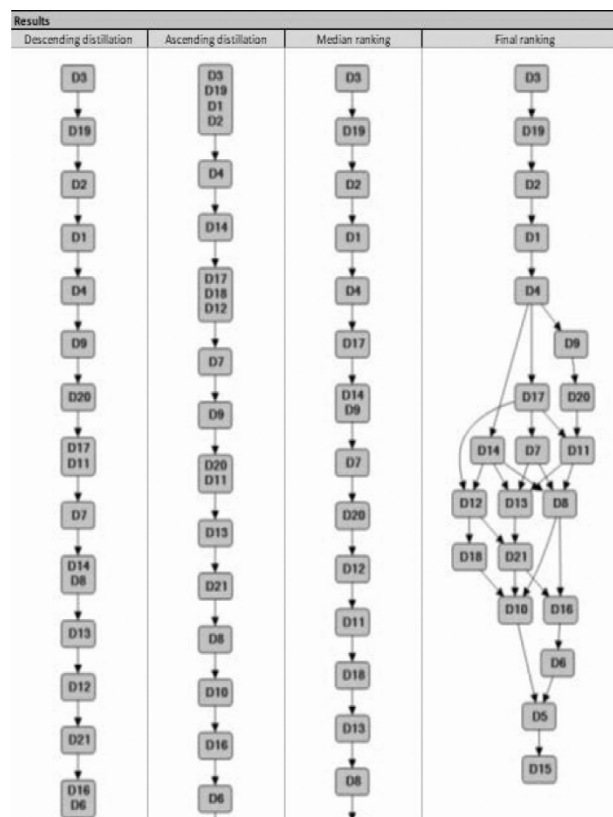


Fig. 2. The final ranking in the case study- Electre III/IV method.

Source: the authors' study.

In accordance with the Promethee II method algorithm the evaluation matrix has been constructed and the DM's preference model has been defined in the process of naming the wages of criteria and thresholds: indifference threshold q and preference threshold p . Computational experiments resulted in obtaining the final ranking are represented in Fig. 3.

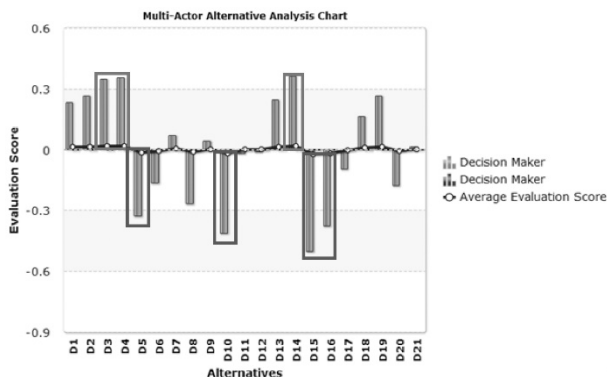


Fig. 3. The final ranking in the case study - Promethee II method.
Source: the authors' study.

The final rankings obtained with the computational experiments results indicated the best and the worst suppliers in the case study described. They are represented in Table 3.

Table 3. Computational experiments results.

Features of the Solutions	Electre III/IV method	Promethee II method
Leading Variants/Suppliers	D3, D19, D2, D1, D4	D3, D4, D14
Bottom Variants/Suppliers	D10, D16, D6, D5, D15	D5, D10, D15, D16
Recommended Supplier	D3 or D4	

Source: the authors' study.

The final selection of the best supplier for the company operating in the furniture industry indicates two different leaders of the rankings: variant D3 and variant D4. In both rankings they are placed at the top positions, in the inverse order. However, it is not definite which variant is better, so the final selection is up to a decision maker's preference. Both suppliers offered the same raw material price (coniferous boards: K1.1). Delivered raw material was featured by the same, great quality (K3.3). The delivery distance in both cases was the same (K4 and K5.2). Supplier D3 additionally demonstrated relatively modern approach (K9) while supplier D4 offered more

favourable payment terms (K1.2). Finally, supplier D4 exists longer on a market (K7.1). At the same time, in both cases it is hard to indicate any weak sides.

6. CONCLUSIONS

The article presented a comprehensive study concerning identification, evaluation and selection of suppliers in regional terms, considering the concept of regional supply and all aspects contributing to its effectiveness. The major methodological output of this research is a universal methodology of developing the suppliers, composed of the following phases: identification, limiting, evaluation and selection.

The authors of this article (and methodology) claim that evaluation of suppliers should have a multiple criteria character and thus, develop their proposal based on the principles of Multiple Criteria Decision Making/ Aiding (MCDM/A). They formulate the problem of evaluating suppliers as a multiple criteria ranking problem. They propose heuristic – identification phase, based on expert knowledge, to select all manufacturers which corresponded to the profile of the company. In the second phase – limiting the number of suppliers – they have been limited (elimination of suppliers who do not have needed goods). Suppliers chosen at the second stage have undergone the third stage which is a detailed suppliers evaluation. In this phase two computer-based MCDA ranking methods, including Electre III/IV and Promethee II have been applied. Finally – in selection phase, the best suppliers have been indicated. The proposed methodology has been developed in accordance with the established regional supply strategy.

Based on the case study analysis, which referred to the identification and evaluation of coniferous boards suppliers for the company operating in furniture industry, the authors clearly indicated features specific for regional market activity. These features were further implemented to a proposed methodology of suppliers evaluation and selection, where decision maker – the owner of the company – indicated some of the criteria as not important (not included in experiments) and formulated the other criteria wages. The most important criteria were the ones which contribute to the idea of effective regional supply.

Based on the generated results the authors of this article recommend variants (suppliers) D3 or D4 as the most desired solutions for regional

supply. The selected regional suppliers are featured by the following characteristics:

- low price of raw materials,
- very good quality of delivered raw materials,
- short delivery distance.

The article is of both methodological and utilitarian character. The developed methodology can be applied in different cases when regional supply strategy is to be developed. In the authors' opinion further research should be carried out in two directions:

- application of alternative MCDM/A methods (AHP, ANP, UTA) to the evaluation of different categories of suppliers,
- further analysis of suppliers' selection processes in different industries.

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