Comparative analysis of multiple criteria evaluations of suppliers in different industries

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Abstract

The paper presents the comparative analysis of suppliers’ selection problems in different industries, formulated as multiple criteria ranking problems. The evaluation of logistics service providers (LSPs) in a household chemistry industry and meat suppliers in a food industry are carried out. The author compares both the alternative formulations of the decision problems (input) and generated results – output rankings of suppliers. On the input side he confronts: alternative definitions of variants, construction of different families of evaluation criteria, various ways of modelling of the DM’s preferences. On the output side the results of computational experiments performed with the application of ELECTRE III/IV and AHP methods are demonstrated. Different aspects of the decision processes concerning the selection of suppliers are thoroughly discussed.

1. Introduction

The process of procurement has a critical significance for the daily operations of almost all manufacturing and service companies all over the world. Different entities order and purchase various categories of raw materials, components, semi-finished goods, final products, by-products, utilities and services. They search for the most efficient arrangement of their deliveries, which translates into the overall profitability and competitive position of individual companies and whole supply chains. It also has a strong impact on satisfaction and trust of their customers. The smooth delivery process strongly depends on the proper selection of appropriate suppliers.
The selection and evaluation of suppliers is a widely discussed topic in the literature (Brewer A., et al, 2006; Coyle J. et al, 2010). Different procedures have been developed to recognize strengths and weaknesses of suppliers, evaluate their experience and market position, assess their organizational capabilities and compatibility with the customer (Coyle J. et al, 2010, Rushton A., 2006). The suppliers’ evaluation process should include (Galinska B., et al, 2015; Zak J., 2005, Brewer A., et al, 2006) different functional segments of the supplying company and various aspects of their activities. Some researchers (Sawicka H., Zak J., 2014; Galinska B. et al, 2015) claim that the evaluation of suppliers should include the analysis of their potential to build long-term, stable cooperation, cultural and organizational integrity with the customer, capabilities for innovation and development, reliability and trustworthiness in other partnerships, willingness to share risk and profit with the cooperating institution. Based on the universal logistics principles, the suppliers are obliged to satisfy a widely known standard of the “7 Rights Rule” - right product, condition, quantity, time, customer, place and costs. (Shapiro R., Haskett J., 1985).

As discussed above and also supported by other reports (Galinska B., et al, 2015; Zak J., 2005, Brewer A., et al, 2006; Rushton A., 2006) the assessment and selection of suppliers has a multiple criteria character. It should include various aspects of technical, economic, social, organizational, market-oriented and environmental character and the interests of different stakeholders (interveners). Thus, in such a context, the natural trade-offs and contradictions should be taken into account and the effort must be focused on searching for the compromise solutions that would balance them. Some of the papers [Anders W., 1992] present different approaches for short- and long-term selection of the suppliers, also modified for local and global markets. In other works [Galinska B., et al, 2015, Brewer A., et al, 2006; Rushton A., 2006] the analysis of suppliers refers to the comprehensive problem of developing a stable, extended supply network.

In this paper the author carries out a comparative analysis of multiple criteria evaluations of suppliers in two different industries. The goal of this paper is to find similarities and differences in the evaluation processes of suppliers in different industries, based on the principles of multiple criteria analysis. The author assumes that the presented article should contribute in the future to the development of a universal, generic methodology of selecting the suppliers for different environments, supply conditions and external circumstances. The challenge and the novelty of this work is to present the comparison of the evaluations of suppliers across different industries, where the nature of the selection process and the profile of suppliers are entirely different. The originality of this work consists also in the description and confrontation of all components of multiple criteria analysis of suppliers in different industries. To the best of the author’s knowledge such a contribution have not been reported in the literature, so far.

The paper is composed of 5 sections. In the first one the background of the analysis is presented and the principles of the suppliers’ selection are discussed. In addition, objectives of the research are defined. The second section includes the description of the Multiple Criteria Decision Making/Aiding (MCDM/A), including the presentation of the applied MCDM/A methods. Section 3 is focused on the presentation of two case studies. Each of them refers to the selection of suppliers in a different industry. Section 4 presents the results of computational experiments generated with the application of Electre III/ IV and AHP methods, followed by their analysis. Section 5 includes the comparison of the considered decision processes focused on the selection of suppliers and final conclusions. The paper is supplemented by a list of references.

2. Multiple Criteria Decision Making/Aiding (MCDM/A)

2.1. General features of MCDM/A

Multiple Criteria Decision Making/Aiding (MCDM/A) is a field of study that develops rules, tools and methods supporting the decision maker (DM) in solving complex decision problems, in which several – often contradictory – points of view must be taken into account (Figueira J. et al, 2005, Vincke P., 1992; Zak J., 2005). The methodology of MCDM/A has a universal character and can be applied in various cases when the DM solves a so called multiple criteria decision problem (MCDP).

MCDP is a situation in which, having defined a set of actions/variants/solutions A and a consistent family of criteria F the DM tends to (Figueira J. et al, 2005, Vincke P., 1992; Zak J., 2005):.

- determine the best subset of actions/variants/solutions in A according to F (choice problem),
• divide $A$ into subsets representing specific classes of actions/variants/solutions, according to concrete classification rules (sorting problem),
• rank actions/variants/solutions in $A$ from the best to the worst, according to $F$ (ranking problem).

There are two major components of each MCDP, i.e. a set of actions/variants/solutions $A$ and a family of criteria $F$. In the analysed cases the MCDPs are formulated as multiple criteria ranking problems. The set of $A$ is defined directly in the form of a complete list and includes all considered suppliers. The family of criteria $F$ should satisfy the conditions of consistency (Roy B., 1990; Vincke P., 1992). In the analysed cases the applied families of criteria $F$ are different. They evaluate various aspects of the considered variants and represent the interests of different stakeholders. Based on the performed evaluation the variants – suppliers are finally ranked from the best to the worst.

When the MCDPs are solved it is practically impossible to select options or variants which are the best from all points of view simultaneously. Thus, multiple criteria methods do not yield “objectively best” solutions. Instead of that they focus on producing compromise solutions (Figueira J., et al, 2005), i.e. such variants that take into account the trade-offs between criteria, balance the expectations of different stakeholders and satisfy the preferences of the DM. The above defined MCDPs are solved with the application of specific procedures, methods and decision making/aiding tools, which can be classified according to several criteria, including the manner of the preference aggregation (Zak J., 2005; Zak J., 2010). Using this classification criterion one can distinguish:

• The methods of American inspiration (Keeney R., Raiffa H., 1993) based on the utility function; e.g. AHP (Satty T., 1980; Satty T., 1995) or UTA (Figuira J., et al, 2005)
• The methods of the European/French origin, based on the outranking relation (e.g. Electre methods (Roy B., 1990), Promethee I and II (Figuira J., et al, 2005).

In this paper the Electre III/IV method and AHP method are applied to rank the suppliers in the two above mentioned industries. The evaluation of suppliers is carried out based on a universal 5-step procedure of solving the multiple criteria decision problem, described in the works of B. Roy (Roy B., 1990) and J. Figueira et al (Figueira J., et al, 2005).

2.2. Short description of Electre III/IV method

The Electre III/IV method belongs to a family of multiple criteria ranking procedures based on the outranking relation (Roy B., 1990). It generates final rankings of a finite set of variants and orders them from the best to the worst, taking into account the following relationships between variants: indifference (I), preference (P) and incomparability (R).

To start the computational procedure of the Electre method the following input data is required: matrix of performances, which comprises the evaluation of each variant by each criterion and the DM’s preference model constructed with the application of indifference $q_j$, preference $p_j$ and veto $v_j$ thresholds as well as the weight $w_j$, defined for each criterion. The thresholds define the sensitivity of the DM to the changes of the criteria values and the weight $w_j$ expresses the importance of each criterion.

The computational procedure starts with the calculation of concordance indicators $C(a,b)$ for each pair of variants $a$ and $b$ and presented as a concordance matrix. $C(a,b)$ expresses the extent to which the scores of $a$ and $b$ on all criteria is in concordence with the proposition $a$ outranks $b$. Next, the discordance index $D_j(a,b)$ is calculated for each criterion $j$, taking into account arguments represented by the values of criteria for which one cannot accept the statement that $a$ outranks $b$. Finally the outranking relation $S$ is constructed. $S$ indicates the extent to which “$a$ outranks $b$” overall. It is expressed by the degree of credibility $d(a,b)$.

Based on $d(a,b)$ the method establishes two preliminary rankings (complete preorders) using a classification algorithm (distillation procedure). During this procedure one can obtain a descending and an ascending preorder. In the descending distillation the variants are ranked from the best to the worst, while in the ascending distillation they are ranked in the inverse order. The intersection of two preorders gives the final ranking. Further details of the
computational algorithm applied in Electre III/IV method can be found in the works of (Roy B., 1990; Vincke P., 1992; Figueira J., et al, 2005).

2.3. Short description of Analytic Hierarchy Process (AHP) method

Similarly to Electre III/IV method the AHP is also a multiple criteria ranking procedure that ranks a finite set of variants from the best to the worst. It is focused on the hierarchical analysis of the decision problem. Through the definition of the overall objective, evaluation criteria, subcriteria and variants the method constructs the hierarchy of the decision problem. As opposed to Electre III/IV method the AHP is based on a multi-attribute utility theory (Keeney R., Raiffa H., 1993) and generates final rankings of variants based on their aggregated evaluations represented by a utility function. In the final rankings generated by the AHP method the possible relationships between variants are limited to: indifference (I) and preference (P). All variants evaluated by the AHP method are comparable.

The computational procedure of the AHP method starts with the definition of the DM’s preferential information on each level of the hierarchy, based on the pair-wise comparisons of criteria, sub-criteria and variants. This model of preferences is expressed in the form of relative weights \( w_r \) (Saaty T., 1980), which represent relative strength of the compared element against another, expressed on the 1 to 9 point scale. All weights have a compensatory character, i.e.: the value that characterizes the less important element (1/2, 1/5, 1/9) is the inverse of the value assigned to the more important element in the compared pair (2, 5, 9).

In the next step of the AHP computational procedure, the consistency of the above mentioned preferential information given by the DM on each level of the hierarchy, is investigated. For each matrix of relative weights \( w_r \) the consistency index \( CI \) is computed. If the value of \( CI \) is close to 0 the preferential information given by the DM is considered to be almost perfect. The acceptable level of \( CI \) is below 0.1. If this condition is not satisfied the redefinition of the preferential information is required.

The algorithm of the AHP method solves a, so-called, eigenvalue problem (Saaty, 1980) on each level of the hierarchy. As a result, a set of vectors containing normalized, absolute values of weights \( w_a \) for criteria, subcriteria and variants, is generated. The sum of the elements of the vector is 1 (100%). The absolute weights \( w_a \) are aggregated by an additive utility function. The utility of each variant \( i \) – \( U_i \) is calculated as a sum of products of absolute weights \( w_a \) on the path in the hierarchy tree (from the overall goal, through criteria and subcriteria) the variant is associated with. The utility \( U_i \) represents the contribution of variant \( i \) in reaching an overall goal and constitutes its aggregated evaluation that defines its position in the final ranking.

3. Selection of suppliers in different industries

3.1. Case study 1 - analysis of suppliers in the household chemistry industry

The decision problem considered in the first case study consists in evaluating and ranking a set of logistics service providers (LSPs) that compete for transportation services to be delivered to a customer - manufacturer and distributor of cosmetics, detergents and washing articles. The customer - an international company CUS located in Warsaw, Poland delivers its products to 400 customers distributed all over Poland and generates an annual turnover of 400 mln Polish zloty [PZL] (roughly - 100 mln Euro). The considered transportation operations are of a large scale (annual distance - 5 mln km; monthly shipments - 20 000 – 25 000 Euro pallets). The management team of CUS, acting as a decision maker (DM) is not satisfied with the existing level of transportation services offered by the current carrier. Thus, they search for a new transport operator and carry out a multidimensional analysis of the considered carriers - LSPs.

In the analysis 8 LSPs - carriers, operating on both Polish and international market constitute the variants. They have different market experience and reputation. Their annual sales range between 7,5 mln [PZL] and 182 [PZL]. The smallest company employs 53 employees, while the largest almost 1000 people. The fleet of each carrier is composed of tractors and traitors, trucks and vans. The overall fleet size being in possession of each carrier is diversified and ranges between 0 and 200 vehicles. Some of the LSPs do not maintain their own fleet and subcontract transport operations. The variants are denominated by their abbreviated names: ERD, HARTK, NOLIM,
POLBI, PTRAN, SPOL, RDPOL, TR-UN. The analysis allows to compare the existing carrier – RDPOL with 7 prospect service providers.


3.2. Case study 2 - analysis of suppliers in the food industry

The second case study refers to the selection of meat suppliers for a small producer GARM of ready-made food products, such as: dumplings stuffed with meat, rump stakes and meat croquettes. Due to the fact that current level of GARM’s sales has been relatively small (0.20 mln PLN per year) the company has been focused on purchasing the raw material (pork meat) from a local retailer. In the recent months the demand for GARM’s products has increased substantially which has resulted in the need for ordering the meat in much larger quantities. The demand for pork meat has doubled from 300 kg per month to 600 kg per month. It has been forecast that the future annual demand for meat may reach the level of 10 000 kg (10 tonnes). This level of demand qualifies GARM for wholesale purchases and requires much larger and more frequent meat deliveries with higher regularity.

In such circumstances the manager/owner of GARM, acting as a decision maker (DM), has decided to terminate the contract with the existing meat supplier and select a new one. Due to the increased demand for meat and the resulting wholesale nature of meat purchases he/she has decided to investigate a group of slaughterhouses and/or meat processing plants as prospect suppliers of pork meat for GARM. In his/her opinion, the effect of scale and elimination of one link of the supply chain should result in certain cost savings (cheaper meat) and higher quality of the delivered material (pork meat). The DM wants to carry out a comprehensive, multiple aspect evaluation of all considered suppliers, including the existing one.

In the analysis 7 meat suppliers - variants, operating on the local market have been considered. The suppliers are denominated by symbolic names: D1, D2, D3, D4, D5, D6 and D7. They are featured by different size, experience and market reputation. In this set of suppliers 6 companies (D1, D2, … D6) represent the meat processing plants. Four of them have their own slaughterhouses and purchase the livestock from Polish farmers, while the two remaining ones cooperate with external slaughterhouses and purchase the preprocessed meat in the form of carcass (of slaughtered animals). The current supplier – D7, being the meat retail store, purchases the meat from a local slaughterhouse.


4. Computational experiments

Both cases of the suppliers’ selection problems have been solved with the application of two multiple criteria ranking methods: ELECTRE III/IV AND AHP. A universal, 5-step procedure of solving multiple criteria decision
problems (Vincke P., 1992; Zak J., 2005, Zak J. 2010) have been applied. In both cases it involved the following elements:

1. Identification and verbal description of both decision problems (as presented in sections 3.1 and 3.2, respectively).
2. Formulation of the mathematical model representing the problem and collection of the relevant data required to run the model. Definition of variants (suppliers) and consistent families of criteria. Recognition of the DM and stakeholders. Modeling of their preferences.
3. Analysis and selection of computer-based procedures capable to solve multiple criteria ranking problems. In the analyzed cases the ELECTRE III/IV and AHP methods have been chosen. The following computer implementations of these methods have been applied: MCDM Toolkit (Excel Version of ELECTRE method) and Transparent Choice Software (AHP method).
4. Running a series of computational experiments with the following sub-steps:
   - Entering the data into the software. Construction of the Evaluation Matrix.
   - Building the model of preferences. In AHP method the model of preferences involved the pairwise comparisons of all elements of the hierarchy (criteria, sub-criteria and variants) on a 1-9 point scale, resulting in the computation of relative weights \( w_r \). In ELECTRE III/IV method this phase has been focused on the definition of the criteria weights \( w_j \) and thresholds of indifference – \( q_j \), preference – \( p_j \) and veto – \( v_j \).
   - Computing appropriate indexes and parameters, including:
     - The consistency indexes \( CI \) for each matrix of relative weights \( w_r \), absolute weights \( w_a \) (solving an eigenvalue problem), utility value of each variant \( i \) – \( U_i \) (aggregation of \( w_a \) by an additive utility function) in AHP method.
     - The concordance indicators \( C(a,b) \) for each pair of variants \( a \) and \( b \), discordance indexes \( D_j(a,b) \) for each criterion \( j \) and degrees of credibility \( d(a,b) \) representing the outranking relation \( S \) in ELECTRE III/IV method.
   - Generating the final rankings of variants based on their computed utilities in the AHP method and through descending and ascending distillations in ELECTRE III/IV method.
   - Analyzing the results of computational experiments and selecting the most desirable solutions (from among the leaders of the rankings).
5. Recommending the selected variant for implementation. Comparing the existing solution with the new one.

4.1. Case study 1 - analysis of suppliers in the household chemistry industry

The ranking of LSPs generated by the application of the AHP method is presented in fig.1, while its equivalent produced by the ELECTRE III/IV method is shown in fig. 2. As demonstrated in the figures the generated rankings are quite different, however their certain similarities can be noticed. The AHP-based ranking has a graphical - quantitative character and shows the overall utility of each variant (between 0.28 for POLBI and 0.77 for PTRAN). In this case all variants can be compared through the analysis of their utilities and the distance between them can be computed. For instance the “utility distance” between PTRAN and SPOL is around 0.11 while the distance between TR-UN and RIDPOL is close to 0.02. The interesting feature of this ranking is its capability to present the contribution of each criterion to the fulfillment of the final goal. As one can see the criteria that contribute the most to the success of PTRAN are: C3 and C7. The ELECTRE–based ranking has a graphical – qualitative nature. Neither final graph nor the ranking matrix contain numerical results. Thus, the distances between rankings cannot be recognized. At the same time one can observe in the ranking generated by ELECTRE method an enriched model of mutual relationships between variants, including: indifference (I) – variants placed in one box on a graph; preference (P) – one variant placed above another one; inverse of preference (P') – one variant placed below another one and incomparability (R) – variants without connection on a final graph.

In the experiment based on the application of AHP method the three leading variants include: PTRAN, SPOL and ERD. These LSPs substantially outperform the remaining candidates. In the ELECTRE-based experiment four leading positions are occupied by: SPOL, ERD, PTRAN and HARKT. Based on the rankings generated by both methods the most recommended solution seems to be SPOL. This LSP is a market leader with a noticeable market
share (above 5%). It offers high quality, reliable and quick response customer service. SPOL is a flexible service provider that guarantees high standard at a reasonable cost (average level of transportation costs).

Fig. 1. The results of computational experiments for case study 1 generated with the application of AHP method. The ranking of LSPs.

a)

b)

c)

Fig. 2. The results of computational experiments for case study 1 generated with the application of ELECTRE III/IV method. a) Descending and ascending distillations b) Final ranking c) Ranking matrix for LSPs.
4.2. Case study 2 - analysis of suppliers in the food industry

Similar rankings have been generated with the application of AHP and ELECTRE methods in the second case study. They are presented in figures 3 and 4, respectively.

As shown in the graphs, the positions of the variants – meat suppliers in the rankings generated by AHP and ELECTRE methods are not identical. However, certain similarities in the evaluation of the variants can be identified. The leaders of both rankings are the same: D3, D6 and D7, however their sequence is different in these...
two rankings. The AHP-based ranking strongly supports the selection of variant D7, while the ELECTRE-based ranking promotes variant D3. In the ranking generated by the AHP method the evaluations of two remaining leaders: D3 and D6 are almost equal – their utilities are close to 0.59. At the same time the utility-based distance between them and the first-positioned variant D7 is substantial – around 0.12. At the same time the results generated by ELECTRE method prove that position of variant D7 may be ambiguous. Especially, in the descending distillation its rank is low – bottom level. In the final ranking of the ELECTRE method, D7 is outperformed by the two remaining leaders: D3 and D6. In these circumstances the recommended solution is variant D3, placed first in the ELECTRE-based ranking and second in the AHP-generated ranking. Supplier D3 is a large and efficient meat processing plant with its own slaughterhouse, featured by a good market position and 25-year experience in delivering meat to different customers, including large market chains.

The bottom parts of both rankings are very similar and include variants: D4, D5, D2 and D1. The AHP method prioritizes D4 against D5 (by 0.10 – utility wise), while ELECTRE method considers these variants as incomparable (placed in disconnected boxes). The AHP method differentiates variants D1 and D2 (priority is given to D2), while ELECTRE method positions them as indifferent variants (D1 and D2 are placed in the same box).

5. Comparison of the suppliers’ evaluation and selection processes. Final conclusions

As presented in both case studies the evaluation of suppliers has a multiple criteria character, regardless of the considered industry. It can be formulated as a multiple criteria ranking problem, which results in ordering the variants – suppliers from the best to the worst. The author claims that the proposed formulations are satisfactory and allow for evaluation of the considered suppliers from different perspectives. He recommends that suppliers’ evaluation in different industries should be formulated as a multiple criteria ranking problem.

As demonstrated in the paper the stages of the suppliers’ evaluation processes (presented in section 4) have a generic and universal character and can be identical, regardless of the considered industry. They involve: 1. Identification and verbal description of the decision situation; 2. Formulation of the mathematical model; 3. Analysis and selection of computer-based solution procedures; 4. Running a series of computational experiments; 5. Final recommendations.

Due to specific nature of each industry different families of criteria should be defined to evaluate suppliers in respective sectors. The author has demonstrated in the paper that in household chemistry and food industries the proposed families of criteria that evaluate suppliers may and should be different. In table 1 he has presented the comparison of the proposed families of criteria with the generic logistics standard of “7 Rights”. He has also demonstrated their assignment to major categories/aspects of suppliers’ evaluation, described in literature (Brewer A., et al, 2006; Galinska B., et al, 2015). As one can see in case study 1 several elements of “7 Rights Concept” have not been included in the analysis of LSPs. In case study 2 all of them have been taken into account. In case study 1 the omitted components have included: right product, right quantity, right place. In the author’s opinion these components are quite important and should be included in the evaluation of suppliers. In case study 1 “Right place” was considered equivalent to “Right customer”. The other two elements: “Right product” and “Right quantity” have been eliminated from the analysis by the DM and replaced by critical constraints - 100% satisfaction on both of them.

It is also worth emphasizing that in certain cases of suppliers’ evaluation the “7 Right Concept” does not exhaust all the required aspects of the analysis. This is visible in case study 1, where several criteria concerning: the supplier’s market position, economic efficiency and availability are important for the DM and definitely go beyond the “classics” of the “7 Right Concept”. It is important to notice that these aspects are not considered in case study 2.

The important issue to be discussed is the question of the “consistency” of the proposed families of criteria in case studies 1 and 2. From a methodological point of view in each multiple criteria analysis the consistency of the family of criteria should be satisfied. In the author’s opinion the notion of consistency is not generic and universal. Thus, in case of suppliers’ evaluation it may indicate that in specific cases (products delivered, industries, stakeholders) the criteria used for evaluation of concrete supplier may differ and at the same time satisfy the condition of “consistency”. This question requires further research and in-depth analysis.
It is also important to mention that in both cases the major actors participating in the decision process and expressing their interests were quite similar. The selections of LSPs and meat suppliers were run by the managers/owners of the serviced companies (customers).

Table 1. The comparison of evaluation criteria used in case studies 1 and 2 with major aspects of suppliers’ evaluation reported in the literature and presented in the “7 Right Concept”.

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<tbody>
<tr>
<td>1.</td>
<td>Cost of Delivery</td>
<td>Right Cost</td>
<td>Transportation Cost</td>
<td>Cost of Delivery. Financial Conditions</td>
</tr>
<tr>
<td>2.</td>
<td>Cost of the Product Delivered</td>
<td>Right Cost</td>
<td>(+)</td>
<td>Unit Price of the Meat</td>
</tr>
<tr>
<td>3.</td>
<td>Reliability of Delivery</td>
<td>Right Product. Right Quantity. Right Place.</td>
<td>(-)</td>
<td>Accuracy of Order Fulfilment (No. of Claims/ Month) Risk of Delivery / Exposure to Danger.</td>
</tr>
<tr>
<td>5.</td>
<td>Quick Response. Order Fulfilment Time</td>
<td>Right Time</td>
<td>Delivery Time</td>
<td>Frequency of Delivery</td>
</tr>
<tr>
<td>6.</td>
<td>Timeliness of Deliveries</td>
<td>Right Time</td>
<td>(-)</td>
<td>Timeliness of Deliveries.</td>
</tr>
<tr>
<td>7.</td>
<td>Market Position, Image, Experience of the Supplier</td>
<td>(-)</td>
<td>Market Experience; Market Share</td>
<td>(-)</td>
</tr>
<tr>
<td>8.</td>
<td>Economic Efficiency of the Supplier.</td>
<td>(-)</td>
<td>Fixed Assets Turnover. Sales/ Employee.</td>
<td>(-)</td>
</tr>
<tr>
<td>9.</td>
<td>Availability of Supplier. Accessibility to the Delivery System</td>
<td>(-)</td>
<td>Service Complexity and Availability</td>
<td>(-)</td>
</tr>
<tr>
<td>10.</td>
<td>Quality and Suitability of the Delivery Fleet</td>
<td>Right Condition</td>
<td>Fleet Quality and Suitability</td>
<td>Quality and Modernity of the Fleet</td>
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These bodies acted as the decision makers (DMs) in the respective cases. In addition, in both cases interests of similar stakeholders have been taken into consideration. In case study 1 these stakeholders have included: management team and the owners of the considered company (customer), as well as second echelon customers. In case study 2 the group of stakeholders have covered the customer represented by the manager and owner of the considered entity, the supplier and final consumer of the manufactured products. It is worth noticing that the content of the suppliers’ evaluation may differ substantially, case by case, depending on the number of stakeholders being considered in the decision making process in each of them. In the author’s opinion the suppliers’ selection requires that the interests of stakeholders representing different links of the supply chain should be considered. It has been proved in this article that different models of preference can be applied to express subjective opinions and expectations of the DM and stakeholders.

As proved in this paper different multiple criteria ranking methods, including AHP and ELECTRE can be applied to rank the suppliers. Due to axiomatic differences of various MCDM/A methods the generated rankings of suppliers may differ. However, the differences between rankings generated by the AHP and ELECTRE methods are not substantial. That is why, the author suggests that in the evaluation of suppliers different multiple criteria ranking methods can be applied. In case the final rankings generated by the applied methods differ substantially several experiments should be performed simultaneously with the application of different MCDM/A tools. Final recommendations should be constructed based on the comparison of several generated rankings and their aggregation with a procedure that satisfies the DM’s expectations and preferences.
In the analyzed cases, based on the results generated in computational experiments carried out with the application of AHP and ELECTRE methods, the recommended solutions have the following features: they are placed at the upper parts of the rankings, at least at the top position in one of them; they do not have critical weak points and ambiguous trade-offs; their evaluations are high on many parameters, including the most important criteria.

The important feature of the LSPs selection process is the fact that it refers to the service provider, while the analysis of meat suppliers is focused on the evaluation of material providers. In the author’s opinion this difference should have an impact on the assessment process. The specific features of each service that distinct it from the material – physical product should be taken into consideration. In the analyzed cases this aspect is visible in the inclusion of “Unit price / cost of the product delivered” in case study 2 as opposed to case study 1.

In the author’s opinion further research should be carried out in two directions:

- Application of alternative MCDM/A methods (Promethee, Mappac, Pragma, ANP, UTA) to the evaluation of different categories of suppliers and in-depth analysis of their suitability, strengths and weaknesses.
- Analysis of suppliers’ selection processes in different industries. Comparison of evaluation criteria, aspects considered and interests of various stakeholders. Undertaking an effort to define a generic, consistent family a criteria to be applied in various suppliers’ selection processes.

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