Cost criterion versus price criterion in multi-criteria decision-making for supplier selection

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***Abstract*— The article aims to present a method developed by the authors to enhance the likelihood of selecting the optimal delivery option. Delivery costs can often constitute the largest component of manufacturing expenses for many companies, making optimization in this area particularly critical. Multiple criteria decision-making in supplier selection offers a solution. However, to make accurate assessments based on these criteria, it is essential to define them beforehand. Even the best multi-criteria analysis method will fail if the data used is inadequate, emphasizing the importance of selecting appropriate criteria. The author focuses on price and transport costs, proposing that these two individually assessed criteria be combined into a single cost criterion encompassing both price and delivery costs. This approach eliminates errors associated with determining the weight of each verifier when treated as separate criteria.**

Keywords— multiple criteria decision making, purchasing, model, price, transport costs

I. INTRODUCTION

Despite the fact that resource productivity continues to increase, and in recent years this process has gained momentum, e.g., resource productivity in comparison with GDP and DMC in the European Union increased by as much as 52% between 2000 and 2024 (EUROSTAT, 2025), the share of purchases is still one of the most important cost items for many companies. Furthermore, this indicator does not fully reflect the share of production material costs in the overall cost structure, as it only refers to the ratio of raw materials used to produce GDP – and their prices are still rising. The share of purchasing costs in manufacturing costs can reach up to 70% (Łapuszek, 2006, p. 19). The importance of choosing the right suppliers is demonstrated by the fact that the quality (or rather the lack thereof) of purchases accounts for up to 30% of operating costs, as was already noted in the 1990s (Kotewicz, 2006, p. 17, citing: Central Unit on Procurement, 1991, pp. 1-4). The importance of purchasing, including the selection of suppliers, is evidenced by the fact that entire books are devoted to this topic (Pooler&Pooler 1997), and in the 1990s a new field of knowledge called purchasing emerged (Tuszyńska, Zarzycki, 1994, p. 130). On the other hand, however, negligence in this area (at the expense of, for example, sales activities) has been pointed out for just as long, e.g., that purchasing strategies are just as important as sales and marketing strategies (Weele, 2005, pp. 16-18).

On the other hand, the issue of supply management and selecting the right supplier is treated as an afterthought by authors dealing with logistics, and in many (comprehensive) textbooks, this issue is not addressed at all or is only mentioned marginally. An example of this is a publication advertised as a 'complete handbook of logistics and supply management' (Bozarth, Handfield, 2019), whose authors devoted only a few of the more than five hundred pages to this topic.

The simplest form of supplier selection is single-criterion evaluation (e.g., based on price, availability, quality, etc.). Although simple, it carries a high risk of error, as such a selection will generally overlook many important aspects beyond the criterion used (Skowronek, Sarjusz-Wolski, 1999, pp. 137-138). It seems that the general principles of supplier selection, based on multiple criteria decision making (MCDM), were developed as early as the 20th century. It was then that the so-called point method, which is still widely used today, was developed (Abt, 2001, p. 140), presented in two forms: graphical or tabular (Sarjusz-Wolski, Skowronek, 1995, p. 5). It involves selecting criteria and assessing the supplier's

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compliance with these criteria. Most often, weights are used for the criteria to take into account the importance of a given criterion in the purchasing process. This is essentially the use of the SAW (Simple Addictive Weighting) method. It gained popularity shortly after its presentation by C. W. Churchman and R. L. Ackoff in 1954 (Churchman, Ackoff, 1954, pp. 172-187). Theoretically, instead of the SAW method, a related method called WPM (Weighted Product Model) can be used, in which the final result is not the sum of weighted scores but their product (Azadfallah, 2015, pp. 1-5; Pratama, Jumali, 2024, pp. 1688-1695), or the very similar SMART Simple Multi-Attribute Ranking Technique (Risawandi, Rahim, 2016, pp. 491-494; Taherdoost, Mohebi, 2024, pp. 190-197), where deviations from the mean act as weights and the best option is selected using weights and deviations. In addition, there are other methods described by Yildiz and Yayla (Yildiz, Yayla, 2015, pp. 158-177), although they are often considered more in theory than in practice in supply management, e.g., Analytical Network Process (ANP) (Sarkis, Talluri, 2002, pp. 18-28; Bayazit 2006, pp. 566–579; Gencer, Gurpinar, 2007, pp. 2475–2486; Liao, Chang, Tseng, 2010, pp. 753–767), Data Envelopment Analysis (DEA), (Narasimhan, Talluri, Mendez, 2001, pp. 28-37; Mahdiloo, Noorizadeh, Saen, 2011, pp. 261-266; Dobos, Vörösmarty, 2014, pp. 273-278), Grey Relational Analysis (GRA) (Li, Yamaguchi, Nagai, 2008, pp. 1032–1040), - Artificial Neural Networks (ANN) being a simulation using a neural model (Florez-Lopez, 2007, pp. 1169–1179; Aksoy, Ozturk, 2011, pp. 6351–6359; Golmohammadi, 2011, pp. 490–504), Goal Programming (GP) (Karpak, Kumcu, Kasuganti, 2001, pp.209–216; Jadidi, Zolfaghari, Cavalieri, 2014, pp. 158-165), Linear programming (LP) (Ghodsypour, O'Brien, 2001 pp. 15-27; Talluri, 2002, pp. 171–180; Talluri, Narasimhan, 2003, pp. 543–552; Hong, Park, Jang, Rho, 2005, pp. 629–639; Ng, 2008, pp. 1059–1067; Ware, Singh, Banwet, 2014, pp. 671-678, - Multi-Objective Programming (MOP) (Narasimhan, Talluri, Mahapatra, 2006, pp. 577–603; Ozkok, Tiryaki, 2011. pp.11363–11368; Amin, Zhang, 2012. pp. 6782-6791), Case-Based Reasoning (CBR) (Choy, Lee, Lo, 2005, pp. 1–17), Genetic Algorithm (GA) (Liao, Rittscher, 2007, pp. 150–159). In practice, the TOPSIS method is also used relatively frequently; hence, it is not uncommon to find publications on its application in the selection of suppliers. (Technique for Order of Preference by Similarity to Ideal Solution) (Azadfallah 2016, pp. 1-8; Chaising, Temdee, 2017, pp. 104-109; Thanh, 2025, pp. 279-290; Ristono, Wahyuningsih, Muhsin 2024, pp. 1-20; Gidiagba, Tartibu, Okwu, 2023, pp. 1243-1255). Hybrid methods are, in a sense, the 'crowning achievement' of these approaches, e.g. : AHP–fuzzy-TOPSIS, AHP–fuzzy-Weighted Sum Model WSM, AHP–fuzzy-Weighted Product Mean and many more (Lahdhiri et. al., 2024, 1-16; Zulaihan, Siswanto, 2025, pp. 4079-4090; Ortiz-Barrios et. al. 2020, pp. 443–481).

The literature on the subject contains recommendations regarding the criteria for selecting suppliers, but these are generally vague, and it is difficult to find a gradation of them. The exception are publications dealing with specific purchasing markets, such as those concerning hospitals (Hayati et al., 2025, pp. 63-83), or the selection of the most suitable company to supply smart home systems (Pirinç, Küpçüoğlu, Alakaş, 2025, pp. 1293-1306). In the case of a hospital supplier, the criteria and sub-criteria were initially identified through a review of relevant literature and subsequently refined through consultations with decision-makers, where the decision-makers were: three decision-makers (DMs), namely the head of the Goods and Services Division with 3 years of experience (DM 1), the head of the General and Engineering Department with 26 years of experience (DM 2), and the head of the Procurement Department with 3 years of experience (DM 3). The results of the study lead to the conclusion that non-price factors are important in hospitals – empirical results from a case study in a general hospital in Indonesia show that social aspects, such as patient safety and reputation, are a priority compared to economic and environmental criteria – the authors therefore deal with the selection of supplier evaluation criteria to a limited extent and focus more on ranking (assigning weight) to individual criteria than on what the criteria themselves should be.

Other articles discussing criteria address the relatively new phenomenon that has influenced supplier management and, consequently, related choices, namely the pandemic (Wang et al., 2022, pp. 3005-3019) or related to green supply chains (Karamaşa, Korucuk, Ergün, 2021, pp. 311-324). However, even when the intention is to write about criteria in green supply chains, the subject matter is mainly limited to determining the importance of the criteria, rather than defining the criteria themselves, as the authors themselves admit „This study aims to determine the significance levels of the factors that need to be taken into account when determining the criteria to be used in the selection of a green supplier and an ideal distribution model for the company. (…) to determine the significance levels of the factors".

There are few comprehensive studies reviewing the criteria, i.e., works whose authors have conducted both an in-depth analysis of the criteria and a review of the extensive literature on the subject. In recent years, the studies by G. W. Dickson certainly stand out in this regard (Dickson, 1966, pp. 5-17), C. A. Weber, J. R. Current, and W. C. Benton, (Weber, Current, Benton 1991, pp. 2-18), W. Thanaraksakul and B. Phruksaphanrat (Thanaraksakul, Phruksaphanrat, 2009), czy również H. Taherdoost and A. Brard (Taherdoost, Brard, 2019, pp. 1024–1034).

II. METHODS EMPLOYED

The very issue of selecting the right suppliers is based on finding the right selection criteria and then choosing the best option based on those criteria. One could say, following Oakland, that it requires proper design (quality of design) and proper quality of conformity to design (quality of conformity to design) (Oakland, 1989, p.6).

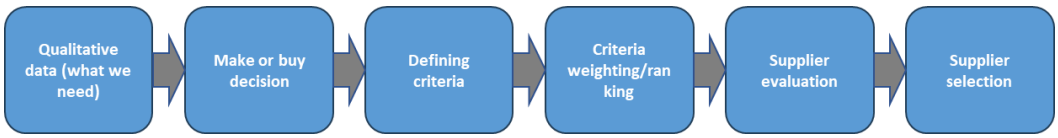
In the first stage, we can use the methodology proposed by van Weele (van Weele, 2010):

- determining the extent to which we use purchases (make or buy decision),

- determining the qualifications of potential suppliers and compiling a list of them,
- preparing requests for proposals and then analysing the offers received,
- selecting a supplier.

He therefore suggests that we first determine which elements, raw materials, parts or components we purchase (outsource production with cooperation) and which we produce ourselves. This stage should, of course, be preceded by a needs analysis, i.e., the collection of data for this analysis. When writing about supplier qualifications, Van Weele probably had in mind not so much determining their qualifications as what qualifications they should have, i.e., the criteria on the basis of which we will select a supplier. The final selection is preceded by market research (e.g., in the form of requests for proposals) to help us assess the extent to which potential suppliers meet our criteria (Fig. 1.). This process (detailed in terms of the selection of suppliers) can proceed as proposed, for example, by S. Krawczyk (Krawczyk, 2001, pp. 333-341), czy Z. Sarjusz-Wolski i Cz. Skowronek (Skowronek, Sarjusz-Wolski, 1999, pp.138-139).

FIG. 1.: SUPPLIER SELECTION PROCESS (A)



Source: own work.

According to S. Krawczyk, the supplier selection process consists of the following steps (Krawczyk 2001, pp. 333-341):

- establishing a list of criteria and organising them,
- determining the weights for individual criteria,
- defining the rules for calculating partial benefits,
- calculating scores,
- selecting the best candidate.

The process presented by Cz. Skowronek and Z. Sarjusz-Wolski is as follows (Skowronek, Sarjusz-Wolski, 1999, pp.138-139):

- defining the basic selection criteria,
- establishing scoring rules in relation to the criteria,
- introducing weights for individual criteria,
- comparing results,
- selection.

In cases of ranking and comparison, this may look slightly different than in the case of the point method, but in general, the process is very similar. The methods of selecting suppliers are presented in the introduction to this article. There are many of them, and they are probably the most mathematical and best-described stage of the process. However, it is more difficult to find literature on methods for determining (selecting) supplier criteria and assigning weights to criteria. The first stage – determining needs – is also often overlooked in the literature, perhaps because it is considered obvious. Therefore, there are no clear guidelines on how this data should be provided to the procurement department or in what form it should be implemented.

As noted, authors dealing with the subject of supplier selection generally neglect the analysis of supplier selection criteria. A notable exception is the work of H. Taherdoost and A. Brard (Taherdoost, Brard, 2019, pp. 1028-1030). The authors conducted a thorough review of the literature, which is presented in tabular form (Table 1). pp. 1028-1030). The authors conducted a thorough review of the literature, which is presented in tabular form (Table 1)

The authors, analysing a very extensive literature on the subject, listed 25 criteria – some, such as 'Quality', appeared quite commonly (in 14 authors), while others appeared sporadically, such as 'Process Improvement', which appeared in only one.

In turn, C. A. Weber, J. R. Current, and W. C. Benton identified 23 criteria (Weber, Current, Benton, 1991, pp. 2-18), while T. Worapon and B. Phruksaphanrat (Worapon, Phruksaphanrat, 2009) expanded them to 33:

- Quality,
- Delivery,
- Cost,
- Production facility and capacity,
- Flexibility and reciprocal arrangement,
- Technical capacity and support,
- Repair services and follow-up,
- Information technology and communication systems,
- Financial status,
- Innovation and R&D,
- Operating controls,
- Quality system,
- Management and organization,
- Personnel training and development,
- Product reliability,
- Performance history,
- Geographical location,
- Reputation and references,
- Packaging and handling ability,
- Amount of past business,
- Customer relationship,
- Warranties and claim policies,
- Procedural compliance,
- Customer satisfaction and impression,
- Attitude and strategic fit,
- Labor relations record,
- Economical aspect,
- Desire for business,
- Environmental and social responsibility,
- Safety awareness,

- Domestic political stability,
- Cultural congruence,
- Terrorism risk.

The history and types of make-or-buy decisions are also presented by many authors. A very comprehensive source is Klein P. G., Mazzoni J. F. R. (Klein, Mazzoni, 2025, 448-466), who shows the development of methods for making these decisions, starting from early empirical work on the make-or-buy decision to today's operational research techniques in this area.

In summary, we are currently dealing with successive stages of supplier selection. The first stage is the need to determine purchasing needs (what to buy), which is not really analysed in studies – there are no comprehensive solutions on how to create information about purchasing needs and how they should be systematically communicated to the purchasing department. The next stage is the collection of data on suppliers. This is also a topic that rarely appears in the literature. The next stage is the development of criteria. The literature available on this subject may not be the most extensive, but, as shown, it is possible to find publications that cover it quite comprehensively. The final stage is the selection of suppliers, for which, as shown, there are many developed methods (and, consequently, a wealth of literature).

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TABLE 1.: SUPPLIER SELECTION CRITERIA WITH THEIR RELATED SOURCES

Criteria	Definition
Quality	The ability of the supplier to meet quality specifications consistently which include quality features (material, dimensions, design, durability), variety, production quality (production lines, manufacturing techniques machinery), quality system, and continuous improvement.
Delivery	The ability of the supplier to meet specified delivery schedules which include lead-time, on-time performance, fill rate, returns management, location, transportation, and incoterms.
Performance history	The performance history of the supplier in the financial, economic, social, organizational, and societal area
Warranties and claim policies	The superiority of the specified written guarantee that promise to repair or replace product if necessary within a specified period and also the claim policy as a formal request for coverage or compensation for a covered loss or policy event.
Production capacity	The volume of products or services that can be produced by a supplier using current resources
Price	The price criteria includes unit price, pricing terms, exchange rates, taxes, and discount.
Technology and capability	The technological capability of a supplier and ability to acquire new technologies and technical resources for research and development practices and processes.
Cost	The cost is a monetary valuation of effort, material, resources, time and utilities consumed, risks incurred, and opportunity forgone in production and delivery of a good or service.
Mutual trust and easy communication	The level of trust on the quality of the work provided by supplier. And refers to the obligations owed between the buyer and the supplier. The easy communication is a simple exchanging of information between the firm and the supplier
Communication system	The communication system of the supplier including information on progress data of orders.
Reputation and position in industry	A ranking and reputation of a brand, product, or company, in terms of its sales volume relative to the sales volume of its competitors in the same industry.
Supplier's profile	The superiority and reputability of the supplier's status, past performance, finance, certificates, and references
Management and organisation	The reputability of the supplier's management team and the efficiency of their decision making to resolve issues in order to be both effective and beneficial.
Repair service	The ability of the supplier to restore something damaged, faulty, or worn to a good condition.
Attitude	The attitude of the supplier while you are in contact with them such as politeness and confidence
Risk factor	The risk factor is a measurable characteristic or element, a change in which can affect the value of an asset, such as exchange rate, interest rate, and market price.
Commercial plans and structure	The supplier's format statement of a business goals, reasons they are attainable, and plans and infrastructure for reaching them.
Labour relations record	The supplier's relationship between management and its workforce.
Geographical location	The geographical location of the supplier.
Reliability	The supplier's quality of being trustworthy and dependable based on the references (buyers feedback), financial stability (capital, annual turnover), past and current business partners, company organization and personnel, diversity of ownership, and cultural awareness.
Service	The ability of supplier to provide intangible products including the customization (size, shape, color, design, OEM, label service), minimum order quantity, communication (respond time, information, language), industry knowledge, flexibility, and response to change.
Process improvement	The ability of the supplier to identify, analyse, and improve upon existing business processes within its company for optimization and to meet new quotas or standards of quality
Product development	The ability of supplier to modify an existing product or its presentation, or formulation of an entirely new product that satisfies a newly defined customer want or market niche.
Environmental and social responsibility	The supplier's responsibility to use natural resources carefully, minimize damage, and ensure these resources will be available for future generations
Professionalism	The supplier's competence or skill expected of a professional.

Source: (Taherdoost, Brard, 2019, pp. 1028-1030 based on: Thanaraksakul, Phruksaphanrat, 2009; Sarkar, Mohapatra, 2006, pp. 148-163; Wadhwa, Ravindran, 2007, pp. 3725-3737; Xia, Wu, 2007, pp. 494-504; Shyur, Shih, 2006, pp. 749 761; Chan, Kumar, 2007, pp. 417-431; Jharkharia, Shankar, 2007, pp. 274 289; Gencer, Gürpinar, 2007, pp. 2475-2486; Wang, Cheng, Huang, 2008, pp. 377-386; Yu, Tsai, 2008, pp. 634-646; Cakir, Canbolat, 2008, pp. 1367-1378; Hsu, Hu, 2009, pp. 255-264; Ustun, Demirtas, 2008, pp. 918-931; Wadhwa, Ravindran, 2007, pp. 3725-3737; Watt, Kayis, Willey, 2010, pp. 51-60; Tahriri F., 2008, pp. 201-208; Ha, Krishnan, 2008, pp. 1303-1311; Bottani, Rizzi, 2008, pp. 763-781; Levary, 2008, pp. 535-542; Bayazit, Karpak, 2005; Bai, Sarkis, 2010, pp. 1200-1210; Florez-Lopez, 2007, pp. 1169–1179).

III. ASSUMPTIONS OF THE NEW METHOD

When analysing the successive stages of selecting sources of purchase, it is important to note that the stage preceding the make-or-buy decision (the first stage of work related to selecting a source of purchase) generally only occurs as a stage determining 'what we will need'. How much we will need is often overlooked, especially in situations where we assume in advance that the make-or-buy decision will be 'buy'. However, in practice, the failure of companies to determine their needs in terms of both quality and quantity can lead to poor decisions at subsequent stages of supplier selection, as discussed below.

The next stage – making the make-or-buy decision – is not controversial at this point and is not the subject of analysis in this study.

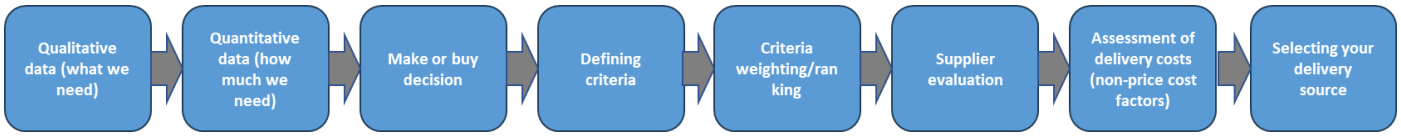
The most controversial issue, however, is the method of determining the criteria for selecting suppliers and, consequently, the weights assigned to these criteria. It should be noted that in C. A. Weber, J. R. Current, and W. C. Benton (Weber, Current, Benton, 1991, pp. 2-18) and T. Worapon, B. Phruksaphanrat (Worapon, Phruksaphanrat, 2009), there is no mention of price or quality in relation to a specific product (which is surprising given that price is considered the most important criterion (Antonowicz, 1994, after Coyle, Bardi, Langley 1988)) . The preferred model therefore concerns the evaluation of the supplier itself rather than the goods we would potentially like to purchase from them. This approach obviously allows for the evaluation of the supplier, but it is problematic whether it allows for the evaluation of whether it is a satisfactory place to source goods, as we are unable to evaluate and compare the prices offered by different suppliers. Perhaps some of the authors, when writing about the cost criterion, mean price (or vice versa). Some authors seem to equate these concepts, describing the criterion as, for example, 'price/cost' (Shyur H.J., Shih H.S. 2006).

However, even assuming that we are moving towards a method that also allows for price-based assessment, such as that used by H. Taherdoost and A. Brard (Taherdoost, Brard, 2019, pp. 1028-1030), where both the concepts of cost and price appear, we still do not have clear evaluation criteria, as some of them overlap (the evaluation of certain aspects is therefore duplicated), e.g. in the case of the 'cost' criterion, defined as: 'The cost is a monetary valuation of effort, material, resources, time and utilities consumed, risks incurred, and opportunity forgone in production and delivery of a good or service' and "delivery" defined as 'The ability of the supplier to meet specified delivery schedules which include lead-time, on-time performance, fill rate, returns management, location, transportation, and incoterms'. This leads to the conclusion that too many criteria do not make the evaluation system more transparent, but rather the opposite.

From the point of view of our considerations, the most important concepts are price and delivery costs. Some authors limit themselves to price (e.g. Krawczyk, 2001, p. 338; Skowronek, Sarjusz-Wolski, 1999, pp. 139-142, Szymonik, Nowak, 2018, p. 104), while others suggest that, in addition to price, transport costs should also be taken into account (e.g., Milewska, 1999, p. 22). Why are criteria related to transport, and in particular transport costs, not often taken into account by authors dealing with supplier evaluation? There is only one answer: because delivery costs are not an inherent feature of the supplier. Therefore, it is not possible to evaluate a supplier taking into account transport costs (unless the supplier is the one responsible for them); however, on the other hand, how can we compare two suppliers, where one does not have transport for which it charges the recipient, and the other does? On the other hand, the decision to buy from a supplier is not only based on how much we pay for the product itself but also on how much it costs us to transport the goods to our company.

The first important consideration that arises from these reflections is that evaluating a supplier is one thing, but deciding whether to buy from them is another – hence the proposal to change the supplier selection process (Fig. 2). The second is that to know how much something costs us, we need to know not only its price but also the transport costs. The third is that to find out the transport costs, we need not only qualitative information (what to buy), but also quantitative information (how much we will need).

FIG. 2.: SUPPLIER SELECTION PROCESS (B)



Source: own work

So what is to be done?

Let us start by making some assumptions:

- we are only concerned with price and transport costs (assuming ceteris paribus for the other criteria),
- we are also not interested in what strategy we should adopt in accordance with, for example, the Kraljic matrix (see: C. Goldman, van Weele, 2005, p. 4),
- we assume that we are already at the stage where the make-or-buy decision is to 'buy',
- we are not considering the problem of choosing a method for multiple criteria decision-making (MCDM).

Why is it so important to consider these two criteria (purchase price and transport cost)? On the one hand, the reason is that delivery costs are commonly overlooked when selecting a source of supply, or the method of delivery is analysed only after the supplier has been selected (selecting the best transport for the best supplier only after selecting that supplier – see, for example, Skowronek, Sarjusz-Wolski, 1999, pp. 142-144). Secondly, in practice, it is impossible to construct a weighting for two separate criteria: price and transport costs, in such a way

that they take into account the mutual relationship between these two variables – this is due to significant differences in delivery costs – e.g., a comparison of domestic deliveries for European countries with deliveries from China. It will also be incomparable in situations where one supplier, using e.g. DPU Incoterms (Delivery at Place Unloaded), includes delivery costs in the price of the goods, while another uses EXW Incoterms (Ex Works). In summary, our aim is neither to buy at the lowest possible price nor to minimise transport costs, but to buy at the lowest possible cost – which means that the total purchase price and transport costs should be as low as possible, i.e., we are looking for the minimum purchase cost, and this cannot be achieved by considering both components of this cost separately (this refers to considering them as separately assessed criteria).

IV. CONCLUSIONS

The analyses conducted show that we cannot treat transport costs and purchase price as two separate criteria but should combine them into one – purchase cost. This requires treating the choice of purchase source not only as the choice of the best supplier but also as the best delivery option (purchase cost) = supplier (purchase price) + transport (transport cost).

From the above comments, several other aspects that require examination should also be noted:

- whether it is possible to conduct this type of analysis instead of a 'traditional' supplier evaluation,
- distinguishing between supplier evaluation, supplier evaluation in the context of the goods delivered, and delivery evaluation (evaluation of the supplier and delivery conditions together),
- establishing the appropriate supplier selection process (delivery selection process),
- analysing the processes of providing the procurement department with quantitative and qualitative information on materials and raw materials for purchase,
- the criteria for selecting suppliers need to be examined so that they are not too numerous and at the same time enable proper selection.

The proposed assumptions and new methodology for selecting sources of supply to replace the 'traditional' method of supplier evaluation would certainly contribute to increasing the efficiency of procurement logistics, but it requires research into its effectiveness in procurement management practice. In particular, the question is whether companies will be willing to incur the costs of introducing this innovation in supply logistics.

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