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Research paper

The use of multi-criteria assessment to select a general contractor for a development investment

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Abstract: The article presents the tender procedure used to select the best – according to the investor's requirements – variant of the offer for the General Contractor of a development investment. The subject of the contract was the comprehensive construction of a complex of single-family, semi-detached buildings with a traditional brick structure. In the opinion of the authors of the article, a well-thought-out selection of an appropriate contractor is one of the most important elements of the investment process, because it has a direct impact on the fluency of the construction stage and the future use of the investment, during the warranty period. In addition, a diligently conducted tender procedure allows to minimize the risk of selecting an unprofessional contractor and thus allows to counteract many possible problems and conflicts during the implementation of the subject of the contract. At the stage of the tender procedure, four variants of offers for the comprehensive implementation of the construction of a complex of single-family semi-detached buildings of the following criteria: price (C1), lead time (C2), form of payment (C3), liquidity (C4), experience (C5) and resources (C6). In this article, the authors presented in details the calculation procedure using the ideal point method. Conducting a multi-criteria assessment of variants, based on the selected methods, also clearly verified the strengths and weaknesses of all tenderers, enabling the selection of the best one in the light of the adopted assessment criteria.

Keywords: tender for the implementation of the investment, general contractor, multi-criteria assessment, decision variant, criterion, ideal point method

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1. Introduction

The problem of choosing the best solution is very common in construction practice. The selection of an "appropriate" contractor meeting the Investor's requirements is one of the most important stages of the investment process. A properly conducted tender procedure allows to minimise the risk of selecting an unreliable contractor and thus allows to counteract many possible problems during the implementation of the task. In the opinion of the authors of this article, the price, widely recognised as the key tender criterion, due to its nature, is quite suggestive and thus may distort the objectivity of the decision. Therefore, carrying out a multi-criteria assessment of variants, based on the selected methods, clearly verified both the strengths and weaknesses of all bidders, enabling the selection of the best one in the light of the adopted criteria.

2. Tender process – selected issues

In the private sector, the following tendering procedures are most often used to select the General Contractor for an investment:

– The public call for tender for construction works (via the Internet or other tools).
– Letter of inquiry – Two-stage tender: sending an inquiry to selected companies and selecting those that have submitted proposals for participation, which is not yet the offer itself.
– Letter of inquiry – One-stage tender: sending an inquiry to selected companies and invitation to participate in the tender.

One of the basic and key elements of the tender documentation is the design documentation itself, as it is the basis for the scope of the planned works. It is the basis for the Tenderers to prepare bills of quantities for construction works as well as the cost estimate and the contract price. Additionally, the tender documentation according to Polish regulations should include the following elements [13]: A letter inviting to participate in the tender; Instructions for Bidders; Technical specifications for the execution and acceptance of works; Offer form and required attachments to the offer; Bill of quantities table to be prepared by the Bidders; Proposed contractual conditions.

It is worth paying attention to this that the selection of the General Contractor, which is based only on the criterion of the lowest price, may have a serious impact on the selection of the potential implementation of the entire investment, including, inter alia, the quality of the work performed [1], the date of their completion [17], etc. For this reason, it was decided that the investor should detail and expand the requirements for bidders with additional evaluation criteria, such as: implementation time, experience, financial liquidity and resources that will be at the disposal of the potential contractor of the investment and the form of payment. Selected decision-making methods (i.e. weighted sum, ideal point and AHP) were used to evaluate the considered variants of offers. The last stage of the tender process is the signing of the contract by the contracting authority with the Contractor. The above-mentioned example of the tender procedure is only the proposed formula to be followed when selecting the General Contractor. Each contracting authority has the right to freely adjust and extend each stage of the tender.

3. Decision problem, decision making procedure

The analysis of the decision situation is the first task of the decision maker. A decision-making situation is a set of all factors influencing the decision made by the evaluator in the decision-making process [2–4]. In the process of defining a decision problem, factors independent of the decision maker usually refer to a set of variants, while factors dependent on the decision maker – are the criteria for evaluating solutions [6, 7, 10].

The basic assumption of all methods supporting decision making is the correct formulation of the decision problem [16]. The aim of the article is to present the procedure for selecting the best variant of an offer for a development investment, using selected multi-criteria evaluation methods and at the stage of the tender process. As part of the tender procedure assessment, the subject of the contract was the comprehensive construction of a complex of single-family, semi-detached houses with a traditional brick structure. In order to enable the preparation of the offer, the investor provided potential contractors with the detailed design of the facilities, including the scope of works to be performed, as well as technical descriptions, tables and a blind cost estimate. The contractor was responsible for checking the submitted cost estimates and the need to modify and supplement any gaps / inaccuracies in the bill of quantities and cost estimates (if, in his opinion, errors were possible). It should be emphasised that the full responsibility for the underestimation rested with the Contractor, therefore, it was not possible to demand any compensation or additional payments on this account from the Investor. Submission of partial bids was not allowed.

A part of the offer in question was also the obligatory demonstration by the potential contractor that he has employees belonging to the investor’s supervision team, which must include the obligatory qualified Site Manager with at least 3 years of experience in conducting this type of works. The bidder was also required to submit at least three letters of reference from previous clients, confirming reliability and experience in the implementation of similar investments, referred to in the Letter of inquiry. The contract, constituting an attachment to the Inquiry, contained detailed conditions for the construction execution. Therefore, according to the guidelines, the submitted offer should contain: a completed offer form, along with the company stamp of the potential contractor, date of preparation, bidder’s registered office address, company telephone number, company tax identification number, telephone number and e-mail address of the contact person. The offer form should also be signed legibly by an authorised representative of the Contractor. The value of all works proposed by the tenderer should take into account the flat-rate price specified in the Letter of inquiry and precisely specify the deadlines for their implementation, preferably in the form of a schedule [13, 17]. The lump sum price should be understood as the global amount for the execution of a complete set of construction works [18–22]. At the same time, the bidder should declare in writing that he will not demand a higher remuneration from the investor than that stated in the offer.

The tender procedure for the execution of this investment took place in 2018. At present, due to a pandemic situation, bidders – with regards to construction development investments – often practice submitting bids in accordance with the principle in which they adopt a clear distinction between the components of the price for construction works. Namely the labour cost and the cost of the use of machinery and equipment, treat as a constant value in the offer. On the other hand, the cost of building materials – as the current value for a given month of submitting the offer. Due to the very high dynamics of the increase in the prices of construction production on the market, including construction materials, conducting the tender procedure in 2021 for a small investment with a flat price is very difficult due to the well-founded fear of bidders about further price increases. The tendering practice shows a noticeable tendency of contracting companies to exert significant pressure on investors to allow the possibility of submitting the so-called partial offers (including the cost of labour and use of machines), with the transfer of the cost of purchase of materials to the investor, or taking into account the cost of materials in the offer, as the current value for a given month of submitting the offer for subsequent settlement, in the event of an increase in the prices of construction materials in individual categories or in specific months of construction.

3.1. Description of the adopted procedure

The guidelines for the tender procedure were developed by the Project Manager in order to select and choose the general contractor for the development project, in accordance with the Investor's expectations and the rules for carrying out such activities. In this case, the tendering procedure consisted of the following phases [13, 15, 17]:

1. Preparation of tender guidelines for formal and substantive evaluation of offers,
2. Organising meetings with potential bidders and accepting tender procedures,
3. Preparation and sending of letter of inquiries to bidders,
4. Collection of offers,
5. Review, analysis and evaluation of received offers,
6. Sending comments to the offers with a request to supplement them,
7. Re-review and analysis of updated (supplemented) offers,
8. Negotiation meetings,
9. Collection of updated offers with granted discounts,
10. Creating a recommendation (ranking of offers) based on the applied methods of multi-criteria evaluation of variants,
11. Selection of the General Contractor, the best in the light of the adopted evaluation criteria,
12. Signing the contract with the contractor for the implementation of the investment.

All information on offers for construction works used for the purposes of this article comes from the collections of the authors and their study. They were obtained from companies conducting construction activities in communes near Warsaw. Due to the relatively low value of the investment in question, compared to the parallel development investments carried out in the vicinity, offers were obtained only from small, local companies. Until the tender was announced, these companies were mainly involved in the construction of single-family houses for individual clients and the implementation of small municipal projects. However, the summary of the values of the submitted offers – decision variants is presented in Table 1.

Table 1. List of the value of offers (variants) after the discount granted by the contractor

	Bidder A Variant 1	Bidder B Variant 2	Bidder C Variant 3	Bidder D Variant 4
Discount amount [%]	2.00	4.00	3.00	1.00
Value of the offer after the discount granted [PLN]	5543742.54	6452645.76	6872934.54	6126934.76

3.2. Characteristics of decision criteria

In each method of multi-criteria analysis, a very important stage is the proper selection of decision criteria and insightful and reliable assessment of each variant in the light of the adopted requirements [5, 8, 10]. The criteria for evaluating options should be specified clearly and legibly for the evaluator. Thanks to this, in the opinion of the authors, it will be possible to receive reliable and objective assessments from decision-makers. The evaluation values of individual criteria should be selected in such way that the change in the value of one of them does not directly affect the value of another. The following criteria, presented in Table 2, were adopted for the evaluation of the considered variants (offers).

Table 2. Characteristics of the adopted decision criteria

No.	Criterion	Characteristics of the criterion
1	C1. Price	It means the value of the offer for the performance of all works included in the contract, together with the tenderer's declaration that – in the event of unforeseen circumstances – he will not demand higher remuneration. The key criterion for the investor.
2	C2. Lead time	It means the time from handing over the construction site to obtaining the occupancy permit.
3	C3. Payment method	Means the date of payment of the VAT invoice and the deposit defined as a percentage of the amount retained by the investor on each invoice for the guarantee, which will be returned to the contractor after approval of the final settlement of the works.
4	C4. Financial Liquidity	Understood as the tenderer's ability to pay short-term liabilities on time (e.g. payment to subcontractors for products and services, payment of salaries to employees, etc.). It is defined by three main indicators: 1) current liquidity (CR) – current liquidity ratio = current assets / short-term liabilities 2) quick liquidity (QR) – quick liquidity ratio = (current assets – inventories) / short-term liabilities 3) instant liquidity – immediate liquidity ratio = short-term investments / short-term liabilities.
5	C5. Experience	Defined by the number of completed construction investments similar to the designed facilities and confirmed by positive customer references.
6	C6. Resources	Understood and characterised by: 1) the number of full-time manual workers employed by the tenderer and their professional qualifications, 2) number of employees belonging to the construction management staff (site manager, contract engineer, etc.), 3) the number and type of machines and construction equipment (e.g. scaffolding, light wheeled vehicles, etc.) necessary for the execution of works.

Tables 3–11 present the value of offers (analysed variants) from the point of view of individual decision criteria.

PRICE (C1)

Table 3 presents the assessment of variants in the light of the C1 criterion.

Table 3. The values of the offers (variants) in relation to the criterion C1

	Variant 1	Variant 2	Variant 3	Variant 4
Criterion 1 [PLN]	5543742.54	6452645.76	6872934.54	6126934.76

LEAD TIME (C2)

Table 4 summarises the ratings of variants with respect to criterion 2, which is decided by the execution time of investment bidders.

Table 4. The values of the offers (variants) in relation to the criterion C2

	Variant 1	Variant 2	Variant 3	Variant 4
Criterion 2 [weeks]	57	51	49	50

PAYMENT METHOD (C3)

This feature depends on two parameters: the date of payment of the VAT invoice and the percentage of the deposit retained for warranty services. The values of these parameters are shown in Table 5.

Table 5. Values of partial parameters for the criterion C3

	Variant 1	Variant 2	Variant 3	Variant 4
Date of payment of the VAT invoice [days]	7	14	21	30
Warranty deposit [%]	0	7	10	5

In order to standardise the values of partial ratings of the parameters for criterion 3, they were quantified using a four-level subjective rating scale, where 1 – means unfavourable value, and 4 – the best. The quantified values of the obtained variant assessments constitute the arithmetic mean of the partial parameter assessments for criterion 3, which are presented in Table 6.

Table 6. Assessment of variants in the light of the C3 criterion and its partial parameters

	Variant 1	Variant 2	Variant 3	Variant 4
Criterion 3	**1**	**2.5**	**3.5**	**3**
Date of payment of the VAT invoice [days]	1	2	3	4
Warranty deposit [%]	1	3	4	2

FINANCIAL LIQUIDITY (C4)

This ratio, like criterion 3, is also dependent on three partial indicators, which include: current financial liquidity (CR), quick liquidity (QR) and immediate liquidity. The values of these indicators are presented in Table 7.

Table 7. Values of partial parameters for the criterion C4

	Variant 1	Variant 2	Variant 3	Variant 4
Current financial liquidity (CR)	1.08	1.37	1.81	0.78
Fast financial liquidity (QR)	0.64	1.09	1.18	0.52
Instant financial liquidity	0.48	0.78	0.98	0.34

In order to standardise the values of partial ratings of the parameters for criterion 4, they were also quantified using a four-level subjective rating scale, where 1 – the worst value, and 4 – the best one. The quantified variants' scores are also the arithmetic mean of the scores of partial indicators for criterion 4, which are presented in Table 8.

Table 8. Assessment of variants in the light of the C4 criterion and its partial parameters

	Variant 1	Variant 2	Variant 3	Variant 4
Criterion 4	**2**	**3**	**4**	**1**
Current financial liquidity (CR)	2	3	4	1
Fast financial liquidity (QR)	2	3	4	1
Instant financial liquidity	2	3	4	1

EXPERIENCE (C5)

Table 9 presents a list of the number of buildings, similar to the investment in question, completed by bidders in the last five years of operation on the construction market.

Table 9. Variant values for the criterion C5

	Variant 1	Variant 2	Variant 3	Variant 4
Criterion 5	2	6	8	5

RESOURCES (C6)

To evaluate the considered variants in the light of the C6 criterion, a subjective, four-level rating scale defined by the Investor was used, where:

1 – means that the tenderer does not permanently employ manual workers, but only the site manager. The entire implementation of the investment will be based on subcontractors and rented construction equipment.

2 – means that the tenderer does not employ any manual workers. However, it has a permanent construction manager and contract engineer. It also has its own scaffolding and light wheeled vehicles to the extent necessary to service the investment.
3 – means that the tenderer permanently employs about 20 blue-collar workers, trained in reinforced concrete works. It has no full-time management staff. It has no construction equipment and machinery.
4 – means that the tenderer permanently employs about 20 manual workers trained in masonry and finishing works. It also has a full technical background in the form of a site manager and contract engineer. It does not have any construction equipment and machinery, which it will rent, depending on the needs.

The quantified values of the variants' assessments for the C6 criterion are presented in Table 10.

Table 10. Variant scores against the criterion C6

	Variant 1	Variant 2	Variant 3	Variant 4
Criterion 6	1	4	3	2

On the other hand, the collective list of variant assessment values for the adopted criteria, constituting the input matrix of solutions, is presented in Table 11.

Table 11. Variant assessment values in relation to the adopted criteria

	C1	C2	C3	C4	C5	C6
V1	5543742.54	57.00	1	2	2	1
V2	6452645.76	51.00	2.5	3	6	4
V3	6872934.54	49.00	3.5	4	8	3
V4	6126934.76	50.00	3	1	5	2

The authors of the article conducted a multi-criteria evaluation of offer variants using the weighted sum, ideal point and AHP methods, the calculation algorithms of which have been described in many studies. In this article, the authors presented in detail the procedure for evaluating variants using the ideal point method [5, 7, 14].

In the multi-criteria assessment, both measurable criteria, expressed with numerical values, and, depending on the needs, difficult to measure criteria, which cannot be directly expressed numerically, are used [12]. Difficult-to-measure features are subjected to quantification, e.g. by introducing a specific rating scale, which enables their comparison and evaluation of variants [14, 16, 23].

Additionally, the criteria may be stimulants and destimulants depending on whether the aim is to maximise their value (e.g. quality, efficiency) or minimise (e.g. cost, time) [2, 3, 15]. Considering the above, in order to obtain the desired comparability of the considered variants, the input matrix of solutions should be normalised (e.g. using a fairly popular vector method), reducing the values of the criteria increasing to decreasing (in the case of minimisation) or decreasing to increasing (in the case of maximisation).

3.3. Assessment of variants using the ideal point method

The ideal point method uses the concept of aggregation with a single synthetic criterion, removing all incomparability according to non-compensatory logic. It allows to organise the analysed variants on the basis of determining their smallest and greatest distance from the ideal and anti-ideal solution. This method requires additional information about the features describing particular criteria. It has a multi-stage character and can be used to organize and classify sets of the same type of variants (e.g. offers). The evaluation procedure under the ideal point method is presented in the stages [5, 7].

STAGE I – standardisation of the input solution matrix **P**, the individual terms of which constitute the final evaluations of the variants with regards to individual criteria. Words of normalised matrix $\overline{\mathbf{P}}$, which is calculated by the formula (3.1) are presented in Table 12.

$$\overline{p_{ij}} = \frac{p_{ij}}{\sqrt{\sum_{i=1}^{m} p_{ij}^2}} \qquad i = \overline{1, m}, \quad j = \overline{1, n} \tag{3.1}$$

where: m – number of variants, n – number of criteria.

Table 12. Normalised input solution matrix $\overline{P}$

Criterion / Variant	C1	C2	C3	C4	C5	C6
	Evaluation of the fulfilment of the criteria					
V1	0.558	0.452	0.187	0.365	0.176	0.183
V2	0.480	0.505	0.468	0.548	0.528	0.730
V3	0.450	0.525	0.656	0.730	0.704	0.548
V4	0.505	0.515	0.562	0.183	0.440	0.365

STAGE II – determination of a normalised solution matrix $\boldsymbol{V}$, taking into account the importance of individual criteria. The normalised matrix $\boldsymbol{V}$ is calculated according to the formula (3.2).

$$V_{ij} = \overline{p_{ij}} \cdot q_j \qquad i = \overline{1, m}, \quad j = \overline{1, n} \tag{3.2}$$

The vector of weights of the individual $\boldsymbol{Q}$ criteria is described according to the formula (3.3).

$$\boldsymbol{Q} = \left[q_j \right] \qquad \sum_{j=1}^{n} q_j = 1 \tag{3.3}$$

The levels of importance for individual criteria were assumed subjectively, in line with the investor's preferences, and are presented in Table 13. On the other hand, the normalised matrix of $\boldsymbol{V}$ solutions is shown in Table 14.

STAGE III – defining the ideal and anti-ideal solution.

Individual words of an ideal solution $A^+ = \left[a_i^+\right]$, is calculated by the formula (3.4).

$$a_i^+ = \left\{ \left(\max_i \ V_{ij/j} \in J \right), \ \left(\max V_{ij/i} \ j \in J' \right), \ i = \overline{1, m} \right\} = \left\{ V_1^*, V_2^*, \ldots, V_n^* \right\}, \quad j = \overline{1, n} \tag{3.4}$$

Table 13. Weight vector criteria Q

	C1	C2	C3	C4	C5	C6
The degree of importance of the criterion	0.60	0.15	0.05	0.05	0.10	0.05
						1

Table 14. Normalised matrix of solutions V

Criterion / Variant	C1	C2	C3	C4	C5	C6
V1	0.3350	0.0677	0.0094	0.0183	0.0176	0.0091
V2	0.2878	0.0757	0.0234	0.0274	0.0528	0.0365
V3	0.2702	0.0788	0.0328	0.0365	0.0704	0.0274
V4	0.3031	0.0772	0.0281	0.0091	0.0440	0.0183

However, the words of the anti-ideal solution $A^{-} = \left[a_i^{-}\right]$, is calculated according to the formula (3.5).

$$a_i^{-} = \left\{\left(\min_i V_{ij/j} \in J\right) V_{ij/j} \in J, \left(\min V_{ij/i}\ j \in J'\right), i = \overline{1,m}\right\} = \left\{V_1^*, V_2^*, \ldots, V_n^*\right\}, \quad j = \overline{1,n} \tag{3.5}$$

where: J – criteria for which the highest value is the best (criteria of the "profit" type), J' – criteria for which the lowest value is the best (criteria of the "cost" type).

In the case under consideration, for the ideal solution, the maximum values from individual columns of the $\boldsymbol{V}$ matrix were selected, and for the anti-ideal solution – the minimum values, respectively. The calculated matrix terms for the ideal and anti-ideal solutions are shown in Tables 15 and 16.

Table 15. Matrix terms for an ideal solution

Ideal solution A+	0.3350	0.0788	0.0328	0.0365	0.0704	0.0365

Table 16. Matrix words for an anti-ideal solution

Anti-ideal solution A–	0.2702	0.0677	0.0094	0.0091	0.0176	0.0091

STAGE IV – determining the distance of the considered variants from the ideal and anti-ideal solutions. The distance of the variant from the ideal solution is calculated on the basis of the formula (3.6).

$$L_i^{+} = \sqrt{\sum_{j=1}^{n}\left(V_{ij} - V_j^*\right)^2} \qquad i = \overline{1,m} \tag{3.6}$$

where: i – means another solution.

However, the distance of the variant from the anti-ideal solution is calculated from the formula (3.7).

$$L_i^- = \sqrt{\sum_{j=1}^{n} \left(V_{ij} - V_j^-\right)^2} \qquad i = \overline{1, m'} \tag{3.7}$$

Tables 17 and 18 summarise the final results of the calculations.

Table 17. The values of the distance vector of variants from the ideal solution

	L1+	L2+	L3+	L4+
Distances from the ideal solution L_i+	0.0674	0.0521	0.0654	0.0531

Table 18. The values of the distance vector of variants from the anti-ideal solution

	L1–	L2–	L3–	L4–
Distances from the anti-ideal solution L_i-	0.0654	0.0538	0.0674	0.0480

STAGE V – calculation of the relative distance of individual variants in relation to the ideal solution from the formula (3.8).

$$K_i = \frac{L_i^-}{\left(L_i^+ + L_i^-\right)} \qquad 0 < K_i < 1 \qquad i = \overline{1, m} \tag{3.8}$$

The greater the value of K_i (the evaluation of a given variant), the better the solution is [5, 7].

The final summary of the evaluation values of the analysed variants is presented in Table 19.

Table 19. Final variant scores

Variant	Relative distance of the variant K from the ideal solution	Variant evaluation
V1	$K1$	0.4925388
V2	$K2$	**0.5078753**
V3	$K3$	0.5074612
V4	$K4$	0.4746801

A number of preferential variants for the ideal point method are shown in Figure 1.

In order to compare the obtained results of the evaluation of offer variants using the weighted sum and AHP methods [8, 11, 22], the authors presented the obtained variants in the rankings in Figures 2 and 3.

On the other hand, table 20 presents the final ranking of the offer variants subject to multi-criteria assessment, in the light of the assessment criteria adopted by the investor, in the order from the best to the worst.

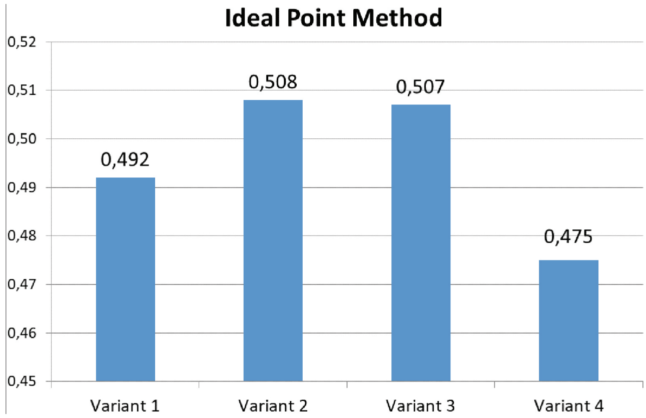

Fig. 1. Visualisation of the ranking of variants using the ideal point method

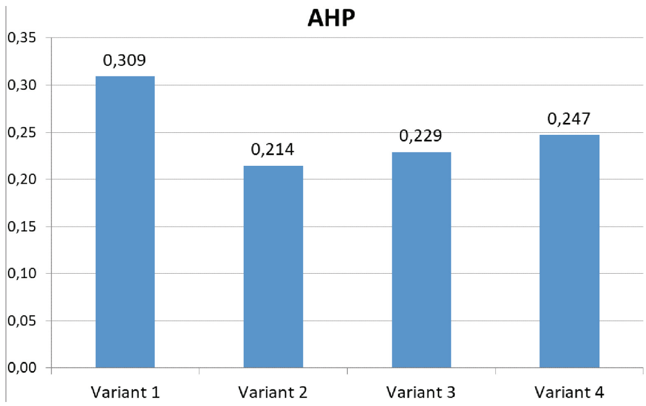

Fig. 2. Visualisation of the ranking of variants using the AHP method

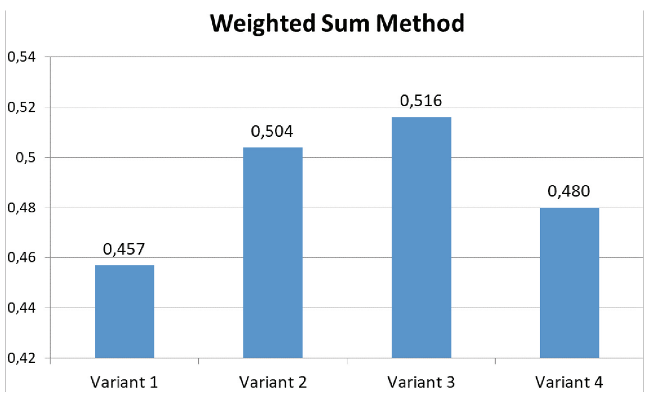

Fig. 3. Visualisation of the ranking of variants using the weighted sum method

Table 20. Final ranking of decision variants

	Weighted sum method	The ideal point method	AHP method	FINAL GRADE
Variant 1	4	3	1	2.67
Variant 2	2	1	4	2.33
Variant 3	**1**	**2**	**3**	**2.00**
Variant 4	3	4	2	3.00

The higher the value of the variant's final score, the worse the solution is. Thus, the variant of bid no. 3 is the best.

The visualisation of the final ranking – as part of the tendering procedure – of the four variants of offers for the implementation of a development investment subject to multi-criteria assessment is presented in Figure 4.

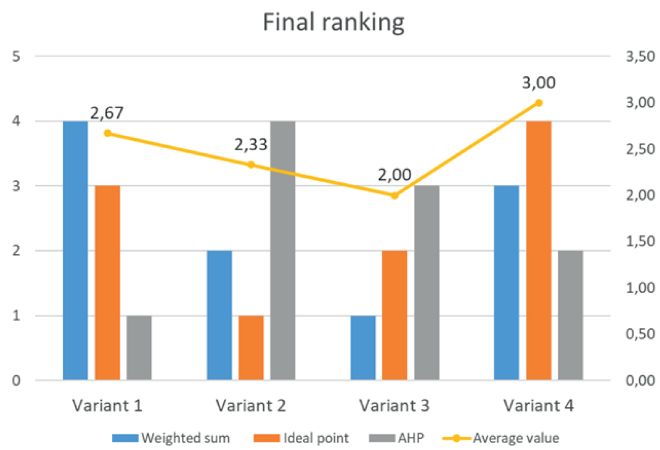

Fig. 4. Visualisation of the final ranking of offered variants

As there are many factors influencing relevant assessment methods presentation of the average results helps to make the score more objective.

4. Conclusions

The purpose of this article was to present the procedure for selecting the General Contractor for the investment at the stage of the tender procedure and to carry out a multi-criteria evaluation of four – closest to the investor's preferences – offers (decision variants) for the comprehensive implementation of the construction of a complex of single-family semi-detached buildings with traditional brick construction. Each of the four bidders was assessed using the weighted sum method, AHP and the ideal point in terms of the following criteria: Price (C1), Lead Time (C2), Form of Payment (C3), Financial Liquidity (C4), Experience (C5) and Resources (C6).

In the opinion of the authors of the article, a well-thought-out selection of the General Contractor is one of the most important elements of the investment process, because it has a direct impact on the liquidity of the construction stage and the future use of the investment, during the warranty period. Therefore, a diligently conducted tender procedure allows to minimise the risk of selecting an unprofessional contractor (with regards to, inter alia, professional ethics, construction art, timely execution of works) and thus allows to counteract many possible problems during the implementation of the subject of the contract.

According to the authors, the multi-criteria assessment methods contribute to the improvement of the decision-making process, because they enable the ranking of the set of considered solutions and the selection of the best variant in the light of the adopted assessment criteria. In addition, the methods of multi-criteria analysis are also a comprehensive tool for evaluating the compared variants. Particular methods differ in the degree of complexity of the computational algorithms, which have a direct impact on the accuracy of the calculations.

As a result of the performed calculation procedure, a ranking of offer variants was obtained in the order from best to worst. Under the ideal point method, tenderer B turned out to be the best (option 2). It should be mentioned that under the AHP method – option 1 turned out to be the best, and under the weighted sum method – option 3 (tenderer C). However, in the final ranking, the best decision variant turned out to be bidder C, which ultimately won the tender procedure for the investment, and the worst – bidder D. The degree of detail and differentiation of the algorithms of the evaluation methods used to differentiate the results of the variants ranking.

In the opinion of the authors of the article, despite the investor assigning the C1 criterion the highest importance (60%) and a significant discrepancy in the amount proposed by the bidders for the implementation of the investment (PLN 1.329 million the difference between the cheapest and the most expensive offer), the multi-criteria evaluation showed that the offer is the most expensive in this case is the best. Additionally, comparing the criteria in pairs under the AHP method revealed that for the investor the price (which is the key indicator in the tender procedure) turned out to be less important than stated directly. On the other hand, the contractor's experience and execution time turned out to be more important for him than he assumed. Conducting a multi-criteria assessment of options, based on the selected methods, also clearly verified both the strengths and weaknesses of all bidders, enabling the selection of the best one in the light of the adopted criteria.

Of course, it is difficult to unequivocally determine which of the methods is the best for a specific decision-making task, because the difficulty in assessment results primarily from the complexity of the decision-making task, the complexity of the variants and the evaluator's preferences, which always depend not only on the knowledge and experience of the decision-maker, but above all, from his point of view and subjective perception of the decision problem and many other coexisting hardly measurable factors influencing the decision-making process.

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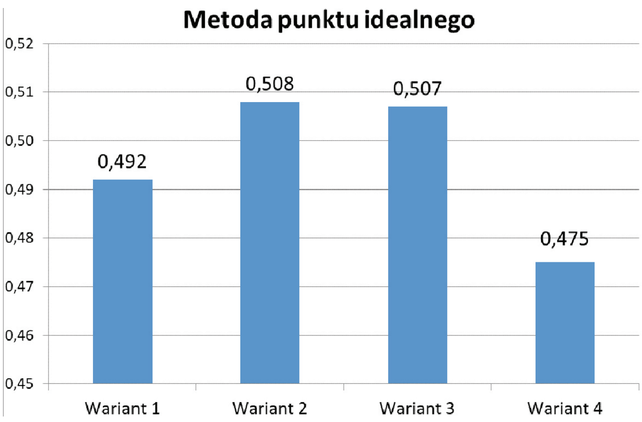
Wykorzystanie oceny wielokryterialnej do wyboru generalnego wykonawcy inwestycji deweloperskiej

Słowa kluczowe: przetarg, generalny wykonawca, ocena wielokryterialna, wariant decyzyjny, kryterium, punkt idealny

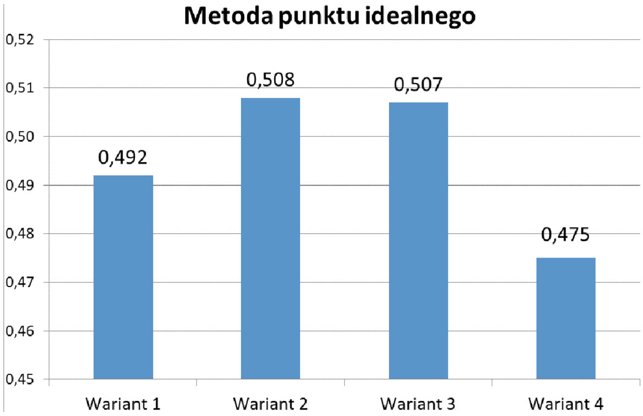
Streszczenie:

Przedmiotem artykułu było zaprezentowanie procedury przetargowej zastosowanej do wyboru najlepszego – w świetle wymagań inwestora – wariantu oferty Generalnego Wykonawcy inwestycji deweloperskiej. Przedmiot zamówienia stanowiła kompleksowa realizacja budowy zespołu budynków jednorodzinnych w zabudowie bliźniaczej o konstrukcji tradycyjnej murowanej. W opinii autorów artykułu, przemyślany wybór odpowiedniego wykonawcy, stanowi jeden z najważniejszych elementów procesu inwestycyjnego, ponieważ wywiera bezpośredni wpływ na płynność etapu budowy oraz przyszłe użytkowanie inwestycji, w trakcie trwania okresu rękojmi gwarancyjnej. Dodatkowo, rzetelnie przeprowadzona procedura przetargowa w dużej mierze pozwala zminimalizować ryzyko wyłonienia wykonawcy nieprofesjonalnego i tym samym daje możliwość przeciwdziałania wielu możliwym do zaistnienia potencjalnym problemom i konfliktom w trakcie realizacji przedmiotu zamówienia. Na etapie postępowania przetargowego wyselekcjonowano i poddano ocenie wielokryterialnej cztery – najbliższe preferencjom inwestora – warianty ofert na kompleksową realizację całego przedsięwzięcia budowlanego. Każdego z wyłonionych oferentów przeanalizowano przy wykorzystaniu następujących metod oceny: sumy ważonej, AHP oraz punktu idealnego, z punktu widzenia określonych przez zamawiającego kryteriów, a więc: cena (C1), czas realizacji (C2), forma płatności (C3), płynność finansowa (C4), doświadczenie (C5) i zasoby (C6). W niniejszym artykule autorzy szczegółowo zaprezentowali procedurę obliczeniową przy wykorzystaniu metody punktu idealnego. W wyniku przeprowadzonych obliczeń otrzymano szereg wariantów preferencyjnych, który przedstawiono na rysunku 1.



Rys. 1. Wizualizacja rankingu wariantów przy wykorzystaniu metody punktu idealnego

W wyniku przeprowadzonej procedury obliczeniowej otrzymano ranking wariantów ofert w kolejności od najlepszej do najgorszej. W ramach metody punktu idealnego najlepszym okazał się być oferent B (wariant 2). Należy wspomnieć, iż w ramach metody AHP – najlepszy okazał się wariant 1, a w metodzie sumy ważonej – wariant 3 (oferent C). Natomiast w rankingu końcowym, najlepszym wariantem decyzyjnym okazał się oferent C, który ostatecznie wygrał postępowanie przetargowe na realizację inwestycji, a najgorszym – oferent D. Wizualizację ostatecznego uszeregowania wariantów ofert zaprezentowano na rysunku 2. Ponieważ istnieje wiele czynników wpływających na otrzymywane wyniki w ramach różnych metody oceny, prezentacja średnich rezultatów rankingu pomaga w zwiększeniu obiektywizmu oceny.



Rys. 2. Wizualizacja finalnego uszeregowania wariantów ofert

W opinii autorów, do zróżnicowania wyników rankingu wariantów ofert w dużej mierze przyczynił się stopień uszczegółowienia i zróżnicowania algorytmów obliczeniowych wykorzystanych metod oceny. Warto nadmienić, iż w trakcie postępowania przetargowego okazało się, iż zdefiniowane przez dla inwestora kryterium ceny, jako wskaźnik kluczowy było znacznie mniej istotne, niż doświadczenie wykonawcy i czas realizacji całej inwestycji. Przeprowadzenie wielokryterialnej oceny wariantów, w oparciu o wybrane metody w jasny sposób zweryfikowało także mocne, jak i słabe strony wszystkich oferentów. W wyniku przeprowadzonych obliczeń i analiz otrzymano szereg wariantów preferencyjnych, co umożliwił wybór najlepszego – w świetle przyjętych przez inwestora kryteriów oceny – wariantu oferty i tym samym generalnego wykonawcy dla przedmiotowej inwestycji. Autorzy pragną nadmienić, iż postępowanie przetargowe na wykonanie niniejszej inwestycji odbyło się w 2018 r. W chwili obecnej, wskutek zaistnienia sytuacji pandemicznej oferenci – w odniesieniu do budowlanych inwestycji deweloperskich – często praktykują składanie ofert zgodnie z zasadą, na podstawie której przyjmują wyraźne rozróżnienie elementów składowych ceny za roboty budowlane. Mianowicie koszt robocizny oraz koszt wykorzystania maszyn i urządzeń, traktują jako wartość stałą w ofercie. Natomiast koszt materiałów budowlanych – jako wartość aktualną na dany miesiąc składania oferty. W związku z bardzo wysoką dynamiką wzrostu cen produkcji budowlanej na rynku, a w tym materiałów budowlanych, przeprowadzenie postępowania przetargowego w 2021 r. dla małej inwestycji z ceną ryczałtową jest bardzo utrudnione ze względu na uzasadnioną obawę oferentów o dalsze wzrosty cen. Praktyka przetargowa pokazuje zauważalną tendencję wywierania przez firmy wykonawcze istotnej presji na inwestorów, aby dopuszczali oni możliwość składania w przetargu tzw. ofert częściowych (uwzględniających koszt robocizny i wykorzystania maszyn). Alternatywnie proponują także branie pod uwagę kosztów materiałów budowlanych w ofercie jako wartości aktualnej na dany miesiąc składania oferty do późniejszego jej rozliczenia w przypadku wzrostu cen materiałów budowlanych w poszczególnych kategoriach lub w konkretnych miesiącach realizacji budowy. Artykuł kończą stosowne wnioski i podsumowanie.

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