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ANEW APPROACH FOR SELECTING ALTERNATIVES BASED ON THE ADAPTED WEIGHTED SUM AND THE SWARA METHODS: A CASE OF PERSONNEL SELECTION

Abstract. *In this manuscript, a multiple criteria decision-making approach adapted for collaborative decision-making and negotiation, based on the use of the adapted Weighted Sum and SWARA methods, is proposed. Contrary to the commonly used approaches, in this approach, every decision-maker involved in evaluation useshis/her own weights of criteria and determines the ranking order of the evaluated alternatives. Therefore, the final selection of the most appropriate alternative is made on the basis of negotiation in this approach. Finally, at the end of the paper, an empirical illustration is presented in order to highlight the proposed approach. The obtained results confirm the usability and efficiency of the proposed approach.*

Keywords: *decision making, negotiation, weighted sum method, WS PLP, SWARA.*

JEL Classification: C02, C44, C61

1. Introduction

The selection of the one, or more precisely, selecting the most appropriate from a set of available alternatives, has always been important in Multiple Criteria Decision Making (MCDM).

As a result of a number of aspirations to form the procedure which can provide an adequate selection of the most acceptable alternative, many MCDM methods have been proposed, starting from some simple to some more complex MCDM methods, such as: the AHP, TOPSIS, PROMETHEE, ELECTRE and VIKOR.

Some of the simplest MCDM methods, sometimes referred as metrics, which can be mentioned, are the following: the Max-Min, the Min-Max, the Conjunctive and the Disjunctive methods. Some of these metrics have been subsequently integrated into some of the currently prominent MCDM methods. For example, the Min-Max method is used in the MULTIMOORA method proposed by Brauers and Zavadskas (2010).

The prominent MCDM methods can also be classified in several ways, of which the distance-based and the performance-based approaches are particularly emphasized here (Stanujkic *et al.*,2013a).

In the distance-based approaches, the overall ratings of the considered alternatives are calculated on the basis of their distances to the ideal points or the ideal solutions. The TOPSIS and the VIKOR methods can be stated as the typical representatives of this group of methods.

In the performance-based approach, the overall ratings of the considered alternatives are calculated on the basis of the weighted normalized ratings; the Weighted Sum (WS) method can be mentioned as a typical representative.

The WS method, more often known as the Simple Additive Weighted (SAW) method, proposed by Churchman and Ackoff (1954) and MacCrimmon (1968), is one of the probably best-known and previously most widely used MCDM methods.

The basic idea of the WS method is to calculate the overall performance rating of an alternative *i* as a sum of products of normalized performance ratings and the weights of criteria. The WS method can be used with different normalization procedures, such as the max, the max-min, the sum, the vector normalization and other procedures. A comprehensive overview of the normalization procedures was given in Zavadskas and Turskis (2008) and Celen (2014), whereas the use of the WS method with different normalization procedures was discussed in Stanujkic *et al*. (2013a).

Based on Weitendorf (1976) and Juttler (1966), Stanujkic *et al*. (2013b) suggested a normalization procedure allowing decision-makers to more appropriately express their preferences for preferred performance ratings. On the basis of that procedure, Stanujkic and Zavadskas (2015) further proposed an extension of the WS method under the name of a Modified Weighted Sum Method, based on the decision-maker's Preferred Levels of Performances (WS PLP).

Using this approach, the overall ratings of the alternatives that have performance ratings equal to the preferred performance ratings are equal to zero. The alternatives whose one or more preference ratings are better than the preferred performance ratings or the alternatives whose better performance ratings successfully compensate for the impact of the worse performance ratings have the overall ratings greater than zero (Stanujkic andZavadskas,2015). By using this approach, the set of the available alternatives is transformed into a set of more acceptable alternatives, from which the most appropriate one should be selected.

Apart from the determining of the overall performance ratings of the considered alternatives, the determining of the weights of the evaluation criteria is also a very important activity in the MCDM models, which is the reason why several methods for determining weights of criteria have also been proposed.

The new Step-Wise Weight Assessment Ratio Analysis (SWARA) was proposed by Kersuliene *et al.* (2010). Despite the fact that the SWARA method is a newly-proposed MCDM method, it was used for solving a number of decision-making problems (HashemkhaniZolfani*et al.*, 2015; Arabzad*et al*., 2015).

Solving some complex decision-making problems sometimes requires more participants, which is why many ordinary MCDMs have been extended in order to support the group decision-making approach. In such extensions, the individual weights of criteria and the ratings are in some way transformed into group weights and ratings before applying the aggregation procedures similar to the aggregation procedure used in ordinary MCDM methods.

In order to provide greater flexibility in solving complex Multiple Criteria Group Decision Making (MCGDM) problems, a new approach is proposed in this manuscript. The proposed MCGDM approach is based on the adapted WS PLP and SWARA methods.

However, contrary to the usually used MCGDM approaches, in which the overall performance ratings are determined on the basis of group weights and group ratings, an approach in which each decision-maker involved in evaluation uses his/her own weights and ratings to form his/her personal ranking order of the considered alternatives is proposed in this manuscript. For that reason, the last step in the proposed approach is the negotiation phase, in which all the participants involved in evaluation should reach a consensus on the most acceptable alternative or determine the final ranking order of the alternatives.

The problem of selecting candidates in the recruitment and selection process, i.e. the selection of the best candidate among several candidates/alternatives, is a complex problem, usually accompanied by vagueness, imprecision and subjectivity in some segments, which can be successfully solved by the utilization of MCDM methods. Karabasevic *et al*. (2016) state that in the real world, in the process of the recruitment and selection of personnel, decision makers make their decision on the final selection of candidates mainly by basing it on the applied traditional approaches, namely the MCDM methods, whereas the potential they bring remains unused to some extent. Therefore, various authors and theorists often refer to the problem of the personnel selection approaches by using different MCDM methods, such as: the personnel selection based on the application of the fuzzy MULTIMOORA (Balezentis*et al*., 2012), the personnel selection based on fuzzy ELECTRE (Rouyendegh and Erkan, 2013), the application of the SWARA-VIKOR framework for personnel selection (Nabian, 2014), the application of the new KEMIRA method for personnel selection (Kosareva*et al*., 2016), the SWARA-MULTIMOORA approach to personnel selection (Karabasevic *et al*., 2015), the SWARA and fuzzy ARAS approach to personnel selection (Karabasevic *et al*., 2016) and so on.

For all the above-mentioned reasons, the rest of this paper is organized as follows: In Section 2, the WS is presented; however, in Subsection 2.1, its extension WS PLP approach is also described. The SWARA method and its adaptation are considered in Section 3 and Subsection 3.1. In Section 4, a framework for the selection of the alternatives based on the use of the WS and the SWARA methods is given. In Section 5, an empirical illustration of personnel selection is considered, with the aim to explain in detail the proposed methodology. Finally, the conclusions are given.

2. The WS Method

As previously stated, the WS method is one of the best-known and the simplest MCDM methods. The basic idea of the WS method can be shown as follows:

$$S_i = \sum_{j=1}^{n} w_j \cdot r_{ij} \, , \tag{1}$$

where S_i denotes the overall performance rating of the alternative *i*, $w_j$is the weight of the criterion *j*, r_{ij} is the normalized performance rating of the alternative *i* with respect to the criterion *j*, *n* is the number of the criteria and $S_i \in [0, \ 1]$.

2.1. The WS PLP Approach

By using Eq. (1) and the normalization procedure proposed by Stanjkic *et al*. (2013b), the values of $S_i$are between -1 and 1. At the same time, the alternatives whose S_i is greater than 0 create a set of the most acceptable alternatives.

However, in this approach, the higher values of S_i can sometimes be obtained on the basis of higher deviations from the preferred level of the performance of a single criterion or a few criteria. Therefore, Stanujkic and Zavadskas (2015) proposed the WS PLP approach, as follows:

$$S_i' = \sum_{j=1}^{n} w_j \, r_{ij} - \gamma \, c_i \, , \tag{2}$$

where S_i' denotes the adjusted overall performance rating of the alternative *i*, c_i is the compensation coefficient; $c_i > 0$, γ is the coefficient; $\gamma = [0,1]$.

In that approach, the compensation coefficient is introduced with the aim to provide adequate ratios between the greatest possible value of S_i and the better matching with the preferred performance ratings given by decision-makers. According to Stanujkic and Zavadskas (2015), the compensation coefficient should be calculated as follows:

$$c_i = \lambda \, d_i^{\max} + (1-\lambda) \, \bar{S}_i^{+} \, , \tag{3}$$

where:

$$d_i^{\max} = \max_i d_i = \max_i r_{ij} w_j \,, \tag{4}$$

$$\overline{S}_i^{+} = \frac{S_i^{+}}{n_i^{+}} \text{, and} \tag{5}$$

$d_i^{\max}$ denotes the maximum weighted normalized distance of the alternative *i* to the preferred performance ratings of all the criteria, so that $r_{ij} > 0$, $\overline{S}_i^{+}$ denotes the average performance ratings achieved on the basis of the criteria, so that $r_{ij} > 0$, n_i^{+} denotes the number of the criteria of the alternative *i*, so that $r_{ij} > 0$, λ is coefficient; $\lambda = [0,1]$ and is usually set at 0.5.

Instead of n_i^{+} and $\overline{S}_i^{+}$, in this approach, the use of n_i^{*} and $\overline{S}_i^{*}$ is proposed. On that basis, the coefficient c_i and $\overline{S}_i^{*}$ are calculated as follows

$$c_i = \lambda\, d_i^{\max} + (1-\lambda)\, \overline{S}_i^{*} \text{, and} \tag{6}$$

$$\overline{S}_i^{*} = \frac{S_i^{+}}{n_i^{*}} \,, \tag{7}$$

where n_i^{*} denotes the number of the criteria of the alternative *i*, so that $r_{ij} \geq 0$ and $\overline{S}_i^{*}$ denotes the average performance ratings achieved on the basis of the criteria, so that $r_{ij} \geq 0$.

2.2. The Computational Procedure of the WS PLP Approach

Based on the above considerations, the calculation procedure of the WS PLP approach for a MCDM problem containing *m* alternatives and *n* criteria can precisely be expressed by using the following steps:

***Step* 1**. Evaluate the alternatives in relation to the selected set of criteria.

***Step* 2**. Define the preferred performance ratings for each criterion. In this step, the decisionmaker sets the preferred performance ratings for the evaluation criteria, thus forming the virtual alternative $A_0 = \{x_{01}, x_{02}, ..., x_{0n}\}$. If the decisionmaker does not have preferences for any criterion, it should be determined as follows:

$$x_{0j} = \begin{cases} \max_i x_{ij} \mid j \in \Omega_{\max} \\ \min_i x_{ij} \mid j \in \Omega_{\min} \end{cases}, \tag{8}$$

where x_{0j} denotes the preferred performance rating of the criterion *j*.

***Step* 3**. Construct a normalized decision matrix. The normalized performance ratings should be calculated as follows:

$$r_{ij} = \frac{x_{ij} - x_{0j}}{x_j^+ - x_j^-}, \tag{9}$$

where:

$$x_j^+ = \begin{cases} \max_i x_{ij} \mid j \in \Omega_{\max} \\ \min_i x_{ij} \mid j \in \Omega_{\min} \end{cases}, \text{ and} \tag{10}$$

$$x_j^- = \begin{cases} \min_i x_{ij} \mid j \in \Omega_{\max} \\ \max_i x_{ij} \mid j \in \Omega_{\min} \end{cases}. \tag{11}$$

***Step* 4**. Calculate the overall performance rating for each alternative. The overall performance ratings should be calculated by using Eq. (1).

As in the ordinary WS method, the ranks of the considered alternative can be determined on the basis of S_i, where the alternative with the largest value of S_i is the most appropriate. However, when two or more alternatives have S_i>0, the computational procedure can be continued as follows.

***Step* 5**. Calculate the compensation coefficient for all the alternatives with $S_i > 0$. The compensation coefficient should be calculated by applying Eq. (6).

***Step* 6**. Calculate the adjusted performance rating for all the alternatives with $S_i > 0$. The adjusted performance ratings should be calculated by using Eq. (2), where the decisionmaker can reduce, or even totally eliminate, the impact of the compensation coefficient by varying the values of the coefficient γ.

***Step* 7**. Rank the alternatives and select the most efficient one. The considered alternatives are ranked by ascending S_i' and the alternative with the greatest value of S_i' is the most appropriate.

3. The SWARA Method

As previously stated, the SWARA method was proposed by Kersuliene*et al*. (2010).

Similarly to the well-known AHP method, the SWARA methods can be used to determine the weight of criteria as well as to completely solve MCDM problems. The SWARA method requires the significantly lower number of pairwise comparisons, but it does not include a mechanism for checking the consistency of the performed comparisons.

On the basis of the said, the recommendation according to which the SWARA method can be believed to be more effective in many cases when experienced decision-makers and/or experts familiar with the MCDM are determining the weights of criteria can be accepted. However, due to the simplicity of its use, the SWARA method should be mentioned as a very acceptable method for online surveys and for surveying ordinary respondents.

The lack of an integrated mechanism for checking the consistency can also be overcome, for example by applying Spearman's correlation coefficient.

3.1. The Computational Procedure of the SWARA Method

Based on Kersuliene *et al*. (2010) and Stanujkic *et al.* (2015), the computational procedure of the ordinary SWARA method can be shown through the following steps:

***Step* 1**. Determine the set of the relevant evaluation criteria and sort them in descending order, based on their expected significances.

***Step* 2**. Starting from the second criterion, determine the relative importance s_j of the criterion j in relation to the previous (j-1) criterion, and do so for each particular criterion.

***Step* 3**. Determine the coefficient k_j as follows:

$$k_j = \begin{cases} 1 & j = 1 \\ s_j + 1 & j > 1 \end{cases}. \tag{12}$$

***Step* 4**. Determine the recalculated weight q_j as follows:

$$q_j = \begin{cases} 1 & j = 1 \\ \dfrac{q_{j-1}}{k_j} & j > 1 \end{cases}. \tag{13}$$

***Step* 5**. Determine the relative weights of the evaluation criteria as follows:

$$w_j = \frac{q_j}{\sum_{k=1}^{n} q_k}, \tag{14}$$

where w_j denotes the relative weight of the criterion *j*.

3.2. An Adaptation of the SWARA Method for Group Decision Making

A real difficulty that can occur when applying the SWARA method to solving real decision-making problems in a group environment is the forming of the list of the evaluation criteria sorted according to their expected importance, because the respondents may have different attitudes about the importance of the criteria. Therefore, in this adoption, the values of s_j should be assigned as follows:

$$s_j = \begin{cases} >1 & when\, C_j \succ C_{j-1} \\ 1 & when\, C_j = C_{j-1} \\ <1 & when\, C_j \prec C_{j-1} \end{cases}. \tag{15}$$

Due to assigning values to s_j in such a manner, a certain modification in Eq. (12) is required, as follows:

$$k_j = \begin{cases} 1 & j=1 \\ 2-s_j & j>1 \end{cases}. \tag{16}$$

In the proposed modification, the remaining part of the computational procedure of the SWARA method remains the same as in the ordinary SWARA method, i.e. Eqs (13) and (14) remain unchanged.

3.3. Checking the Consistency by Using Spearman's Rank Correlation Coefficient

Spearman's rank correlation is a nonparametric technique, proposed by Spearman (1904, 1906) and Kendall (1948), for determining linear correlation between two independent data series, as follows:

$$r_s = 1 - \frac{6\sum_{i=1}^{n} d_i^2}{n\,(n^2-1)} \tag{17}$$

where r_s denotes the correlation coefficient, d_i denotes the distance between the ranks for each x_i, y_i denotes the data pairs, x and y denote the data series, n is the number of the elements in each data series and $r_s \in [-1,1]$.

The greater value of r_s indicates higher correlation between two data series, i.e. the value 1 is perfect positive correlation, the value -1 is indicative of the perfect negative correlation and the value 0 indicates no correlation at all.

Spearman's rank correlation coefficient can be used by the SWARA method in order to determine correlation between the responses obtained from the questioned respondents.

In this approach, correlation is calculated between the responses given by the questioned respondents and the average responses determined as follows:

$$\bar{s}_j = \frac{1}{K}\sum_{l=1}^{K} s_j^k \qquad (18)$$

where $\bar{s}_j$ denotes the average importance of the criterion j, s_j^k denotes the relative importance of the criterion j, obtained from the respondent k, and K is the number of the respondents.

4. A Framework Based on the Use of the Adapted Weighted Sum and SWARA Methods

The framework based on the adopted SWARA and WS PLP can accurately be expressed through the following phases and the corresponding steps.

PhaseI ***Form a team of experts who will carry out the evaluation, determine the set of available alternatives and form the set of the evaluation criteria***.

PhaseII ***Determine the relevance and the weights of the evaluation criteria***. In the proposed approach, the adapted SWARA method is used for determining the weights of the evaluation criteria, as shown in Section 3.

PhaseIII ***Evaluate the alternatives***. The evaluation of the alternatives is based on the application of the WS PLP approach, as shown in Section 2.

The five-point Likert Scale, shown in Table 1, is proposed for evaluating the alternatives with respect to the selected evaluation criteria.

Table 1. Ratings for evaluating criteria

Ratings	Meaning
1	Excellent
2	Good
3	Average
4	Fair
5	Poor

In this phase, by applying the first part of the WS PLP method, or more precisely the steps 1 to 4, each expert involved in the evaluation calculateshis/her own overall ratings for the considered alternatives.

PhaseIV ***Negotiation and the selection of the most appropriate alternative***. As a result of conducting the previous phase, the *K* ranking orders of the alternatives are obtained. Therefore, in this phase two, characteristic cases can be identified as follows:

- the case in which the selection of the most appropriate from the set of the available alternatives should be performed, and
- the case in which the selection of a few most appropriate from the set of the available alternatives should be performed.

Selection of One Candidate

In particular cases, when an alternative is the best-placed of all inthe ranking lists, it is not difficult to choose the most appropriate one.

However, in some cases of solving real-world decision-making problems, respondents can be expected to propose different ranking orders as well as different alternatives as the most appropriate. In such cases, the alternatives appearing in the first position the largest number of times are potentially the most appropriate.

In such cases, especially in the cases where the dominant alternative is difficult to identify, the most acceptable alternative can be determined as a result of negotiations between DMs, wherein the parameters such as $d_i^{\max}$, n_i^+ and n_i^* can be very useful.

Therefore, three approaches for selecting the most appropriate alternative on the basis of different ranking lists are proposed in this manuscript, as follows:

- ranking based on the use of the theory of ordinal dominance,
- ranking based on the use of the WS PLP approach, and
- ranking based on the use of the weighting averaging operator

The ranking based on the theory of ordinal dominance. The theory of ordinal dominance was proposed by Brauers and Zavadskas (2010, 2011) as an approach which can be used to summarize the ranks obtained from different parts of the MULTIMOORA method. Based on this approach, an alternative appearing in the first position at most times is the best.

The ranking based on the use of the WS PLP approach. In the cases when two or more alternatives have S_i>0, the steps 4 to 6 of the WS PLP computational procedure can be used in order to harmonize the ranks of the considered alternatives.

The ranking based on the theory of the weighted averaging operator. The weighted averaging (WA) operator, defined by (Harsanyi, 1955), allows the mapping of the *k* dimensions in a single overall score $WA: R^k \rightarrow R$, as follows:

$$WA(a_1, a_2, \ldots, a_k) = \sum_{l=1}^{k} \omega_j a_j \quad (19)$$

where a_j denotes the performance of the criterion *j* and ω_j denotes the weight of the dimension *j*; $\omega_j \in [0,1]$ and $\sum_{j=1}^{n} \omega_j = 1$

Based on the use of the WA operator, the final ranking order of the considered alternatives can be determined as follows:

$$S_i^{'} = \sum_{l=1}^{k} \omega_k S_i \quad (20)$$

where ω_k denotes the significance of the decisionmaker *k*.

Selection of a Few Candidates

In the cases when it is necessary to select more than one candidate, Eq.(20) can be applied for the purpose of ranking the alternatives and the selecting of a sufficient number of the best-ranked alternatives.

5. An Empirical Illustration of the Proposed Approach to Personnel Selection

In this section, an empirical illustration is conducted in order to emphasize the usability and effectiveness of the proposed approach.

The BTL marketing company, which organizes promotions, marketing and merchandising activities, should temporarily hirepromoters. That is why a team of three human resource managers (HRMs) was formed. The team of the HRMspreselected six candidates out of 23 potential candidates for further interviewing and evaluation, with the aim to select the three most appropriate promoters.

The team ofthe HRMs also identified the six criteria for the further evaluation of the candidates, as follows:

- Personality (C_1),
- Self-confidence (C_2),
- Communication and presentation skills (C_3),
- Interview preparedness (C_4),
- Education (C_5), and
- Relevant work experience (C_6).

The significances of the evaluation criteria, determined by using the adapted SWARA method, are shown in Tables 2, 3 and 4.

Table 2. The responses obtained from the first of the three HRMs and the weights of the criteria

Criteria	s_j	k_j	q_j	w_j
C_1		1	1	0.20
C_2	0.9	1.1	0.91	0.19
C_3	1	1	0.91	0.19
C_4	0.75	1.25	0.73	0.15
C_5	1	1	0.73	0.15
C_6	0.8	1.2	0.61	0.12
			4.88	1.00

Table 3. The responses obtained from the second of the three HRMs and the weights of the criteria

Criteria	s_j	k_j	q_j	w_j
C_1		1	1	0.18
C_2	1	1	1.00	0.18
C_3	0.9	1.1	0.91	0.17
C_4	0.85	1.15	0.79	0.14
C_5	1.1	0.9	0.88	0.16
C_6	1	1	0.88	0.16
			5.46	1.00

Table 4. The responses obtained from the third of the three HRMs and the weights of the criteria

Criteria	s_j	k_j	q_j	w_j
C_1		1	1	0.20
C_2	1	1	1.00	0.20
C_3	1	1	1.00	0.20
C_4	0.8	1.2	0.83	0.16
C_5	0.8	1.2	0.69	0.14
C_6	0.7	1.3	0.53	0.11
			5.06	1.00

The correlations between the experts' attitudes determined by applying Spearman's rank correlation coefficient are accounted for in Table 5.

Table 5. Spearman's rank correlation coefficient of the three HRMs

	E_1	E_2	E_3
r_k	0.94	0.77	0.69

In the next Phase III, the HRMs made an evaluation of the alternatives in relation to the set of the evaluation criteria. The obtained ratings, as well as the weights and the preferred ratings, obtained from the three experts are given in Tables 6, 7 and 8.

Table 6. The ratings, the weighting and the preferred ratings obtained from the first of the three HRMs

Criteria	C_1	C_2	C_3	C_4	C_5	C_6
w_j	0.20	0.19	0.19	0.15	0.15	0.12
A*	4	4	4	4	3	3
A_1	4	4	4	4	3	4
A_2	4	4	4	4	4	2
A_3	5	4	5	3	3	5
A_4	4	4	3	3	4	3
A_5	4	4	3	3	3	5
A_6	3	2	2	4	3	3

Table 7. The ratings, the weighting and the preferred ratings obtained from the second of the three HRMs

Criteria	C_1	C_2	C_3	C_4	C_5	C_6
w_j	0.18	0.18	0.17	0.14	0.16	0.16
A*	4	4	3	3	3	4
A_1	4	3	3	2	2	3
A_2	4	4	4	3	3	3
A_3	3	3	4	3	2	3
A_4	3	3	4	4	2	3
A_5	4	4	4	4	4	4
A_4	3	2	2	3	3	4

Table 8. The ratings, the weighting and the preferred ratings obtained from the third of the three HRMs

Criteria	C_1	C_2	C_3	C_4	C_5	C_6
w_j	0.20	0.20	0.20	0.16	0.14	0.11
A*	4	3	4	3	3	3
A_1	4	3	4	3	4	2
A_2	4	2	3	3	3	3
A_3	5	3	3	2	3	3
A_4	3	3	3	4	3	4
A_5	4	3	4	4	3	3
A_6	3	2	3	4	4	3

The normalized decision matrix and the weighted normalized decision matrix formed on the basis of the responses obtained from first of the three HRMs are presented in Tables 9 and 10.

Table 9. The normalized decision matrix based on the responses obtained from the first of the three HRMs

Criteria	C_1	C_2	C_3	C_4	C_5	C_6
A_1	0.00	0.00	0.00	0.00	0.00	0.33
A_2	0.00	0.00	0.00	0.00	1.00	-0.33
A_3	0.50	0.00	0.33	-1.00	0.00	0.67
A_4	0.00	0.00	-0.33	-1.00	1.00	0.00
A_5	0.00	0.00	-0.33	-1.00	0.00	0.67
A_6	-0.50	-1.00	-0.67	0.00	0.00	0.00

Table 10. The weighted normalized decision matrix based on the responses obtained from the first of the three experts

Criteria	C_1	C_2	C_3	C_4	C_5	C_6
A_1	0.00	0.00	0.00	0.00	0.00	0.04
A_2	0.00	0.00	0.00	0.00	0.15	-0.04
A_3	0.10	0.00	0.06	-0.15	0.00	0.08
A_4	0.00	0.00	-0.06	-0.15	0.15	0.00
A_5	0.00	0.00	-0.06	-0.15	0.00	0.08
A_6	-0.10	-0.19	-0.12	0.00	0.00	0.00

In the same manner, the normalized decision matrix and the weighted normalized decision matrix for the second and the third experts are calculated.

The overall ratings of the considered alternatives obtained from the three experts by using Eq. (1) are shown in Table 11.

Table 11. The overall ratings and the ranks obtained from the three HRMs

	E_1		E_2		E_3	
	S_i	*Rank*	S_i	*Rank*	S_i	*Rank*
A_1	0.04	3	-0.41	4	0.08	**1**
A_2	0.11	**1**	-0.08	2	-0.40	6
A_3	0.10	2	-0.43	5	-0.18	4
A_4	-0.06	4	-0.36	3	-0.16	3
A_5	-0.13	5	0.24	**1**	0.08	2
A_6	-0.41	6	-0.45	6	-0.27	5

The three candidates denoted as A_2, A_5 and A_1 appear in the first position, based on the opinions of the HRMs involved in the evaluation.

Due to disagreements between the HRMs regarding the most appropriate promoter(s), the estimation of the most appropriate candidate based on the use of the WS PLP approach and the theory of dominance is shown in Tables 12, 13, 14 and 15. The adjusted overall ratings in Table 15 are calculated for $\gamma = 0.5$ and $\lambda = 0.5$.

Table 12. The additional parameters obtained on the basis of the responses of the first of the three HRMs

	S_i	Ranks	d_i^{+max}	n_i^*	S_i^*	$S_i^{'}$	Final ranks
A_1	0.04	3	0.04	6	0.01	0.03	3
A_2	0.11	1	0.15	5	0.03	0.08	2
A_3	0.10	2	0.10	5	0.05	0.09	1
A_4	-0.06	4	0.15	4			
A_5	-0.13	5	0.08	4			
A_6	-0.41	6	0.00	3			

Table 13. The additional parameters obtained on the basis of the responses of the second of the three HRMs

	S_i	Ranks	d_i^{+max}	n_i^*	S_i^*	$S_i^{'}$	Final ranks
A_1	-0.41	4	0.00	2			
A_2	-0.08	2	0.08	5			
A_3	-0.43	5	0.08	2			
A_4	-0.36	3	0.08	2			
A_5	0.24	1	0.08	6	0.04	0.23	1
A_6	-0.45	6	0.00	3			

Table 14. The additional parameters obtained on the basis of the responses of the third of the three HRMs

	S_i	Ranks	d_i^{+max}	n_i^*	S_i^*	$S_i^{'}$	Final ranks
A_1	0.08	1	0.14	5	0.03	0.06	2
A_2	-0.40	6	0.00	4			
A_3	-0.18	4	0.10	4			
A_4	-0.16	3	0.08	4			
A_5	0.08	2	0.08	6	0.01	0.07	1
A_6	-0.27	5	0.14	3			

Table 15. The overall ratings and the ranks obtained from the three HRMs obtained on the basis of the WS PLP approach

	E_1		E_2		E_3	
	$S_i^{'}$	*Rank*	$S_i^{'}$	*Rank*	$S_i^{'}$	*Rank*
A_1	0.03	3			0.06	2
A_2	0.08	2				
A_3	0.09	**1**				
A_4						
A_5			0.23	**1**	0.07	**1**
A_6						

As it can be seen from Table 15, the candidate A_5 ranks in the first position twice, on the basis of the opinions of the experts E_2 and E_3, whereas the candidate A_3 ranks in the first position only once, on the basis of the opinion of the expert E_1.

The similar ranking results were obtained by using the WA-operator-based approach, or more precisely by using Eq. (19) and $\omega_k = 0.33$, as it is shown in Table 16.

Table 16. The overall ratings and the ranks obtained from the three HRMs, obtained on the basis of the WS PLP approach

	S_i	*Rank*
A_1	-0.09	**2**
A_2	-0.12	**3**
A_3	-0.17	4
A_4	-0.19	5
A_5	0.06	**1**
A_6	-0.38	6

As it can be seen from Table 16, the candidate denoted as A_3 remains the most appropriate candidate, whereby the three best placed candidates are A_5, A_1 and A_3.

6. Conclusions

In contrast to a number of MCDM approaches proposing evaluation carried out on the basis of group criteria weights and group performance ratings, this manuscript makes a proposal for a specific approach adapted for negotiation purposes.

In the proposed approach, each expert and/or decisionmaker involved in evaluation, sets the values for his or her preferred performance ratings of the selected evaluation criteria and determines his/her ranking list of the alternatives. After that, the alternative with the largest number of appearances in the first position in the ranking lists is declared the most acceptable alternative, or the most acceptable alternative(s) is (are) determined in the negotiation process if there is no dominant alternative.

The proposed approach is based on the use of the WS PLP approach and the adapted SWARA method, as well as on the use of the three methods for determining the most acceptable alternative in the negotiation process. Such a proposed framework has certain advantages, of which the fact that the personal preferences and attitudes of each one of the decisionmakers involved in evaluation do not drown into group weights and ratings can be identified as one of the most important.

Using the WS PLP approach, decisionmakers are given a possibility to personalize the ranking results obtained using the WS method by applying simple MCDM methods, such as the Max-Min Metric or the Conjunctive method. In this way, decisionmakers can fine-adjust their choices, varying between the higher performances and better matching with preferences.

In the proposed approach, the SWARA method is also adapted so that its calculation procedure does not require a unique list of the evaluation criteria sorted on the basis of their expected significances, which can be very important when more decisionmakers are involved in evaluation.

In addition to this, in the proposed adaption of the SWARA method, Spearman's ranking correlation coefficient is used to identify the respondents whose responses significantly deviate from the commonly given.

Finally, the considered example of the selection of candidates in the recruitment process has confirmed the applicability of the proposed approach.

REFERENCES

[1] **Arabzad, S. M., Ghorbani, M.,HashemkhaniZolfani, S. (2015),*A Multi-Objective Robust Optimization Model for a Facility Location-Allocation Problem in a Supply Chain under Uncertainty***. *InzinerineEkonomika-Engineering Economics* 26(3): 227-238;

[2] **Baležentis, A., Baležentis, T., Brauers, W. K. (2012),*Personnel Selection Based on Computing with Words and Fuzzy MULTIMOORA.*** *Expert Systems with applications* 39(9): 7961-7967;

[3] **Brauers, W. K. M., Zavadskas, E. K. (2010), *Project Management by MULTIMOORA as an Instrument for Transition Economies.*** *Technological and Economic Development of Economy* (1): 5-24;

[4] **Brauers, W.K., Zavadskas E.K. (2011), *MULTIMOORA Optimization Used to Decide on a Bank Loan to Buy Property.*** *Technological and Economic Development of Economy* 17(1): 174-188;

[5] **Celen, A. (2014), *Comparative Analysis of Normalization Procedures in TOPSIS Method: with an Application to Turkish Deposit Banking Market.*** *Informatica* 25(2): 185-208;

[6] **Churchman, C. W., Ackoff, R. L. (1954), *An Approximate Measure of Value.*** *Journal of the Operations Research Society of America* 2(2): 172-187;

[7] **Harsanyi, J.C. (1995), *Cardinal Welfare, Individualistic Ethics, and Interpersonal Comparisons of Utility.*** *Journal of Political Economy* 63(4): 309-321;

[8] **Hashemkhani Zolfani, S., Maknoon, R.,Zavadskas, E. K. (2015), *Multiple Nash Equilibriums and Evaluation of Strategies. New Application of MCDM Methods.*** *Journal of Business Economics and Management* 16(2): 290-306;

[9] **Juttler, H. (1966), *Untersuchungen zur Fragen der Operationsforschung und ihrer Anwendungsmoglichkeiten auf okonomische Problemstellungen unter besonderer Berucksichtigung der Spieltheorie***. Dissertation A an der Wirtschaftswissenschaftlichen Fakultat der Humboldt-Universitat, Berlin;

[10] **Karabasevic, D., Stanujkic, D., Urosevic, S., Maksimovic, M. (2015), *Selection of Candidates in the Mining Industry Based on the Application of the***

***SWARA and the MULTIMOORA Methods*.** Acta MontanisticaSlovaca 20(2): 116-124;
[11] **Karabasevic, D., Zavadskas, E. K., Turskis, Z., Stanujkic, D. (2016),** ***The Framework for the Selection of Personnel Based on the SWARA and ARAS Methods under Uncertainties.*** *Informatica* 27(1): 49-65;
[12] **Kendall, M. G. (1948)*, Rank Correlation Methods*.** London: Griffin;
[13] **Kersuliene, V., Zavadskas, E. K.,Turskis, Z. (2010),** ***Selection of Rational Dispute Resolution Method by Applying New Step-Wise Weight Assessment Ratio Analysis (SWARA).*** *Journal of Business Economics and Management* 11(2): 243-258;
[14] **Kosareva, N., Zavadskas, E. K., Krylovas, A., Dadelo, S. (2016),** ***Personnel Ranking and Selection Problem Solution by Application of KEMIRA Method.*** *International Journal of Computers Communications & Control* 11(1): 51-66;
[15] **MacCrimon, K.R. (1968)*, Decision Marking among Multiple-Attribute Alternatives: A Survey and Consolidated Approach*.** RAND memorandum, RM-4823-ARPA;
[16] **Nabian, A. (2014),** ***Presenting New MCDM Framework Based on SWARA-VIKOR in Personnel Selection*.** *Applied mathematics in Engineering, Management and Technology* 2(1): 28-36;
[17] **Rouyendegh, B. D.,Erkan, T. E. (2013)*, An Application of the Fuzzy ELECTRE Method for Academic Staff Selection.*** *Human Factors and Ergonomics in Manufacturing & Service Industries* 23(2): 107-115;
[18] **Spearman, C. (1904)*, The Proof and Measurement of Association between two Things*.***The American journal of psychology* 15(1): 72-101;
[19] **Spearman, C. (1906)*, 'Footrule'for Measuring Correlation*.***British Journal of Psychology* 2(1): 89-108;
[20] **Stanujkic, D.,Zavadskas, E. K. (2015)*, A Modified Weighted Sum Method based on the Decision-maker's Preferred Levels of Performances.*** *Studies in Informatics and Control* 24(4): 61-470;
[21] **Stanujkic, D., Djordjevic, B., Djordjevic, M. (2013a),** ***Comparative Analysis of some Prominent MCDM Methods: A Case of Ranking Serbian Banks.*** *Serbian Journal of Management* 8(2): 213-241;
[22] **Stanujkic, D., Karabasevic, D., Zavadskas, E. K. (2015),** ***A Framework for the Selection of a Packaging Design Based on the SWARA Method;*** *InzinerineEkonomika - Engineering Economics* 26(2): 181-187;
[23] **Stanujkic, D., Magdalinovic, N., Jovanovic, R. (2013b),** ***A Multi-attribute Decision Making Model Based on Distance from Decision Maker's Preferences.*** *Informatica*24(1): 103-118;
[24] **Weitendorf, D. (1976);** ***Beitrag zur Optimierung der raumlichen Struktur eines Gebaude,*** Dissertation A, Hochschule fur Architektur und Bauwesen, Weimar;
[25] **Zavadskas, E. K., Turskis, Z. (2008)*, A New Logarithmic Normalization Method in Games Theory.*** *Informatica* 19(2): 303-314.