INFORMATICA, 2016, Vol. 27, No. 1, 49–65

DOI: http://dx.doi.org/10.15388/Informatica.2016.76

The Framework for the Selection of Personnel Based on the SWARA and ARAS Methods Under Uncertainties

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Received: March 2015; accepted: February 2016

Abstract. In the hiring process at companies, decision makers have underused the methods of the multi-criteria decision-making processes of selection of personnel. Therefore, this paper aims to establish a framework for the selection of candidates during the process of the recruitment and selection of personnel based on the SWARA and ARAS methods under uncertainties. The usability and efficiency of the proposed framework is considered in the conducted case study of the selection of candidate for the position of the sales manager.

Key words: selection of personnel, recruitment, competencies, fuzzy, MCDM.

1. Introduction

In modern business conditions and an increased competition, companies are increasingly recognizing the importance of quality personnel, and their activities in the human resources (HR) direct the focus on finding primarily professional, competent and motivated personnel. Competent employees are the key resource of any organization. The process of the recruitment and selection of employees is an extremely complex, where, in a short period of time, candidates should be selected on the basis of pre-generated applications only to be employed upon the completion of the process. However, there is always a possibility of having good candidates rejected in some cases; for the better effectiveness of the process and the better evaluation of potential candidates, decision-makers in the hiring of personnel are given various available "tools" in order to eliminate such a possibility or reduce it to the minimum.

Recruitment and selection of personnel is an extremely demanding process attempting to predict how well someone will work during a period of, say, 10 years on the basis of

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information that can be collected within the time of 30 minutes to maximum 3 days. While there are always ethical and legal constraints on the one hand, and there is a natural desire of candidates to present themselves in the best possible light, on the other (Cook and Cripps, 2005).

During recruitment and selection of personnel, candidates key competencies play an important role. Depending on the position and job analysis for that particular position, each position has a defined set of the key competencies; so, based on the evaluation of candidates key competencies, decision-makers in the hiring process make the final decision on which candidates who meet the required conditions best.

Certain number of studies have been devoted to the recruitment and selection of personnel. A significant number of them are dedicated to the use of psychometric tests, cognitive tests, personality tests, structured interviews, assessment centres of competencies (Cooper and Robertson, 1995; Smith and Robertson, 1990; Sackett and Lievens, 2008; Cook and Cripps, 2005; Robertson and Smith, 2001; Miller and Gordon, 2014).

In due course of time, Multiple Criteria Decision Making (MCDM) methods were used for solving many problems, as well as providing specific approaches to certain problems such as new application of SWARA Method in prioritizing sustainability assessment indicators of energy system (Hashemkhani Zolfani and Saparauskas, 2013), investment prioritizing in high tech industries based on SWARA-COPRAS approach (Hashemkhani Zolfani and Bahrami, 2014), a novel hybrid SWARA and VIKOR methodology for supplier selection in an agile environment (Alimardani *et al.*, 2013), investigating on successful factors of online games based on explorer (Hashemkhani Zolfani *et al.*, 2013), integrated evaluation of external wall insulation in residential buildings using SWARA-TODIM MCDM method (Ruzgys *et al.*, 2014) and assessment of regions priority for implementation of solar projects in Iran (Vafaeipour *et al.*, 2014).

One part of studies have been based on the use of the MCDM methods in the recruitment and selection of personnel, such as the application of the AHP method proposed by Saaty (1977, 1980), where Güngör *et al.* (2009) uses the fuzzy AHP approach for the personnel selection; the fuzzy MCDM method for the personnel selection proposed by Petrovic-Lazarevic (2001), and the personnel selection using the fuzzy MCDM algorithm proposed by Liang and Wang (1994); the ANP method, also proposed by Saaty (1996), where Lin (2010) uses the ANP and fuzzy data envelopment analysis approaches for the personnel selection, as well as the Step-wise Weight Assessment Ratio Analysis (SWARA) method, proposed by Keršulienė *et al.* (2010), used for the selection of personnel (Zolfani and Banihashemi, 2014; Nabian, 2014); the new Additive Ratio Assessment (ARAS) method, proposed by Zavadskas and Turskis (2010) is also used for the selection of the chief accountant (Keršulienė and Turskis, 2014).

The paper will focus on the case study in which a framework for the selection of a candidate in the recruitment and selection for the position of a sales manager will be presented and applied. The research is based on the SWARA-ARAS MCDM framework. The SWARA method will be used for the determination of weighting factors, whereas the ARAS fuzzification will be used for ranking alternatives for the candidates in this case study.

Therefore, this manuscript is organized as follows: in Section 2, the criteria for the selection of a sales manager are defined; in Section 3, the fuzzy set theory is shown; Section 4 of the paper presents the SWARA method and Section 5 presents the ARAS method. In order to thoroughly inspect the selection of candidates based on the application of the SWARA and ARAS methods, Section 6 provides us with a framework for the selection of a candidate in the recruitment and selection of personnel. Finally, Section 7 is dedicated to a case study of the recruitment and selection of a sales manager in a local company.

2. The Set of Proposed Evaluation Competencies in the Case Study

A set or model of competencies is usually described as a set of knowledge, skills and behaviours, i.e. as motifs, characteristics and a set of the desired behaviour of an individual for a particular job or level.

There are a large number of papers devoted to the models of competencies as well as to the very notion of a competency. So, Kurz and Bartram (2002) see a competency as a "set of behaviours that are instrumental in providing the desired results or outcomes". According to their approach to the assessment and selection of candidates and from their point of view, competencies are seen as identifying, defining and measuring individual differences in regard to specific job demands relevant for successful business.

Boyatzis (1982) defines competencies as the "structural characteristics of a person that result in an effective and/or superior performance on the job". It can be seen that, in contrast to the previous definition, Boyatzis rather sees competencies as structural characteristics (not as a set of behaviour).

Tripathi and Agrawal (2014) observed different types of competencies: managerial competencies and functional competencies. Managerial competencies (soft competencies) represent one's ability to manage work and the development of an interaction with other people, i.e. problem solving, communication, leadership, etc. Functional competencies (hard competencies) represent one's functional capacity for work. They are mainly related to the technical aspects of work, such as market research, financial analysis, etc. In their study, Suhairom *et al.* (2014) disclose a conceptual framework, where one's technical competencies, non-technical competencies, career competencies and personality lead to a superior job performance.

The literature is partly devoted to defining a set of the input competencies necessary for the evaluation of candidates in the recruitment and selection of personnel. So, Ruetzler *et al.* (2010) propose the following seven evaluation criteria in the recruitment and selection process: the average mark, interpersonal skills (soft skills), preparedness for an interview, the ability to work with others, compliance with the organizational culture and work experience.

As a necessary attribute in the process of the recruitment and selection of candidates, Biesma *et al.* (2007) favour the following competencies: communication skills, teamwork skills, flexibility, problem solving, creativity and the knowledge of public health.

The models of demanding input competencies in the recruitment and selection process change and adapt to the demands of work. Based on the analysis of work and positions, the

Table 1
The set of competencies for the position of Sales Manager.

	Criteria
C_1	Interview preparedness
C_2	Relevant work experience
C_3	Education
C_4	Interpersonal skills
C_5	Communication and presentation skills
C_6	Computer skills
C_7	Foreign languages

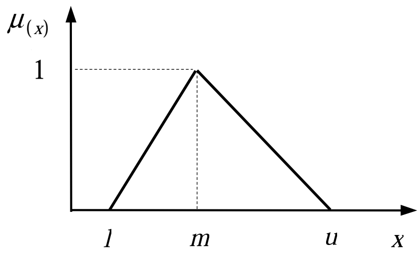

Fig. 1. The triangular fuzzy number.

minimum input criteria for candidates in the recruitment process are created. Therefore, the evaluation of the competencies in this case plays an important role because it is a rolled evaluation of candidates who meet the required conditions to the fullest extent.

Therefore, for the selection of a sales manager, the authors of the case study propose the following list of competencies, shown in Table 1 that will be evaluated by experts in human resources (HR experts, HR partners, HR managers etc.).

3. The Fuzzy Set Theory

Zadeh (1965) introduced the Fuzzy Sets Theory, which allows a partial membership in a set. As a result, instead of the exclusive use of crisp numbers, the fuzzy set theory allows the use of the other forms of numbers, such as triangular, trapezoidal, and bell-shaped numbers.

3.1. *The Triangular Fuzzy Numbers*

The triangular fuzzy number (TFN), shown in Fig. 1 below, is fully characterized by the triplet of real numbers (l, m, u), where parameters l, m, and u indicate the smallest possible value, the most promising value, and the largest possible value, respectively, that describe a fuzzy event (Dubois and Prade, 1980; Ertugrul and Karakasoglu, 2009).

The membership function of the TFN is defined as:

$$\mu(x) = \begin{cases} 0, & x < l, \\ (x-l)/(m-l), & l \leqslant x \leqslant m, \\ (u-x)/(u-m), & l \leqslant x \leqslant u, \\ 0, & x > u. \end{cases} \tag{1}$$

Let $\tilde{A}$ and $\tilde{B}$ be two triangular fuzzy numbers, parameterized by the triple (a_l, a_m, a_u) and (b_l, b_m, b_u), respectively. Then, the basic operations on these fuzzy numbers are defined as Dubois and Prade (1980), Wang and Chang (2007), Baležentis and Zeng (2013), Vahdani *et al.* (2014), Stanujkic (2015):

$$\tilde{A} + \tilde{B} = (a_l + b_l, a_m + b_m, a_u + b_u), \tag{2}$$

$$\tilde{A} - \tilde{B} = (a_l - b_u, a_m - b_m, a_u - b_l), \tag{3}$$

$$\tilde{A} \times \tilde{B} = (a_l b_l, a_m b_m, a_u b_u), \tag{4}$$

$$\tilde{A} \div \tilde{B} = \left(\frac{a_l}{b_u}, \frac{a_m}{b_m}, \frac{a_u}{b_l}\right). \tag{5}$$

The following unary operations on the triangular fuzzy numbers are also important:

$$k \times \tilde{A} = (ka_l, ka_m, ka_u), \tag{6}$$

$$\tilde{A}^{-1} = \left(\frac{1}{a_u}, \frac{1}{a_m}, \frac{1}{a_l}\right). \tag{7}$$

3.2. *Defuzzification of TIFNs*

As the result of performing an operation on the fuzzy numbers, the obtained result is also a fuzzy number. Therefore, in order to rank alternatives in a fuzzy environment using the MCDM methods, these methods must be able to perform the ranking based on overall fuzzy responses, or they must transform overall fuzzy responses into crisp responses before they perform such ranking. Over time, a number of different methods for defuzzification are proposed, from which two have been considered.

Liou and Wang (1992) proposed the Interval Value Method for ranking fuzzy numbers, as follows:

$$gm(\tilde{A}) = \frac{1}{2}\big[(1-\lambda)l + m + \lambda u\big], \tag{8}$$

with λ as the coefficient representing the decision-maker's risk-taking attitude, also denoted as the index of optimism, and $\lambda \in [0, 1]$.

Opricovic and Tzeng (2004) proposed a centroid method, which provides a crisp value based on the centre of gravity, as follows:

$$gm(\tilde{A}) = \frac{l + m + u}{3}. \tag{9}$$

4. The SWARA Method

The new Step-wise Weight Assessment Ratio Analysis (SWARA) method was proposed by Keršulienė *et al.* (2010). Despite the fact that is a relatively new method, the SWARA method has already found its application in solving various problems such as the rational dispute resolution (Keršulienė *et al.*, 2010), the architect selection (Keršulienė and Turskis, 2011), the design of products (Zolfani *et al.*, 2013), the machine tool selection (Aghdaie *et al.*, 2013), a framework for the selection of a packaging design based on the SWARA method (Stanujkic *et al.*, 2015) and the personnel selection (Zolfani and Banihashemi, 2014).

The process of determining the relative weighting factors of the criteria using the SWARA method can accurately be shown through the following steps:

Step 1. The criteria are sorted in descending order, based on their expected significances.

Step 2. Starting from the second criterion, the respondent expresses the relative importance of the criterion j in relation to the previous $(j-1)$ criterion, for each particular criterion. According to Keršulienė *et al.* (2010), this ratio is called the Comparative Importance of Average Value s_j.

Step 3. Determine the coefficient k_j as follows:

$$k_j = \begin{cases} 1, & j = 1, \\ s_j + 1, & j > 1. \end{cases} \tag{10}$$

Step 4. Determine the recalculated weighting factors q_j as follows:

$$q_j = \begin{cases} 1, & j = 1, \\ \frac{q_{j-1}}{k_j}, & j > 1. \end{cases} \tag{11}$$

Step 5. The relative weighting factors of the evaluation criteria are determined as follows:

$$w_j = \frac{q_j}{\sum_{k=1}^{n} q_k}, \tag{12}$$

where w_j denotes the relative weighting factors of the criterion j.

5. The ARAS Method

The ARAS method was proposed by Zavadskas and Turskis (2010). The well-known ARAS method was used to solve many MCDM problems, such as model based on ARAS-G and AHP methods for multiple criteria prioritizing of heritage (Turskis *et al.*, 2013), proposing a new model for waste dump site selection: case study of Ayerma phosphate mine (Shariati *et al.*, 2014), applying fuzzy MCDM for financial performance evaluation of Iranian companies (Ghadikolaei *et al.*, 2014), an integrated model for extending brand based on fuzzy ARAS and ANP methods (Zamani *et al.*, 2014), and Extension of the ARAS method for Decision-making problems with Interval-Valued Triangular Fuzzy Numbers (Stanujkic, 2015).

The process of solving decision-making problems using the ARAS method, similarly to the other MCDM methods, starts with forming a decision matrix. In the case of MCDM problems based on the use of only benefit criteria, the remaining computational procedure of the ARAS method can precisely be expressed applying the following steps:

Step 1. Determine the optimal performance rating for each criterion. In this step, the decision maker sets the optimal performance rating for each criterion. If the decision maker does not have preferences, the optimal performance ratings are calculated as:

$$x_{0j} = \max_i x_{ij}, \tag{13}$$

where x_{0j} denotes the optimal performance rating of the j-th criterion, x_{ij} denotes the performance rating of the i-th alternative with respect to the j-th criterion; i denotes the number of alternatives; $i = 1, \dots m$. j denotes the number of criteria; $j = 1, \dots, n$.

Step 2. Calculate the normalized decision matrix. The normalized performance ratings are calculated by applying the following formula:

$$r_{ij} = \frac{x_{ij}}{\sum_{i=0}^{m} x_{ij}}, \tag{14}$$

where r_{ij} denotes the normalized performance rating of the i-th alternative in relation to the j-th criterion, $i = 0, 1, \dots, m$.

Step 3. Calculate the weighted normalized decision matrix. The weighted normalized performance ratings are calculated by the application of the following formula:

$$v_{ij} = w_j r_{ij}, \tag{15}$$

where v_{ij} denotes the weighted normalized performance rating of the i-th alternative in relation to the j-th criterion, $i = 0, 1, \dots, m$.

Step 4. Calculate the overall performance rating, for each alternative. The overall performance ratings can be calculated through the application of the following formula:

$$S_i = \sum_{j=1}^{n} v_{ij}, \tag{16}$$

where S_i denotes the overall performance rating of the i-th alternative, $i = 0, 1, \dots, m$.

Step 5. Calculate the degree of utility for each alternative. When evaluating alternatives, it is not only important to determine the best ranked alternative but it is also important that we determine the relative performances of the considered alternatives in relation to the optimal alternative. For this purpose, the degree of utility is used, and it can be calculated as follows:

$$Q_i = \frac{S_i}{S_0}, \tag{17}$$

where Q_i denotes the degree of utility of the i-th alternative, and S_0 is the overall performance index of the optimal alternative, $i = 1, 2, \dots, m$.

Step 6. Rank the alternatives and/or select the most efficient one. The considered alternatives are ranked by ascending Q_i, i.e. the alternative with the largest value of Q_i is the best placed one.

6. The Framework for the Selection of a Candidate in the Recruitment and Selection Process

The framework for evaluation, based on the use of the SWARA and ARAS methods, can accurately be expressed through the following steps:

Step 1. Forming a team of k experts (HR_k) who will make an evaluation of candidates.

Step 2. Determining the weighting factors of the evaluation criteria. In this step, by applying the SWARA method, the experts involved in the evaluation determine the significance of the criteria.

Thereafter, the resulting weighting factors are determined as follows:

$$w_j = \frac{1}{K} \sum_{k=1}^{K} w_j^k, \tag{18}$$

where w_j^k denotes the weighting factors of the j-th criterion obtained from the k-th HR, $k = 1, 2, \dots, K$, and K is the number of HR.

Step 3. The evaluation of candidates in relation to the selected set of criteria. In this step, by applying the ratings in the interval 1–5, the experts perform the evaluation of the candidates in relation to the selected criteria.

The meaning of the ratings 1–5, used for the evaluation purpose, is shown in Table 2.

Table 2
Ratings for evaluation.

Ratings	Meaning
1	Strongly disagree
2	Disagree
3	Slightly agree
4	Agree
5	Strongly agree

Table 3
The minimum required level of the criteria.

Criteria	Minimum required level
C_1	4.45
C_2	4.20
C_3	4.00
C_4	3.95
C_5	3.85
C_6	3.70
C_7	3.50

In Table 3 is shown the minimum required level for each criterion. Applicants who do not meet the minimum competency levels for one are taken into no further consideration.

Step 4. The determination of the average scores of all candidates and the elimination of the candidates who have not reached the minimum required level with respect to each one of the above criteria.

The average rating is calculated as follows:

$$\bar{x}_{ij} = \frac{1}{K}\sum_{j=1}^{k} x_{ij}^{k}, \tag{19}$$

where $\bar{x}_{ij}$ denotes the average rating of the i-th candidate in relation to the j-th criterion, and x_{ij}^{k} denotes the rating of the i-th candidate in relation to the j-th criterion obtained from the k-th HR.

Step 5. Calculate the fuzzy group decision making matrix. Higher advantages are known to be possible to achieve by applying fuzzy numbers compared to the crisp ones. Therefore, in this step, the fuzzy ratings $\tilde{x}_{ij} = (l_{ij}, m_{ij}, u_{ij})$ are calculated as follows:

$$l_{ij} = \min_{k} x_{ij}^{k}, \tag{20}$$

$$m_{ij} = \frac{1}{K}\sum_{j=1}^{k} x_{ij}^{k}, \tag{21}$$

$$u_{ij} = \max_{k} x_{ij}^{k}. \tag{22}$$

Step 6. Determine the optimal performance rating for each criterion. In this step, the optimal performance rating for each criterion $\tilde{x}_{0j} = (l_{0j}, m_{0j}, u_{0j})$ is calculated as follows:

$$l_{0j} = \max_{j} l_{ij}, \tag{23}$$

$$m_{0j} = \max_j m_{ij}, \tag{24}$$

$$u_{0j} = \max_j u_{ij}, \tag{25}$$

where $\tilde{x}_{0j}$ denotes the optimal performance rating of the j-th criterion.

Step 7. Calculate the normalized fuzzy decision making matrix. Instead of using Eq. (14), the normalized fuzzy ratings $\tilde{r}_{ij} = (\bar{l}_{ij}, \bar{m}_{ij}, \bar{u}_{ij})$ can be calculated as follows:

$$\bar{l}_{ij} = \frac{l_{ij}}{\sum_{i=0}^{m} u_{ij}}, \tag{26}$$

$$\bar{m}_{ij} = \frac{m_{ij}}{\sum_{i=0}^{m} u_{ij}}, \tag{27}$$

$$\bar{u}_{ij} = \frac{u_{ij}}{\sum_{i=0}^{m} u_{ij}}, \tag{28}$$

where $i = 1, \ldots, m$; $j = 0, \ldots, n$.

Step 8. Calculate the weighted normalized fuzzy decision matrix. The weighted normalized fuzzy decision matrix $\tilde{v}_{ij}$ can be calculated as follows:

$$\tilde{v}_{ij} = w_j \tilde{r}_{ij}. \tag{29}$$

Step 9. Calculate the overall fuzzy rating for each alternative. Overall fuzzy performance ratings can be calculated as follows:

$$\tilde{S}_i = \sum_{j=1}^{n} \tilde{v}_{ij}, \tag{30}$$

where $\tilde{S}_i$ denotes the overall fuzzy rating of the i-th alternative, $i = 0, 1, \ldots, m$.

Step 10. Calculate the degree of utility for each alternative. The results achieved by applying Eq. (29) are fuzzy numbers and must be defuzzified prior to applying Eq. (17). For the purpose of defuzzification, Eq. (9) can be used.

Step 11. Rank the alternatives and/or select the most efficient one. In the described scenario, the best placed alternative can be determined in the same manner as in the case of the ordinary ARAS method.

However, significant advantages can be achieved if the fuzzy degree of utility is calculated, as follows:

$$\tilde{Q}_i = \frac{\tilde{S}_i}{\tilde{S}_0}. \tag{31}$$

Subsequently, based on the formula (8), different variants can be considered, in which variants greater importance is given to either pessimistic or optimistic HR attitudes.

7. Case Study

A local furniture manufacturing and selling company is looking for a sales manager. In the recruitment process, the total of three experts in human resources participate, so a decision on the final selection of the candidate who best meets the required criteria and possess the required competencies will be brought by applying the SWARA and fuzzified ARAS methods for decision making. On the basis of the vacancy announcement and the job analysis, the sales manager will have some of the following responsibilities, namely: defining sales strategies, monitoring and market analysis, concluding contracts with strategic customers, maintaining contact with the existing and future customers, reporting on the results to the director of the company and being in charge of the presentation of products and services to the domestic and foreign partners.

Based on the position and the requirements defined in the vacancy, the decision-makers have created a pre-requisite set of competencies necessary for candidates to possess. If a candidate does not possess the minimum expected level with respect to any of the competencies, he/she will undergo no further process of selection.

In the vacancy announcement for the position of the sales manager, the total of 21 candidates applied; out of the 21 candidates, four candidates are taken into consideration for a further selection process.

The framework for the selection of candidates in the recruitment and selection process is applied as follows:

Step 1. The team of experts have estimated the competencies of the four candidates. In Step 1, the human resources decision makers determined the importance of the criteria to be used for the evaluation based on the SWARA method. The results obtained from the first HR are shown in Table 4.

Step 2. The resulting weighting factors, obtained on the basis of the three HRs, are shown in Table 5.

Step 3. The results of evaluating candidates, obtained from the three HRs, are shown in Tables 6 to 9. The resulting average of group ratings (AVG) are obtained also by applying Eq. (19).

Table 4
The responses obtained from the first of the three HRs and the relative weighting factors of the criteria.

Criteria	s_j	k_j	q_j	w_j
C_1		1	1	0.23
C_2	0.05	1.05	0.95	0.22
C_3	0.32	1.32	0.72	0.16
C_4	0.10	1.10	0.66	0.15
C_5	0.25	1.25	0.52	0.12
C_6	0.40	1.40	0.37	0.08
C_7	1.00	2.00	0.19	0.04
			4.42	1.00

Table 5
The resulting weighting factors based on the three HRs.

Criteria	C_1	C_2	C_3	C_4	C_5	C_6	C_7
HR_1	0.22	0.21	0.16	0.14	0.11	0.08	0.04
HR_2	0.25	0.23	0.18	0.12	0.09	0.07	0.03
HR_3	0.20	0.20	0.16	0.16	0.14	0.08	0.05
Resulting weighting factors	0.23	0.22	0.17	0.15	0.12	0.08	0.04

The resulting (group) weighting factors are obtained by applying Eq. (18).

Table 6
The ratings obtained by the first candidate of the three HRs.

Criteria alternatives	C_1	C_2	C_3	C_4	C_5	C_6	C_7
HR_1	4	5	2	4	4	4	5
HR_2	5	5	5	4	5	3	4
HR_3	5	3	5	4	4	5	2
Level	4.67	4.33	4.00	4.00	4.33	4.00	3.67
AVG	0.22	0.13	0.00	0.05	0.48	0.30	0.17

Table 7
The ratings obtained by the second candidate of the three HRs.

Criteria alternatives	C_1	C_2	C_3	C_4	C_5	C_6	C_7
HR_1	5	5	4	5	5	5	5
HR_2	5	5	4	5	5	5	5
HR_3	5	4	4	5	5	5	4
Level	5.00	4.67	4.00	5.00	5.00	5.00	4.67
AVG	0.55	0.47	0.00	1.05	1.15	1.30	1.17

Table 8
The ratings obtained by the third candidate of the three HRs.

Criteria alternatives	C_1	C_2	C_3	C_4	C_5	C_6	C_7
HR_1	4	4	4	4	4	3	4
HR_2	5	5	3	5	5	4	3
HR_3	5	5	5	5	4	5	5
Level	4.67	4.67	4.00	4.67	4.33	4.00	4.00
AVG	0.22	0.47	0.00	0.72	0.48	0.30	0.50

Table 9
The ratings obtained by the fourth candidate of the three HRs.

Criteria alternatives	C_1	C_2	C_3	C_4	C_5	C_6	C_7
HR_1	5	5	4	5	4	3	3
HR_2	5	5	5	2	4	4	4
HR_3	4	5	3	5	5	5	4
Level	4.67	5.00	4.00	4.00	4.33	4.00	3.67
AVG	0.22	0.80	0.00	0.05	0.48	0.30	0.17

Table 10
The group matrix.

Criteria candidates	C_1	C_2	C_3	C_4	C_5	C_6	C_7
K_0	(5, 5, 5)	(5, 5, 5)	(4, 4, 5)	(5, 5, 5)	(5, 5, 5)	(5, 5, 5)	(4, 4.67, 5)
K_1	(4, 4.67, 5)	(3, 4.33, 5)	(2, 4, 5)	(4, 4, 4)	(4, 4.33, 5)	(3, 4, 5)	(2, 3.67, 5)
K_2	(5, 5, 5)	(4, 4.67, 5)	(4, 4, 4)	(5, 5, 5)	(5, 5, 5)	(5, 5, 5)	(4, 4.67, 5)
K_3	(4, 4.67, 5)	(4, 4.67, 5)	(3, 4, 5)	(4, 4.67, 5)	(4, 4.33, 5)	(3, 4, 5)	(3, 4, 5)
K_4	(4, 4.67, 5)	(5, 5, 5)	(3, 4, 5)	(2, 4, 5)	(4, 4.33, 5)	(3, 4, 5)	(3, 3.67, 4)

Table 11
The normalized decision matrix.

Criteria candidates	C_1	C_2	C_3	C_4	C_5	C_6	C_7
w_i	0.23	0.22	0.17	0.15	0.12	0.08	0.04
K_0	(0.2, 0.2, 0.2)	(0.2, 0.2, 0.2)	(0.17, 0.17, 0.21)	(0.21, 0.21, 0.21)	(0.2, 0.2, 0.2)	(0.2, 0.2, 0.2)	(0.17, 0.19, 0.21)
K_1	(0.16, 0.19, 0.2)	(0.12, 0.17, 0.2)	(0.08, 0.17, 0.21)	(0.17, 0.17, 0.17)	(0.16, 0.17, 0.2)	(0.12, 0.16, 0.2)	(0.08, 0.15, 0.21)
K_2	(0.2, 0.2, 0.2)	(0.16, 0.19, 0.2)	(0.17, 0.17, 0.17)	(0.21, 0.21, 0.21)	(0.2, 0.2, 0.2)	(0.2, 0.2, 0.2)	(0.17, 0.19, 0.21)
K_3	(0.16, 0.19, 0.2)	(0.16, 0.19, 0.2)	(0.13, 0.17, 0.21)	(0.17, 0.19, 0.21)	(0.16, 0.17, 0.2)	(0.12, 0.16, 0.2)	(0.13, 0.17, 0.21)
K_4	(0.16, 0.19, 0.2)	(0.2, 0.2, 0.2)	(0.13, 0.17, 0.21)	(0.08, 0.17, 0.21)	(0.16, 0.17, 0.2)	(0.12, 0.16, 0.2)	(0.13, 0.15, 0.17)

Table 12
The weighted normalized decision matrix.

Criteria candidates	C_1	C_2	C_3	C_4	C_5	C_6	C_7
K_0	(0.05, 0.05, 0.05)	(0.04, 0.04, 0.04)	(0.03, 0.03, 0.03)	(0.03, 0.03, 0.03)	(0.02, 0.02, 0.02)	(0.02, 0.02, 0.02)	(0.01, 0.01, 0.01)
K_1	(0.04, 0.04, 0.05)	(0.03, 0.04, 0.04)	(0.01, 0.03, 0.03)	(0.02, 0.02, 0.02)	(0.02, 0.02, 0.02)	(0.01, 0.01, 0.02)	(0, 0.01, 0.01)
K_2	(0.05, 0.05, 0.05)	(0.03, 0.04, 0.04)	(0.03, 0.03, 0.03)	(0.03, 0.03, 0.03)	(0.02, 0.02, 0.02)	(0.02, 0.02, 0.02)	(0.01, 0.01, 0.01)
K_3	(0.04, 0.04, 0.05)	(0.03, 0.04, 0.04)	(0.02, 0.03, 0.03)	(0.02, 0.03, 0.03)	(0.02, 0.02, 0.02)	(0.01, 0.01, 0.02)	(0.01, 0.01, 0.01)
K_4	(0.04, 0.04, 0.05)	(0.04, 0.04, 0.04)	(0.02, 0.03, 0.03)	(0.01, 0.02, 0.03)	(0.02, 0.02, 0.02)	(0.01, 0.01, 0.02)	(0.01, 0.01, 0.01)

Table 13
The overall performance indices and degrees of utility.

Criteria candidates	S_i	Q_i	Rank
K_0	0.20		
K_1	0.17	0.85	4
K_2	0.19	0.97	1
K_3	0.18	0.90	2
K_4	0.18	0.89	3

Step 4. The group, group-normalized and group-weighted-normalized matrices are shown in Tables 10, 11 and 12.

Step 5. The overall performance of indices and degrees of utility obtained by using formulae (5) and (9) are shown in Table 13.

If necessary, decision makers can use Eq. (8) to perform various analyses to respectively consider the selection of candidates with a pessimistic or an optimistic perspective. According to the given framework and the methodology, candidate K_2 is ranked as the best one in terms of the evaluated competencies.

8. Conclusions

Employees at the time of increased competitiveness are the key for achieving success in companies and achieving competitive advantage. Therefore, it is very important for the organization that during the recruitment to select the most appropriate personnel who is primarily competent and motivated among other candidates. One MCDM model for the selection of candidates in the recruitment and selection process is considered in this paper. As can be concluded from the paper, the proposed model is effective and easy to use. In order to form a simple model, a relatively small number of criteria are initially selected; depending on the goal we want to achieve, such an initial set of criteria may be amended or supplemented if necessary. By increasing the number of criteria as well as having them hierarchically organized, much more reliable selections of candidates can be accomplished. From the above framework as well as the case study conducted, it can be concluded that the same is easily applicable, adaptive and possible to apply in order to choose the best candidates in the recruitment and selection process. Proposed model in the manuscript can be easily modified and adapted to a certain extent and could solve problems in other areas as well. Additionally, the manuscript provides a set of evaluation competencies for the position of Sales Manager. As a direction for future research, the other MCDM methods, such as TOPSIS, VIKOR, COPRAS, MULTIMOORA or WASPAS can be used in this area, accompanied by additional criteria or sub-criteria.

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Personalo atrankos sistema taikant SWARA ir ARAS metodus

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Įmonės personalo įdarbinimo procese pradeda naudoti daugiakriterinius sprendimų priėmimo metodus. Straipsnyje pateikiama sistema, grindžiama SWARA ir ARAS metodais, skirta personalo atrankai ir įdarbinimo procesui atlikti. Sukurta sistema, pritaikyta personalo vadybininko kandidatūrai atrinkti.