# Multi-criteria decision making in salesforce recruitment

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**Abstract**

The aim of this article is to propose and apply a suitable method of a multi-criteria decision making for evaluating candidates in salesforce recruitment and to select optimal one. As a multi-criteria decision making method there was used TOPSIS which is one of the best known and is not difficult to process. This method was used to evaluate a group of candidates who applied for a job in the sales department. Quantitative and qualitative criteria was set including their weights and TOPSIS calculations gave us a candidate who represent the optimal choice. Part of this paper is a survey if HR specialists and others competent decision makers use multi-criterial decision making methods in employee recruiting or not and if so which method is the most favorite and commonly used.

**Key words**

Multi-criteria decision making, employees´ selection, HR recruitment, multi-criteria evaluating, survey, TOPSIS

**JEL classification**

M12, M51, C02

## Introduction

The selection procedure for filling a new job is a real situation in which the decision maker has to evaluate a candidate according to several often inconsistent decision criteria. These criteria are usually not consistent with each other, in the variant which is best rated for one criterion is not best rated for the other one. Variants here are candidates for the relevant job position and criteria characterize these individual candidates. There are concerned educations, languages, psychological and other tests, individual interviews with the candidate, etc. The aim is to propose the practical utilization of the multi-criteria decision-making method in the real situation of HR recruitment and to implement their practical application on the specific group of job applicants. Only few real situations are decided only by one single criterion. The mono-

criterial nature of decision-making problems is an exception in the real world. Significantly more frequent decision-making problems are multi-criterial such as a recruitment where candidates have to be assessed and evaluated according to several different criteria which are often non-additive which means that they are not in the same units of measure. Often it is a mixed set of criteria which is characterized by some criteria being of a qualitative nature and some of a quantitative nature. The aim is to set such a solution to the decision problem which is generally the most advantageous or in other words optimal or to determine the preferential order of candidates. The chosen option should be the best in terms of the whole set of criteria.

## 1 Formulation of the issue

Samanlioglu, F. et al. (2018) describes the personnel selection process as a group multi-criteria decision-making problem. Nowadays, organizations need personnel who make a difference through innovative ideas and who keep up with the rapid changes. Human resource planning helps managers to anticipate and meet changing needs related to the acquisition, deployment, and utilization of employees. Such information enables a company to plan its recruitment and selection strategies. The hiring phase of human resource management involves policies and procedures used by organizations to recruit and select employees. The aim of recruitment practices is to identify a suitable pool of applicants quickly, cost-efficiently, and legally. Selection involves assessing and choosing among job candidates. To be effective, selection processes must be both legally and technically sound. The main concern of the hiring phase, both for HR manager and applicants, is the transparency of the process (Dockalikova, I., Kashi, K. 2013). The selection of the best employees is one of the process of evaluating how well the performance of the employees is adjusted to the standards set by the company management. In general, the selection of the best employees is still performed manually with many criteria and alternatives, and this usually make it difficult top managerial making decisions as well as the selection of the best employees periodically into a long and complicated process. Therefore, it is necessary to build a decision support system that can help facilitate the decision maker in determining the best choice based on standard criteria faster and more objective (Rahim, R. et al. 2018). Kashi, K. (2015) focuses on real-life application of multiple decision making methods (MCDM) and their adaptation in a way which can be acceptable for human resource practice, describes and shows that MCDM methods can be used by human resources professionals for a better decision making when it comes to hiring new employees. We have several multi-criteria decision making methods for finding the best or optimal solution. One of them is TOPSIS. This

method has been chosen for the sake of simple and quick application and good intelligibility and clarity for the target group of HR specialists.

## 2 Methodology and data

In the tasks of multi-criterial evaluation of variants there is defined a set of decision variants (candidates) $X = \{X_1, X_2, \dots, X_n\}$ which are evaluated according to criteria $Y_1, Y_2, \dots Y_k$. According to these criteria each candidate $X_1, i = 1, 2, \dots, n$ is described by a vector of so-called criteria values $(y_{i1}, y_{i2}, \dots, y_{ik})$.

The mathematical model of the multi-criterial variants evaluation can be expressed in the form of the criterion matrix (Jablonský, J. 2007).

$$\begin{array}{c} \\ X_1 \\ X_2 \\ \vdots \\ X_n \end{array} \begin{array}{c} \begin{array}{cccc} Y_1 & Y_2 \dots & & Y_k \end{array} \\ \begin{bmatrix} y_{11} & y_{12} & \cdots & y_{1k} \\ y_{21} & y_{22} & \cdots & y_{2k} \\ \vdots & \vdots & \ddots & \vdots \\ y_{n1} & y_{n2} & \cdots & y_{nk} \end{bmatrix} \end{array} \quad (1)$$

Requirements and demands for a given job candidate are transformed into individual criteria which usually have different weightings. In other words a different significance factor. After defining the criteria the next step is to determine the weights of the individual evaluation criteria. The criteria weights represent a numerical expression of the significance and importance of the observed properties and assumptions. A criterion with a bigger importance for a decision-maker has a higher value and vice versa. It is necessary to standardize weights to achieve a comparability so that their sum is equal to the number one. A scoring method was used to determine the criteria weights which is to assign a certain number of points from the selected scale to each criterion according to how an assessor evaluates the significance of each criterion.

### 2.1 TOPSIS

The Technique for Order of Preference by Similarity to Ideal Solution (TOPSIS) is a multi-criteria decision analysis method. TOPSIS method is based on the selection of a variant which is closest to the so-called ideal variant which is characterized by the vector of the best criterion values and at the same time furthest from the so-called basal variant. It´s the variant which is represented by the worst criterion vector (Jablonský, J. 2007).

Description of the method:

The original $y_{ij}$ criteria are transformed into $r_{ij}$ values by relations

$$r_{ij} = \frac{y_{ij}}{\left(\sum_{i=1}^{n} {y_{ij}}^2\right)^{\frac{1}{2}}}, \quad i = 1,2,\dots,n;\ j = 1,2,\dots,k. \tag{2}$$

The elements of normalized criterion matrix $W = (w_{ij})$ are calculated as

$$\mathrm{w}_{ij} = v_j r_{ij} \tag{3}$$

where $v_j$ is the weight of $j$ criterion.

The ideal variant with the criterion values $(H_1,\ H_2, \dots, H_k)$ and the basal variant with the values $(D_1,\ D_2, \dots, D_k)$ are determined from the elements of the matrix $W$ where

$$\mathrm{H}_j = max_i(w_{ij}) \text{ and } \quad \mathrm{D}_j = min_i(w_{ij}), \qquad \mathrm{i} = 1,2,\dots,\mathrm{n}. \tag{4}$$

The distance of variants from ideal and basal variants are calculated according to relations

$$d_i^+ = \left[\sum_{j=1}^{k} (w_{ij} - H_j)^2\right]^{\frac{1}{2}}, \qquad \mathrm{i} = 1,2,\dots,\mathrm{n}. \tag{5}$$

$$d_i^- = \left[\sum_{j=1}^{k} (w_{ij} - D_j)^2\right]^{\frac{1}{2}}, \qquad \mathrm{i} = 1,2,\dots,\mathrm{n}. \tag{6}$$

Then indicator $c_i$ is calculated as the relative distance of variants from the basal variant:

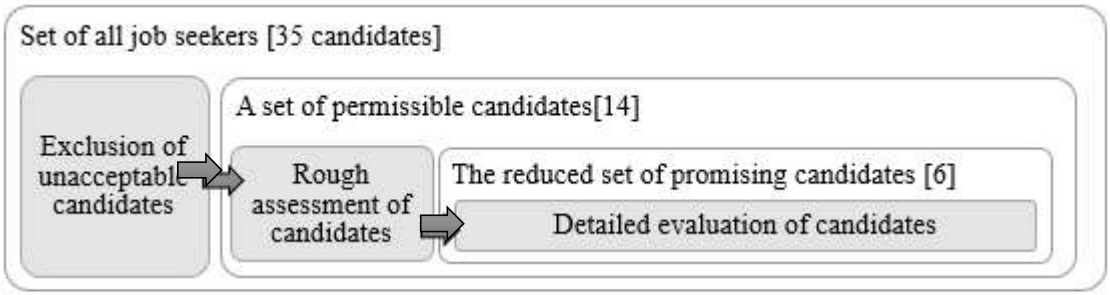
$$\mathrm{c}_i = \frac{d_i^-}{d_i^- + d_i^+}, \qquad \mathrm{i} = 1,2,\dots,\mathrm{n} \tag{7}$$

Values $c_i$ are from the interval <*0, 1*>. They get *0* for the basal variant and *1* for the ideal variant. Variants can be arranged according to decreasing values $c_i$. For more detailed information please see (Fiala et al. 1994).

## 3 Case study

This case study was made in the selected company employing 2,500 employees located in Přerov (Olomouc region, Czech Republic). The essence of this case study was to propose, create and implement a quantifiable multi-criteria evaluation of candidates in salesforce recruitment. Candidates in the recruitment were evaluated on the basis of multi-criteria evaluation using TOPSIS. The selection process in the salesforce recruitment represented a larger number of permissible candidates. So the evaluation process was divided into a few steps. In the first step there was some rough assessment of candidates in order to eliminate those permissible candidates who were less favorable than the other permissible candidates. In this rough assessment of candidates the focus was mainly on key criteria and the dominance principle was used. That is, eg the candidate Cx1 dominated the candidate Cx2 when he/she was better in terms of at least one criterion and was not worse to any criterion. In the second step the more detailed evaluation of the reduced set of promising candidates was carried out using one of methods of multi-criteria decision making. The chosen method was TOPSIS. The stage approach is shown schematically in the Figure 1. As a result of this stage approach it was possible to significantly reduce the time needed to evaluate candidates and select optimal one to successfully fill the job. In total 35 candidates applied for the position of Area Sales Manager for US market. This number was reduced from 35 to 14 candidates by the exclusion of unacceptable candidates. This set of permissible candidates was then roughly assessed to achieve a representing set of promising candidates from 14 to 6 candidates. This six-member group was subjected to a detailed multi-criterial evaluation by TOPSIS.

**Picture no. 1 Process of candidates evaluation**




Source: Fotr et al. (2006, p. 168) – modified

The decision problem is an evaluation of candidates and finding the optimal solution. As variants there are chosen 6 most promising candidates named anonymously as C1, C2, C3, C4, C5, C6.

Evaluation criteria are:

- Practice, professional experience [years]
- Knowledge of the field [yes = 1, no = 0]
- Characteristic properties [max 100 points]
- Communication, presentation, representative behavior, enthusiasm [0-25]
- Proactive and initiative negotiations, decisiveness [0-25]
- Customer and target orientation [0-25]
- EQ – self-awareness, self-control, social awareness, ability to cooperate with the social environment – relationship management, problem solving [0-25]
- Relevant education in the field – Education out of the field [0], High school in the field [1], Bachelor's degree in the field [3], Master´s degree in the field [5]
- Salary demands [CZK]
- English skills [A1 = 0, A2 = 0, B1 = 1, B2 = 2, C1 = 3, C2 = 4]

Criterial matrix according to the Equation 1 is contained in the Table 1. In this table there are also shown types of criteria (MAX/MIN) and their weights. The sum of weights is not equal to 1. Therefore, the weights had to be transformed to a sum equal to 1. It was enough to divide each weight by 41 which is the sum of all weights. You can see results in the Table 2. The minimization criterion in the matrix Y had to be transformed to maximization one so that the original values were replaced by the distance. (The difference of the criterion values from the worst ones.) In the modified matrix Y in the Table 2 Candidate C1 has a value 10000

because he requires 10 000 CZK less than candidate C5 who demands the most from the whole group and has therefore the worst value 0. The normalized criterion matrix R (Table 3) which is derived from the original matrix Y (Table 2) was recalculated according to Equation 2 and is shown in the Table 3. The Table 4 contains a matrix W which is derived from the matrix R by multiplying the relevant weights according to the Equation 3 then contains the ideal and basal variant according to the Formula 4, distances $d^+$ and $d^-$ from these variants calculated according to the Equation 5 and 6 and coefficients $c_i$ calculated according to the Equation 7 according to which variants are ranked.

**Table no. 1 Criterial matrix Y**

| Criteria | | Practice, professional experience [years] | Knowledge of the field [Yes,No] | Characteristic properties [max 100 points] | Education in the field | Salary demands [CZK] | English |
|---|---|---|---|---|---|---|---|
| MIN/MAX | | MAX | MAX | MAX | MAX | MIN | MAX |
| Weights | | 10 | 3 | 10 | 8 | 2 | 8 |
| Candidates | C1 | 1 | Yes | 78 | Master | 35000 | B2 |
| | C2 | 8 | No | 70 | Bachelor | 42000 | C1 |
| | C3 | 3 | No | 81 | Master | 36000 | C1 |
| | C4 | 6 | Yes | 85 | High school | 43000 | B2 |
| | C5 | 2 | No | 45 | Bachelor | 45000 | B1 |
| | C6 | 4 | No | 50 | High school | 39000 | B1 |

Source: Own data obtained from HR selection process

**Table no. 2 Criterial matrix Y modified to numerical values**

| Criteria | | Practice, professional experience [years] | Knowledge of the field [Yes,No] | Characteristic properties [max 100 points] | Education in the field | Salary demands [CZK] | English |
|---|---|---|---|---|---|---|---|
| MIN/MAX | | MAX | MAX | MAX | MAX | MAX | MAX |
| Weights | | 10 | 3 | 10 | 8 | 2 | 8 |
| Standardized weights | | 0,24 | 0,07 | 0,24 | 0,20 | 0,05 | 0,20 |
| Candidates | C1 | 1 | 1 | 78 | 5 | 10000 | 2 |
| | C2 | 8 | 0 | 70 | 3 | 3000 | 3 |
| | C3 | 3 | 0 | 81 | 5 | 9000 | 3 |
| | C4 | 6 | 1 | 85 | 1 | 2000 | 2 |
| | C5 | 2 | 0 | 45 | 3 | 0 | 1 |
| | C6 | 4 | 0 | 50 | 1 | 6000 | 1 |

Source: Own calculations

**Table no. 3 TOPSIS - normalized criterial matrix R**

| Critera | | Practice, professional experience | Knowledge of the field | Characteristic properties | Education in the field | Salary demands | English |
|---|---|---|---|---|---|---|---|
| MIN/MAX | | MAX | MAX | MAX | MAX | MAX | MAX |
| Weights | | 10 | 3 | 10 | 8 | 2 | 8 |
| Standardized weights | | 0,24 | 0,07 | 0,24 | 0,20 | 0,05 | 0,20 |
| Candidates | C1 | 0,0877 | 0,7071 | 0,4557 | 0,5976 | 0,6594 | 0,3780 |
| | C2 | 0,7016 | 0 | 0,4090 | 0,3586 | 0,1978 | 0,5670 |
| | C3 | 0,2631 | 0 | 0,4732 | 0,5976 | 0,5934 | 0,5669 |
| | C4 | 0,5262 | 0,7071 | 0,4966 | 0,1195 | 0,1319 | 0,3780 |
| | C5 | 0,1754 | 0 | 0,2629 | 0,3586 | 0 | 0,1890 |
| | C6 | 0,3508 | 0 | 0,2921 | 0,1195 | 0,3956 | 0,1890 |

Source: Own calculations

**Table no. 4 TOPSIS – results**

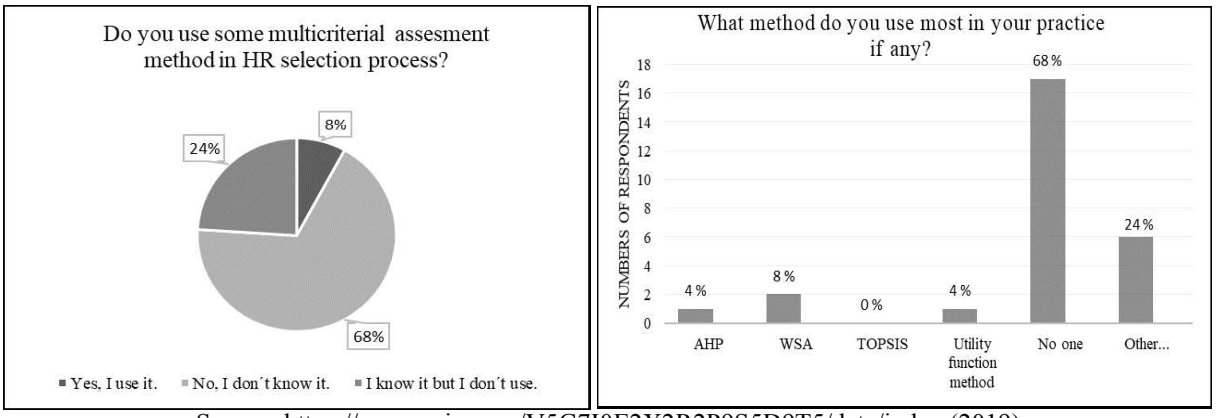
| Criteria | | Practice, professional experience | Knowledge of the field | Characte-ristic properties | Education in the field | Salary demands | English | $d_i^+$ | $d_i^-$ | $c_i$ | *Ran-king* |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Candidates | C1 | 0,0214 | 0,0517 | 0,1112 | 0,1166 | 0,0322 | 0,0737 | 0,1545 | 0,1264 | 0,4500 | 4 |
| | C2 | 0,1711 | 0,0000 | 0,0998 | 0,0700 | 0,0096 | 0,1106 | 0,0763 | 0,1772 | 0,6991 | 1 |
| | C3 | 0,0642 | 0,0000 | 0,1154 | 0,1166 | 0,0289 | 0,1106 | 0,1190 | 0,1394 | 0,5395 | 3 |
| | C4 | 0,1283 | 0,0517 | 0,1211 | 0,0233 | 0,0064 | 0,0737 | 0,1120 | 0,1370 | 0,5501 | 2 |
| | C5 | 0,0428 | 0,0000 | 0,0641 | 0,0700 | 0,0000 | 0,0369 | 0,1762 | 0,0513 | 0,2255 | 6 |
| | C6 | 0,0856 | 0,0000 | 0,0713 | 0,0233 | 0,0193 | 0,0369 | 0,1637 | 0,0674 | 0,2916 | 5 |
| Ideal | | 0,1711 | 0,0517 | 0,1211 | 0,1166 | 0,0322 | 0,1106 | | | | |
| Basal | | 0,0214 | 0,0000 | 0,0641 | 0,0233 | 0,0000 | 0,0369 | | | | |

Source: Own calculations

## 3.1 Survey

The aim of this survey is to find out if HR specialists and others competent decision makers use multi-criterial decision making methods in the selection process in employee recruiting or not and if so which method is the most favorite and commonly used. I contacted HR specialists from 23 companies employing more than 200 employees in Olomouc region and HR specialists from 5 recruitment agencies with nationwide scope. 25 of them were willing to participate in this survey and respond. I collected data through the web questionnaire created on the website my.survio.com.

**Figure no. 1 Survey results**




Source: https://my.survio.com/V5G7I0E2X2R2P9S5D9T5/data/index (2019)

The results of my survey show that 92 % of recruiters in HR departments in contacted companies do not use multi-criteria evaluation methods in job aplicants´ selection procedures. Only 8 % of respondents said that they use these methods in their tasks. In total 32 % of respondents knows these multi-criteria evaluation methods but 24 % of them do not use them.

## Conclusion

This paper shows possible way how to decide in multi-criteria evaluation of job applicants in HR recruitment using a multi-criterial decision making method. In this decision problem there was implemented TOPSIS method to find the optimal candidate. According to TOPSIS calculations the most successful candidate is C2 and this one was finally also selected by decision makers. This whole evaluation process using TOPSIS was a trial version. This method has never been before applied in the selected company in the area of HR recruitment. Most involved decision makers agreed that in this case they would have made the same selection also without using TOPSIS method due to the greatest sympathy and the most distinctive personality of the selected candidate. They agreed they would differ in the preference of other candidates in ranking. TOPSIS allowed to provide precise quantification of compliance with criteria by individual candidates and allowed to choose the best or let´s say optimal option based on the sophisticated mathematical method. Using TOPSIS has proven itself in candidate selection procedures. The use of this method was simple, user-friendly and, in conclusion, successful. My research shows that 68 % of respondents do not know multi-criteria decision making methods at all. 24 % of respondents know them but do not use and only 8 % of respondents sometimes use these methods in their practiceas mentioned in the chart: AHP [4 %], Weighted Sum Approach [8 %], Utility Function Method [4 %]. During my personal

meetings and interviews I was investigating the reason for not using multi-criteria decision making methods also in HR area. The first reason was related to the level of education and the second one was related to the field of education. Some HR specialists have passed university studies in andragogy or in the other field of humanities that is why they are not too much familiar with mathematics and with such quantitative methods of analysis. Some ones have passed only high school what is the limitation factor because they have not come into a contact with these methods in this level of education. (Doesn´t matter if their education is in the economic field or in humanities). Based on my obtained data from this addressed group of respondents each researched HR specialist with high school did not know these methods. 8 % of researched HR specialists who confirmed they know multi-criteria decision making methods and they use them have passed master´s degree in economy. 24 % of respondents who replied: "Yes, I know these method but I don´t use" have passed master´s degree in economy but they have stated they do not like mathematics and do not like use such quantitative methods how these methods are. In general, I can summarize the weak awareness of multi-criteria decision making methods in HR field and their very low frequency of use in HR tasks in the surveyed group of companies. On the basis of all these findings and conclusions my recommendation is a special training in multi-criteria decision making methods customized for HR specialists´ needs. For their practical use in the recruiting I recommend to set up a file with locked formulas (it is enough in Microsoft Excel) in which the user/evaluator will be able to flexibly change the criteria and their weights according to the required job profile and will fill only input data about compliance of criteria by individual candidates. This application can be an effective support for the work of HR specialists or others decision makers and can make their evaluation easier and more transparent and can make the comparison of candidates more objective. As a further scientific research it would be beneficial to find out whether the results of TOPSIS calculations in further selection procedures will match the real subjective choices made by decision makers or will differ and what will be users´ experience and satisfaction with the application of this evaluation method. A subjective view of respondents can be a factor which can distort results and can be a limitation of the research.

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