Personnel Training Selection Problem Based on SDV-MOORA

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Abstract: Selection of qualified human resources is a key success factor for an organization. The adequate personnel training have a dramatic effect on improving the employees' performance, which will be reflected on the growth and competence of the whole organization, especially in large-size and multinational companies and organizations. Personnel selection problem is a well known Multi Criteria Decision Making (MCDM) problem which involves many conflicting attributes. In This article a MCDM problem is presented and a real-life international company personnel selection problem of a new manner is illustrated. A modified Technique for Multi-Objective Optimization on the basis of Ratio Analysis (MOORA) method combined to Standard Deviation weight method is presented to solve the MCDM problem.

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1. Introduction

Training and education are designed to meet personal
needs for knowledge, talents, and skills, as well as the organization's need for qualified personnel. Selection of qualified human resources is a key success factor for an organization. The complexity and importance of the problem call for analytical methods rather than intuitive decisions [6]. There is high interest in analyzing the criteria of selecting personnel for training as well as their educational services provided locally or in other countries. Personnel training process is very crucial in developing organizations. It implies more than one dimension to be optimized. Many conflicting criteria should be considered when comparing alternatives to choose among or rank them [4].

The MCDM includes many solution techniques such as Simple Additive Weighting (SAW), Weighting Product (WP) [7], and Analytic Hierarchy Process (AHP) [11]. The problem of allocating the weights of criteria when no preference is an open research area. Many scholars tried to tackle this problem by various techniques like Information Entropy Weight method, the weighted average operator (OWA), and other several methods [5].The personnel selection problem, from the multi-criteria perspective, has attracted the interest of many scholars as in [9,10].

In this paper a new personnel training selection problem existed in a multi-national company is presented. The Multi-Objective Optimization on the basis of Ratio Analysis (MOORA) method, a branch of MCDM methods, is applied to rank the candidates for an international course of one year duration provided by the company to its employees. The Standard Deviation (SDV) being a measure of dispersion is employed to assign weights for criteria in the problem. The new method so-called SDV-MOORA is applied for ranking candidates in the case study given. The rest of this paper is organized as follows: Section 2 is made for the MOORA approach, the proposed Standard Deviation method is illustrated in section 3, the case study is presented in section 4, and finally section 5 is made for conclusion.

2. MOORA

A MCDM problem can be concisely expressed in a matrix format, in which columns indicate criteria (attributes) considered in a given problem; and in which rows list the competing alternatives.

$$D = \begin{array}{c} \\ A_1 \\ A_2 \\ A_3 \\ \vdots \\ A_m \end{array} \begin{array}{c} \begin{matrix} C_1 & C_2 & C_3 & \cdots & C_n \end{matrix} \\ \begin{bmatrix} x_{11} & x_{12} & x_{13} & \cdots & x_{1n} \\ x_{21} & x_{22} & x_{23} & \cdots & x_{2n} \\ x_{31} & x_{32} & x_{33} & \cdots & x_{3n} \\ \vdots & \vdots & \vdots & \ddots & \vdots \\ x_{m1} & x_{m2} & x_{m3} & \cdots & x_{mn} \end{bmatrix} \end{array} \quad (1)$$

As shown in Eq.(1), a MCDM problem with m alternatives ($A_1, A_2, \ldots, A_m$) that are evaluated by n criteria ($C_1, C_2, \ldots, C_n$) can be viewed as a geometric system with m points in n-dimensional space. An element x_{ij} of the matrix indicates the performance rating of the i^{th} alternative A_i, with respect to the j^{th} criterion C_j.

Brauers first introduced the MOORA method in order to solve various complex and conflicting decision making problems [3]. The MOORA method starts with a decision matrix as shown by Eq. (1). The procedure of MOORA for ranking alternatives can be described as following:

***Step 1*:** Compute the normalized decision matrix by vector method as shown in Eq. (2)

$$x_{ij}^* = \frac{x_{ij}}{\sqrt{\sum_{i=1}^{m} x_{ij}^2}}, \quad i = 1,\ldots,m; j = 1,\ldots,n. \tag{2}$$

***Step 2*:** Calculate the composite score as illustrated in Eq. (3)

$$z_i = \sum_{j=1}^{b} x_{ij}^* - \sum_{j=b+1}^{n} x_{ij}^*, \quad i = 1,\ldots,m. \tag{3}$$

where $\sum_{j=1}^{b} x_{ij}^*$ and $\sum_{j=b+1}^{n} x_{ij}^*$ are for the benefit and non-benefit (cost) criteria, respectively. If there are some attributes more important than the others, the composite score becomes

$$z_i = \sum_{j=1}^{b} w_j x_{ij}^* - \sum_{j=b+1}^{n} w_j x_{ij}^*, \quad i = 1,\ldots,m. \tag{4}$$

where W_j is the weight of j^{th} criterion.

***Step 3*:** Rank the alternative in descending order.

Recently, MOORA has been widely applied for dealing with MCDM problems of various fields, such as economy control [2], contractor selection [1], and inner climate evaluation [8].

3. Standard Deviation for allocating weights

In this paper, the well known standard deviation (*SDV*) is applied to allocate the weights of different criteria. The weight of the criterion reflects its importance in MCDM. Range standardization was done to transform different scales and units among various criteria into common measurable units in order to compare their weights.

$$x'_{ij} = \frac{x_{ij} - \min_{1\le j\le n} x_{ij}}{\max_{1\le j\le n} x_{ij} - \min_{1\le j\le n} x_{ij}} \tag{5}$$

$D'=(x')_{mxn}$ is the matrix after range standardization; max x_{ij}, min x_{ij} are the maximum and the minimum values of the criterion (j) respectively, all values in D' are $(0 \le x'_{ij} \le 1)$. So, according to the normalized matrix $D'= (x')_{mxn}$ the standard deviation is calculated for every criterion independently as shown in Eq. (6):

$$SDV_j = \sqrt{\frac{1}{m}\sum_{i=1}^{m}(x'_{ij} - \bar{x}'_j)^2} \tag{6}$$

where $\bar{x}'_j$ is the mean of the values of the j^{th} criterion after normalization and $j = 1,2,\ldots,n$.

After calculating (*SDV*) for all criteria, the weight (W_j) of the criterion (j) can be defined as:

$$W_j = \frac{SDV_j}{\sum_{j=1}^{n} SDV_j} \tag{7}$$

where $j = 1,2,\ldots,n$.

4. Case Study

A multi-national company that works in Tele-Communications is willing to select one of its employees from its personnel to join a one-year course provided by one of its suppliers in Europe. The company restricted the selection to middle management in the technical support department found in the whole company branches and offices. After many procedures and tests done, six candidates are eligible to have the opportunity of the course, the multinational company Human Resources department specifies five criteria to compare the six candidates and put them through many tests for them in order to select only one. The process of ranking the six candidates in order to select optimally one is a typical MCDM problem.

The Human Resources department set two exams to the six candidates; first the fluency in the foreign language test was set to be out of 100 points, and the second computer skills test including basic programming concepts to be out of 20 points. The human resources department set the first criterion C_1 to be the age of the candidate, the younger is preferable. C_2 is set to be the experience years in the field; C_3 is the number of years passed by the candidate inside the company. C_4 and C_5 are the grades obtained by each candidate in the two exams set by Human Resources department. Table 1 shows the five criteria, and their computation units.

Table 1: Criteria and their relevant weights

Index	Branch Location	Units
C_1	Age	No. of Years
C_2	Work Experience	No. of Years
C_3	Company Experience	No. of Years
C_4	Computer Skills	Grade (1-20)
C_5	Fluency in the Foreign Language	Grade (1-100)

The Human Resources department presented the data included in the decision matrix found in Table 2 showing the six candidates, and their performance ratings with respect to all criteria. All candidates are indexed by the term (CAND) for simplicity.

Table 2: Decision matrix

Index	C_1	C_2	C_3	C_4	C_5
CAND1	32	10	9	93	80
CAND2	35	13	12	88	75
CAND3	45	16	15	67	69
CAND4	41	9	6	80	84
CAND5	50	12	20	75	82

In the considered case study, the Standard Deviation method is employed to allocate the weights. Table 3 illustrates the range standardization done to decision matrix as in Eq.(5).

Table 3: Range standardized decision matrix

Index	C_1	C_2	C_3	C_4	C_5
CAND1	0	0.143	0.214	1	0.733
CAND2	0.167	0.571	0.429	0.808	0.4
CAND3	0.722	1	0.643	0	0
CAND4	0.5	0	0	0.5	1
CAND5	1	0.429	1	0.308	0.867

Table 4 shows the values of the Standard Deviation (SDV_j), and the weight assigned to each criterion (W_j) as shown in Eqs. (6 and 7).

Table 4: Weights assigned to criteria

	SDV_j	W_j
C_1	0.4056	0.2046
C_2	0.3912	0.1973
C_3	0.3866	0.1950
C_4	0.3965	0.2
C_5	0.4028	0.2031

By applying the procedure of MOORA, the normalized decision matrix found in Table 3 is used. In Table 5, the benefit, cost, and composite scores are listed for all candidates. The second candidate should be selected because it has the maximum composite score.

Table 5: Ranking lists and scores

	Benefit criteria	Cost criteria	Composite score	Rank
CAND1	0.2920986	0	0.2920986	2
CAND2	0.32256612	0.0254	0.29715029	**1**
CAND3	0.25728902	0.1101	0.14715378	4
CAND4	0.2005679	0.0762	0.12432043	5
CAND5	0.37653217	0.1525	0.22403723	3

5. Conclusion

In this paper, the Standard Deviation (SDV) is incorporated to Multi-Objective Optimization on the basis of Ratio Analysis (MOORA) technique in order to determine weights when no preference exists in MCDM problems. A new method to solve MCDM problems is presented and illustrated. A real-life personnel selection training problem existing in multi-national company is introduced.

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