Selection of a Consulting Firm by Using SDV-MOORA

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Abstract: Many companies usually ask for consulting firm service to cautiously deal with critical problems, such that introducing new product, pricing, marketing strategies. Thus evaluating and selecting a suitable consulting firm becomes an important issue. Many criteria must be considered when evaluating consulting firms, some of them are qualitative others are quantitative. In This article a Multi-Criteria Decision Making (MCDM) problem of a real-life international company is presented. The MCDM problem of selecting consulting firm existed in the company is tackled by a new proposed method. 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

The MCDM includes many solution techniques such as Simple Additive Weighting (SAW), Weighting Product (WP) [7], and Analytic Hierarchy Process (AHP) [10]. 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 [5,6].

A consulting firm is a firm of experts providing professional advice to an organization for a fee. A consulting firm consists of consultants who are experts in their field. For some global consulting firms, their employees represent from many nationality. Usually, a consulting firm provides its service which is in core business discipline, from marketing to operations; but there are consulting firms which not only provide business service but politics as well [4].

In this paper a new MCDM problem of selecting consulting firm 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 firms. 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 firms 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 after illustrating the consulting firms problem, 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.

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

As shown in Eq.(1), a MCDM problem with m alternatives (A_1, A_2, ..., A_m) that are evaluated by n criteria (C_1, C_2, ..., 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)

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

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

$$z_i = \sum_{j=1}^{b} x^*_{ij} - \sum_{j=b+1}^{n} x^*_{ij}, \; i = 1,...,m. \tag{3}$$

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

$$z_i = \sum_{j=1}^{b} w_j x^*_{ij} - \sum_{j=b+1}^{n} w_j x^*_{ij}, \; i = 1,...,m. \tag{4}$$

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. Consulting Firms Problem

Many criteria must be considered when evaluating consulting firms, some of them are qualitative, such as reputation, some are quantitative, such as firm size; moreover, criteria may have different importance. Therefore, how to comprehensively aggregate these criteria and importance weights becomes a critical issue in effectively evaluating consulting firms [4].

Some relevant works have been studied in the evaluation of consulting firms. However they did not talk detail about the other criteria that are supposed to be considered by a consulting firm such as the implementation cost and its knowledge. Wang and Chen [11] presented how human inputs (top management, users, and external consultants) are linked to communication effectiveness and conflict resolution in the consulting process, as well as the effects of these factors on the quality of the system implemented. In [9], the authors used Nominal Group Technique (NGT) in deciding criteria for selecting the best consultant firm.

A multi-national manufacturing company must select a consulting firm to help determine the price for its new product. After preliminary screening, five alternative consulting firms are short-listed. A committee is formed to conduct the evaluation and selection of the five alternative consulting firms. The committee set five criteria to be compared; three benefit criteria, the company size (C_1), potential profit (C_2), and expected growth (C_3). Two cost criteria, the cost of the initial consultation (C_4) is also considered, and finally the monthly current installments paid to the firm as its monthly fees (C_5). All criteria considered are quantitative type. Table 1 shows the five criteria, and their computation units.

Table 1: Criteria and their relevant weights

Index	Branch Location	Units
C_1	Company Size	No. of employees
C_2	Potential Profit	L.E.(Millions)
C_3	Expected Growth	Percentage
C_4	Initial Cost	L.E.(Thousands)
C_5	Current Cost	L.E.(Thousands)

The management presented the data included in the decision matrix found in Table 2 showing the five firms, and their performance ratings with respect to all criteria.

Table 2: Decision matrix

Index	C_1	C_2	C_3	C_4	C_5
FIRM1	1523	15.6	36%	635	15
FIEM2	1068	10.6	42%	862	18
FIRM3	569	32.7	20%	742	34
FIRM4	1023	20.3	31%	167	50
FIRM5	425	12.4	16%	982	34

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
FIRM1	1	0.226	0.769	0.574	0
FIEM2	0.586	0	1	0.853	0.086
FIRM3	0.131	1	0.154	0.706	0.543
FIRM4	0.545	0.439	0.577	0	1
FIRM5	0	0.081	0	1	0.543

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	0.3891	0.1986
C_2	0.4001	0.1995
C_3	0.4178	0.2084
C_4	0.3848	0.1919
C_5	0.4043	0.2016

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 firms. The first firm should be selected because it has the maximum composite score.

Table 5: Ranking lists and scores

	Benefit criteria	Cost criteria	Composite score	Rank
FIRM1	0.30947025	0.0689	0.24052762	**1**
FIEM2	0.23962406	0.1161	0.12356477	2
FIRM3	0.22164724	0.1713	0.05032406	4
FIRM4	0.24846562	0.1596	0.0889061	3
FIRM5	0.01453431	0.2067	-0.1921441	5

5. Conclusion

In this paper, A real-life consulting firms' selection problem existing in multi-national company is introduced. 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. The new method SDV-MOORA is employed to solve the MCDM problem.

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