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Evaluation and Selection of Optimal Contractor to execute project Using FTOPSIS Method (Case Study: Kermanshah Gas Company)

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ABSTRACT: Evaluation and selection is one major task of managers in operational processes. Appropriate selection and evaluation in management plays effective roles in efficiency, utility, and more importantly, the quality of operation. Contractors are the major providers of services and equipment required for projects. At each part of project, there are always a few contractors capable and qualified to execute project. The contractor selection could be regarded as a kind of decision making. The present study attempted to investigate the selection of contractor in Kermanshah Gas Company, and taking into account effective qualitative and quantitative factors selected the optimal contractor for executing project. Firstly, a decision making group was formed and the most effective criteria (including work experience, financial situation, etc. for selecting contractor using questionnaire were identified. Then, taking advantage of the opinion of the experts which include five members of the technical committee, the weight of criteria was determined in a fuzzy procedure. Which based the obtained weights, work experience attribute acquired the maximum weight. Then four contract companies were evaluated using FTOPSIS and finally Nil AbMostahkamGharb Company was selected as the qualified company for executing project.

Keywords:Multi Attribute Decision Making, Fuzzy Theory, Verbal Variables, Normalization, Ranking

INTRODUCTION

Managing an organization and solving its different problems require crucial factors such as effectual management, organization, policy making and realistic and reasonable planning, which lack of each causes major problems and challenges. Because appropriate organization and planning are able to present an acceptable and suitable combination of human resources and material facilities for meeting demands and solving problems. One of the most significant factors in planning and decision making on the effective execution of projects is the selection of a qualified contactor. There are different qualified contactors for different projects but the main issue is to determine the best and most qualified contactor (ZareMehjerdi et al., 2010). A cursory look at the present techniques to select an efficient contactor shows that financial attributes are prominently emphasized and they have the maximum weight among decision making attributes. In addition, the absence of a modern method and dependent upon scientific attributes is one major problem in the current situation which may lead to making personal and dogmatic decisions with maximum disadvantages and costs. One significant issue in evaluating contractors is that decision makers for making each decision usually consider criteria or attributes. In case such criteria and attribute are quantitative and explainable in the form of numbers, there are various mathematical techniques for solving them, and in case they are qualitative, quantitative and mathematical techniques could not be easily used and they have their own special methods. In the process of evaluation and selection of contractors, it could be seen that decision making criteria are both quantitative and qualitative. The present study attempts to identify the most significant contractor selection criteria using Multi Attribute Decision Making (MADM) techniques and provide a suitable device for selecting the best contractor. One way to reduce risks of making wrong decisions in selecting contractors is to use modern decision making techniques. Selecting the optimal contactor requires a complete understanding based on scientific and sensible criteria.

Research Literature

Fuzzy Theory

Fuzzy theory is applied to take action when facing with uncertainty. The theory is able to convert most incorrect and enigmatic concepts, variables and systems into a mathematical form and set the context for reasoning, deduction and decision making at uncertainty conditions (Moemeni, 2007). Fuzzy logic is "reasoning with fuzzy sets". Fuzzy management science is able to generate the models which almost like human, processes qualitative information intelligently. Thus management systems become more flexible and it is possible to organize large and complex organizations in variable environments (Azar&Faraji, 2006). The fuzzy theory" was proposed by in 1965 by Professor Lotfi AsgarZadeh, an Iranian scientist and professor at Berkeley University of America. This theory has undergone various expansions and deepening since its presentation and found various applications in different areas. It is a theory for integration in indeterminacy conditions. It is capable of transforming many of the concepts, variables and systems that are imprecise and vague into a mathematical form and it sets the context for reasoning, inference, control and decision making under indeterminacy situations (Moemeni, 2009).

FUZZY TOPSIS METHOD

In the TOPSIS method, accurate and definite values are applied to determine criteria and options weight. In most cases, human thinking is accompanied by indeterminacy and this influences decision making. Therefore, it is better to use fuzzy methods which the method of the similarity to fuzzy ideal option is one of such methods. In this case, the elements of decision making matrix or criteria weight or both of them are evaluated by using lingual variables presented by fuzzy umbers and thereby the problems with the method of similarity to ideal option have been overcome.

Fuzzy TOPSIS method steps

Chen and Huang have described the stages of fuzzy TOPSIS method in the multi-criteria decision making with n criterion and m option as follows:

Stage 1: the formation of decision matrix

Considering the number of criteria and options and the evaluation of all options for different criteria, decision matrix is formed as follows:

$$\widetilde{D} = \begin{pmatrix} \tilde{x}_{11} & \cdots & \tilde{x}_{1n} \\ \vdots & \ddots & \vdots \\ \tilde{x}_{m1} & \cdots & \tilde{x}_{mn} \end{pmatrix}$$

When fuzzy numbers are used, $\tilde{x}_{ij=(}a_{ij}, b_{ij}, c_{ij})$ is the function of the option i(i=1,2,…,m) in relation to the criterion j(j=1,2,…,n). if decision maker committee have k member and fuzzy ranking k is OMIN of decision maker $\tilde{x}_{ijk=(a_{ijk},b_{ijk},c_{ijk})}$ (triangular fuzzy number) for (j=1,2,…,n) and (i=1,2,…,m), considering integrated fuzzy ranking criteria $\tilde{x}_{ij=(}a_{ij}, b_{ij}, c_{ij})$, the options could be obtained as follows:

$a_{ij} = \min_k\{a_{ijk}\}$ (1)

$b_{ij} = \frac{\sum_{k=1}^{k} b_{ijk}}{k}$(2)

$c_{ij}=\max_k\{c_{ijk}\}$(3)

Stage 2: determining the matrix of criteria weight

In this stage, different criteria significance coefficient in decision making is defined as follows:

$$\widetilde{w} = [\widetilde{w}_1, \widetilde{w}_2, \dots, \widetilde{w}_n]$$

Which if triangular fuzzy numbers is used, each component w_j (the weight of each criterion) is defined as $\widetilde{w}_j =(w_{j1}, w_{j2}, w_{j3})$. If decision making committee have K member and the K^{th} significance coefficient of the decision maker $\widetilde{w}_{jk} =(w_{jk1}, w_{jk2}, w_{jk3})$ (triangular fuzzy number) for j=1, 2,…,n, the integrated fuzzy ranking $\widetilde{w}_j =(w_{j1}, w_{j2}, w_{j3})$could be obtained as follows:

$w_{j1} = \min_k\{w_{jk1}\}$(4)

$w_{j2} = \frac{\sum_{k=1}^{k} w_{jk2}}{k}$(5)

$w_{j3} =\max_k\{c_{jk3}\}$(6)

Stage 3: the normalization of fuzzy decision matrix

When every x_{ij} is fuzzy, every r_{ij} is undoubtedly fuzzy, as well. To normalize, linear scale change for transforming different criteria scale into applicable criterion is used. If fuzzy number is triangular, it will be calculated in non-scale decision arrangements for criteria with negative and positive dimensions as follows:

$\tilde{r}_{ij} = \left(\frac{a_{ij}}{c_j^*}, \frac{b_{ij}}{c_j^*}, \frac{c_{ij}}{c_j^*}\right)$(7)

$\tilde{r}_{ij} = \left(\frac{a_j^-}{c_{ij}}, \frac{a_j^-}{b_{ij}}, \frac{a_j^-}{a_{ij}}\right)$(8)

Which in these equations:

$c_j^* = \max_i c_{ij}$(9)

$a_j^- = \min_i a_{ij}$(10)

Stage 4: determining weighted fuzzy decision matrix

Given the weight of different criteria, weighted fuzzy decision matrix is obtained through multiplying significance coefficient related to each criterion in fuzzy normalized matrix as follows:

$\tilde{v}_{ij} = \tilde{r}_{ij}.\tilde{w}_j$(11)

If fuzzy numbers are triangular, for criteria with a positive and negative dimension, we have:

$\tilde{v}_{ij} = \tilde{r}_{ij}.\tilde{w}_j = \left(\frac{a_{ij}}{c_j^*}, \frac{b_{ij}}{c_j^*}, \frac{c_{ij}}{c_j^*}\right).\ (w_{j1}, w_{j2}, w_{j3}) = \left(\frac{a_{ij}}{c_j^*}w_{j1}, \frac{b_{ij}}{c_j^*}w_{j2}, \frac{c_{ij}}{c_j^*}w_{j3}\right)$ (12)

$\tilde{v}_{ij} = \tilde{r}_{ij}.\tilde{w}_j = \left(\frac{a_j^-}{c_{ij}}, \frac{a_j^-}{b_{ij}}, \frac{a_j^-}{a_{ij}}\right).(w_{j1}, w_{j2}, w_{j3}) = \left(\frac{a_j^-}{c_{ij}}w_{j1}, \frac{a_j^-}{b_{ij}}w_{j2}, \frac{a_j^-}{a_{ij}}w_{j3}\right)$ (13)

Stage 5: finding ideal fuzzy solution (FPIS,A^*) and anti-ideal fuzzy solution (FNIS,A^-)

Ideal fuzzy solution (FPIS,A^*) and anti-ideal fuzzy solution (FNIS,A^-) are solved as follows:

$A =^* \{\tilde{v}_1^*, \tilde{v}_2^*, \dots, \tilde{v}_n^*\}$(14)

$A^- = \{\tilde{v}_1^-, \tilde{v}_2^-, \dots, \tilde{v}_n^-\}$(15)

which$\tilde{v}_i^*$ is the best value of i among all options and $\tilde{v}_i^-$ is the worst value of among all options. The values are obtained through the following equations:

I=1,2,…,m ,j=1,2,…,n (16) $max_i\{\tilde{v}_{ij3}\} = \tilde{v}_j^*$

$\tilde{v}_j^- = min_i\{\tilde{v}_{ij1}\}$ i=1,2,…,m ,j=1,2,…n (17)

The options which are placed in A^*&A^-, show very better and very worse options, respectively. In this study, $A^* = (1,1,1)$ is considered as positive ideal reply and $A^- = (0,0,0)$ as negative ideal reply (Babaei, 2009).

Stage 6: calculating distance between fuzzy ideal solution and fuzzy anti-ideal solution

The distance of each option from fuzzy ideal solution and fuzzy anti-ideal solution could be obtained as follows:

$S_i^* = \sum_{j=1}^n d(\tilde{v}_{ij}, \tilde{v}_j^*)$,i=1,2,…,m (18)

$S_i^- = \sum_{j=1}^n d(\tilde{v}_{ij}, \tilde{v}_j^-)$,i=1,2,…,m (19)

d(.,.) is the distance between two fuzzy numbers, which if $(a_2, b_2, c_2)$and (a_1, b_1, c_1) aretwo triangular fuzzy numbers, the distance between two numbers is:

$d_v(\tilde{M}_1, \tilde{M}_2) = \sqrt{1/3[(a_1 - a_2)^2 + (b_1 - b_2)^2 + (c_1 - c_2)^2]}$(20)

It could be said that $d(\tilde{v}_{ij}, \tilde{v}_j^-)$ and $d(\tilde{v}_{ij}, \tilde{v}_j^*)$are crisp numbers.

Stage 7: similarity attributes calculations

Similarity attribute is obtained by the following equation:

$CC_i = \frac{S_i^-}{S_i^* + S_i^-} i = 1,2, \dots, m$(21)

Stage 8**: **ranking the options

In this stage, considering the amount of the similarity attribute, the options are ranked, so that the options with similarity attribute are prioritized (Ataee, 2010).

Research Background

A review of research conducted over the selection of contractors represents the fact that focus on bidding cannot lead to the selection of an optimal contractor.In this section, some of the research done is presented. Expressing the importance of selecting a contractor for a building project, Edita Plebankiewicz

proposes a model for determining a qualified contractor which includes standing list and per project list. In the former, using fuzzy theory for achieving employer's goals, different criteria for evaluating the contractors are considered.At the latter model, a mathematical model is used to select the contractor for any project, which by a focus on a part of plan, employer will be able to assess to the contractor for each project.Employer's objectives include cost, time and quality (Plebankiewicz, 2011).

Gray. D. Holt's article entitled "which is the contractor selection methodology?" investigates different methods for selecting the contractor including multi-criteria analysis, multi-variable utility theory, cluster analysis, multiple regression and fuzzy theory.Holt explains contractor selection in two stages: 1) to determine eligibility and 2) to evaluate contractor, and proposes cluster analysis method for first stage and multivariate utility theory for the second stage (Holt, 1998). Russel and Skibniewski give high priority to the factors including measures of reputation, past performance, financial condition, workload and technical expertise (Russel and Skibniewski, 1998).

Expressing the importance of choosing the contractor of the building projects, Hatush and Skitmore acknowledge that contractor selection based on the minimum bid leads to project risk in the long run. Using multi-criteria utility theory, they considered five other criteria in addition to bid, each of which contains five other sub-criteria and examined contractor selection by 24 criteria (Hatush and Skitmore, 1997). Holt, Olomolaiye& Harris considered the right selection of contractor as critical factor for employer, so that the employee trust in the proper performance of the project by contractor .For contractor selection, they used multi-criteria analysis method and utility theory. Model developed by them has three stages including pre-qualification, evaluation and final selection of the contractor (Holt et al, 1994).

Similar studies on the selection of contractor also conducted in Iran which some of them are as follows. Nassim Nahavandi and Ashraf Nowrouzi presented a multi-criteria decision making model based on fuzzy integral to the evaluation of the contractors in passenger rail transport industry in Iran. In this study, a group AHP method was used for the initial weighting of criteria, and a descriptive structural analysis was applied to recognize the internal relationship between sub-criteria, and also fuzzy integrals waere applied to calculate the overall score of performance in a criterion, under the condition that its constituents are not independent of each other (Nahavandi&Nowrouzi, 2011). Identifying the effective measures on the selection of contractor in the first stage and also access to the most effective criteria and determining their weight through sending a questionnaire for petrochemical industry, YahiaZareMehrjerdi, Moemeni and Barghy ranked the contractors and selected the contractor that achieved the highest score. In the ranking, in order to rank contractors participating in tender, first TOPSIS technique was individually performed for each expert and their opinions were integrated suing Breda teqnique (Zare et al., 2009). Expressing the significance of selecting a contractor IT inner-boundary outsourcing, ShaebanElahi, Kalantari, Hassan Zadeh and Shaian, have attempted to design a fuzzy expert system for selecting the right contractor in such projects (Elahi et al, 2010). Expressing the significance of the contractor in building projects, JaefarRazmi, Haleh and Meshkinfam attempted to present a mathematical model using fuzzy multi-attribute decision making model, in order to consider not only the bid of contractors in a tender, but also the score of other criteria that are more qualitative (Razmi et al, 2007).Ali Heidari and Mohammad Heidari, while expressing the importance of the process of contractor selection and evaluation in construction process, used AHP model for selecting the most appropriate contractor based on prioritized attributes in Lordegan credit and financial institution project. In this study, after the formation of pairwise comparisons matrix and investigating the information obtained from data analysis and making a comparison with the ongoing procedure to select contractors concluded that contractors bid (which nowadays is regarded as the highest bid in the most cases, has the lowest significance (Heidari and Heidari, 2007).

Study questions

What are the most important criteria for selecting contractors in Kermanshah Gas Company?

what is the way of determining weight and prioritizing effective criteria in the selection of Kermanshah Gas Company contractors?

Based on each intended criteria, how to rank the options?

Does the process of selecting contractors in Kermanshah Gas Company correspond with Multi Attribute decision Making Model?

Conceptual Model

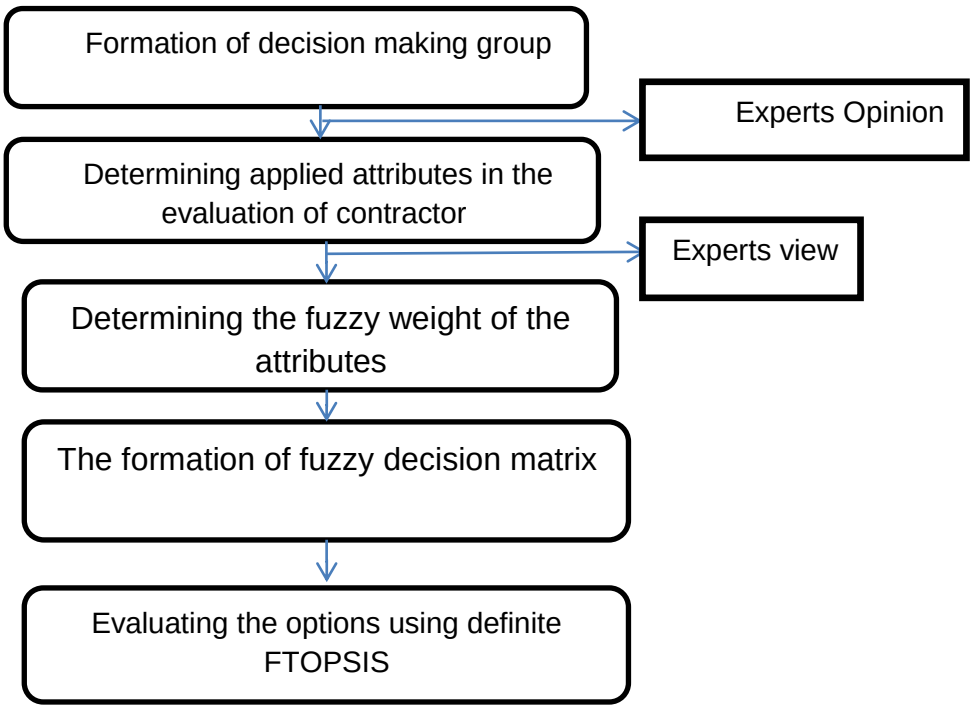

Figure 1.the study conceptual model

RESEARCH METHODOLOGY

The present study is applied in terms of its objective. The study results could be used by Gas Company. On the other hand, the study could be represented as an analysis by the subfield operational study. As data used in the present study is of a qualitative and quantitative type, it could be added that the study is of an integrated type in terms of the way of conduct.

Research Objectives

The present paper attempts to design a Multi Attribute Decision Making Model to select the most qualified contractor among a group of volunteer contactors to execute projects. The study secondary objectives include

Identify the most important criteria for contractor selection in Kermanshah Gas Company.

Determine the weight (the significance) and prioritizing the effective criteria for selecting gas companies contractors.

Ranking the contractors based on any of the criteria considered in the contractor selection process

Providing a comprehensive scientific model to identify and rank the best contractors in gas company projects.

The Research Conceptual Model

Then the proposed model is described in the form of a numerical example.

Stage 1: the formation of decision making group

The first stage to select a qualified contractor is the formation of decision making group. Considering the procedure to select contractor in Kermanshah Gas Company, decision making group is composed of five members of technical committee with positions such as managing consultant, chief technical inspector, estimation expert, planning supervisor and financial affairs supervisor. The group is entitled to investigate the experiences of the contractors participating in tender.

Stage 2: determining applied attributes in evaluating contractors

In this stage, to determine contractor selection attributes, while studying document and papers on the selection of contractor, 8 attributes were selected and the attributes were delivered to Kermanshah Gas Company experts in the form of a questionnaire and they were asked to determine the significance of each attribute from a score of 1-10. After determining the experts' opinions and taking into account total experts' scores, the attributes including financial strength, financial stability, bidding, work experience, machinery and

equipment, skilled manpower and quality, good reputation and history were selected as applied indicators. Among the proposed attributes, bidding is related to negative dimension and others are related to positive dimension.

Stage3: Determining the fuzzy weight of the attributes

In order to calculate attribute fuzzy weight, verbal variables are used. The experts express their ideas on the attributes in the form of verbal variables. Triangular fuzzy scale to show the opinions is presented.

Table 1.verbal variables for evaluating the significance of the attributes

Fuzzy Numbers	Significance
(0,0,0.1)	(VL)Very Low
(0,0.1,0.3)	(L)Low
(0.1,0.3,0.5)	(ML) Mean-Low
(0.3,0.5,0.7)	(M) Mean
(0.5,0.7,0.9)	(MH) Mean-High
(0.7,0.9,1)	(H) High
(0.9,1,1)	(VH)Very High

Source: (Tiryaki and Ahlatcioglu, 2005)

Experts' opinion in the form of verbal variables is as follows.

Table 2.the significance of the attributes from experts' opinion

	DM_1	DM_2	DM_3	DM_4	DM_5
C_1	M	M	M	ML	MH
C_2	MH	MH	MH	L	M
C_3	ML	ML	MH	H	VH
C_4	VH	VH	VH	MH	VH
C_5	H	H	H	ML	MH
C_6	ML	ML	M	ML	M
C_7	L	L	L	L	MH

After presenting the opinions, the mathematical mean is used to integrate experts' opinions. Then, fuzzy weight matrix is formed as follows:

Table 3.the attributes' fuzzy weight matrix

Attributes	Triangular Fuzzy Weight
C_1	(0.3,0.5.0.7)
C_2	(0.36,0.54,0.74)
C_3	(0.46,0.64,0.78)
C_4	(082,0.94,0.98)
C_5	(0.54,0.74,0.88)
C_6	(0.18,0.38,0.58)
C_7	(0.1,0.22,0.42)

Stage 4:The formation of fuzzy decision matrix

to form the fuzzy matrix, the information on four contract companies which participated in the tender are presented in Table 4. The information of initial matrix decision is as follows.

Table 4.the formation of initial decision matrix

Manpower	Machinary	Popularity	Work experience	Bid amount	Financial stability	Financial power	
1	400000000	H	H	915221526	M	1200000000	GharbKoushaMe'maran Co.
5	1200000000	VH	VH	833318835	M	1200000000	Nil AbMostahkamGharb Co.
2	80000000	VH	VH	777828000	MF	1000000000	SamanGostarBardia Co.
2	1200000000	H	H	1037700760	M	1000000000	TosanSan'atBehin Co.

To form fuzzy matrix, the experts was asked to present their ideas on the above mentioned companies in the form of verbal variables. The triangular fuzzy scales applied to rank the options are as follows.

Table 5.verbal variables for ranking the options

Fuzzy Numbers	Significance
(0.0.1)	(VP) Very Poor
(0,1,3)	(P) Poor
(1,3,5)	(MP) Mean Poor
(3,5,7)	(F) Fair
(5,7,9)	(MG) Mean-Good
(7,9,10)	(G) Good
(9,10,10)	(VG) Very Good

Source: (Tiryaki and Ahlatcioglu, 2005)

The experts' opinion on the situation of companies is presented in the following matrix:

Table 6.the experts' opinion matrix on the situation of the companies

		C_1	C_2	C_3	C_4	C_5	C_6	C_7
DM_1	A_1	MG	F	F	G	G	F	G
	A_2	F	F	MG	G	G	F	G
	A_3	F	F	G	MG	F	F	G
	A_4	F	F	MP	MG	F	F	G
DM_2	A_1	MG	F	MG	VG	G	MG	MG
	A_2	G	F	G	VG	G	MG	MG
	A_3	G	F	VG	F	G	F	MG
	A_4	MG	F	F	F	G	F	MG
DM_3	A_1	G	F	MG	VG	G	G	F
	A_2	G	F	MG	G	G	G	F
	A_3	MG	F	G	F	G	F	F
	A_4	MG	F	F	F	G	F	F
DM_4	A_1	MG	F	MG	VG	G	MG	G
	A_2	G	F	G	VG	G	MG	G
	A_3	G	F	VG	G	F	G	G
	A_4	MG	F	F	G	F	F	MG
DM_5	A_1	MG	F	MG	VG	G	G	F
	A_2	MG	F	G	VG	G	G	F
	A_3	MG	F	VG	F	G	F	F
	A_4	MG	F	F	F	G	F	F

To integrate the opinions, the arithmetic mean was used. The obtained fuzzy matrix is as follows:

Table 7.the integrated fuzzy decision matrix

	C_1	C_2	C_3	C_4	C_5	C_6	C_7
A_1	(5.4,7.4,9.2)	(3,5,7)	(4.6,6.6,8.6)	(8.6,9.8,10)	(7,9,10)	(5.4,7.4,9)	(5,7,8.6)
A_2	(5.8,7.8,9.2)	(3,5,7)	(6.2,8.2,9.6)	(8.2,9.6,10)	(7,9,10)	(5.4,7.4,9)	(5,7,8.6)
A_3	(5.4,7.4,9)	(3,5,7)	(8.2,9.6,10)	(4.2,6.2,8)	(5.4,7.4,8.8)	(3.8,5.8,7.6)	(5,7,8.6)
A_4	(4.6,6.6,8.6)	(3,5,7)	(2.6,4.6,6.6)	(4.2,6.2,8)	(5.4,7.4,8.8)	(3,5,7)	(4.6,6.6,8.4)

Stage 5: the evaluation of contract companies using fuzzy TOPIS method
In order to rank the options using fuzzy TOPSIS method, the following steps must be taken:
Step 1: the formation of fuzzy decision matrix

Table 8.fuzzy decision matrix

	C_1	C_2	C_3	C_4	C_5	C_6	C_7
A_1	(5.4,7.4,9.2)	(3,5,7)	(4.6,6.6,8.6)	(8.6,9.8,10)	(7,9,10)	(5.4,7.4,9)	(5,7,8.6)
A_2	(5.8,7.8,9.2)	(3,5,7)	(6.2,8.2,9.6)	(8.2,9.6,10)	(7,9,10)	(5.4,7.4,9)	(5,7,8.6)
A_3	(5.4,7.4,9)	(3,5,7)	(8.2,9.6,10)	(4.2,6.2,8)	(5.4,7.4,8.8)	(3.8,7.4,8.8)	(5,7,8.6)
A_4	(4.6,6.6,8.6)	(3,5,7)	(2.6,4.6,6.6)	(4.6,6.2,8)	(5.4,7.4,8.8)	(3,5,7)	(4.6,6.6,8.4)

Step 2: determining the attributes' weight matrix
In this step, after integrating the opinions on the applied attributes, the following matrix is obtained:

Table 9. Fuzzy weight matrix

Triangular fuzzy matrix	Attribute
(0.3,0.5,0.7)	C_1
(0.36,0.54,0.74)	C_2
(0.46,0.64,0.78)	C_3
(0.82,0.94,0.98)	C_4
(0.54,0.74,0.88)	C_5
(0.18,0.38,0.58)	C_6
(0.1,0.22,0.42)	C_7

Step 3: the normalization of fuzzy decision matrix
In this step: the fuzzy decision matrix must be normalized. The normalized matrix is obtained as follows:

Table 10.fuzzy normalized matrix

	C_1	C_2	C_3	C_4	C_5	C_6	C_7
A_1	(0.587,0.804,1)	(0.428,0.714,1)	(0.302,0.394,0.565)	(0.86,0.98,1)	(0.7,0.9,1)	(0.6,0.822,1)	(0.581,0.814,1)
A_2	(1,0.848,1)	(0.428,0.714,1)	(0.271,0.317,0.419)	(0.82,0.96,1)	(0.7,0.9,1)	(0.6,0.822,1)	(0.581,0.814,1)
A_3	(0.630,0.804,1)	(0.428,0.714,1)	(0.26,0.271,0.317)	(0.42,0.62,0.8)	(0.54,0.74,0.880	(0.422,0.644,0.844)	(0.581,0.814,1)
A_4	(0.5,0.717,0.934)	(0.428,0.714,1)	(0.394,0.271,0.317)	(0.42,0.62,0.8)	(0.54,0.74,0.88)	(0.422,0.644,0.844)	(0.535,0.767,0.977)

Step 4:determining weighted fuzzy decision matrix
In this step, by multiplying fuzzy decision matrix into the attributes fuzzy matrix, the weighted fuzzy decision matrix is formed as follows:

Table 11.weighted fuzzy decision matrix

	C_1	C_2	C_3	C_4	C_5	C_6	C_7
A_1	(0.176,0.402,0.7)	(0.154,0.385,0.74)	(0.139,0.252,0.441)	(0.705,0.921,0.98)	(0.378,0.666,0.88)	(0.108,0.312,0.58)	(0.058,0.179,0.42)
A_2	(0.189,0.424,0.7)	(0.154,0.385,0.74)	(0.125,0.203,0.327)	(0.672,0.902,0.98)	(0.378,0.666,0.88)	(0.108,0.312,0.58)	(0.058,0.179,0.42)
A_3	(0.176,0.402,0.7)	(0.154,0.385,0.74)	(0.112,0.173,0.247)	(0.344,0.583,0.784)	(0.292,0.548,0.774)	(0.076,0.244,0.489)	(0.058,0.179,0.42)
A_4	(0.15,0.358,0.654)	(0.154,0.385,0.74)	(0.181,0.359,0.78)	(0.344,0.583,0.784)	(0.292,0.548,0.774)	(0.06,0.201,0.451)	(0.058,0.179,0.42)

Step 5.finding the fuzzy positive ideal solution and fuzzy anti-ideal solution
In this study, $A^* = (1,1,1)$ is regarded as positive ideal solution and $A^- = (0,0,0)$ as negative ideal solution (Vafaei & Babaei, 2011).
Step 6.calculating distance between fuzzy ideal and anti-ideal limit
The distance between each option and fuzzy ideal solution is as follows.

$S_1^* = 3.618709$
$S_2^* = 3.556658$
$S_3^* = 3.933891$
$S_4^* = 4.327273$

The distance between each option and fuzzy anti-ideal solution is as follows.

$S_1^- = 3.901274$
$S_2^- = 3.94661$
$S_3^- = 3.546441$
$S_4^- = 3.258132$

Step 7.calculating similarity attribute
In this step, the relative closeness of each option to ideal solution is calculated.

$$CC_1 = \frac{3.901274}{3.901274 + 3.618709} = 0.518788$$
$$CC_2 = \frac{3.94661}{3.94661 + 3.556658} = 0.525985$$
$$CC_3 = \frac{3.546441}{3.546441 + 3.933891} = 0.474102$$
$$CC_4 = \frac{3.258132}{3.258132 + 4.327273} = 0.429526$$

Stage 8.ranking the options

In this step, considering the degree of similarity attribute, the options are ranked. So that the options with the higher similarity attribute are prioritized:

$$A_2 > A_1 > A_3 > A_4$$

Considering the ranking, Nil AbMostahkamGharb Company was regarded as a top company for executing the project is selected and introduced.

CONCLUSIONS

Tendering based on minimum price has some disadvantages which overshadow its advantages.Asdecision making parameter is bid amount, some problems concerning time, quality, immunity, etc. may happen. Considering the above and the results from the present paper, even though bidding is significant, it has achieved second rank among the applied criteria to evaluate and rank contractors.Given that the evaluation of contractors is done using multiple criteria, using Multi Attribute Decision Making techniques are regarded as the best technique. Multi Attribute Decision Making techniques are divided into compensatory and non-compensatory ones, which in the former the disadvantages of an attribute are offset by the strengths of another. Therefore, in this study, only the capability of compensation methods in ranking contractors was examined. When Fuzzy TOPSIS method is used the utility of each contractor must be steadily decreasing (or increasing), i.e. the best value of an attribute shows its ideality and its worst value shows its negative ideal.

Suggestions

Based on the results from the current study, some suggestions are presented as follows:

In the present paper, contractors were evaluated and ranked considering 7 criteria and it was specified that further emphasis on financial attributes, especially bidding is regarded as a disadvantage and also a hindrance in the process of contractors' selection. In fact, contractors could be selected appropriately when all criteria are considered and the result will be the increased efficiency of projects which are going to be handled by contractors.

A comprehensive information bank is also recommended in order to gather all the information on contactors participating in tender, in an attempt to evaluate and rank contractors in an appropriate manner.

To facilitate rules and documents related to the presence of contracting companies in tender, in a way that further contractors find the opportunity to attend tender is another useful suggestion.

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