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BUILD A MULTI-CRITERIA EVALUATION MODEL FOR THE SELECTION OF A CONTRACTOR IN CONSTRUCTION PROJECTS

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ABSTRACT: The current study provides a methodological framework to regulate the perceptions of decision-makers to take various criteria including increases Foundation benefit and provide them tool supportive of the resolution represented technology FAHP)) to choose the appropriate contractor so that the guide is the right choice without a bias factor, or the existence of personal interests and in foggy conditions. This technique can be applied in the early stages of the referral process to avoid non-qualified contractors participate in the competition for the business process at hand, and according to the employer's requirements. It was extracted most of the criteria that could affect the process of selecting the optimal tender by conducting personal interviews with relevant subject matter of the owners of expertise as well as a field survey in order to identify the main criteria and sub relative importance of each criterion that can be relied upon in the process of evaluating and selecting the optimal contractor. It includes the main criteria (the financial side, the technical side, the management side, the legal side and the reputation of the contractor, the environmental side) and all the standard of the main criteria contain sub-criteria its example the financial side that contains five criteria a subset (the bid amount, the financial situation of the contractor, insurance work, the availability of financial resources, the burden of current business).

Keywords: Contractor selection; analytic hierarchy process; fuzzy analytic hierarchy process

1. INTRODUCTION

Choose the wrong contractors lead to significant financial losses incurred by the institutions represented by poor quality, or increase time required for implementation and doubled efforts to obtain the required service from the implementation of construction projects, or failure commitment Contractor requirements of the labor and other negatives caused by the wrong decision at the appropriate tender selection. While it is raising the right decision from the benefits received by the beneficiary side of the service such as high-quality or building a strategic relationship with the contractor managed to get a competitive advantage.

The process of searching for new methods and techniques for the selection of the contractor optimal concern for researchers and specialists in the field of construction projects and in all institutions; where committees bidding analysis in all institutions rely on the experience, knowledge and intuition in choosing the right contractor. However, the quest to develop an integrated system that helps in choosing the right contractor on the basis of standards (the bid amount and duration of implementation and similar acts) and others to represent the factors and metrics to choose the President, Which was adopted later in technologies to assist in decision making multiple criteria, including the hierarchical analysis technique Analytic Hierarchy Process (AHP).

RESEARCH OBJECTIVES

The objectives of the research the following:

1. Identify the various quantitative and qualitative criteria for the selection of contractors.
2. Set the relative importance of the criteria for the selection and evaluation of contractor performance later.
3. Regular use technology to be supportive of the decision-making process such as Analytic Hierarchy Process (AHP) and Fuzzy Analytic Hierarchy Process (FAHP) to differentiate between contractors.

STAGES OF THE INVESTIGATION OF CONSTRUCTION PROJECTS

Going through the process of construction in several phases of the project starting with the formation of an initial idea of the project and the decision to implement it and ending with "the process of construction to operation and maintenance (sometimes), among those stages stage receipt for implementation and open and analyze bids and then the referral, where this stage will depend on what is preparation of designs and documents entrepreneurship as well as to identify the criteria that will be reliable in the process of evaluating and selecting the bid optimization and determine the relative importance of each of these measures, and it is to choose the right contractor from among contractors applying for a job is an important part of the contractual process and the removal of most of the causes of the problems and future claims process that impede the progress of the work. In view of this, the stages throughout the project are: -

THE FEASIBILITY STUDY PHASE (DECISION)

Before you start doing any construction project must be studied from the economic and technical point of view to determine the costs and estimate the yield whether this yield materially "or the return of public services, being a choice between different solutions evaluates each solution which (profitability, funding requirements, construction costs, operating costs, costs Maintenance, for the completion of the implementation and the development of the project in the case of full performance) ^[1].

STAGE DESIGN AND CREATE DOCUMENTS CONTRACT PREPARATION

This phase includes the preparation of the charts with the writing of specifications, which is one of the important documents that require knowledge of specialist minute for everything related to the project, the Specifications is explaining charts explanation "full" so requires that the specifications written in a clear and simple language and the concept of expressive words unbeatable diligence in interpretation.

THE BIDDING PHASE

Contractors are invited to bid for the implementation of the action by following one of the following methods ^[2]: -

1. THE PUBLIC TENDER:

It is declared to all who wish to contribute to the implementation of the work contract of this method is based on the basis of free competition for all eligible who have a desire to participate in the tender and contracted to carry out the work required in order to obtain the best bid.

2. DIRECT INVITATION

This method is in direct invitation to at least three of the contractors for their ability and technical competence and financial, and that the way to ensure competition and to participate in the implementation of the business for a limited number of contractors designated by the employer. Use this formula in order to maintain the technical level of implementation and to ensure that contractors entering the incompetent or for security reasons.

3-COMMISSIONING

This method followed in special circumstances require the selection of a contractor and sign him quickly, especially if the contractor is an experienced and trusted by the employer

and in this method are choosing a particular contractor given "to his qualifications and assigned to work after the agreement on terms and prices.

COMMISSION OPENING OF TENDERS

Committee responsible for the opening of the tenders which meet once the time the auction to close, as is the opening of tenders under the minutes and form a committee to open bidding in every ministry constitute this committee as instructed by the implementation of and follow-up projects and the work of national development plans, and may set up committees to open bidding in the circles each ministry and be formed along the lines of formation of a committee to open bidding in the ministry, and the responsibilities of this Committee the following^[3,4]:-

1. Verify the seals placed on the covers of tenders
2. exclusion of bids that are not accompanied by a bid bond and competent minister to accept bids that are not accompanied by a bid bond if it is found that in refusing to seriously damage the treasury that is added insurance expenses to these tenders when conducting analysis.
3. Rejection of the bid based on the allocation of a percentage or a lump sum of any of the other bids received in the tender and not to accept any reduction offers after the tender closing date.
4. Install the number of component securities of which each bid.
5. Put a clear sign about every Knit or erase, add or correct the amounts stated in the table with the signature of the President and members of the Committee.
6. Ensure the signing of the contractor on each page of the calorimeter and the appendices quantities with a Tender table.
7. Noted in the record to the observations or reservations Entries in the tender and appendix and check the models provided with public bidding and install their descriptions.
8. Mark bidding pages stamp Committee with the signing of its members at all calorimeter table quantities pages with explicit reference to any data or information not submitted with the tender and which must be submitted pursuant to instructions to bidders.

After it has finished the process of opening of the tenders by the Chairman of the Commission declare the prices submitted by the bidders in the bulletin board as set out in their bids with the assurance that the stated prices are subject to scrutiny and analysis is then refer the bids and its annexes to the audit committee and the analysis of bids under a special Minutes so.

COMMITTEE SCRUTINY AND ANALYSIS OF TENDERS

Is the committee that receives bids and its annexes from the Commission on the opening of tenders, the formation of a committee bidding analysis along the lines of the Commission on the opening of tenders as it should be headed by an employee of not less degree of functional Director General and members of the representatives of the Legal Department and the Department (or section) accounts and circle (or section) Affairs engineering as well as engineers and technicians observers in civil, electrical and plumbing and mechanical disciplines depending on the nature of the project, Article Six of the Implementing Regulations of confirmed and follow-up projects and the work of national development to take into account the following matters in the audit procedures and analysis of bidding plans ^[3,4]:

1. Price check mathematically and make the necessary corrections.
2. In the case of a reduction percentage or lump sums should exclude the amounts recognized in the tender of bidders' rate amounts for the purposes of comparison and analysis, and calculating the price of all bids on a uniform basis.
3. counting on the price set out in writing in case of disagreement with the price blogger numbers also count on the unit price in the case of the invalidity of the amount paragraph, if received a paragraph or paragraphs did not note down against which the price in the tender submitted is the cost of that paragraph or paragraphs and up Entries quantities

towards them included prices other paragraphs and if otherwise happened in opinion between those who analyze the bids must install the differences in the final report.

4. After the completion of the analysis process regulates detailed schedule tenders all it shows all the related details and shortcomings that I found from a comparison and evaluation of the technical, legal and financial aspects with a statement of the bidder name of the candidate for referral and the basis upon by the Committee in this nomination.
5. Support the Commission that the paragraphs of the tender bidder balanced and harmonious candidate with the cost of speculative price and a reasonable period of implementation.

Hence the importance of finding a scientific and logical method for the selection of the optimal tender from among the bids received for the implementation of construction projects using techniques of multi-criteria decision-making and .

REFERRAL STAGE

A decision is made the referral by tender study of ways, all depending on the criteria set by the department concerned and by the employer requirements, as well as to make sure that no tender amount is less than the estimated cost for the project within the required specifications ignorance or deceit from the contractor.

WAYS TO REFER CONTRACT

There are certain ways to refer the contract including what is traditionally known locally and user and global ways of which is commonly used, and these methods are^{[3,4]::}

1- A METHOD OF REFERRAL STAGE ONE

The traditional way and the most widely used "in which the contractor pricing quantities agenda promotes the documents on which are referral and the Contractor shall submit presented on the basis of pricing table quantities, which depends on the availability of detailed plans to be able to perform pricing on business precisely because the contractor has factual information on the project is due to identification the quantities required for each paragraphs of work on the project.

2-WAY REFERRAL ON THE BASIS OF APPROXIMATE QUANTITIES TABLE

Way similar to the way the referral stage one but applicable in the case of non-designs completed and documents entrepreneurship as be a referral on the basis of the amounts approximate is detailed and not accurate because of the design is complete, but there is a general idea of the project without any details and the progress of work on the project and to provide designs are re-full costs of the project audited accounts on the prices in the approximate amounts agenda as defined in the contract.

IMPLEMENTATION PHASE

This phase comes after the completion of the designs and the development of specifications, bills of quantities, monitoring and allocation of funding for the project way and refer them to one of the executive bodies and competent after the signing of the contract between the employer and executive the contract; to convert plans into reality the case for the implementation of origin in accordance with the agreed contract documents in the contract formula.

OPERATING AND MAINTENANCE PHASE

The final phase of any project and begin after the completion of the project and initial receipt to him by the employer and be for this phase is usually a specified period in the contract. During this phase, and in some types of contracts the contractor shall be responsible "for the operation of origin after implementation

FACTORS INFLUENCING THE SELECTION OF A CONTRACTOR

Contractor to choose a big role in the success of the project will be completed within the time and cost specified in contract documents should therefore be on the employer to take, given the following factors in the election of the contractor^{[4]:-}

1. Technical competence and experience in the field work required.
2. Physical qualifications and include cash, equipment and vehicles owned by the Contractor.
3. Confidence and good reputation of the contractor.
4. The efficiency of the executive staff and good administrative management and the most important aspect, which provides all of the workers trust and good reputation of the contractor in case of exceptional circumstances.
5. Similar work carried out by the contractor.

DIFFICULTIES IN THE PROCESS OF SELECTING THE CONTRACTOR: -

There are many factors that affect the evaluation and selection of the contractor the best among several alternatives and could be clarified as follows ^[5, 6]:

1. Bias in the decision-making process of selecting the optimal bid by the persons responsible for the decision-making process because of the diversity of individual preferences, tastes, beliefs, and personal experience in the evaluation of bids.
2. Great pressure on for taking decisions to choose the perfect contractor committees, which leads to the possibility of making non-optimal decisions.

THE MOST IMPORTANT CRITERIA THAT CAN BE TAKEN INTO ACCOUNT FOR THE EVALUATION AND SELECTION OF THE OPTIMAL TENDER

Based on the foregoing from previous studies and research that dealt with many of the standards and reliable in the process of selecting the bid optimization in construction projects, it enables a researcher from the inventory of the most important criteria that can be taken in view of the assessment and referral of the bids depending on the relative importance of each of the criteria mentioned based on Expert opinion and according to the requirements of each institution, which will be explained in detail in the practical side of the research, as follows^[4]:

1. Bid amount
2. The time required for implementation (project period)
3. The quality of the work carried out
4. Previous experience
5. Similar work and their quality
6. Ability to work management
7. Qualifications of the technical and administrative staff
8. Reputation
9. Prior trade relations
10. Legal claims (disputes).
11. Deprivation, exclusion or disqualification.
12. Compliance with the regulations and instructions.
13. The financial situation of the company or contractor.
14. The current workload.
15. Availability of equipment and machinery, laboratories, qualities and specifications
16. Availability of financial resources and how to manage.
17. The methods and techniques used in the implementation.
18. Quality control
19. Rating company
20. The availability of trade union records
21. Employment Insurance
22. Safety and Security Management
23. Observance of environmental factors
24. Relationship with the employer and other institutions.
25. Performance Evaluation in previous projects.
26. Value Engineering and alternatives

ANALYTICAL HIERARCHY PROCESS (AHP)

The Analytic Hierarchy Process Analytic Hierarchy Process (AHP) methods of a more multi-criteria decision-making application, as it is more commonly used algorithms regarding the selection of the optimal alternative. This method was designed by Professor Thomas L.Saaty in Pittsburgh University in the US in the mid-seventies ^[7, 8], and can be defined as a method to arrange alternatives decision and choose the best alternative when the decision maker targets or multiple criteria on which to base the decision [36]. AHP is a simple, flexible and practical multiple criteria decision making method for analyzing qualitative issues in a quantitative way. It is characterized by the hierarchy of the various factors in a complex problem. AHP connects effectively the expert's knowledge to the objective judgment results, based on certain subjective judgment on the objective reality (mainly

pairwise comparisons). AHP uses mathematical methods to rank the weights of each element's relative importance in the same hierarchy. Through the total ranking of all the hierarchies, AHP calculates and ranks the weights of all the elements' importance. Because of its combined process of qualitative and quantitative factors, and the flexible and simple characters.

FUZZY ANALYTIC HIERARCHY PROCESS (FAHP)

One of the problems is that when reflecting the decision maker's opinions, the traditional AHP can only use an exact comparison value. Other disadvantages, like an unbalanced scale of judgments and its adequacy of inherent uncertainty and imprecision in the pairwise comparison process,. To overcome all these shortcomings, FAHP was developed for solving these hierarchical problems. Decision makers usually find that FAHP is more confident in give interval judgments than fixed value judgments, because usually they are unable to express the preference about the fuzzy nature of the comparison process. Many FAHP methods and applications in the literature have been proposed by various researchers. Van Laarhoven and Pedrcyz (1983) were the first researchers to introduce the application of fuzzy logic principle to AHP, i.e. the use of triangular fuzzy numbers. To reflect the decision maker's opinion of each criterion, Buckley (1985) first used fuzzy numbers. Chang (1996) used a new approach, namely, triangular fuzzy numbers for a pairwise comparison scale of FAHP.

FAHP ALGORITHM

The extent of FAHP is utilized in four steps [9], as stated below:

$$M^1_{gi}, M^2_{gi}, M^m_{gi}, \quad i = 1, 2, \dots, n$$

Where, all of the M^j_{gi} ($j = 1, 2, \dots, m$) are TFNs.

Step 1: The value of fuzzy synthetic extent with respect to the ith object is defined as:

$$S_i = \sum_{j=1}^m M^j_{gi} * [\sum_{i=1}^n \sum_{j=1}^m M^j_{gi}]^{-1} \text{-----} 1$$

To obtain the $\sum_{j=1}^m M^j_{gi}$, we perform the fuzzy addition operation of m extent analysis values for a particular matrix such that:

$$\sum_{j=1}^m M^j_{gi} = \{ \sum_{j=1}^m l_j, \sum_{j=1}^m m_j, \sum_{j=1}^m u_j \} \text{-----} 2$$

Obtaining the $[\sum_{i=1}^n \sum_{j=1}^m M^j_{gi}]$, we perform the fuzzy addition operation of M^j_{gi} ($j=1, 2, 3, \dots, m$) values such that

$$\sum_{i=1}^n \sum_{j=1}^m M^j_{gi} = \{ \sum_{i=1}^n l_i, \sum_{i=1}^n m_i, \sum_{i=1}^n u_i \} \text{-----} 3$$

Compute the inverse of the vector above, such that :

$$[\sum_{i=1}^n \sum_{j=1}^m M^j_{gi}]^{-1} = \{ \frac{1}{\sum_{i=1}^n u_i}, \frac{1}{\sum_{i=1}^n m_i}, \frac{1}{\sum_{i=1}^n l_i} \} \text{-----} 4$$

Step2: As $\tilde{M}1 = (L_1, M_1, U_1)$ and $\tilde{M}2 = (L_2, M_2, U_2)$ are two TFNs, the degree of possibility of

$M2 = (L_2, M_2, U_2) \geq M1 = (L_1, M_1, U_1)$ is defined as:

$$= \begin{cases} 1, & \text{if } m1 \geq m2 \\ 0, & \text{if } l1 \geq u2 \\ \frac{l1-u2}{(m2-u2)-(m1-l1)} & \text{otherwise} \end{cases} \text{-----} 5$$

Or

$$= \begin{cases} 1, & \text{if } m2 \geq m1 \\ \frac{u2-l1}{(u2-m2)+(m1-l1)} & \text{if } l1 \leq u2 \\ 0, & \text{otherwise} \end{cases} \text{-----} 6$$

Step3: The possibility degree for a convex fuzzy number to be greater than k convex fuzzy numbers can be defined by:

$$M_i \quad (i=1,2,k)$$

$$V(M \geq M_1, M_2, \dots, M_k) = V[(M \geq M_1) \text{ and } (M \geq M_2) \text{ and } \dots \text{ and } (M \geq M_k)] = \min_{i=1,2,3,\dots,k} V(M \geq M_i) \quad \text{-----7}$$

Assume that $d(A_i) = \min V(S_i \geq S_k)$ for $k=1,2,\dots,n, k \neq i$, the weight vector is given by :

$$W' = (d'(A_1), d'(A_2), \dots, d'(A_n))^T \quad \text{-----8}$$

To compare M_1 and M_2 , we need both of the values of $V(M_1 \geq M_2)$ and $V(M_2 \geq M_1)$, figure 1 illustrates this state .

Step4: the normalized weight vectors would be:

$$W = (d(A_1), d(A_2), \dots, d(A_n))^T \quad \text{-----9} \quad \text{where } W \text{ is non-fuzzy number.}$$

Application of analytic hierarchy process (AHP) and (FAHP) on the Case Study

Based on analytic hierarchy process steps(AHP) and (FAHP) , this paragraph deals with steps to clarify the application of (AHP) and (FAHP) after gathering all the necessary information from on the criteria used for the purpose of comparisons between the contractors and as shown in Table (1) , and from a range of construction projects for the implementation of or for the processing of materials and equipment import and local tenders. In order to clarify the application will be limited to tender (3/2014) for the implementation of the project (paving streets and rehabilitation of district teachers in the holy city of Karbala center)^[4].

1. Accounts for the relative importance of the major criteria for using the technique (AHP):For the purpose of calculating the relative importance of the criteria by using a technique (AHP)^(10,11) Note tables (2) and (3).and weights $W = (0.4219, 0.2432, 0.1409, 0.1350, 0.0590)$
2. Accounts for the relative importance of the major criteria for using the technique (FAHP):For the purpose of calculating the relative importance of the criteria by using a technique (FAHP):

	C_1	C_2	C_3	C_4	C_5
C_1	[1, 1, 1]	[3/2, 2, 5/2]	[2, 3, 4]	[5/2, 4, 11/2]	[3, 5, 7]
C_2	[2/5, 1/2, 2/3]	[1, 1, 1]	[3/2, 2, 5/2]	[3/2, 2, 5/2]	[3, 4, 6]
C_3	[1/4, 1/3, 1/2]	[2/5, 1/2, 2/3]	[1, 1, 1]	[1, 3/2, 2]	[2, 3, 4]
C_4	[2/11, 1/4, 2/5]	[2/5, 1/2, 2/3]	[1/2, 2/3, 1]	[1, 1, 1]	[2, 3, 4]
C_5	[1/7, 1/5, 1/3]	[1/6, 1/4, 1/3]	[1/4, 1/3, 1/2]	[1/4, 1/3, 1/2]	[1, 1, 1]

$$\sum_{j=1}^m l_j = 1+3/2+2+5/2+3=10$$

$$\sum_{i=1}^n l_i =$$

$$(1+2/5+1/4+2/11+1/7)+(3/2+1+2/5+2/5+1/6)+(2+3/2+1+1/2+1/4)+(5/2+3/2+1+1+1/4)+(3+3+2+2+1)=$$

$$=27.54$$

$$\sum_{j=1}^m m_j = 1+2+3+4+5=15$$

$$\sum_{i=1}^n m_i$$

$$=(1+1/2+1/3+1/4+1/5)+(2+1+1/2+1/2+1/4)+(3+2+1+2/3+1/3)+(4+2+3/2+1+1/3)+(5+4+3+3+1)=37.37$$

$$\sum_{j=1}^m u_j = 1+5/2+4+11/2+7=20$$

$$\sum_{i=1}^n u_i$$

$$=(1+2/3+1/2+2/5+1/3)+(5/2+1+2/3+2/3+1/3)+(4+5/2+1+1+1/2)+(11/2+5/2+2+1+1/2)+(7+6+4+4+1)=50.57$$

$$[\sum_{i=1}^n \sum_{j=1}^m M_{gi}^j]^{-1} = \left\{ \frac{1}{\sum_{i=1}^n u_i}, \frac{1}{\sum_{i=1}^n m_i}, \frac{1}{\sum_{i=1}^n l_i} \right\} = \{1/50.57, 1/37.37, 1/27.54\}$$

$$S_{c1} = \sum_{j=1}^m M_{gi}^j * [\sum_{i=1}^n \sum_{j=1}^m M_{gi}^j]^{-1} = (10, 15, 20) * \{1/50.57, 1/37.37, 1/27.54\}$$

$$= (0.198, 0.401, 0.726)$$

		C2	C3	C4	C5
$\sum_{j=1}^m M_{gi}^j$	(10, 15, 20)	(7.4, 9.5, 12.67)	(4.65, 6.33, 8.17)	(4.08, 5.42, 7.07)	(1.81, 2.12, 2.67)
$[\sum_{i=1}^n \sum_{j=1}^m M_{gi}^j]^{-1}$	{1/50.57, 1/37.37, 1/27.54 }				
$S_{c1} = \sum_{j=1}^m M_{gi}^j * [\sum_{i=1}^n \sum_{j=1}^m M_{gi}^j]^{-1}$	(0.198, 0.401, 0.726)	(0.146, 0.254, 0.46)	(0.092, 0.169, 0.297)	(0.08, 0.145, 0.257)	(0.036, 0.057, 0.097)

$$V(S_{c1} \geq S_{c1}) = 1 \quad V(S_{c1} \geq S_{c2}) = 1 \quad V(S_{c1} \geq S_{c3}) = 1 \quad V(S_{c1} \geq S_{c4}) = 1$$

$$V(S_{c2} \geq S_{c1}) = \frac{0.46 - 0.198}{(0.46 - 0.254) + (0.401 - 0.198)} = 0.641$$

$$V(S_{c2} \geq S_{c3}) = 1 \quad V(S_{c2} \geq S_{c4}) = 1 \quad V(S_{c2} \geq S_{c5}) = 1$$

$$V(S_{c3} \geq S_{c1}) = 0.299 \quad V(S_{c3} \geq S_{c2}) = 0.639 \quad V(S_{c3} \geq S_{c4}) = 1 \quad V(S_{c3} \geq S_{c5}) = 1$$

$$V(S_{c4} \geq S_{c1}) = 0.187 \quad V(S_{c4} \geq S_{c2}) = 0.505 \quad V(S_{c4} \geq S_{c3}) = 0.873 \quad V(S_{c4} \geq S_{c5}) = 1$$

$$V(S_{c5} \geq S_{c1}) = 0 \quad V(S_{c5} \geq S_{c2}) = 0 \quad V(S_{c5} \geq S_{c3}) = 0.162 \quad V(S_{c5} \geq S_{c4}) = 0.043$$

Then priority weights are calculated using the above results:

$$d'(C1) = \min(1, 1, 1, 1) = 1$$

$$d'(C2) = \min(0.641, 1, 1, 1) = 0.641$$

$$d'(C3) = \min(0.299, 0.639, 1, 1) = 0.299$$

$$d'(C4) = \min(0.187, 0.505, 0.873, 1) = 0.187$$

$$d'(C5) = \min(0, 0, 0.162, 0.043) = 0$$

Priority weights $W' = (1, 0.641, 0.299, 0.187, 0)$

After normalization of these values, W are calculated as:

$$W1 = \frac{1}{1 + 0.641 + 0.299 + 0.187 + 0} = 0.470 \quad W = (0.470, 0.301, 0.141, 0.088, 0)$$

3- Accounts for the relative importance of the contractors for each criterion by using the technique (AHP):

For the purpose of calculating the relative importance of the contractors by using a technique (AHP) Note tables (4) and (5) which illustrate the relative importance of contractors' accounts for the financial criterion. And Relative importance of each contractor within the main criteria Note Table 6.

4- The final weights for contractors by using the technique (AHP) calculated the following way :

$$\text{The final weight of the contractor(A)} \\ = (0.4219 * 0.074) + (0.2432 * 0.2235) + (0.1409 * 0.2181) + (0.1350 * 0.0977) + (0.059 * 0.3094) = 0.1477$$

In the same way are the final weights for other contractor account as shown in the table (7)

ANALYSIS AND DISCUSSION OF RESULTS

The results of comparing the relative importance of the major criteria used to determine the optimal Contractor was:-

1- Using the method (AHP): $W = (0.4219, 0.2432, 0.1409, 0.1350, 0.0590)$

2- Using the method (FAHP): $W = (0.470, 0.301, 0.141, 0.088, 0)$

CONCLUSIONS

1. Showing through expert analysis answers the lack of systematic and scientific method is based on the optimal choice of tender by the beneficiaries, but the process is done by choosing the lowest bid.
2. The hierarchical analysis technique (AHP) and (FAHP) help in the selection of the optimal solution from among several solutions perform the same purpose and help in decision-making and analysis and assessment of the available alternatives and thus help the Commission analysis own bid to take the appropriate decision without fear of legal liability because of the choice of a lower bid.
3. (FAHP) technique take into consideration the foggy conditions that plagued Iraq reverse (AHP) technique that relies on clear values, calculating the relative importance of the criteria by using a technique (AHP) : $W = (0.4219, 0.2432, 0.1409, 0.1350, 0.0590)$
While calculating the relative importance of the criteria by using a technique (FAHP): $W = (0.470, 0.301, 0.141, 0.088, 0)$.
4. Successful use of (FAHP) technique in the evaluation of the work contractors in terms of project management, and through the action of this technique accounts between contractors to the main criteria for this administration in foggy conditions..

RECOMMENDATIONS

1. The need to keep up with new management tools and a private analytical gradient technique (AHP) and technology (FAHP) to take advantage of them in the evaluation and selection of the optimal tender.
2. Speed up the application of the proposed regulations for the selection of the contractor in all its effectiveness by researchers and through the work of Induction these systems and how to deal with events.

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Table (1) Criteria for selection of the contractor

	Considerations	Criteria
1	the financial side(F)	Bid amount
		The financial status of contractor
		Employment Insurance
		Availability of financial resources
		Current workload
2	technical side(T)	Duration of employment
		Technical staff and qualifications
		quality management
		Similar work and quality
		Current workload
		Styles and ways employee
3	management side(M)	Administrative staff and qualifications
		Safety and Security Management
		Current workload
4	the legal side and the reputation of the contractor (L)	The relationship with the employer and other institutions
		Compliance with regulations and instructions
		Previous claims and disputes, exclusion and disqualification and deprivation
		Assess the performance of previous projects
		Rating company
5	the environmental side(E)	The use of materials, equipment and plants and their environmental impact
		Styles and methods used and their environmental impact

Table (2) marital comparison to the results of the questionnaire major standards

E	L	M	T	F	Criteria
5	4	3	2	1	F
4	2	2	1	0.5	T
3	1	1	0.5	0.33	M
3	1	1	0.5	0.25	L
1	0.33	0.33	0.25	0.20	E
16	8.33	7.33	4.25	2.28	Total

Table (3) accounts for the relative importance of major criteria

Relative importance	E	L	M	T	F	Criteria
0.4219	0.3125	0.480	0.409	0.470	0.438	F
0.2432	0.25	0.240	0.272	0.235	0.219	T
0.1409	0.1875	0.120	0.136	0.117	0.144	M
0.1350	0.1875	0.120	0.136	0.117	0.1096	L
0.0590	0.0625	0.0396	0.045	0.0588	0.0877	E

$P = 5.234, CI = 0.0585, RI = 1.12, CR = 0, 0522 < 0.1 \rightarrow O.K$

Table (4) marital comparison of the bids within the standard financial side

G	F	E	D	C	B	A	CONTRACTOR
4	2	3	1/5	1/5	1/7	1	A
8	6	7	5	5	1	7	B
7	5	6	2	1	1/5	5	C
7	5	6	1	1/2	1/5	5	D
2	1/2	1	1/6	1/6	1/7	1/3	E
3	1	2	1/5	1/5	1/6	1/2	F
1	1/3	1/2	1/7	1/7	1/8	1/4	G

Table (5) natural matrix of the bids within the standard financial side

G	F	E	D	C	B	A	CONTRACTOR
0.125	0.1008	0.1276	0.0229	0.0277	0.0722	0.052	A
0.250	0.3025	0.2978	0.574	0.6935	0.5057	0.366	B
0.2187	0.2521	0.2553	0.2296	0.1387	0.1011	0.262	C
0.2187	0.2521	0.2553	0.1148	0.0693	0.1011	0.262	D
0.0625	0.0252	0.0425	0.0190	0.0230	0.0722	0.0172	E
0.093	0.0504	0.0851	0.0229	0.0277	0.0839	0.0262	F
0.0312	0.0166	0.02127	0.0163	0.0198	0.0632	0.0131	G

Table (6) the relative importance of each contractor within the main criteria

G	F	E	D	C	B	A	CONT CR.
0.0257	0.0547	0.0369	0.1790	0.2053	0.4238	0.074	F
0.0778	0.1455	0.0339	0.2235	0.0715	0.2235	0.2235	T
0.1716	0.1591	0.068	0.0578	0.3202	0.1455	0.0778	M
0.0358	0.353	0.0471	0.0452	0.0652	0.3560	0.0977	L
0.1146	0.03	0.2029	0.1288	0.0603	0.154	0.3094	E

Table (7) final weights for contractors

contractors	A	B	C	D	E	F	G
final weights for contractors	0.1477	0.3210	0.1361	0.1743	0.0469	0.1243	0.0489

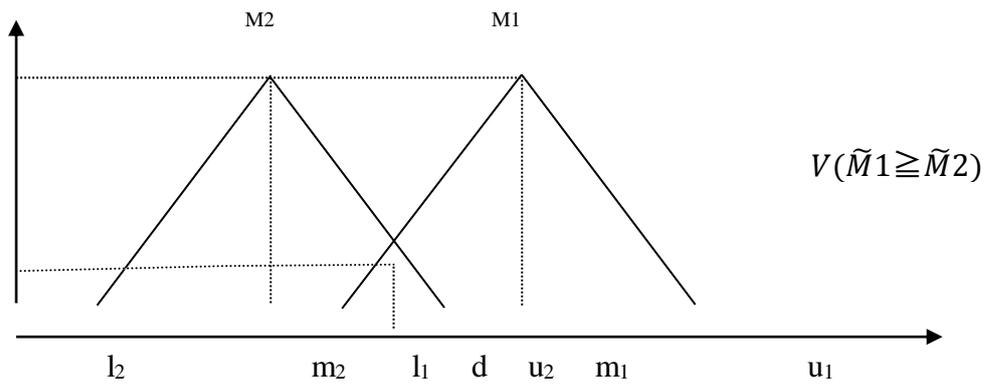


Figure 1: The intersection between M1 and M2 ^(8,9)

بناء نموذج التقييم المتعدد المعايير لاختيار المقاول في المشاريع الانشائية

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الخلاصة

إن الدراسة الحالية تقدم إطاراً منهجياً لتنظيم إدراكات صانعي القرار لأخذ مختلف المعايير بما يزيد من منفعة المؤسسة وتزويدهم بأداة داعمة للقرار متمثلة بتقنية (FAHP) لاختيار المقاول الملائم بحيث يكون دليل على الاختيار الصحيح بدون وجود عامل التحيز أو وجود مصالح شخصية وفي ظروف ضبابية . ويمكن تطبيق هذه التقنية في المراحل الأولى من عملية الإحالة لتجنب اشتراك المقاولين غير المؤهلين في عملية التنافس على الأعمال المطروحة , وبحسب متطلبات صاحب العمل. تم استخراج اغلب المعايير التي من الممكن أن تؤثر في عملية اختيار العطاء الأمثل من خلال إجراء المقابلات الشخصية مع المعنيين بالموضوع من أصحاب الخبرة وكذلك إجراء الاستبيان الميداني لأجل تحديد المعايير الرئيسية والفرعية والأهمية النسبية لكل معيار التي من الممكن الاعتماد عليها في عملية تقييم واختيار المقاول الأمثل . تشمل المعايير الرئيسية (الجانب المالي , الجانب الفني , الجانب الإداري , الجانب القانوني وسمعة المقاول , الجانب البيئي) وكل معيار من المعايير الرئيسية يحتوي على معايير فرعية مثالها الجانب المالي الذي يحتوي على خمسة معايير فرعية وهي (مبلغ العطاء , الوضع المالي للمقاول , التأمين على العمل , توفر الموارد المالية , عبء الأعمال الحالية) .

الكلمات الدالة : اختيار المقاول ، تقنية التدرج التحليلي ،تقنية التدرج التحليلي الضبابية