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CONSTRUCTION VENDOR SELECTION USING MULTI CRITERIA DECISION MAKING: A REVIEW

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Abstract- Nowdays it is very difficult to select a qualified contractor since they have huge impacts upon projects and their success. In this paper review concerning the Analytic Hierarchy process as a multi criteria decision making tools for contractor selection. A hierarchy structure is built for the prequalification criteria. By using the AHP, the prequalification criteria are typically organized and a descendent order list of contractors are made so as to choose the best contractors suitable for the projects. This paper reviews the application of AHP for contractors selection. The paper will give ideas and uses of the multi criteria decision making, the AHP's execution steps, and exhibit AHP application on contractor prequalification problem. By using this model and with the use help of AHP strategy one can select a qualified contractor suitable for the project.

Keywords- Analytical hierarchy process, decision support system, multi criteria decision- making, contractor.

1. INTRODUCTION

Choosing an suitable contractor is essential to the successful implementation of a construction project. A construction project is developed considering the goals and necessities of a client and also the potential of a contractor and suppliers. Although the lowest bid method is adopted to award contracts for many public construction projects in india. In any case, a construction contractor may neglect to fulfill the agreement needs identified with an office. Therefore, screening of qualified contractors during the selection process is incredibly necessary for project owners to select the qualified contractor.

In India, construction project owners usually compare the prequalification and bidding price of all of the qualified contractors. The contractor with the lowest bid will win the project ‘’It is seen that the lowest bid isn't commonly the most prudent and best arrangement in the long haul" Kumaraswamy [14], both the chose standards and a sound assessment approach are fundamental factors in any contractor choice method, including prequalification, so as to guarantee the capacity of chose contractor accomplish all the while time, cost, and quality particulars.

The Analytical Hierarchy process (AHP) is a decision aiding method developed by Saaty [23,24,25,26,27 and 28. It is a method to derive proportion scale from paired comparisons. The information is acquired from genuine estimation, for example, value, weight, or from emotional conclusion like fulfilment sentiments and inclinations . AHP permit some little consistency in judgment because of human isn't persistently predictable. The proportion scales are derived from the principal Eigen vectors and the consistency index is derived from the principal Eigen value. The principle goal of this part is to demonstrate how an AHP model is utilized for contractor selection. The contractor selection procedure could be a multi-criteria decision- making (MCDM) problem..

This paper reviews the application of AHP for contractors selection. The paper will give ideas and utilizations of the multi criteria decision analysis, the AHP's execution steps, and exhibit AHP application on contractor prequalification problem. The model used in this paper is for assessing contractor's prequalification which can fill in as a decent reference for project owners during this time spent choosing contractors.

REVIEW OF THE LITERATURE:

Analytic hierarchy process (AHP) is a multi-criteria decision making technique for organizing complex decisions that was developed by prof. Thomas L. Saaty. It is a method to derive proportion scale from paired comparisons. The information is acquired from genuine estimation, for example, value, weight, or from emotional conclusion like fulfilment sentiments and inclinations . AHP permit some little consistency in judgment because of human isn't persistently predictable. The proportion scales are derived from the principal Eigen vectors and the consistency index is derived from the principal Eigen value. The principle goal of this part is to demonstrate how an AHP model is utilized for contractor selection. The contractor selection procedure could be a multi-criteria decision- making (MCDM) problem.

In Contractor prequalification number of criteria's are used by the project owners or otherwise expert opinions are used to verify whether or not a construction contractor will adequately perform a contract. Contractor prequalification is regularly utilized for recognizing a certified, sound and solid construction contractor.

Hwang and Yoon [11] Published a far reaching review of different multi-criteria decision techniques and applications. In this, two types of issues that are common within the project management that are structure issues and analysis issues that fit multi- criteria decision models. The analysis issue is concerned with the analysis of, and conceivable decision between, discretely characterized other options. The structure issue is concerned about the distinguishing proof of a favoured options from a conceivably boundless arrangement of options certainly sketched out by a gathering of limitations.

Belton [6] looked at AHP and a simple multi-attribute value (MAV), as two of the different models draws near. She saw that each approaches are wide utilized by and by which might be thought of as a proportion of progress. She likewise remarked that the best shortcoming of the MAV approach is its inability to remember efficient checks for the consistency of judgment. She likewise saw that for large examination, the measure of decisions required by the AHP is fairly a weight.

Russell and Skibniewski [12] made the pc program Qualifier-1 to draw up a model with a straight mix of choice rules. When the rating for each choice factor is gone into the program, the amassed weighted rating of each contractual worker applicant might be estimated to encourage prequalification dynamic.

Lam et al. [13] contend that contractor prequalification is nonlinear and each quantitative and subjective variables should be encased inside the model. In this manner, they build up another fresh out of the box new contractor prequalification model that utilizes a help vector machine.

Capability is sketched out by Moore [15], Clough [8] and Stephen [22] in light of the fact that the screening of development contractual workers by venture proprietors or their delegates as indicated by a foreordained arrangement of rules esteemed fundamental for fruitful task execution, in order to work out the temporary worker's fitness or capacity to take an interest inside the undertaking offer. Russel and Skibniewski [18] conjointly attempted to clarify the contractual worker capability strategy alongside the decision-making techniques and furthermore the elements that impact the strategy.

Russel [19] dissected contractual worker disappointment inside the North american country and recommended that a proprietor ought to have two implies that of dodging or limit the effect of temporary worker disappointment: (an) examining the contract based worker capability before contract grant and (b) watch the contract based worker's exhibition when agreement grant.

Al-Ghobali [18] reviewed the Saudi development showcase and recorded assortment of things against that contractors should be thought of for prequalification. This included experience, financial stability, past performance, current employment management employees, manpower resources convenience, contractor organization, familiarity with the project's geographic location, project management capabilities, quality assurance and management, previous failure to complete a contract, equipment resources, purchase experience and material handling, safety consciousness, claim perspective, planning/scheduling and price management, and equipment repairing and maintenance yard facilities.

For public projects contractor qualification was read by Aitah[1] AL-Alawi[3] and Russel [20]. In these investigations they assessed open structure development extends and completed that the venture granted to the most minimal bidder have lower execution quality and calendar delays when contrasted with the tasks which were granted dependent on explicit capability models.

At that point Al-Harbi [4] concentrated in capability of development companies by utilizing multi-models choice technique. He decided six rules for qualification and attempted to choose the best firm between the six development organizations. The paper has given the AHP as a dynamic strategy that permits the thought of numerous rules. A case of contractor prequalification was made to exhibit AHP application. Contractor prequalification includes standards and needs that are controlled by owner request and inclinations likewise in light of the fact that the attributes of the individual contractor.

A model for estimating contractor execution was made by wong [9] i.e Logistic regression bolstered 31 rules delicate evaluation. Forty-eight undertakings were encased inside the model. A short time later, this model was utilized to approve 20 independent cases, ending up being 75% factually right in anticipating contractor execution..

It is seen that the lowest bid isn't commonly the most prudent and best arrangement in the long haul" Kumaraswamy [14], both the chose standards and a sound assessment approach are fundamental factors in any contractor choice method, including prequalification, so as to guarantee the capacity of chose contractor accomplish all the while time, cost, and quality particulars.

In Contractor prequalification several factors (for instance, experience and financial standing)are taken into account for decision making. Therefore, the factors provided by construction owners should be valid, some of these factors are hard to evaluate during a scientific model. In order to arranged this, a fuzzy set model was developed by Edyta Plebankiewicz [10].

METHODOLGY:

Multi criteria decision making (MCDM)

Decision-makers are no longer considering just one single criterion to make a decision. To create progressing correspondence and think of feasible decisions, organizations considered various multiple-criteria in their decision practice. MCDM is worried about organizing and understanding decision and planning issues including multiple-criteria. The point is to help decision-makers confronting such issues. Commonly, there does not exist a ideal solution for such problems and it is important to utilize decision-maker's preferences to separate between arrangements.

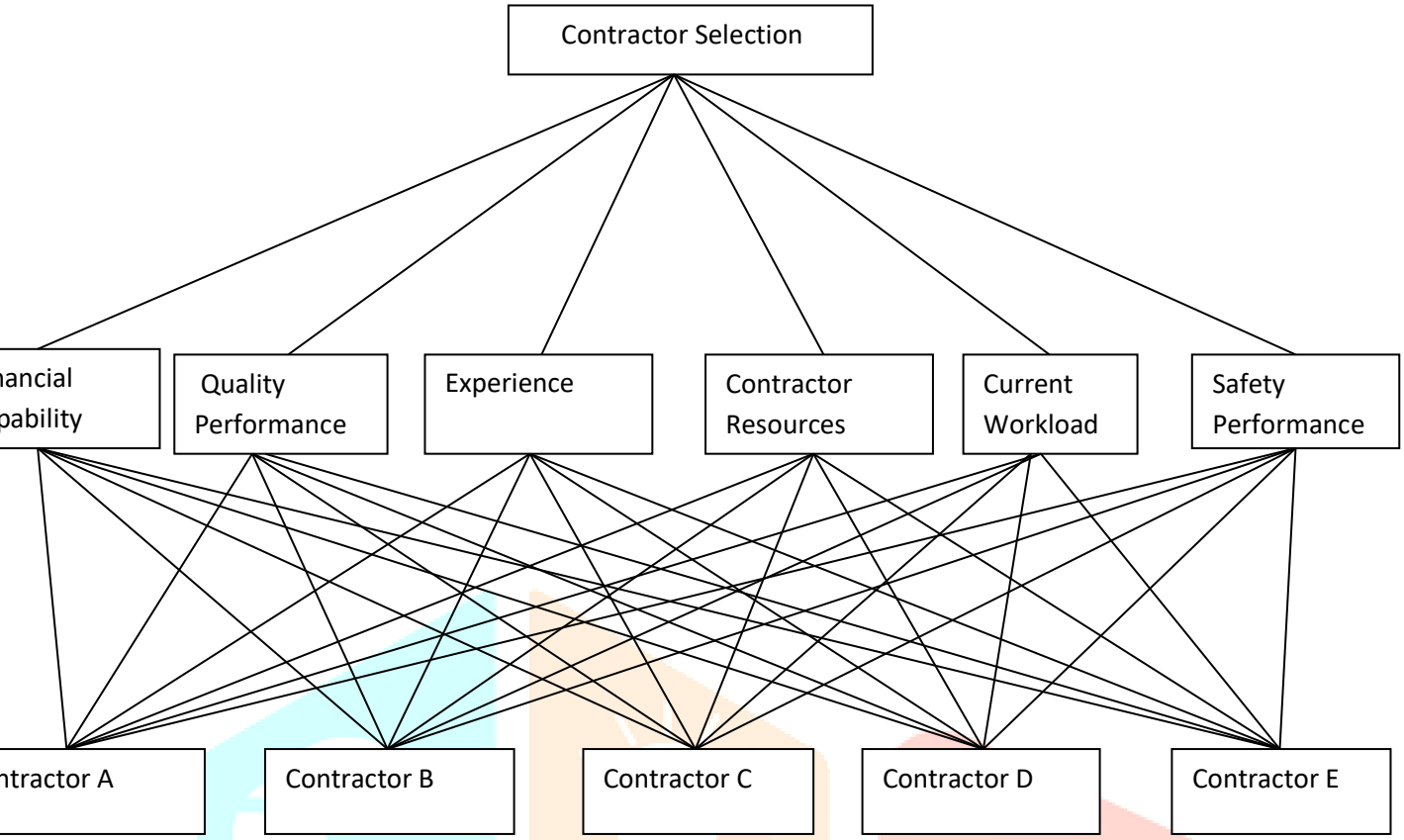
MCDM is a structure for breaking down decision issues indicated by complicated multiple targets [17, 16] . MCDM can deal with long-term time alternatives, unknown aspects, risks, and complex worth consideration. The MCDM practice normally characterizes targets, chooses the necessities to work out the objectives, points of interest alternatives, changes the live qualities, allocates loads to the necessities, utilizes a numerical calculation rule to accomplish choices [5,21].

MCDM has been used in a few fields like, food security, policy examination, resource management, portfolio and financial assets management, location selection, procurance and best supplier selection, forest management, analysis of business units performances, health care system, finance, energy and surroundings risk assessment.

Analytical Hierarchy Process (AHP)

The analytical Hierarchy Process (AHP) was developed by Saaty [23] is a multi criteria decision making method. It consider the human judgment, experience, discernment and emotions in the decision making process. It utilizes an organized procedure for analyzing MCDM issues bolstered pair-wise comparisons. The quality of this methodology is that AHP not exclusively sorts out quantitative and non-quantitative factors in a scaled systematic manner. However additionally gives an organized and nearly clear answers to decision-making problems. Simple hierarchy consists of three levels. First, on the highest is goal, second lies criteria and third lies alternatives.AHP is a powerful tool for finding and decision making in complicated environment.

Hierarchy Tree In order to assess contractor selection, a hierarchy tree is created for contractor prequalification. The AHP requires a goal or objective at the top level. Second lies the criteria. Third lies the alternatives. By using the AHP technique depicted above , the hierarchy tree of the problem can be appeared in the figure below.



These are the steps involved in constructing matrix for each comparisons and criteria:

i. State the matter,first.
ii. List the objectives.
iii. Determine the elements.
iv. Structure the matter in a hierarchy levels comprising goal, criteria, sub-criteria and alternatives.
v. The decision matrix that is predicated on saaty's scale is developed. The decision maker use saaty's scale 1 to 9 to assess the priority score (as shown in table 1).
vi. Each elements is compared within the corresponding level and align them on the numerical scale. n(n-1)/2 comparisons are required, where n is the number of elements with the considerations that diagonal elements are equal or 1 and the other elements will simply be the reciprocal of the earlier comparisons,,
vii. Calculation is done to find the maximum Eigen value, consistency index CI, $CI=(\lambda_{max}-n)/(n-1)$ where λ_{max} is the principal Eigen value of the matrix. consistency ratio CR, CR=CI/RI and normalized values for each criteria/alternative.
viii. If the maximum Eigen value, CI, and CR are satisfactory then decision is taken based on the normalized values lie in a desired range.
ix. The consistency index (CI) needs to be estimated. This is done by adding the columns in the judgment matrix and multiply the resulting vector by the vector of priorities obtained earlier. The closer the consistency index is zero, the greater the consistency.
x. If CR is less than 5% for a 3x3 matrix, 9% for 4x4 matrix, and 10% for larger matrixs, then the matrix is consistent.

The pairwise-comparisons in a judgment matrix are viewed as sufficiently consistent if the consistency ratio(CR) is less than 10%.(i.e 0.10). if it not should repeat the above steps (v.vi.vii,viii) and redo the comparisons..

Table 1

Pair-wise comparison scale for AHP [29]

Numerical scale	Verbal judgment of preferences
1	Extremely preferred
2	Very strongly to extremely
3	Very strongly preferred
4	Strongly to very strongly
5	Strongly preferred
6	Moderately to strongly
7	Moderately preferred
8	Equally to moderately
9	Equally preferred

Table 2

Average random consistency (RI) [ ]

Size of matrix	1	2	3	4	5	6	7	8	9	10
Random consistency	0	0	0.58	0.9	1.12	1.24	1.32	1.41	1.45	1.49

Group Decision Making:

In group decision, members of group utilize their encounters and information to break the problem into hierarchy and illuminate it by utilizing AHP. Group decision involves participants with common interests from many organizations or fields.

- If we expect individual can have his own motivational needs and he will be in conflict on certain problem. Therefore, group members for the indistinguishable can share extra for all intents and purpose than the contention. It is ideal to work a gathering on the off chance that we need to accomplish understanding. This mode boosts correspondence additionally as each gathering individuals stake in the choice.

- Expert choice software typically leads us more understanding of the problem, that helps in minimizing the difficult problem of the group think. Expert choice software diminishes the impacts of gathering think and different choices which can or probably won't be so captivating.

- Expert choice software is used in group session, in which a hierarchy is shown to the group which is prepared in advance. This helps in understanding the problem. A group examines the prepared hierarchy or constructs a

new hierarchy to cover all important points. Once the difficulty is broken into entirely unexpected levels each member present his own opinion. During this mean, the group can can collaborate in distinguishing the general structure of the trouble. The group would then give the judgment On the off chance that it is unimaginable to expect to show up at a judgment, the gathering can take the normal of the of the judgment. All figuring are done on screen.

Conclusion:

Contractor selection is a difficult task for the selection of most applicable contractor, making certain that a project is completed within budget and on schedule. The selection of the foremost applicable contractor for the project is a very important issue. Each private and public sectors are unaware of AHP process. Therefore, these sectors can be benefited from the use of AHP . In this paper, we tend to give an AHP application for contractor selection in multi-criteria surroundings. The AHP allows decision maker to express their opinions concerning the factors and to decide on the best overall alternatives based on selected criteria. The decision model for selecting contractor analyzed during this study concerned numerous measures that were assessed simultaneously by totalling the information of specialists. This model was then used to choose the best suitable contractor appropriate for the project.

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