

## International Journal of Innovative Research in Science, Engineering and Technology

(A High Impact Factor, Monthly, Peer Reviewed Journal)

Vol. 5, Issue 2, February 2016

# A Multi-Perspective Strategic Approach for the Selection of Contractor in Highway Projects

Liz Simon<sup>1</sup>, Arunima Jayakumar<sup>2</sup>

Student, Department of Civil Engineering, SRM University, Chennai, India<sup>1</sup>

Assistant Professor, Department of Civil Engineering, SRM University, Chennai, India<sup>2</sup>

**ABSTRACT:** Contractors play a vital role in the overall performance of a project. Selecting the right contractor for the right project is the most crucial challenge for any construction client. Numerous and often conflicting objectives and alternatives, such as tender price, completion date, and experience, need to be considered. With this aim a study of multi-criteria selection approach for contractor selection in the highway department is carried out. Contractor selection in the highway projects is a very complex and tedious task and needs at most care and attention. Current selection methods are reviewed and the factors affecting appropriate contractor selection are generated. In this study the selection involves evaluation criteria related to these factors and has a process with two main stages: contractor prequalification and the choice of the eligible bidder among prequalified contractors. In this approach the major factors are analyzed using decision making software. Thus this approach can be used as a decision support system for highway projects in order to identify an eligible contractor to be awarded the contract.

**KEYWORDS:** CS criteria, prequalification, bid evaluation, decision support system

## I. INTRODUCTION

The highway construction department is characterized by cost and duration overruns. It also faces problems in meeting with the quality standards and specification, also dealing with claims and conflicts which arises. To minimize or optimize all these risks, selection of an appropriate contractor to deliver the project under consideration as per requirements is the most crucial challenge faced by any construction client. The success level of any project can be argued to depend largely on selecting the most competent contractor. Thus selecting the appropriate contractor is a significant step to highway project success. The complexity of highway projects makes the selection of most competitive contractor that satisfies the project objectives crucial to project performance. Contractor selection depends on many factors. The main decisive criteria are proper bid evaluation and contractor pre-qualification. The other aspects are technical specification, financial stability and general conditions of the contract. The methods used for selecting contractors in order to award public projects in the construction industry are generally based on the principle of acceptance of the lowest bid. Using a multi-criteria approach for evaluating contractors with respect to their economic and technological aspects, quality standards, past performance and other tangible and intangible characteristics will help solve the problem.

## II. PILOT STUDY

Recently the highway projects in the country faces many challenging problems especially during the prequalification stage. The pre-qualification process is generally project specific. It mainly evaluates the bid evaluation process financial, technical aspects, equipment availability and resource constraints in such projects. Many researchers such as Holt et al(1994,1996), EkambaramPalaneeswaran et al(2000) have commonly identified and used the prequalification

# International Journal of Innovative Research in Science, Engineering and Technology

(A High Impact Factor, Monthly, Peer Reviewed Journal)

Vol. 5, Issue 2, February 2016

criteria and also bid evaluation process and have also proposed models for contractor prequalification. Also tender evaluation is relatively important criteria for choosing the right contractor for the work. D J Watt et al(2009) followed an experimental design approach as an alternative to attitudinal studies which rates the perceived importance of each in the context of contractor selection. Results indicate Past Project Performance, Technical Expertise and Cost are the most important criteria in an actual choice of contractor with Organizational Experience, Workload and reputation being the least important. Mohamed M. Marzouk et al (2012) analyzed the various factors influencing sub-contractor selection in construction projects. A questionnaire was carried out which was conducted with experts in the construction field to determine the score of each factor. F. Waara1 et al (2006) describes and explains how public owners use multiple criteria for the award of construction contracts. The main criteria used here a being the Priced criteria which depends on the type of bid in the project and Non priced criteria. Several numerical methods such as multiple-attribute analysis, multiple regression and cluster analysis have been used as a methodology for contractor selection by Gary D Holt et al(1998). Mehmet EmreBayraktar et al (2010) presents a decision support system to assist state Departments of Transportation in selecting suitable contracting strategies for highway work zone projects by considering, at a macro level. It establishes interrelationships between the stakeholders and identifying the critical factors impacting the project. A fuzzy-set method assists the contractor selection process which was proposed by H. M. Alhumaidi1 et al (2014) by providing preferences of criteria in the contractor selection process. Luis Fernando Alarco'n1 et al(2002) studies project performance outcomes for each contractor are under evaluation; these predictions and a contractors' bid prices are then used for contractor evaluation purposes. The Analytical Hierarchy Process (AHP) multi-criteria analysis method—is used to qualify the state of the characteristics for each contractor. Hence studying and prioritizing the relevant factors is very essential for the proper evaluation and selection of contractor Proper assessment and evaluation of the selection methodology is required.

### III. MAIN CRITERIA FOR CONTRACTOR SELECTION

It involves different types of criterion to evaluate the overall suitability of contractors in highway projects. The main criteria being tender and bid evaluation and other criteria such as general prequalifying criteria, technical expertise, managerial aspects, financial stability, organizational strength, and experience in comparable projects; Relevance of experience, size of firm, and safety record.

Table1: Main Criteria and Sub-criteria for Contractors' Prequalification and Bid Evaluation

Project's requirements	Bid price Duration Type of project
Prequalification	Experience in similar projects Resource availability: Personnel, equipment, facilities etc Financial status Technical expertise Firm's history of claims
Tender evaluation	Priced criteria Based on lowest bid price Average bid Bid spread Non priced criteria

# International Journal of Innovative Research in Science, Engineering and Technology

(A High Impact Factor, Monthly, Peer Reviewed Journal)

Vol. 5, Issue 2, February 2016

Financial criteria	Working capital Turnover Current and fixed assets Financial credibility Liquidity status
Technical criteria	Technically equipped staff Experience of key personnel Technical supervision Quality aspects-QA/QC systems
Managerial Capability	Past Performance Project management organization Management Knowledge
Reputation	Past failures Length of time in business Past owner/Contractor relationships Other Relationships

The main criteria and sub-criteria involved in contractor selection is provided in table 1.

## IV. METHODOLOGY

The method for selection of contractor is done in two steps.

### A. Data Collection

In this study initially the need for an appropriate contractor selection is recognized. The major factors relating to selection of contractors are studied and analyzed. The factors are finalized based on the study of previous literature relating to highway projects and also from data from highway department. Also this study aims at identifying the criteria for bid evaluation and the means by which different emphases can be recommended to suit the requirements of clients and highway projects. A detailed study of the prequalification criteria carried out in highway projects is conducted. Based on the various criteria a questionnaire was framed. The questionnaire was circulated to various contractors, subcontractors, clients. A thorough survey is then conducted using the questionnaire framed and the opinion and views of the respondents were taken into account. Also many opinion have been obtained through mails and interview with experts.

### B. Data Analysis

Based on the judgment the various factors are delineated. The factors are rated at a 5 point scale and weightages are assigned to the factors. The factors are ranked from 1 to 5, 1 being the least important and 5 being the most important. The statistical calculations were carried out using SPSS software so as to generate the frequency and cross tab calculations. Using the mean score of each factor and SPSS Software the significance of each factor is determined. Crosstab calculations are the comparison between two factors. Crosstabs are generated between important the significant factors. Some of the significant factors include technical expertise, financial soundness, failure to comply with quality specifications, flexibility in critical activities, efforts to comply with quality specifications, cooperation when resolving delays.

# International Journal of Innovative Research in Science, Engineering and Technology

(A High Impact Factor, Monthly, Peer Reviewed Journal)

Vol. 5, Issue 2, February 2016

## V. DISCUSSION

A quantitative and qualitative judgment is made about selecting the right contractor for the highway project. The initial steps which should be given utmost care is tender evaluation, contractor pre-qualification and eligibility criteria.

### A. Pre-qualification

The assessment by an implementing agency of the suitability of firms to carry out a particular contract prior to being invited to submit a bid is a process called pre-qualification. The process enables prospective bidders, who may be insufficiently qualified on their own, to avoid the expense of bidders to form a venture that may give them a better chance of success. The pre-qualification process includes four main phases: advertising, preparation and issuing of the pre-qualification document, application preparation and submission by bidders, and application evaluation, and pre-qualification of applicants.

### B. Eligibility Criteria

Eligibility criteria generally stipulated for the bid documents should comprise of the following:

- i. Conflict of Interests: A firm that has provided consultancy services to the Employer in the preparation of the project or bid documents etc. or affiliates of such a firm are not eligible to provide services or goods and thus not eligible for bidding.
- ii. Government owned enterprises are not eligible for bidding unless they are legally and financially autonomous and operate under the commercial law.
- iii. A firm declared ineligible for having indulged in corrupt or fraudulent practices by the Employer shall not bid. Firms that have been debarred from participating in the bid processes of the Employer for non-performance shall be ineligible for bidding in the period so applicable.

### C. Qualification Criteria

Generally, the following qualification criteria should be specified in the pre-qualification document qualification of bidders. The criteria may also be used to carry out post-qualification of bidders. The criteria could be modified and expanded to include other conditions to meet requirements of individual works.

- i. Registration of Contractors in Appropriate Class: The Qualification criteria usually stipulate that the bidders must be registered in appropriate class with the Employer or CPWD or State PWDs or highways etc. The registered contractors would be eligible to tender for the class (es) of work(s) for which they are registered and up to the limits of their registration and area of operation.
- ii. General Construction Experience: The qualification criteria stipulates that bidders should have been actively engaged in civil works construction business for similar work at least for 5/10 years immediately prior to the date of submission of application.
- iii. Particular Construction Experience: The qualification criteria stipulation may provide that the bidder should have successfully completed or substantially completed, within the 5/10 financial years, at least one contract of the specified percentage (eg. 75%) of the contract value in question and which is similar to the one now being proposed and (ii) The bidder should also have achieved the minimum annual production rate of the key construction activities stipulated.
- iv. Turnover: The minimum average turnover of the bidder during the preceding 5 to 7 years should be more than the specified value. This is usually two times the estimated cost of the work put to tender divided by the time in years allowed for the work. While working out the turnover of the preceding years, a compounding factor (eg. 10% per year) may be specified.
- v. Bid Capacity: The qualification criteria invariably provide that the bidder should possess the bidding capacity as calculated by the specified formula. The formula generally adopted is:  $\text{Bid Capacity} = A \times N \times F - B$ , where:

# International Journal of Innovative Research in Science, Engineering and Technology

(A High Impact Factor, Monthly, Peer Reviewed Journal)

Vol. 5, Issue 2, February 2016

- a. A = Maximum value of works executed in any one year during the last 5 years (updated at the current price level by a compounding factor eg. 10% per annum), taking into account completed as well as works in progress.
- b. N = Number of years prescribed for completion of the work in question.
- c. B = Value (updated at the current price level) of the existing commitments and ongoing will be completed in the next 'N' years.
- d. F = A multiplier factor (Usually 1.5 to 2)

## D. Financial Capability

With a view to ensure that the bidder has access to or possesses adequate liquid assets and other financial assets to meet the cash flow requirements for the contract in question, the qualification criteria provides that

- (i) The bidder must possess a specified minimum value of liquid assets (Generally 10% of the annual turnover)
- (ii) The bidder should have adequate sources of finance to meet the cash flow requirements of works currently in progress and for future contract commitments and
- (iii) The bidder should possess financial soundness as established by audited balance sheets and of financial statements. Towards this the bidder may be required to produce these details such as Profit and Loss Statements and Balance Sheets for the preceding five or seven years. The bid documents may also provide that the Employer may seek reference from the bidder's bankers to establish his financial soundness.

## E. Equipment Capability

The qualification criteria may provide that the bidders should demonstrate the availability of key equipment necessary for the contract work. This may be through ownership of the equipment or through hire or lease. The prime consideration in this regard would be to assure the availability of the equipment at the time when it is required to be deployed in the contract work.

## F. Technical Capability

The technical capability is judged through resources of the firm in respect to personnel, plant and equipment and site management. The technical expertise of the labors should be improved, induction programs should be provided for the staff and labors. All the works undertaken should be conforming to the quality specifications. In case of road and bridge works the execution should be conforming to the clauses of MORT&H's specifications. Some other codes which are followed in the Indian scenario are IRC codes, IS codes and CPWD specifications

## VI. CONCLUSION

Selection of highway contractors is a very challenging task. A wide range of criteria is subjected to objective evaluation. Assessing the various criteria, proper tender evaluation and prequalification is given prime importance. This study proposes a multiple criteria approach for the selection of an appropriate contractor for the project. The process is project specific and helps in understanding the relevant selection criteria. Additionally, this study collected data from a sample of consultants with extensive industry experience; seeking viewpoints directly, by sampling sets of each of these groups in order to identify the manner both in which they concur with critical management capability variables and ways in which their perspectives differ. This paper helps in setting a rigorous evaluation criteria which could help eliminate incompetent competitors and hence increase the projects competitiveness. Further evaluation and monitoring post assigning of contractor should be conducted to assess the success level attained. Thus this study aims at reducing project risk, maximize the quality and maintain strong relationships between project parties and thus selection of a successful contractor.

# International Journal of Innovative Research in Science, Engineering and Technology

(A High Impact Factor, Monthly, Peer Reviewed Journal)

Vol. 5, Issue 2, February 2016

## ACKNOWLEDGMENT

The authors wish to thank three highway professionals for their valuable contribution to the study. We would also like to acknowledge Highway Research Board, Guindy, Chennai, Natpac, Trivandrum, PWD Mizoram State and also the various contractors and technical experts who assisted in providing data for the paper.

## REFERENCES

1. H. M. Alhumaidi (2014), Construction Contractors Ranking Method Using Multiple Decision-Makers and Multiattribute Fuzzy Weighted Average, Journal of Construction Engineering and Management, © ASCE
2. Y. IlkerTopcu (2003), A decision model proposal for construction contractor selection in Turkey, Building and Environment 39 (2004) 469 – 481
3. Mohamed M. Marzouk a,\*, Ahmed A. El Kherbawy b, MostafaKhalifa b, (2013)Factors influencing sub-contractors selection in construction projects, Housing and Building National Research Center HBRC Journal
4. Waara1 and J. Bröchner2 (2006), Price and Nonprice Criteria for Contractor Selection, Journal of construction engineering and management, vol 132:797-804.
5. D.J. Watt a,b,\*, B. Kayis a, K. Willey (2010), The relative importance of tender evaluation and contractor selection criteria, International Journal of Project Management 28 (2010) 51–60
6. Mehmet EmreBayraktar a, MakarandHastak b (2009), A decision support system for selecting the optimal contracting strategy in highway work zone projects, Automation in Construction 18 (2009) 834–843
7. Holt, G. D., Olomolaiye, P. O. and Harris, F. C.(1994), Factors influencing UK construction clients' choice of contractor. Building and Environment, , 29(2), 241-248.
8. Herbsman, 2. and Ellis, R.,(1992) Multiparameter bidding system-innovation in contract administration. Journal of Construction Engineering and Management,118(1), 142150.
9. Z. Turskis, Multi-attribute contractors ranking method by applying ordering of feasible alternatives of solution in terms of preferability technique, (2008), Technol. Econ. Dev. 14 (2) 224–239.
10. Doloi, Analysis of pre-qualification criteria in contractor selection and their impacts on project success, Constr. Manage. Econ. 27 (12) (2009) 1245–1263.
11. E. Cheng, H. Li, Contractor selection using the analytic network process, Constr. Manage. Econ. 22 (10) (2004) 1021–1032.
12. S. Cheung, T. Lam, M. Leung, Y. Wan, An analytic hierarchy process based procurement selection method, Constr. Manage. Econ. 19 (4) (2001) 427–437.
13. Hatush, Z., and Skitmore, M. (1998). "Contractor selection using multicriteria utility theory: An additive model." Build. Environ., 33(2), 148–164.
14. Russell, J. S., and Skibniewski, M. J. (1988). "Decision criteria in contractor prequalification." J. Manage. Eng., 4(2), 148–164.
15. Palaneeswaran E, Kumaraswamy M. Recent advances and proposedimprovements in contractor prequali3cation methodologies. Buildingand Environment 2001;36:73–87.
16. Nguyen VU. Tender evaluation by fuzzy sets. Journal of Construction Engineering and Management 1985;111(3):231–43
17. Holt GD. Which contractor selection methodology. InternationalJournal of Project Management 1998;16(3):153–64.
18. Saaty TL. Multicriteria decision making: the analytic hierarchyprocess. Pittsburgh: RWS Publishers; 1989.