

# Methodology for Ranking of Factors Affecting Selection of Subcontractor for Construction Contractors of Gujarat

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**Abstract** — Subcontractors play a vital role in the construction industry. Subcontractors are specialty contractors who are hired to perform specific tasks on a project. On many projects, it is common for 80-90% of the work to be performed by subcontractors. Selection of the best sub-contractor is a vital process in construction industry. There are many factors which affecting selection of subcontractors for construction contractors of Gujarat. Improper selection of sub-contractors might lead to many problems during work progress. Mainly, existing models of subcontractor selection evaluate subcontractor based on a set of subjective factors that are deemed important by the decision maker. Such subjective factors include performance on previous projects, financial strength, completion on time, safety record, timely payment to labour and suppliers.

**Keywords** — Subcontractor, Selection criteria.

## I. INTRODUCTION

Subcontracting is an integral component of the construction industry, and its importance has been increasing in the industry over the last two decades in South Africa and elsewhere around the world. This has an impact on the division of labour within the industry, employment and skills patterns, productivity and quality, and the industry's health, safety and environmental management practices. Subcontracting, including specialist, generalist, trade and labour-only subcontractors, is an integral component of the construction industry, and its importance has been increasing in the industry over the last two decades in India and elsewhere around the world.

Maximum value of a job awarded to a subcontractor does not exceed more than 25% of the contractors' turnover. This is because we cannot trust all the subcontractors and they also cannot rely on us! As background, three main categories of subcontractors can generally be identified in the construction sector:

□specialist subcontractors; those that undertake specialist services, especially building or engineering services such as electrical, plumbing and heating, ventilating and air-conditioning (HVAC);

□generalist and specialist trade subcontractors; those that offer general trade services or specialize on specific trades such as painting and brickwork—many of which are general contractors that use subcontracting as a means to get work during periods of tough competition but can and often prefer to work as main contractors; and

□labour-only subcontractors; i.e. skilled tradesmen that provide labour-only services, while the main contractor provides the materials and supervision.

Furthermore, from a contractual point of view, subcontractors can be categorized as:

□domestic subcontractors; those hired by the contractor to perform specific tasks;

□selected subcontractors; subcontractors solicited from a recommended list of potential subcontractors in the tender documents; and

□nominated subcontractors; nominated by the client or client's agent to undertake specified aspects of the main contract.

## II.NEED OF STUDY

Construction industry has complexity in its nature because it contains large number of parties as clients, contractors, subcontractors, consultants, stakeholders, shareholders, regulators and others. Construction projects in the Gujarat suffer from many problems and complex issues in performance because of many reasons and factors. This paper aims to identify and evaluate the main factors affecting selection process of subcontractors for construction projects in Gujarat. The practices concerning with the key parameters such as time, cost, project owner satisfaction and safety checklists will be analyzed in order to know the main practical problems of projects for selecting subcontractors in Gujarat. This study will provide methodology to carry out ranking of factors which affect selection of subcontractors.

## III. CRITICAL LITERATURE REVIEW

The literature review is carried out to identify criteria affecting selection of subcontractors in major construction firms.

Hinze et al. (1994) conducted that the construction of most projects, a significant role is played by specialty contractors, also commonly referred to as subcontractors. Despite the importance of subcontractors, little is publicized about the actual process by which subcontracts are initiated, how award arrangements are made, or how subcontracts are managed. [15]

Warnick et al. (2000) found that one of the most disruptive events in a construction project is a contractor's failure to perform its contractual obligations, especially completion of the agreed-upon work. Performance bonds are frequently utilized to protect the hiring party (owner or contractor) from the financial impact of a contractor or subcontractor default, including the cost of finding a replacement contractor, higher contracting costs, and delays caused by the default. However, many contractors choose to self-insure this risk, and minimize the risk of default using a rigorous prequalification process to select qualified and financially secure subcontractors. [35]

Thomas et al. (2003) identified by questionnaire survey the key criteria for subcontractor's scrutinization process. The questionnaire consisted of two sections. The first section asked for details of the profile of the respondents, while the second focused on the respondents perception of the importance of the 26 criteria. A five point scale was provided, with 1 representing very low importance and 5 denoting very high importance. [32]

Khalfan et al. (2006) examined that true partnering, by definition, is not being practiced between main contractors and downstream supply chain participants. The implications of this finding will be discussed in concluding the study with particular regard to the likelihood for cooperation amongst participants for improved project performance and innovation. Towards the end of this paper, a question was asked to all the readers; domain contractors really work in true partnering with their subcontractors and suppliers or the bottom line is always the reduction in price? [17]

Favié et al. (2007) concluded that a comparison is made between the criteria that were found in literature with the criteria that were found during a study on the Dutch construction industry. The aim of this research was to find the best criteria for the selection of contractors in the Dutch construction industry. [9]

Sahu et al. (2007) concluded that some areas of policy intervention such as providing financial and technological support to small enterprises, enforcement of appropriate legislation to minimize the problem of undue and delayed payments by the parent firms and revamp subcontracting exchange programme and so on for successful and effective operation of subcontracting. [34]

Talukhaba et al. (2007) discussed the factors necessary for domestic subcontractor's selection in South African construction industry. Based on the opinion of contractors and subcontractors measured on the rating scale, the paper highlighted the key factors that are important and which should be considered in selection procedure. [36]

Lavelle et al. (2007) established that price is no longer considered the only important factor in subcontractor selection, and that health and safety, past performance, and insurance cover are considered equally important and, in some scenarios, more important than price. [19]

Hartmann et al. (2009) examined that the relative importance of four criteria in the subcontractor selection process of main contractors from Singapore: price, technical know-how, quality, and cooperation. Although main contractors adopt a multi criteria selection process and perceive all four criteria to be important for their choice decision, the actual choice situation reveals that price is still by far the most important selection criterion, followed by quality, cooperation, and technical know-how. Main contractors are not willing to compromise on price but accept a lower performance of a known subcontractor on the remaining criteria. [13]

Mashaleh et al. (2009) discovered that "Data Envelopment Analysis (DEA)" model to guide general contractors in their subcontractor selection decisions. Existing models of subcontractors' selection evaluate subcontractors based on a set of subjective criteria that are deemed important by the decision maker. The proposed DEA approach addresses the limitation associated with existing models and results in one holistic view for subcontractor evaluation. [23]

Ajayi et al. (2010) examined that the criteria used to evaluate subcontractors and suppliers during prequalification and tender evaluation and also their mode of selection process so that the project can be completed within time, cost and quality standard. [28]

Thomas et al. (2011) studied a number of principles for managing subcontractors have been developed. The principles are presented in the form of a "to do" list for general contractors. The principles are easy to understand and implement. They are presented as a part of a prescription for productivity improvement and should have an immediate and positive effect on job performance. [11]

Mashaleh et al. (2011) from their research concluded that the reliance of general contractors on subcontractors to execute major portions of construction work makes the success of construction projects highly susceptible to the performance of these subcontracting organizations. As a result, subcontractors' selection decisions are of crucial importance to general contractors bearing in mind that such decisions are exercised by general

contractors multiple times in every single project. This study contributes a Data Envelopment Analysis (DEA) model to guide general contractors in their subcontractor selection decisions. [23]

Patil et al. (2012) identified that the primary data relevant to our study through questionnaire. On the basis of the responses that were collected Relative Importance Index (RII) for each option for all the questions were calculated. Based on the RII values author concluded about the various factors that play an important role in selection of suppliers in construction industry. [31]

Vilasini, et al. (2012) identified that the improvement areas to current alliance practice and suggests changes that will permit critical subcontracting processes to be integrated into a project's main alliance. To achieve this objective the research follows a comparative study approach. Information obtained from relevant literature is used to identify current subcontractor management practices and best practices for subcontractor integration in alliances. [39]

Marzouk et al. (2013) questionnaire survey conducted that distributed to experts in the construction domain to determine the importance of factors that are taken into consideration by the main contractor to select the most suitable sub-contractor. A survey conducted that 29 experts in the construction field to determine the score of each factor. Statistical analysis was carried out on the feedback of the respondents of the survey. By using SPSS software, the frequency of the results of the questionnaire was determined. Examples of crosstabs between some of the most important factors are presented to provide a comparison between two factors. The mean score of each factor was determined and the p-value was calculated using the SPSS software, the significance of each factor used in the questionnaire is determined. [22]

Akanni et al. (2015) study concluded that one of the prevailing values that should influence the selection of subcontractors are the requirements of trust worthiness in the construction operation and the need for integrity in collaborating. This will encourage parties to adopt higher technical standards, and achieve improved ethical performance in all their dealings which in turn has the potential to produce an improvement in the ethical climate of the construction industry. [27]

Polat et al. (2015) studied that there are a great number of studies that focus on subcontractor selection practices in the construction industry. These studies can mainly be categorized into two groups, which are; 1) the studies aim to identify the subcontractor selection criteria and their importance levels, and 2) the studies aim to propose tools, techniques and/or methodologies for subcontractor selection. In this study, selection of subcontractors for the all work packages in a construction project

was made using genetic algorithm technique considering time, cost and quality performances. [10]

Subcontracting is a common practice in the commercial construction industry. On any particular project, general contractors may rely on 20 to 40 subcontractors to perform the specific work items that are required. A typical group of contractors that work together on a project may include such diverse trades as electrical, drywall, roofing and steel erection to name a few. The characteristics of the project dictate the type, size and capabilities of each subcontractor that may be required (Knutson, Schexnayder, Fiori & Mayo, 2003). Each project has a unique combination of job-specific subcontractors that are typically assembled under a general contractor acting as the head. The general contractor may also have his own labor force working alongside the various subcontractors throughout the project. There is a team approach to completing the work on most projects with the general contractor taking the lead to manage the jobsite and direct the personnel. Subcontractors are a vital component of the success of every construction project.

General contractors utilize subcontractors for various reasons such as: they lack expertise in these types of work, it enables them to limit their risk exposure or it expands their available workforce so they have more opportunities to improve new projects (Gould & Joyce, 2009). Approximately 80% of the dollar value of construction is accomplished under subcontracts therefore the subcontractor's perspective is important (Currie, Sweeney & Hafner, 1991). Generally, a subcontractor evaluates the performance of the general contractor on a project-by-project basis. A subcontractor can choose which general contractor to work with and this business decision can be affected by a number of factors. The perceived fairness and capability of the general contractor can be significant factors when considering future work with that general contractor (Knutson et al, 2003).

Subcontracting is a business strategy that is used by main contractors to deal with uncertainties in the construction market and to transfer risks, such as financial risks, completion risks and responsibility for employees. Subcontracting reduces direct costs and overheads, and allows main contractors to use more competitive local firms with their lower overhead costs and better knowledge of the local market conditions, practices and procedures. Subcontracting further facilitates the production of quality work through the use of specialist subcontractors with the necessary knowledge and skills in specialized trades. Overall, subcontracting allows the main contractor to reduce operating costs and thereby enhance competitiveness. Briefly stated, there are few models in the construction literature that addressed subcontractor's selection decisions.

Poor working relationships are not in the interest of either the main contractor or the

subcontractor's, and key factors influencing a main contractor's choice of subcontractors include the subcontractor's. From the Different literatures and papers, various factors affecting the process for selecting subcontractors in construction industry have been extracted.

For selection of subcontractors, 30 criteria were identified from the previous work as:

1. Price of previous completed project
2. Past performance
3. Health and safety records
4. Financial capabilities
5. Current work load
6. Reputation
7. Past relationship
8. Resources (both physical and human)
9. Technical / Managerial capability
10. Number of years the firm has been working in market
11. References
12. Location of firm
13. Experience firm has of similar project
14. Appropriate insurance cover
15. Lowest bid price
16. Completion of job within time
17. Quality of production
18. Standard of workmanship
19. Technical know-how
20. Cooperation
21. Financial strength to sustain the required cash flow
22. Adequacy of experienced site supervisory staff
23. Timely payment to labour
24. Adherence to programme
25. Number of relevant project completed on time
26. Sufficient of craft men and labour
27. Provision of safety information
28. Instruction and Training
29. Updating programme as works progress
30. Sufficiency of plant

#### IV. METHODOLOGY FOR RANKING OF FACTORS FOR SELECTION OF SUBCONTRACTORS

There is need to carry out ranking of 30 factors. There are many techniques to carry out raking. Such techniques are as below:

1. Relative Importance Index (RII) Method
2. Important Index (IMP.I.) Method
3. Relative Importance Ratio (RIR) Method

From above methods most appropriate method for ranking factors is Relative Important Index Method.

**The Relative Importance Index (RII)** can be used to rank (R) the different factors. These rankings make it possible to cross-compare the relative importance of the factors as perceived by the four groups of respondents (i.e. clients, consultants and contractors, subcontractors). Each individual factor's RII perceived by all respondents can be used to assess the general and overall rankings in order to

give an overall picture of the factors for selection of subcontractors by contractors in Indian construction industry. This RII technique were used by many researchers like Geraldine john kikwasi (2012), Aftab Hameed Memon et al. (2014) to rank the causes of delay in construction projects. The formula to calculate RII is given below:

$$RII = \frac{\sum W/A * N}{N}$$

Where,

W = Weighting given to each factor by the respondents (ranging from 1 to 5),

A = Highest weight (i.e. 5 in this case),

N = Total Number of respondents.

#### SAMPLE SIZE CALCULATION:

To obtain statistically representative sample size of the population, following equation used:

$$n = \frac{m}{1 + \left[ \frac{m-1}{N} \right]}$$

Where, n, m and N represents the sample size of limited, unlimited and available population respectively. Here, m is calculated by following equation.

$$m = \frac{z^2 * p * (1-p)}{e^2}$$

Where,

z = the statistic value for the confidence level used, i.e. 1.96 and 1.645 for 95% and 90% confidence level respectively;

p = the value of the population that estimated and e = the sampling error to estimated. Because the value of p is unknown. Sinich et al. (2002) suggest the value 0.5 to be used in sample size.

According to the targeted City and Stakeholders, the total no. of available population comprises of construction firms which belongs to Gujarat Contractors Association & lists of registered construction firms of various government departments in construction for targeted cities.

To apply this RII method for survey Questionnaires is given below: APPENDIX A

#### V. CONCLUSION

Subcontractors play a vital role in the construction industry. Subcontractors are specialty contractors who are hired to perform specific tasks on a project. Selection of the best sub-contractor is a vital process in construction industry. This paper study is very important to identify criteria which affect the selection process of subcontractors in construction industry. Total 30 contributing factors are identified. Relative Important Index(RII) is suggested to carryout ranking of above factors.

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**APPENDIX: A**

**QUESTIONNAIREPART- I  
DETAILS OF RESPONDENT'S**

NAME

COMAPANY

EMAIL

WEB

TELEPHONE

FAX

ADDRESS

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EXPERIENCE IN RELEVANT FIELD

- a) 10-15 YEARS       b) 15-20 YEARS   
 c) 20-25 YEARS       d) > 25 YEARS

AGE

- a) < 30 YEARS       b) 40-50 YEARS   
 c) 30-40 YEARS       d) > 50 YEARS

PROFESSION

- a) SUB CONTRACTOR       b) CLIENT/DEVELOPERS   
 c) ARCHITECT       d) CONTRACTOR

<b>QUESTINNAIRE PART- II</b>	
<b>MAIN QUESTIONNAIRE FOR SURVEY ON RANKING OF FACTORS AFFECTING SELECTION OF SUBCONTRACTOR FOR CONSTRUCTION CONTRACTORS OF GUJARAT</b>	
<p>The factors influencing skills of factors affecting Selection of subcontractors with references to success of construction project are divided into different skills. Please tick in the appropriate field and show your perceptions about the impact of these factors affecting selection of subcontractor for construction contractors with references to success of construction project. Give your response as the importance of these individual factor on Selection process for subcontractors with reference to success of construction project as follows:</p> <p>1. Very less important                      2- Less important                      3- Neutral (Important)                      4- More important                      5- extremely important</p>	

SR NO	FACTORS	IMPORTANCES IN PROCESS OF SELECTION FOR SUBCONTRACTORS WITH REFERECES TO SUCCESS OF PROJECT				
		1	2	3	4	5
1.	Price of previous completed projects					
2.	Past performance					
3.	Health and safety records					
4.	Financial capabilities					
5.	Current work load					
6.	Reputation					

7.	Past relationship						
8.	Resources (both physical and human)						
9.	Technical / Managerial capability						
10.	Number of years the firm has been working in market						
11.	References						
12.	Location of firm						
13.	Experience firm has of similar project						
14.	Appropriate insurance cover						
15.	Lowest bid price						
16.	Completion of job within time						
17.	Quality of production						
18.	Standard of workmanship						
19.	Technical know-how						
20.	Cooperation						
21.	Financial strength to sustain the required cash flow						
22.	Adequacy of experienced site supervisory staff						
23.	Timely payment to labour						
24.	Adherence to programme						
25.	Number of relevant project completed on time						
26.	Sufficient of craft men and labour						

27.	Provision of safety information						
28.	Instruction and Training						
29.	Updating programme as works progress						
30.	Sufficiency of plant						