# Multi-criteria Bid/no Bid Decision Support Framework for General Contractors: A Case of Pakistan

By

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A Thesis submitted in partial fulfillment of

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*This thesis is dedicated*

*To my beloved parents for all their affection, support and*

*putting me through the best education possible, I appreciate their sacrifices and*

*I wouldn't have been able to get to this stage without them and*

*To my siblings for always being an unending source of love, inspiration and encouragement*

*and*

*To my supervisor and To the people who propped me up when I wanted to give up!*

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# *ABSTRACT*

In construction industry, adequate and effective decision-making can mean the difference between success and failure. Bidding is the most important element of construction business since it is a mean by which contractors obtain work. This is probably the only option for any contractor firm to sustain in the market and achieve its objective of earning the profits by winning tenders. The capability to select most appropriate ventures not only defines the success and wellbeing of a contractor firm, but even its survival and sustainability in the industry. The construction practitioners are usually on their own when it comes to deciding for bidding for a project or not. Usually, experience based solutions are offered where a lot of subjectivity is involved. This research has been opted considering the local construction industry of Pakistan in order to examine the critical success factors from contractors' perspective while making bidding decisions, listing and evaluating critical factors in order of their importance, grouping shortlisted factors into decision support & decision oppose groups and to develop a framework to help contractors in decision-making process. It is found that profitability, need for work and financial health of client are the most decisive factors in bid/no bid decision-making. Further, to verify the developed framework, case studies have been conducted to evaluate the bid/no bid decision-making in building procurement. This study recommends using a holistic decision-making framework for such business-critical delibrations.

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| | |
|---|---|
| **GDP** | Gross Domestic Product |
| **CI** | Construction Industry |
| **AHP** | Analytical Hierarchy Process |
| **ANP** | Analytical Network Process |
| **KBES** | Knowledge Based Expert System |
| **ANN** | Artificial Neural Network Technique |
| **FMCDMA** | Fuzzy Multi-Criteria Decision-Making Analysis |
| **DEA** | Data Envelopment Analysis |
| **FPR** | Fuzzy Preference Relations |
| **MCPM** | Multi-Criteria Prospect Model |
| **MCDM** | Multi-Criteria Decision-Making |
| **CR** | Consistency Ratio |
| **DS** | Decision Support |
| **DO** | Decision Oppose |
| **SCBMD** | Strategically Correct Bid/No Bid and Markup Decision |

*Chapter 1*

# INTRODUCTION

## 1.1 Overview

Construction sector plays an important role in any economy (Mohammed Wanous et al., 2003) because it retains comparatively a huge percentage of national workforces (Enshassi et al., 2010). In developing countries, it plays a key role in the growth and monetary development (Low et al., 2015). It is a confounded industry that faces ever-changing conditions and the individuals who are not prepared or capable of meeting these demands, may ultimately fail.

In construction industry, adequate and effective decision-making can mean the difference between success and failure (Jato-Espino et al., 2014). Bidding is the most important element of the construction industry since it is a mean by which contractors obtain work (Oyeyipo et al., 2016). This is probably the only option for any contractor firm to sustain in market and achieve its objective of earning the profits by winning tenders (Egemen and Mohamed, 2007). In construction projects, to bid or not to bid is one of the highly critical decisions that is regularly exercised by construction contractors (Egemen and Mohamed, 2007; El-Mashaleh et al., 2014; Oyeyipo et al., 2016).

The capability to select most appropriate ventures not only define the contractor's firm wellbeing and success (Chen et al., 2015), but even its survival and sustainability in the industry (Ahmad and Minkarah, 1988; Leśniak, 2015). Hurried and irrational involvement in aimless bids for the projects which are incompatible with firms core competencies may result in loss of precious time, money and other resources, which otherwise could be directed in a more lucrative enterprise (Jarkas et al., 2013; Ravanshadnia and Rajaie, 2013; Tan et al., 2010). While not bidding for highly suitable project could lead towards losing a possibility to earn substantial profits, amplify organization's strength and position in the market, and establish a profitable relationship with an employer, that can open the new roads of opportunities for the contractor to endeavor (Ahmad and Minkarah, 1988).

It is generally believed that the development of an appropriate bidding strategy is crucial factor in deciding the fate of contracting firms (Lin and Chen, 2004). On the other hand,

Inefficiencies in the construction sector are mainly caused by wrong bidding techniques and strategies, which means improved and modified bidding strategies are likely to create a positive impact on industry's performance, refine the decision-making process and help to attain the strategic targets of the contracting firm (Oyeyipo et al., 2016).

Bidding procedure involves contractors, who makes strategic decisions regarding the managerial, human, physical and financial resources of the organization before undertaking any project (Odusote and Fellows, 1992; Oyeyipo et al., 2016). The bidding decision includes to bid/no bid (Lin and Chen, 2004; Mohammed Wanous et al., 2003) and the price at which to bid (Awwad, 2015; Cheng et al., 2011; B. L. Oo et al., 2012).

The contracting firm's decision about bid/ no-bid is generally related to unpredictability or may be affected by plethora of factors (Enshassi et al., 2010). Lifson and Shaifer (1982) cited in Oyeyipo et al. (2016) argued that comprehending paramount factors having strong impact on decision-making process would enable crucial decisions to be reconsidered and scrutinized regularly. The high level of unpredictability and complexity related with decision-making process involves different multitudes and manifestations of several internal as well as external crucial variables made a compulsion to further investigate crucial factors and provide strength to contractor's bid/ no bid decision (Jarkas et al., 2013). In construction projects, the bidding phenomena is a highly complicated decision-making process which needs to be considered from a multi-criteria maximization perspective while considering the prevailing market situation, level of competitiveness, complete and updated information about rivals, and financial limitations of company (Awwad, 2015).

Pakistan's construction industry is a multilayered industry comprising of challenging and highly competitive environment (Arif et al., 2012). Bidding forms the foundation of construction market where contractors need to make various synchronous and interlinked decisions promptly despite the financial, political and legal risks involved and the limited information available. In Pakistan, construction projects are mostly awarded to contractors via competitive bidding and low-cost bidding approach is used for their evaluation. Once a contracting firm chooses to participate in a certain project, it has to face a sequential challenging decision of setting the right markup to apply to its estimated costs to set some profit margin. Contractors need to do this vigilantly in order to come up with a final bid price

that should not be high enough to lose the project and should not be low enough to result into losses under a low-cost bidding approach (Awwad, 2015).

## 1.2 Problem Statement

The construction practitioners are usually on their own when it comes to deciding for bidding for a project or not. Usually, experience based solutions are offered by professionals where a lot of subjectivity is involved. This research has been opted considering the local construction industry of Pakistan in order to examine the factors from contractors' perspective while making bidding decisions, listing and evaluating critical factors in order of their importance and to develop a framework to help contractors in decision-making process.

## 1.3 Research Objectives

- To identify the critical factors influencing a contractor's bid/no bid decision;
- To evaluate the importance of identified factors for highlighting the critical ones;
- To categorize the significant factors into decision-support or decision-oppose groups;
- To develop a framework for bid/no bid decision-making.

## 1.4 Significance and Scope of Study

This study will help in better understanding of factors which influence bid/no bid decisions. It will assist industry practitioners in making right decisions and will be helpful to contracting firms in sparing them from monetary misfortune and protecting their image in the market.

## 1.5 Relevance to National Needs

According to the Pakistan bureau of statistics, the contribution of the construction industry to the GDP of Pakistan increased from 2.34% in 2013 to 2.58% in 2016. Construction sector is considered to be a basic industry on which the development of the country depends to a larger extent (Lama, 2000).

One of the key activities of any construction company is to select best projects which help them in raising their business. Without a suitable and precise method for selecting the project to bid or not to bid, the future of the construction company will likely be affected. This study would help the industry practitioners to understand the factors which they must consider while making bid/no bid decision for a project.

## 1.6 Thesis Outline

The thesis has been structured in to five chapters. “Introduction” is Chapter 1 which includes an overview to research topic, problem statement, research objectives, significance and scope of the study and relevance of research to national needs. “Literature Review” is Chapter 2 which explains the research already carried out by researchers in same research domain which gives necessary information, required for further research in bid/no bid decision making. Chapter 3 is “Research Methodology” which explains the methodology followed for conducting this research. Chapter 4 is “Data Analysis and Results” which shows the results of data collected in different phases along with its analysis techniques. While chapter 5 is “Conclusions & Recommendations”, it exhibits the conclusion of the research and recommendations provided for future research.

*Chapter 2*

# LITERATURE REVIEW

## 2.1 Introduction to Bid/No Bid Decision

Over the period, bid/no bid decision-making had allured the attention of various researchers and many bidding strategies had been outlined to guide the contractors in constituting bidding decisions. In the construction industry, to stay competitive and achieve its objective, every contractor firm has to gain new tenders and to earn substantial profits out of it (Banki et al., 2009). Contracts are commonly allotted to contractors through a bidding process (Egemen and Mohamed, 2007; Fawale and Dada, 2017). However, this is not the standard practice, but in some uncommon cases the contractors take up the projects and earn revenue without winning a tender (Egemen and Mohamed, 2007).

Bidding is a widely accepted technique for accomplishing dissemination of work to competent contractors whereby contractors are supposed to make strategic decisions (Fawale and Dada, 2017). It is a fairly complex decision involving contemporaneous analysis of a huge number of extremely interrelated factors to reach at a correct decision (Chua et al., 2001).

It is commonly acknowledged that contractors tend to form bidding decision based on instinct feelings that comes from their previous exposure and guess work (Fayek, 1999; Egemen, 2007; Ahmad, 1990; Chua, 2001; Ahmad and Minkarah 1988; Cheng, 2011; Chen, 2015). According to Bageis and Fortune (2009), shrewd contractors understand the significance of conducting preliminary investigation and accessing the feasibility of project before engaging themselves in new construction projects.

At the initial phase of bidding, decision-makers are assumed to make two paramount decisions, i.e., firstly, to bid/no bid decision, which consider key factors that would facilitate contractors to ascertain the appropriate bidding strategy and secondly a mark-up decision, which is considered as one of the outcome of the bidding strategy. This study focuses only on the prior decision.

## 2.2 Bidding in Construction Industry

Competitive bidding is not just confined to construction industry, but it is extensively applied to many other sectors. Bidding procedure falls into one of the two types, open bidding or sealed bidding, or any other form between these two limits, as shown in Figure 2-1 (Harris and McCaffer, 2013).


**Figure 2-1 Different forms of bidding**

Open bidding, commonly applied in the commercial sector, involves an iterative negotiation process, in which all the participants individually negotiate a contract price with the client. Discussions are allowed among all the competing contractors, and they reserve a right to reconsider their bid price until or unless any final decision about bid selection has not been made by the client. Sealed bids commonly prevail in the civil engineering field and construction industry. Sealed bids are somehow different from an open bid in this just one bid per contractor is allowed, consultation between the competing parties and also the revision of bid are barred. Even any discussion pertaining to the bidding project is not permitted. Each party submits a bid (normally in an enclosed envelope) by a certain date and once submitted cannot be reassessed (Banki et al., 2009). In the public sector, sealed bidding process is usually used to award the contract to the lowest responsive bidder.

## 2.3 Bidding Strategies

Bidding strategies include the whole process of shortlisting and picking the highly profitable project to pursue from all possibly available projects keeping in view the resource constraints and competition (Eldukair, 1990). Bidding strategies are highly sensitive in defining the success of any project, especially during the initial stages of the project. It is a managerial skill that keeps in consideration all the possible aspects, whether internal or external to provide a complete and highly competitive bidding with an objective of winning the bid in relation to other competitors and give highest possible returns. In addition, bidding strategy is any company's final game plan is to decide their bid price when striving for any project and

minimum revenue they need to earn out of it while keeping it sure that they will win the project and complete it without (creating any financial insecurity) any financial constrain to the business at that given price. The construction industry is highly competitive and bidding strategy is the best tool to take a lot of decisions which may include the decision to bid or not to bid, minimum profit to be earned from any specific job (Lin and Chen, 2004; Mohammed Wanous et al., 2003), (Awwad, 2015; Cheng et al., 2011; B. L. Oo et al., 2012).

If the company decided to bid, then their bidding strategy would be to bid at a price which ensure profit as well as don't risk losing the job (Chua and Li, 2000). Various research works have been carried out on bidding strategies in the construction industry. Friedman (1956) asserted different viable objectives and strategies to attain those objectives that a bidder might be striving for. It includes; maximizing total expected profit, securing a specific amount of investment, minimizing anticipated losses, minimizing the estimated gains of competitors, continuing the production.

Cooke and Williams (2015) underscore few advantages of bidding strategy in which they discussed the probability of winning a project by bidding, keeping in mind a specific markup, recognizing a specific markup to get the highest possible gain from a project, keeping in consideration the existing market competition, choosing among the different jobs, the project that has potential to yield highest returns and; taking decision on whether any particular job has enough potential to provide a rationale for submitting any bid or not.

## 2.4 Types of Contractor's Bidding Strategies

Many bidding strategies had been developed and identified in literature, such as selective bidding strategies, random bidding strategies (Fu and Drew, 1999), an unbalanced bidding strategy may be taken in as a bidder-based lump sum bidding practice, in which the submitted unit prices are taken as the contractual unit prices (Wong et al., 2001). The risk control strategy had also been considered as one of the most important bidding strategy, specially for global projects which includes a lot of unpredictability and complications (Han et al., 2005).

A study was conducted by Tan et al., 2008, in Hong Kong on an identification of the factors affecting contractor's competition strategy, five types of competition strategies particular to the area of study were identified as a result. They include low bid strategy, joint venture (JV), public relations (PR), risk control and claim strategy. Three other bidding strategies were also

identified as outcome of the study conducted by Emily (2013) on construction bidding-strategies, which were quantity bidding strategy, selective bidding strategy and negotiated work strategy. Together, these strategies are graphically given in Figure 2-2.

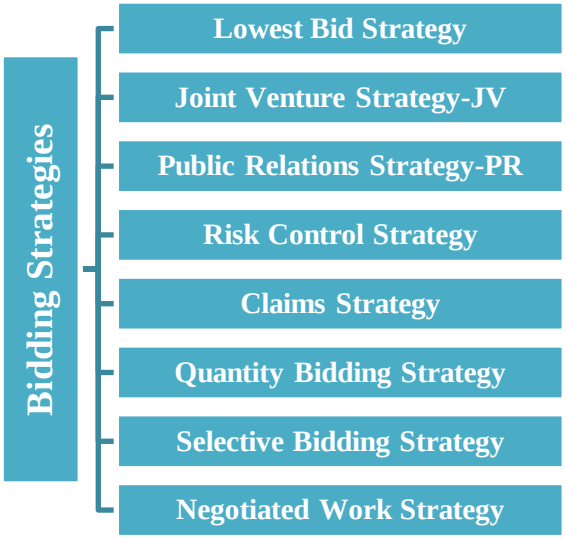



**Figure 2-2 Types of bidding strategies**

### 2.4.1. Lowest bid strategy

According to this strategy, the contract will be awarded to a bidder who proffer lowest bidding price in comparison with other competitors (Tan et al., 2010). However, under this strategy the contractor's motivational level to perform more than the minimal demand is very low as selection of this strategy is in forfeit of the contractor's profit margin, thus leading to poor construction performance.

### 2.4.2. Joint venture strategy

Under this strategy, two or more contracting firms form a joint organization by merging their resources and expertise to achieve a particular goal. The risks and profits of the entities are also shared under this strategy. Due to the increasing complexity of the projects and risky environment of construction sector, there is an increase in demand for contractors having multiple strengths and weaknesses to form joint ventures, to collectively bid for projects (Kumaraswamy et al., 2000). Especially in developing countries, it has become one of the famous strategy for international contractors forming joint ventures with local partners when entering into new business markets (Lim and Liu, 2001).

### 2.4.3. Public relations (PR) strategy

Public relations, commonly used technique to build a bond and organize the flow of information between a firm and all its stakeholders in the construction industry. A strategy that helps an organization in an effective two way flow of information and create a positive image of contractors among the public, client and related consultants (Tan et al., 2008). This communication can be in different forms, such as participating in conferences, achieving recognition in the industry, maintaining the long-term positive relations with clients. This strategy will create a positive image of contractor and increase the probability of winning over competitors due to high goodwill in the industry.

### 2.4.4. Risk control strategy

Risk control is a strategy used to estimate and to mitigate the risk associated with a project. Contractors can depict that they possess complete competence to mitigate and control the risk if they use an appropriate strategy. Therefore, they can grab the best financial deals from clients. According to the PMBOK 5th edition, risk management or risk control strategy comprises of an effort to evade the risk, minimizing the consequences of risk, diverting the risk to other involved parties, or bear the consequences of specific risk. Bid decision-making involves a lot of vulnerabilities and complexities so mitigating risk had always been an important technique to contractors (Han et al., 2005).


**Figure 2-3 Risk matrix**

### 2.4.5. Claims strategy

This kind of strategy will be used when a firm is working on a project and expecting to deal with different uncertainties or there is a probability of change in projects design which in future may result into claims. Different aspects of the project play its role in the selection of this strategy. i.e., project size and level of uncertainty in design. This is an inappropriate

strategy for Small project but with a well-defined and comprehensive design, and highly appropriate strategy for a large and highly complexed project but with a less defined and uncertain design (Tan et al., 2008).

### 2.4.6. Quantity bidding strategy

This is a most commonly used strategy in which contractors bid for all possibly available projects with the belief that submitting a higher volume of bids will increase the probability of winning a certain percentage out of them. This laborious strategy doesn't even ensure high profit margins. This is a best technique for the organizations, which are new in the construction industry and are facing trouble in getting new work. It might be a best strategy for a company grappling to enter in new projects for earning revenues, or those that have a huge number of personnel who are not busy with current projects (Emily, 2013).

### 2.4.7. Selective bidding strategy

Selective bidding strategy is a more effectual strategy to vigilantly estimate bidding opportunities based on quality, and to select the best opportunity out of all available bidding opportunities. This strategy permits estimators to reconsider each bid and to revise their bid price, which ultimately leads to a more successful bid, with high probabilities of getting the job. To adopt this strategy contractors consider their core competencies and choose the work they are best at (Fawale and Dada, 2017).

### 2.4.8. Negotiated work strategy

It is also known as open bidding and it involves a frequentative negotiation process between all competing contractors and the client. Under this strategy, connections and links of the bidders with some powerful people matters a lot as there is no legal bidding to award the work to the lowest responsive bidder. Negotiated work usually results less communication problems and high profit margins (Fawale and Dada, 2017).

## 2.5 Synthesis of Previous Research in Bid/No Bid Decision

Contracting firms need to be selective in choosing projects for tendering from frequently varing assemblage of potential projects, due primarily to the availability of sufficient resources (Smith, 1995). Numerous researches had been carried out in different geographical regions of the world to highlight the critical factors that contributes in bidding decision

making. Odusote and Fellows (1992) investigated 42 factors which building contractors must consider while project selection. According to this research, the most critical factor was ability of client to pay for the cost of work. Further, Shash (1993) identified 55 factors and after rigorous analysis, 3 most critical factors were highlighted; need for work, the number of competitors and the previous experience of competing firms on similar projects.

Hassanein (1996) after conducting a detailed investigation on 26 factors influencing bidding decision claimed financing source and nationality of expected competitors to be the most important factors. Another research conducted by Fayek et al. (1999) concluded that the bid/no bid decision-making process is mainly subjective and it relies on the expert perceptions. M Wanous et al. (1998) conducted a research in Syrian construction industry and uncovered 38 critical parameters. The author claimed to-tender conditions, financial capacity and reputation of client in industry as the top most factors.

Lowe and Parvar (2004) grouped 21 identified factors into six (6) categories such as responsiveness to opportunities, project relationships, strategic competitive advantage, project procedures, financial relationships and project risks. After profound analysis of these 21 factors, the authors highlighted 8 factors as the top most factors which are project's non-monetary contribution, competitive analysis of the tender environment, size of project, lowest cost, resources to tender for the project, alternative design's feasibility to reduce cost, exterior resources and bidding procedures.

Cooke and Williams (2004) discussed few critical factors that have potential to affect the contractor's choice to bid which includes; present workload, enough working capital, resources availability, project's location and type and scope of the project.

According to Bageis and Fortune (2009), bid/no bid decision-making requires an understanding of the company's evaluation in relation to factors affecting the decision. 97 factors were identified from literature although analysis was conducted on 87 factors only, most dominant attributes that influenced their analysis of the weight of importance was contractor's size, contractor's classification status and mainly type of client.

Jarkas et al. (2013) highlighted 10 critical most decision-making factors out of 43 identified factors which are contractor's previous experience with client, need for work, present work in

hand, past experience in similar projects, size of project, client's identity and reputation in the industry, financial stability of the employer, other project's availability, promptness of the employer in the payment process and tender documents quality level.

El-Mashaleh (2012) identified 53 crucial factors and on the basis of this work El-Mashaleh et al. (2014) discussed top ranked bid/no bid factors in comparision with international research. El-Mashaleh et al. (2014) applied different statistical techniques on findings of El-Mashaleh (2012)'s work to investigate the reliability of El-Mashaleh (2012)'s work and degree of consensus among the respondents of El-Mashaleh (2012) work. In the end, variance among the importance weights of the identified factors was calculated using ANOVA. Out of 53 factors, significant differences were indicated among importance weights of 6 identified factors and those 6 factors were; 1) advance payments' clause existence in a contract, 2) project's cash flow requirements, 3) owner's reputation for making timely payments, 4) consultant's identity, 5) consultant's work in-hand, and 6) consultant's reputation.

Oyeyipo et al. (2016) underscored 3 most important factors out of 48 identified factors as client's financial capability, capital availability and material availability; this research also revealed that the competitor's identity and number does not have any remarkable effect on contractors bidding decisions.

Leśniak (2015) highlighted 15 critical most factors and used them as input parameter while modeling bid/no bid decision-making using artificial neural networks technique. Further in 2017, Lesinak attempted to reduce these 15 identified set of bidding factors from 15 to 6 using principal component analysis and these are type of works, previous experience with similar nature of projects, contract's conditions, client's reputation, project value and need of woks.

Banki et al. (2009) in a research tried to estimate proper bidding cost, claimed that number of bidders is inversely proportional to the project bid prices and investigated the aberration among low bid and pre-bid estimates compared to the number of bidders. According to Oberlender and Trost (2001), the accuracy of the estimates is generally influenced by 3 major components: 1) who prepared the estimate, 2) how it was prepared and 3) the level of information known at the time of the estimate.

Another research conducted by Egemen and Mohamed (2007) claimed need for work, profitability, firm's strength and financial situation of client as the top most important factors. While Enshassi et al. (2010) declares contractor's financial capability, client's financial capability, project's financial values, due dates of the payments, material's availability and construction industry's stability as the most influential factors.

## 2.6 Factors Affecting Bid/No Bid Decision-making

After systematic literature review and rummage through 19 related research papers, total 114 factors have been identified influencing the bid/no bid decision-making. The literature based frequency analysis was performed. The literature score for each factor was calculated using Equation 2-1 where LS represents literature score, f represents frequency of each factor, n represents the number of research papers (19), q represents qualitative score (High = 5, Medium = 3, Low = 1) and z is the maximum qualitative score (5).

$$LS = (f / n) \times (q / z) \qquad \text{Equation 2-1}$$

Identified factors along with its literature score, normalized score & cumulative normalized score are mentioned in Table 2-1. Brief introduction of all these factors is given in annexure "A" where all these factors are ranked according to their number of occurrence in concerned papers.

In spite of the fact that previous researches were done in various geographical regions of the world but the critical factors remained almost the same. Although, there is a group of factors in each country which is particular to a specific local market. These observations recommend that the factors having impact on bidding decisions at significant level depends majorly on the market and the environment in which an organization works.

**Table 2-1 Content analysis of factors affecting bid/no bid decision making**

| Rank | Merged Factors Name / Final Factor Names | Literature Score | Normalized Score | Cumulative Normalized Score |
|---|---|---|---|---|
| 1 | Relationship, Identity & Reputation of client | 0.736842105 | 0.07829978 | 0.078299776 |
| 2 | Financial health of client | 0.578947368 | 0.06152125 | 0.139821029 |
| 3 | Project size (Quantum of work, e.g., cubic measure) | 0.526315789 | 0.05592841 | 0.195749441 |
| 4 | Project type | 0.421052632 | 0.04474273 | 0.24049217 |
| 5 | Work in hand | 0.410526316 | 0.04362416 | 0.284116331 |
| 6 | Previous experience in similar projects | 0.378947368 | 0.04026846 | 0.324384787 |
| 7 | Need for work | 0.368421053 | 0.03914989 | 0.363534676 |
| 8 | Profitability | 0.252631579 | 0.02684564 | 0.390380313 |
| 9 | Project monetary size | 0.210526316 | 0.02237136 | 0.412751678 |
| 10 | Contract conditions / details | 0.210526316 | 0.02237136 | 0.435123043 |
| 11 | Project expected risk | 0.210526316 | 0.02237136 | 0.457494407 |
| 12 | Availability of work capital required to start the job | 0.210526316 | 0.02237136 | 0.479865772 |
| 13 | Fulfilling the tender conditions imposed by the client | 0.210526316 | 0.02237136 | 0.502237136 |
| 14 | Availability of potential work | 0.189473684 | 0.02013423 | 0.522371365 |
| 15 | Resource availability - Availability of materials required for the project | 0.157894737 | 0.01677852 | 0.539149888 |
| 16 | Degree of constructability - degree of hazard/difficulty | 0.157894737 | 0.01677852 | 0.555928412 |
| 17 | Prestige of the project /Value of the project | 0.157894737 | 0.01677852 | 0.572706935 |
| 18 | Chances of obtaining the job, / likelihood of winning the project | 0.157894737 | 0.01677852 | 0.589485459 |
| 19 | Location of the project | 0.126315789 | 0.01342282 | 0.602908277 |
| 20 | Type of contract | 0.105263158 | 0.01118568 | 0.61409396 |
| 21 | Knowledge of site - Familiarity with site condition | 0.105263158 | 0.01118568 | 0.625279642 |

| | | | | |
|---|---|---|---|---|
| 22 | General (office) overhead | 0.105263158 | 0.01118568 | 0.636465324 |
| 23 | Similar previous experience - Previous experience with the client | 0.105263158 | 0.01118568 | 0.647651007 |
| 24 | Anticipated rate of return | 0.105263158 | 0.01118568 | 0.658836689 |
| 25 | Competitive advantage - lowest cost | 0.105263158 | 0.01118568 | 0.670022371 |
| 26 | Prequalification requirement | 0.105263158 | 0.01118568 | 0.681208054 |
| 27 | Resource availability - Resources to tender for the project | 0.094736842 | 0.01006711 | 0.691275168 |
| 28 | Site clearance of obstructions | 0.094736842 | 0.01006711 | 0.701342282 |
| 29 | Project cash flow / Cash flow requirements of the project | 0.094736842 | 0.01006711 | 0.711409396 |
| 30 | Project duration | 0.073684211 | 0.00782998 | 0.719239374 |
| 31 | Time to prepare bid | 0.073684211 | 0.00782998 | 0.727069351 |
| 32 | Number & type of competitors tendering / expected competitors | 0.073684211 | 0.00782998 | 0.734899329 |
| 33 | Resource availability - local expertise - Labor availability | 0.063157895 | 0.00671141 | 0.741610738 |
| 34 | Quality of documentation / specification – (Completeness of the bid document) | 0.063157895 | 0.00671141 | 0.748322148 |
| 35 | Public objection | 0.063157895 | 0.00671141 | 0.755033557 |
| 36 | Criteria of bid selection | 0.063157895 | 0.00671141 | 0.761744966 |
| 37 | Soft gains from the projects | 0.063157895 | 0.00671141 | 0.768456376 |
| 38 | Uncertainty in cost estimate | 0.063157895 | 0.00671141 | 0.775167785 |
| 39 | Alternative design | 0.063157895 | 0.00671141 | 0.781879195 |
| 40 | Resource availability - Availability of required equipment | 0.052631579 | 0.00559284 | 0.787472036 |
| 41 | Terms of payment (monthly, quarterly, etc.) | 0.052631579 | 0.00559284 | 0.793064877 |
| 42 | Financing source | 0.052631579 | 0.00559284 | 0.798657718 |
| 43 | Project matching company’s strategy and future vision | 0.052631579 | 0.00559284 | 0.804250559 |
| 44 | Non-monetary contribution of the project (strategic and marketing) | 0.052631579 | 0.00559284 | 0.8098434 |
| 45 | Degree of constructability - Technological difficulty of project beyond the capability of the firm | 0.052631579 | 0.00559284 | 0.815436242 |

| | | | | |
|---|---|---|---|---|
| 46 | Owner's requirement / The client requirements | 0.052631579 | 0.00559284 | 0.821029083 |
| 47 | Expertise in management and coordination | 0.052631579 | 0.00559284 | 0.826621924 |
| 48 | Need for continuity in employment of key personnel and workforce | 0.052631579 | 0.00559284 | 0.832214765 |
| 49 | Local partner | 0.052631579 | 0.00559284 | 0.837807606 |
| 50 | Local competitor (not competing against a local competitor) | 0.052631579 | 0.00559284 | 0.843400447 |
| 51 | Ability of doing the project | 0.052631579 | 0.00559284 | 0.848993289 |
| 52 | Contract Size / Size of contract in SR | 0.052631579 | 0.00559284 | 0.85458613 |
| 53 | Competency – project size | 0.052631579 | 0.00559284 | 0.860178971 |
| 54 | Competitive analysis of the tender environment | 0.052631579 | 0.00559284 | 0.865771812 |
| 55 | Owner's requirement | 0.052631579 | 0.00559284 | 0.871364653 |
| 56 | Payment history of client | 0.031578947 | 0.0033557 | 0.874720358 |
| 57 | Quality of documentation - Rigidity of specifications & Onerous contract condition | 0.031578947 | 0.0033557 | 0.878076063 |
| 58 | Contractor’s financial situation | 0.031578947 | 0.0033557 | 0.881431767 |
| 59 | Site accessibility | 0.031578947 | 0.0033557 | 0.884787472 |
| 60 | Use of nominated subcontractor - Possible subcontractors | 0.031578947 | 0.0033557 | 0.888143177 |
| 61 | Methods of construction (manually, mechanically) | 0.031578947 | 0.0033557 | 0.891498881 |
| 62 | Past experience with the management consultant | 0.031578947 | 0.0033557 | 0.894854586 |
| 63 | Resource availability - Expertise (having the required technical expertise) | 0.031578947 | 0.0033557 | 0.898210291 |
| 64 | Promote the reputation of the firm | 0.031578947 | 0.0033557 | 0.901565996 |
| 65 | Contractor’s own strategic objective | 0.031578947 | 0.0033557 | 0.9049217 |
| 66 | Project’s possible contribution to increase the contractor firm’s classification | 0.031578947 | 0.0033557 | 0.908277405 |
| 67 | Degree of constructability - Degree of difficulty | 0.031578947 | 0.0033557 | 0.91163311 |
| 68 | Quality of documentation/specification - Consultants’ interpretation of the specification | 0.031578947 | 0.0033557 | 0.914988814 |
| 69 | Market knowledge - familiarity with market | 0.031578947 | 0.0033557 | 0.918344519 |

| | | | | |
|---|---|---|---|---|
| 70 | Contractor’s financial situation - Financial status of the company (working cash requirement of project) | 0.031578947 | 0.0033557 | 0.921700224 |
| 71 | Client reliability | 0.031578947 | 0.0033557 | 0.925055928 |
| 72 | Provide client satisfaction | 0.031578947 | 0.0033557 | 0.928411633 |
| 73 | Original price estimated by the client | 0.031578947 | 0.0033557 | 0.931767338 |
| 74 | Relations with other contractors and suppliers | 0.031578947 | 0.0033557 | 0.935123043 |
| 75 | Consortium relationship (Consortium: Did the company work with the other members of the consortium before? (in this country or elsewhere) | 0.031578947 | 0.0033557 | 0.938478747 |
| 76 | Administrative interference | 0.031578947 | 0.0033557 | 0.941834452 |
| 77 | Bond requirement | 0.031578947 | 0.0033557 | 0.945190157 |
| 78 | Amount of work the client carries out regularly | 0.031578947 | 0.0033557 | 0.948545861 |
| 79 | Desire for the project | 0.031578947 | 0.0033557 | 0.951901566 |
| 80 | Size of client | 0.031578947 | 0.0033557 | 0.955257271 |
| 81 | The project supervision procedure | 0.031578947 | 0.0033557 | 0.958612975 |
| 82 | Tendering method (selective, open) / tendering procedures | 0.021052632 | 0.00223714 | 0.960850112 |
| 83 | Degree of constructability - Degree of complexity of works | 0.021052632 | 0.00223714 | 0.963087248 |
| 84 | Resource availability - Availability of qualified staff | 0.021052632 | 0.00223714 | 0.965324385 |
| 85 | Bidding document price | 0.021052632 | 0.00223714 | 0.967561521 |
| 86 | Resource availability-Possessing enough number of required plant & equipment | 0.010526316 | 0.00111857 | 0.968680089 |
| 87 | Resource availability - External resources (materials and subcontractors) to support the implementation of the project | 0.010526316 | 0.00111857 | 0.969798658 |
| 88 | Resource availability - Capacity to supply resources for construction | 0.010526316 | 0.00111857 | 0.970917226 |
| 89 | Resource availability - Type of required labor | 0.010526316 | 0.00111857 | 0.972035794 |
| 90 | Estimating workload | 0.010526316 | 0.00111857 | 0.973154362 |
| 91 | Competitive environment | 0.010526316 | 0.00111857 | 0.974272931 |
| 92 | Time to prepare bid - Time of biding (season) | 0.010526316 | 0.00111857 | 0.975391499 |

| | | | | |
|---|---|---|---|---|
| 93 | Market competition - Influence of the client in making recommendations in the construction market | 0.010526316 | 0.00111857 | 0.976510067 |
| 94 | Market knowledge - Market direction | 0.010526316 | 0.00111857 | 0.977628635 |
| 95 | Degree of difficulties in obtaining bank loan | 0.010526316 | 0.00111857 | 0.978747204 |
| 96 | Requirement of bond capacity | 0.010526316 | 0.00111857 | 0.979865772 |
| 97 | The project management system | 0.010526316 | 0.00111857 | 0.98098434 |
| 98 | Governmental division requirements | 0.010526316 | 0.00111857 | 0.982102908 |
| 99 | Company’s ability in required construction technique | 0.010526316 | 0.00111857 | 0.983221477 |
| 100 | Technological difficulty of the project being beyond the capability of the firm | 0.010526316 | 0.00111857 | 0.984340045 |
| 101 | Competence of estimators | 0.010526316 | 0.00111857 | 0.985458613 |
| 102 | company's strength / Company’s strength in the industry | 0.010526316 | 0.00111857 | 0.986577181 |
| 103 | The contract includes an "Adjustment for Changes in Cost" sub clause | 0.010526316 | 0.00111857 | 0.987695749 |
| 104 | Clarity of bidding and contract procedure, | 0.010526316 | 0.00111857 | 0.988814318 |
| 105 | Project's possible contribution to breaking into new markets | 0.010526316 | 0.00111857 | 0.989932886 |
| 106 | Insurance premium | 0.010526316 | 0.00111857 | 0.991051454 |
| 107 | Uncertainty due to weather conditions | 0.010526316 | 0.00111857 | 0.992170022 |
| 108 | Government legislation | 0.010526316 | 0.00111857 | 0.993288591 |
| 109 | Competitiveness of competitors | 0.010526316 | 0.00111857 | 0.994407159 |
| 110 | Identity of competitors | 0.010526316 | 0.00111857 | 0.995525727 |
| 111 | Additional order scale | 0.010526316 | 0.00111857 | 0.996644295 |
| 112 | Portion subcontracted to others | 0.010526316 | 0.00111857 | 0.997762864 |
| 113 | Tax liability | 0.010526316 | 0.00111857 | 0.998881432 |
| 114 | Value of liquidated damages | 0.010526316 | 0.00111857 | 1 |

## 2.7 Bidding Models

In literature, many bidding models have been developed to help construction practitioners in bid decision-making and selecting the right markup for a potential tender. These models ranged between statistical models, multi-attribute decision models, and artificial-intelligence-based models. Most of the methods developed earlier primarily focused on optimizing the contractors' probability of winning contracts and determining the right bid mark-up size (Pekuri et al., 2015).

Without any doubt, all these researches had substantially revamped not only bid/ no bid decision-making process but also bid markup decision-making. However, some of these models are based on complex, computational and mathematical models which requires much time to learn and are impractical to be widely accepted, applied, and operated by construction professionals (Tan et al., 2010; Mohammad Wanous et al., 2000; Mohammed Wanous et al., 2003).

**Table 2-2 List of models already developed for assisting bid/no bid decision-making and bid markup estimation**

| Reference | Bid/no Bid Model | Markup Estimation Model | Model / Tools & Techniques | Limitations of Models |
|---|---|---|---|---|
| Friedman (1956) | ✓ | × | Mathematical model - Probability theory | 1. Complex formulations.<br>2. Consider profitability and competition only.<br>3. It lacks the ability to accomodate actual bid characteristics i.e. project's complexity, duration of the project, and market conditions.<br>4. No assessment for qualitative factors.<br>5. Unable to describe interactions between factors.<br>6. Classical probability theory fails to incorporate subjective information. |
| Gates (1967) | ✓ | × | Mathematical model - Probability theory | |
| Carr (1982) | ✓ | × | Mathematical model - Probability theory | |
| Ahmad and Minkarah (1988) | ✓ | × | Knowledge based expert system (KBES) | 1. Difficult to extract the knowledge and express it in form of IF-THEN type rules.<br>2. Decision-making is mainly based on gut feeling and analogy with previous cases.<br>3. Requires large amounts of knowledge to arrive at a performance comparable to that of human experts in the field. |
| Tavakoli and Utomo (1989) | ✓ | × | Knowledge based expert system (KBES) | |
| Seydel and Olson (1990) | ✓ | × | Decision analysis Technique - Analytical hierarchy process (AHP) | 1. It involves univariate analysis only.<br>2. Mainly used to deduce predefined solutions, can't generate newones.<br>3. Steady, doesn't cater new bidding experiences. |
| Cagno et al. (2001) | ✓ | × | Analytical hierarchy process (AHP) | |

| | | | | |
|---|---|---|---|---|
| Moselhi et al. (1993) | × | ✓ | Artificial neural network (ANN) | Although neural networks are potent in this domain but it requires<br>1. An extensive number of indoctrination / training cases required,<br>2. Retraining with developing market conditions and<br>3. Adjustment to compliment the bidding strategies of all contractors.<br>4. They can be difficult to interpret. |
| Hegazy and Moselhi (1994) | × | ✓ | Artificial neural network (ANN) | |
| Li (1996) | × | ✓ | Artificial neural network (ANN) | |
| Dias and Weerasinghe (1996) | ✓ | × | Artificial neural network (ANN) | |
| Li and Love (1999) | × | ✓ | Artificial neural network (ANN) | |
| Li et al. (1999) | × | ✓ | Artificial neural network (ANN) | |
| Wanous et al. (2003) | ✓ | × | Artificial neural network (ANN) | |
| Lowe and Parvar (2004) | ✓ | × | Logistic regression model | 1. It can't forecast incessant outcomes.<br>2. Each data point needs to be independent of other data points. If observations are related to one another, then the model will tend to overweight the significance of those observations. |
| Oo et al. (2008) | ✓ | × | Logistic model | |

| | | | | |
|---|---|---|---|---|
| Ahmad (1990) | ✓ | × | Utility value approach | In highly unstructured subjective problems, it is difficult to accurately determine the utility function of decision makers. |
| Dozzi et al. (1996) | × | ✓ | Utility theory model | |
| O. O. Odusote (1992) | ✓ | × | Hypothetical model | - |
| Lai et al. (2002) | ✓ | × | Fuzzy set theory | - |
| Lin and Chen (2004) | ✓ | × | Fuzzy set theory | - |
| Eldukair (1990) | ✓ | × | Fuzzy multi-criteria decision-making analysis (FMCDMA) | - |
| Wanous et al. (2000) | ✓ | × | Parametric solution | - |
| Egemen and Mohamed (2008) | ✓ | ✓ | Knowledge based system software (SCBMD) | - |
| El-Mashaleh (2010) | ✓ | × | Data Envelopment Analysis (DEA) | - |
| Cheng et al. (2011) | ✓ | ✓ | Fuzzy Preference Relations (FPR)<br>Multi-criteria Prospect Model (MCPM) | - |

*Chapter 3*

# *RESEARCH METHODOLOGY*

## 3.1 Introduction

This chapter explains a detailed methodology adopted for achieving research objectives of this study mentioned in Chapter 1. A detailed literature review was conducted to get a vast knowledge on the subject topic which was followed by questionnaire surveys to highlight critical factors and to categorize the significant factors into decision-support or decision-oppose groups, structured interviews were conducted to get pairwise comparison of critical factors, data collected through these phases was analyzed using statistical and MCDM (AHP) techniques. In the end, framework was developed for assisting bid/no bid decision making.

## 3.2 Research Design

With the goal to make bid/no bid decision support framework for general contractors, this study was performed in six phases. In the first phase, a detailed literature review was made on the subject topic, to get the detailed overview of the research already carried out and to identify the critical factors influencing contractors bid/no bid decision. In the second phase, , a closed ended formal questionnaire survey was conducted to identify and to shortlist the critical most factors out of those collected from literature. In third phase, data was collected in two stages, in stage I, detailed questionnaire was conducted from Pakistan construction industry, to categorize the significant factors into decision-support or decision-oppose groups and to collect data on pairwise comparison of criteria. Most of the data collected on pairwise comparison of criteria through detailed questionnaire was found inconsistent, so structured interviews from construction professionals were conducted in stage II. In fourth phase, the data was analyzed using statistical and multi-criteria decision-making technique i.e. AHP. While in fifth and the last phase, conclusions and recommendations were discussed. A brief rundown of the research methodology is shown in Figure 3-1.

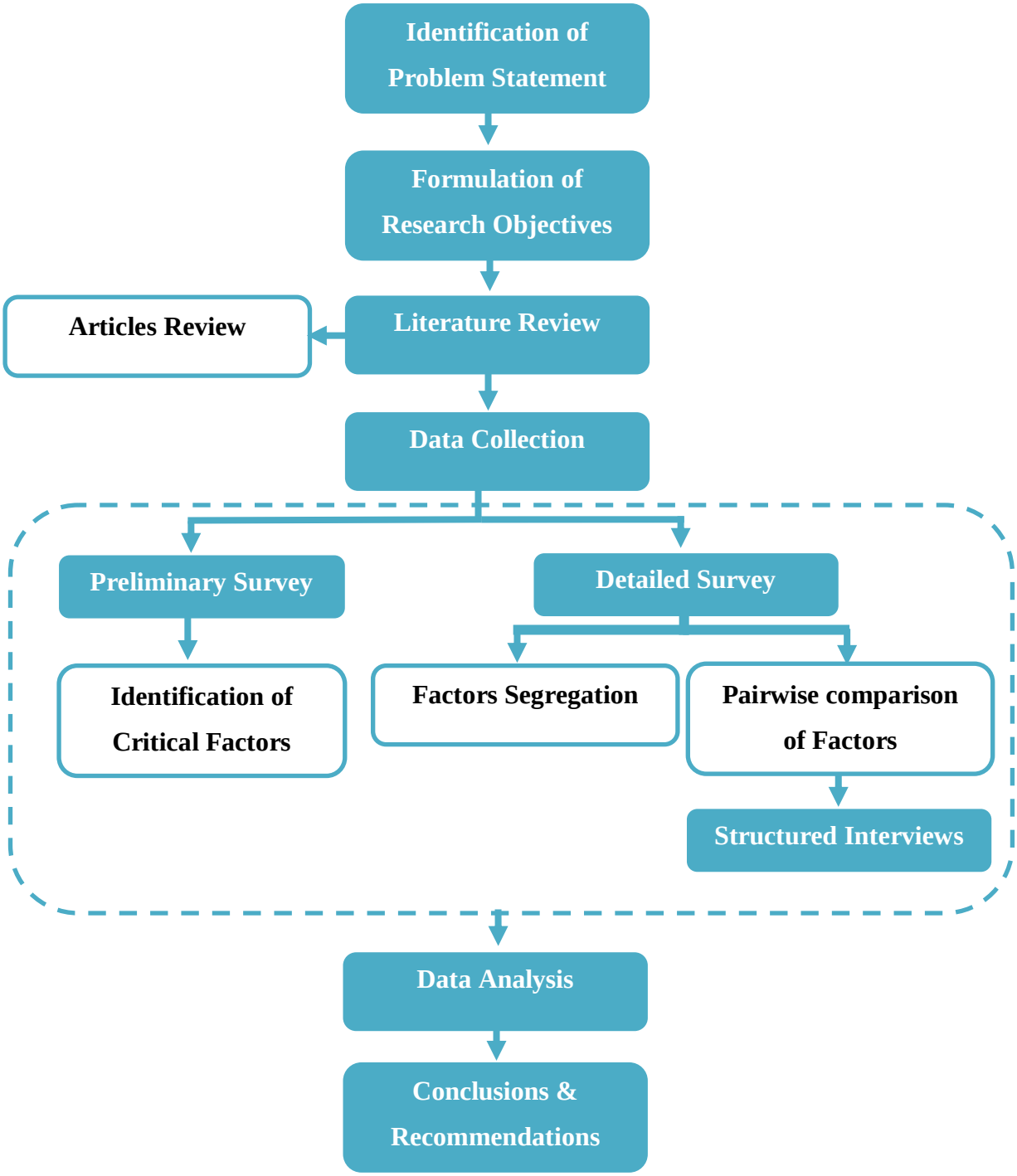



**Figure 3-1 Flowchart of research methodology**

Table 3-1 shows different data sources, method of collection and techniques used for achieving research objectives.

**Table 3-1 Proposed methodology**

| Sr. No. | Objective | Source | Tool and Technique |
|---|---|---|---|
| O-1 | To identify the critical factors influencing a contractor's decision to bid or not to bid. | Research papers, Articles, Books | Literature review |
| O-2 | To evaluate the importance of the identified factors for highlighting the critical ones. | Literature and Industry experts | RII |
| O-3 | To categorize the significant factors into decision-support or decision-oppose groups. | Project managers and other industry professionals | Surveys |
| O-4 | To develop a framework for bid/no bid decision making. | Project managers and other industry professionals | - |

### 3.2.1. Literature review

The purpose of literature review was to gain essential knowledge about the topic and to find out the bid/no bid decision influencing factors. A total of 19 relevant research papers published in international journals were selected to gather bid/no bid decision-making factors and 114 critical factors were identified from the extensive literature review as mentioned in Table 2-1.

An extensive literature review was also done on already developed models for assisting bid/no bid decision-making& bid markup estimation as mentioned in Table 2-2.

### 3.2.2. Sample size

The sample size depends upon the population size, sampling error and confidence level. To determine the population size, the strategy proposed by Dillman (2011) has been used. Equation 3-1 provides formula to calculate sample size.

$$\mathcal{N}\mathfrak{s} = \frac{(\mathcal{N}\mathfrak{p})(\mathcal{P})(1-\mathcal{P})}{(\mathcal{N}\mathfrak{p}-1)(^{\mathcal{B}}/_{\mathcal{C}})2+(\mathcal{P})(1-\mathcal{P})} \qquad \textbf{Equation 3-1}$$

Where, *Ns* is sample size for the desired precision level, *Np* is population size i.e. 40000 in this case, *P* is proportion of the population that is expected to choose one of the responses Categories (yes/no); *P* = 0.5, *B* is acceptable error; (±10% or ±0.10), *C* is Z statistic associated with the confidence level .

For an interview-based qualitative research, the number of interviewees required to make an adequate sample varies from one to a hundred or more. Baker et al., 2012 suggested a sample of around 30 individuals and Adler and Adler, 2011 advised to sample between 12 and 60. The benchmark of sample size for structured interviews is “27”.

### 3.2.3. Data collection

After detailed literature review, a comprehensive data was collected in three phases.

#### 3.2.3.1. Phase 1: Preliminary questionnaire survey

In phase 1, preliminary questionnaire survey was conducted on 114 factors identified from literature review. The purpose of this questionnaire survey was to identify the critical factors influencing a contractor's decision to bid or not to bid.

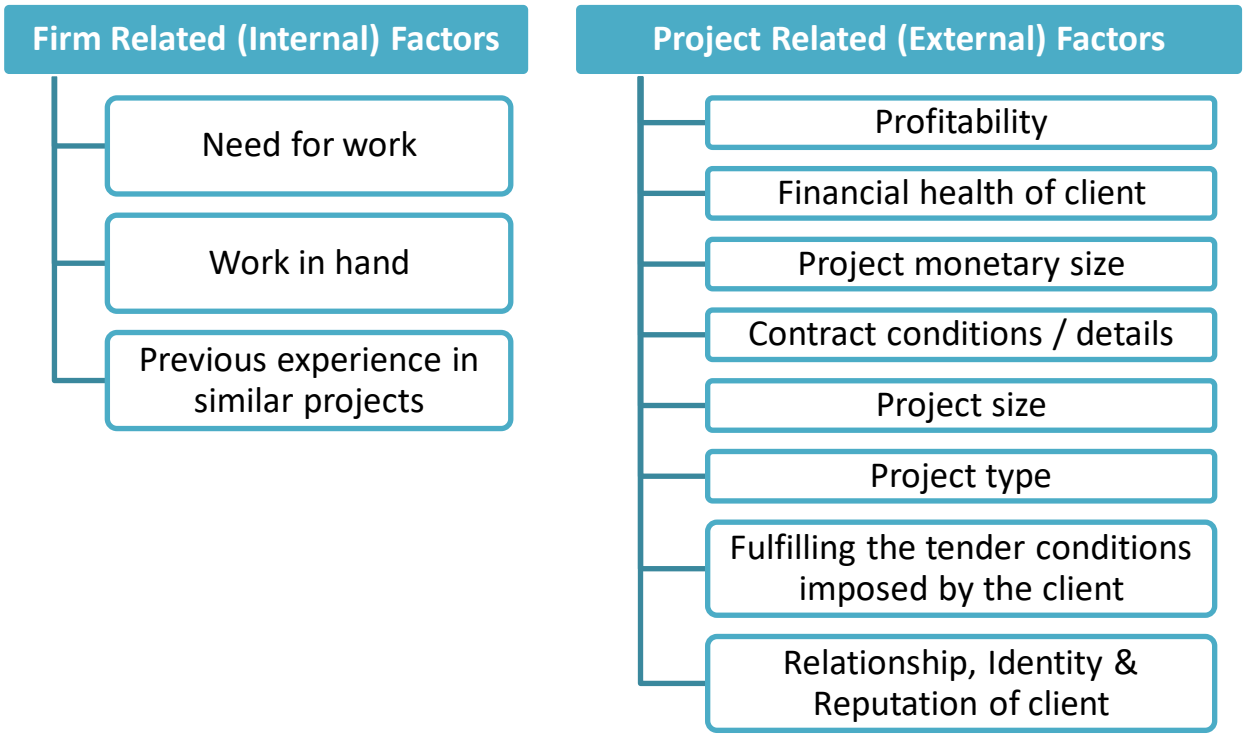



**Figure 3-2 Categorization of factors**

In total, 40 seasoned construction professionals having managerial and decision-making positions were requested to mark the relevance of each bid or not to bid decision-making factor on the five-point Likert scale where 1 stands for very low while 5 stands for very high. 26 responses were received with a response rate of 65%. Final ranking of factors was carried out using Equation 3-2 that includes 40% of literature score and 60% of industry score.

$$FS = 0.4LS + 0.6IS \qquad \textbf{Equation 3-2}$$

Using above equation, total 11 critical most factors were selected for further consideration. These factors were categorized into two categories: firm related (internal) factors and project related (external) factors as shown in Figure 3-2.

### 3.2.3.2. Phase 2: Detailed questionnaire survey (Stage-1)

After critical factors identification, detailed questionnaire was developed to segregate the identified critical bid/no bid decision-making factors into decision support and decision oppose groups. Data was collected from construction industry practitioners. 250 professionals were requested to submit their response while only 124 individuals responded to this questionnaire and submitted their response.

### 3.2.3.3. Phase 2: Detailed questionnaire survey (Stage-2)

The formal questionnaire was prepared from the information which was gathered during the literature review and augmented by questions to gather additional information. It involved pairwise comparison of 11 criteria on scale of 1 to 9 developed by Saaty (2008) as shown below in Table 3-3.

The responses were collected from construction professionals working in Pakistan construction industry. The questionnaire was emailed to 250 construction professionals working with general contractor, sub-contractor and project management firms but got response from only 112 professionals with response rate of 45%. To continue the AHP analysis, Saaty (2008) has declared that a consistency ratio (CR) of 0.10 or less is only acceptable. If the consistency ratio is greater than 0.10, it means serious inconsistencies may exist and AHP analysis may not yield meaningful results.

**Table 3-2 Fundamental scale for pairwise comparisons (source: Dr. T. L. Saaty, 2008)**

| SCALE FOR PAIRWISE COMPARISON | | |
|---|---|---|
| **Intensity of Importance** | **Definition** | **Explanation** |
| **1** | Equally Important | Ci and Cj are of equal importance. |
| **2** | Weak or Slight | |
| **3** | Moderate Importance | Ci is moderately more important than Cj. |

| | | |
|---|---|---|
| **4** | Moderate Plus | |
| **5** | Strong Importance | Ci is strongly more important than Cj. |
| **6** | Strong Plus | |
| **7** | Very Strong Importance | Ci is very strongly more important than Cj. |
| **8** | Very, Very Strong | |
| **9** | Extreme Importance | Ci is extremely more important than Cj. |
| **2, 4, 6, 8** | Intermediate values between the two analyses to be used when the decision maker finds it difficult to choose between two adjacent values. | |
| **Reciprocals** | Opposites | Used for inverse comparison |

In that case, it is necessary to revise the judgments to locate the cause of inconsistency and to make it correct. The judgment matrix of 112 responses were made to check the CR of each judgment submitted by respondents, out of those 112 responses only 17 respondents passed the CR test, which means more than 80% of the respondents were failed to pass the CR test. But rather than revising the judgments, the structured interviews from construction industry professionals were conducted for data collection on pairwise comparison of 11 bid/no bid decision-making criteria. The aim of this approach is to ensure that each interview is presented with exactly the same questions in the same order.

### 3.2.3.4. Phase 3: Structured interviews

In phase 3, the formal interview questionnaire was prepared from the information which was gathered. The 35 construction professionals were approached for conducting structured

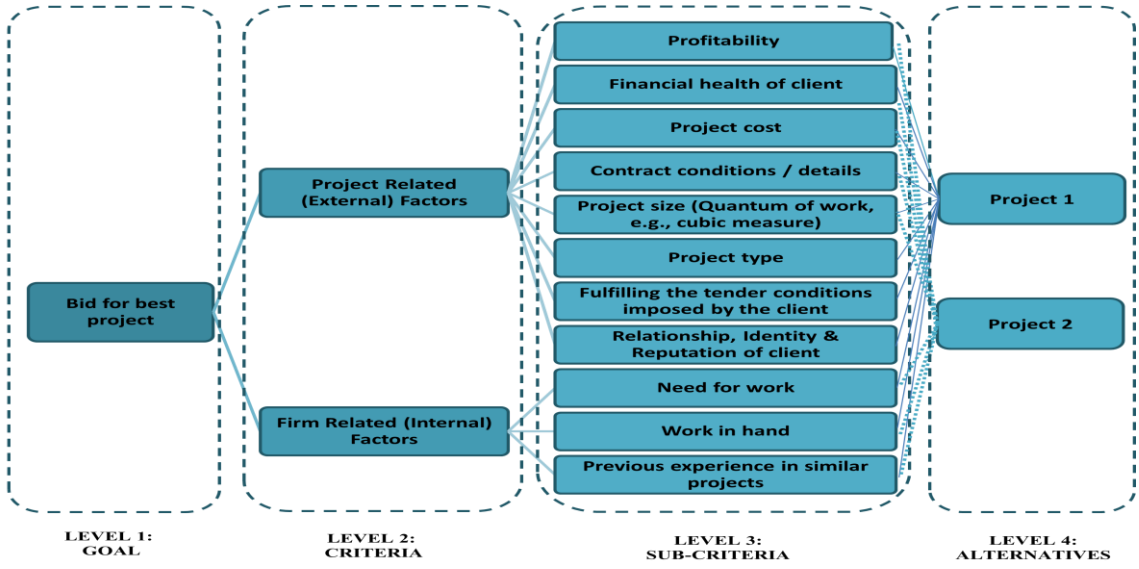



**Figure 3-3: Hierarchy of bid/no bid decision making**

interviews but due to unavailability of 8 construction professionals, interviews were conducted from 28 construction professionals only. The consistency ratio of one respondent was above 0.10 value so it was dropped while responses of all other 27 interviewees were below 0.1 consistency ratio. The hierarchy of bid/no bid decision-making is shown in Figure 3-3.

### 3.2.4. Data analysis

#### 3.2.4.1. Data analysis of phase 1 (Preliminary questionnaire survey)

Descriptive statistics were applied on the data collected through preliminary survey. Firstly, factor analysis was done on the collected data and latterly it was normalized to reduce data redundancy and to improve integrity of the data. Spearman's Rank correlation coefficient is used to identify and test the strength of a relationship between two sets of data. T-test was also applied to check the difference between mean of two sets. Factors were ranked and results were generated on the basis of this analysis.

#### 3.2.4.2. Data analysis of phase2(Detailed questionnaire survey:Stage-1)

All factors were ranked according to their number of occurrence in the data set and were treated as decision support, decision oppose and both on the basis of maximum value.

#### 3.2.4.3. Data analysis of phase 3 (Structured interviews)

The collected data will be analyzed by using MCDM technique called analytic hierarchy process (AHP). AHP structures a decision problem in to hierarchy and accesses the interdependency between decision criteria and factors. It uses a system of pairwise comparisons to measure the weights of the components of the structure, and finally to rank the alternatives in the decision. The data analyzed in this phase will be used for further strategies development.

### 3.2.5. Bid/No Bid Framework

A framework was developed using results of detailed questionnaire and structured interviews assisting contractors of Pakistan construction industry in decision making.

### 3.2.6. Study Validation

Finally to validate the framework developed, four different case studies were performed. Keeping in view the scope of this study, four bidding options were selected and construction professionals were requested to rank each criterion according to the scale developed.

### 3.2.7. Conclusions and Recommendations

In the end, the results of the research will be presented and recommendations will be proposed. Findings from the research will be discussed and conclusions will be made in this section.

*Chapter 4*

# *DATA ANALYSIS & RESULTS*

## 4.1 Introduction

This chapter demonstrates a detailed analysis of the collected data. Results are drawn and a comprehensive discussion has been done on various findings in relevant sections.

## 4.2 Literature Review

The literature review was conducted in the first phase and as a result, 114 factors were identified and ranked on the basis of their frequency of appearance and importance in the literature. The literature score was converted into a qualitative scale of 1 to 5 where 5 stands for High, 3 stands for medium and 1 stands for low. The literature score for each factor was calculated and then normalized. As a result, all factors were ranked on the basis of cumulative normalized score as shown in Table 2-1. Out of 114 factors, top 13 factors were selected only as these factors cover 50% of the complete dataset. In a similar study conducted by El-Mashaleh et al. (2014) and placed client characteristics i.e. financial health of client at first place while El-Mashaleh et al. (2014) ranked relationship, identity & reputation of client as the second most critical factor. Mohammad Wanous et al. (2000) ranked financial health of client as the second most critical factor while ranked relationship, identity & reputation of client as the third most critical factor affecting bid/no bid decision making.

## 4.3 Preliminary Survey

In order to have the opinion of industry practitioners regarding the 114 identified factors and to shortlist the factors for detailed survey, a preliminary survey was conducted in the second phase of the research. Online questionnaire survey was sent to 40 individuals having related experience. A total of 26 were received with a response rate of 65%. Data from 26 preliminary survey responses was analyzed and 11 factors were highlighted as the critical.

### 4.3.1 Demographic profile of the respondents

Data was collected from contracting, sub-contracting and project management firms. The respondents were also asked to specify the PEC category of the contractor they are working with. The organizational profile of the respondents (Left) and PEC Category of the contractor working with (Right) is shown in Figure 4-1.

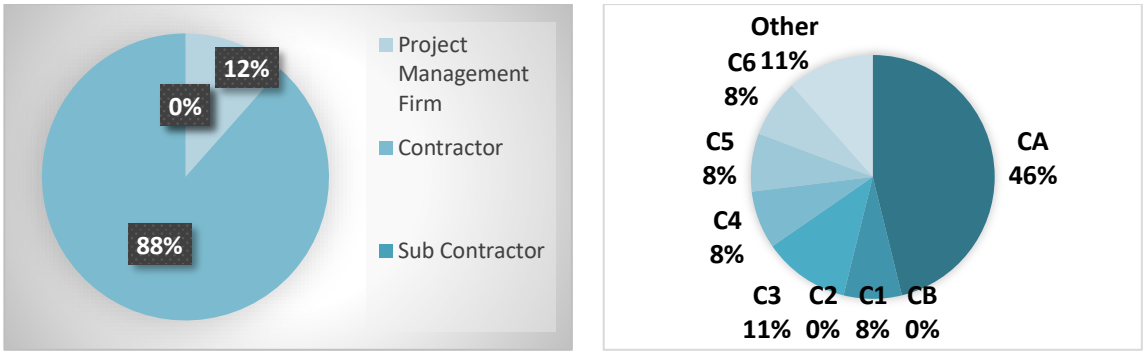



**Figure 4-1: Organizational profile of the respondents (Left) and PEC category of the contractor working with (Right)**

Position of respondents in an organization is shown in Figure 4.2. Data was collected from construction industry professionals i.e. 27% project managers, 20% owners of construction firms and 11% from construction managers and planning engineers.

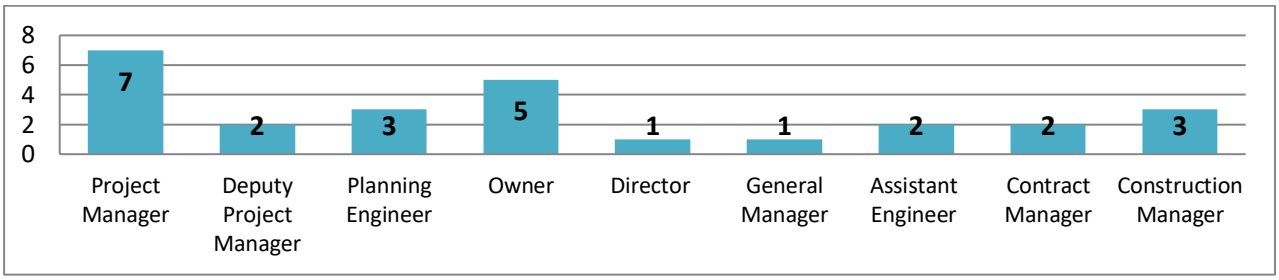



**Figure 4-2: Position of respondents in an organization**

Data was collected from the respondents having minimum 12 years of education. Educational profile of respondents is shown in Figure 4-3.

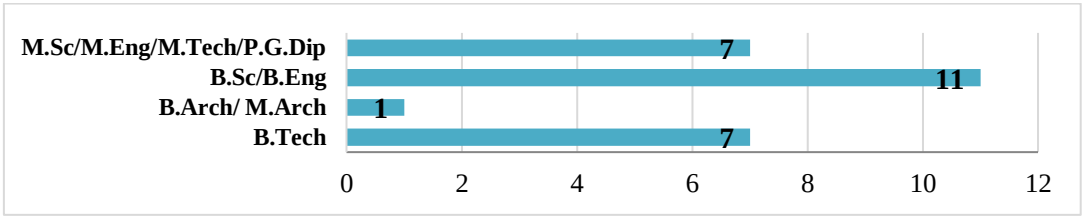



**Figure 4-3: Educational profile of respondents**

Most of the respondents have more than ten years of working experience in the construction industry. Years of working experience of the respondents is shown in Figure 4-4.

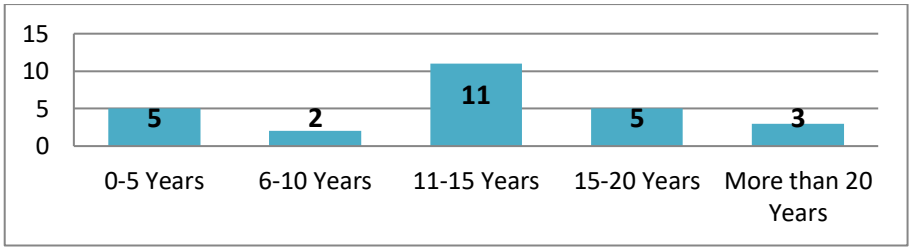



**Figure 4-4: Years of working experience of the respondents**

### 4.3.2 Results of preliminary survey

T-test was applied to check mean and variance of the data while correlation and strength of the data was checked through Spearman's rank-order correlation test.

**Table 4-1: t-Test: Two-Sample Assuming Equal Variances**

| t-Test: Two-Sample Assuming Equal Variances | Survey Rank | Lit Rank |
|---|---|---|
| Mean | 57.5 | 57.5 |
| Variance | 1092.5 | 1092.5 |
| Observations | 114 | 114 |
| Pooled Variance | 1092.5 | |
| Hypothesized Mean Difference | 0 | |
| Df | 226 | |
| t Stat | 0 | |
| P(T<=t) one-tail | 0.5 | |
| t Critical one-tail | 1.651623859 | |
| P(T<=t) two-tail | 1 | |
| t Critical two-tail | 1.970516243 | |

**Table 4-2: t-Test: Paired Two Sample for Means**

| t-Test: Paired Two Sample for Means | Survey Rank | Lit Rank |
|---|---|---|
| Mean | 57.5 | 57.5 |
| Variance | 1092.5 | 1092.5 |
| Observations | 114 | 114 |
| Pearson Correlation | 0.340912497 | |
| Hypothesized Mean Difference | 0 | |
| Df | 113 | |
| t Stat | 0 | |
| P(T<=t) one-tail | 0.5 | |
| t Critical one-tail | 1.658450217 | |
| P(T<=t) two-tail | 1 | |
| t Critical two-tail | 1.981180296 | |

**Table 4-3: Spearman's rank-order correlation test**

| | |
|---|---|
| **Σ** | 162732 |
| **6 x Σ** | 976392 |
| **N** | 114 |
| **n(n2-1)** | 1481430 |
| | |
| | 0.659088 |
| **P** | 0.340912 |

The collected data from industry practitioners was also normalized and in order to determine the most important factors on basis of both literature and survey data, combined ranking of factors was carried out on the basis of cumulative normalized score. Factors were ranked using 40% weighting of the literature score and 60% weighting of the industry score as shown in Equation 2-1.

Some of the factors like relationship, identity & reputation of client and financial health of client have higher ranks in both literature and survey responses, showing consistency between literature and current practices in the industry. However, some factors like need for work have lower rank in the literature but got higher rank in industry survey. This indicates the higher importance of these factors in Pakistan construction industry relative to other construction industries. Table 4-1 shows the critical most 11 factors selected for further analysis.

Results show that six out of 11 shortlisted factors are similar to the top 10 factors identified by the Jarkas et al. (2013) and top 6 factors identified by Leśniak (2017). Oyeyipo et al. (2016) after analyzing the data collected through 50 structured questionnaires found that financial health of client is the most important factor that contractors must consider while making bid/no bid decisions. El-Mashaleh et al. (2014) found that Jordanian contractors give more importance to client characteristics i.e. relationship, identity & reputation of client and financial health of client. While Egemen and Mohamed (2007) ranked financial health of client as the 5$^{th}$ most critical factor. Enshassi et al. (2010) also considered financial health of client as well as good reputation of client as key factors affecting the contractors bidding decision. However some factors like fulfilling the tender conditions imposed by the client are ranked higher in the literature but have lower rank in the current study which may be due to change in area of study and experience of respondents.

**Table 4-4 Results of preliminary survey**

| Lit. Rank | I.D | Factors | Literature Score | Expert Opinion | Normalized Literature Score (A) | Normalized Expert Opinion (B) | Final Score 0.4A + 0.6B | Cumulative Score | Rank |
|---|---|---|---|---|---|---|---|---|---|
| 1 | B1 | Relationship, Identity & Reputation of client | 0.736842105 | 4 | 0.078299776 | 0.009280742 | 0.036888356 | 0.036888356 | 1 |
| 4 | B2 | Financial health of client | 0.578947368 | 5 | 0.061521253 | 0.011600928 | 0.031569058 | 0.068457414 | 2 |
| 5 | B3 | Project size (Quantum of work, e.g., cubic measure) | 0.526315789 | 4 | 0.055928412 | 0.009280742 | 0.02793981 | 0.096397224 | 3 |
| 7 | B4 | Project type | 0.421052632 | 4 | 0.044742729 | 0.009280742 | 0.023465537 | 0.119862761 | 4 |
| 2 | B5 | Need for work | 0.368421053 | 5 | 0.039149888 | 0.011600928 | 0.022620512 | 0.142483273 | 5 |
| 10 | B6 | Previous experience in similar projects | 0.378947368 | 4 | 0.040268456 | 0.009280742 | 0.021675828 | 0.164159101 | 6 |
| 3 | B7 | Work in hand | 0.410526316 | 3 | 0.043624161 | 0.006960557 | 0.021625999 | 0.1857851 | 7 |
| 17 | B8 | Profitability | 0.252631579 | 4 | 0.026845638 | 0.009280742 | 0.016306701 | 0.2020918 | 8 |
| 19 | B9 | Project monetary size | 0.210526316 | 4 | 0.022371365 | 0.009280742 | 0.014516991 | 0.216608792 | 9 |
| 22 | B10 | Contract conditions / details | 0.210526316 | 4 | 0.022371365 | 0.009280742 | 0.014516991 | 0.231125783 | 10 |
| 20 | B11 | Fulfilling the tender conditions imposed by the client | 0.210526316 | 4 | 0.022371365 | 0.009280742 | 0.014516991 | 0.245642774 | 11 |

For example, Mohammad Wanous et al. (2000) ranked fulfilling the tender conditions imposed by the client as the critical most factor while Oyeyipo et al. (2016) ranked it as the fourth most important factor but other authors like Chua and Li (2000) and Bageis and Fortune (2009) do not even consider it as one of the critical factor in their study. This ensures the reliability of the research findings in the light of the published literature.

## 4.4 Detailed Survey

The next step conducted after the preliminary survey was development of detailed questionnaire survey. Online questionnaire survey was sent to 250 individuals having related experience. A total of 124 were received with a response rate of 49.6%.

Detailed survey was conducted in two stages; stage 1 was related to ranking of selected 11 critical most factors into 4 different groups: decision Support, decision oppose, both and not clear. When evaluating a new bidding situation, high bid-scores for some factors usually encourage contractors to bid. Such factors are referred to in this study as decision support factors. Such as Relationship, identity & reputation of client, financial health of client, project size, previous experience in similar projects, need for work, profitability and project monetary size. On the other hand, high bid-scores for some other factors usually discourage contractors to bid. Such factors are referred to in this study as decision oppose factors. Even there are some factors which on case to case basis are encouraging as well as discouraging contractors to bid for new available business opportunities then such factors were ranked in "Both" group by respondents. Such as project type, contract conditions / details and fulfilling the tender conditions imposed by the client. While respondents also selected "Not Clear" group for some factors when they were indecisive in selecting which factor comes under which category.

### 4.4.1 Demographic profile of the respondents

Data for detailed questionnaire survey was also collected from contractor, sub-contractor and project management firm. The respondents were also asked to specify the PEC category of the contractor they are working with. The organizational profile of the respondents (Left) and PEC Category of the contractor working with (Right) is shown in Figure 4.5.

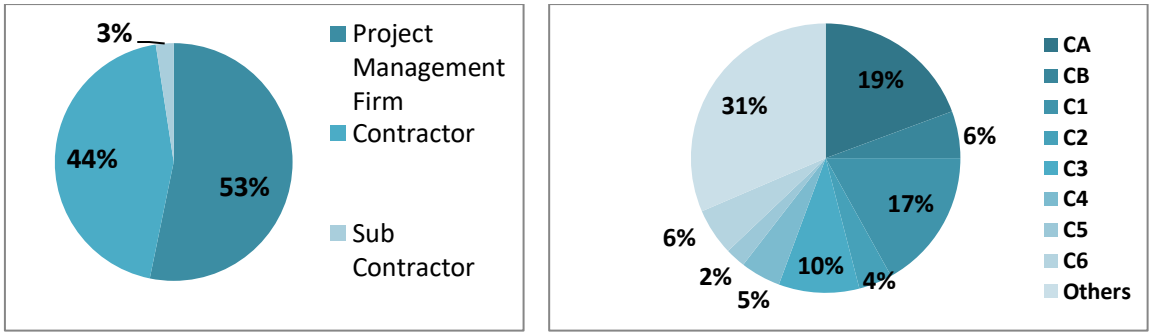



**Figure 4-5: Organizational profile of the respondents (Left) and PEC category of the contractor working with (Right)**

Data was collected from Pakistan construction industry professionals includes: 31% project managers, 13% owners/managing directors of construction firms and 12% from planning engineers and assistant engineers. Position of respondents in an organization is shown in Figure 4-6.

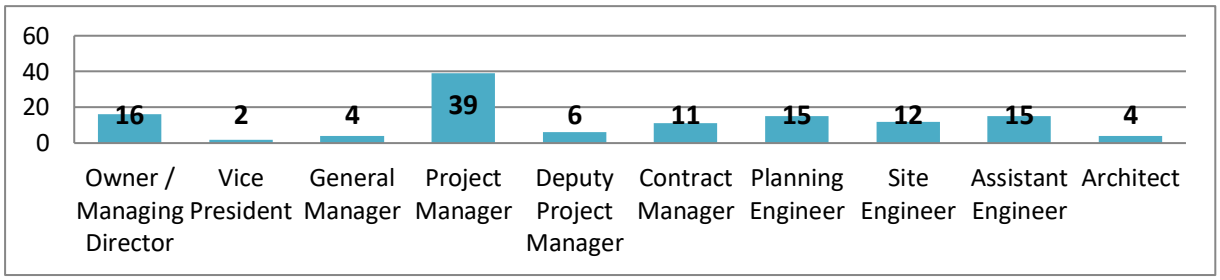



**Figure 4-6: Position of respondents in an organization**

Data was collected from the respondents having minimum 14 years of education. Educational profile of respondents is shown in Figure 4-7.

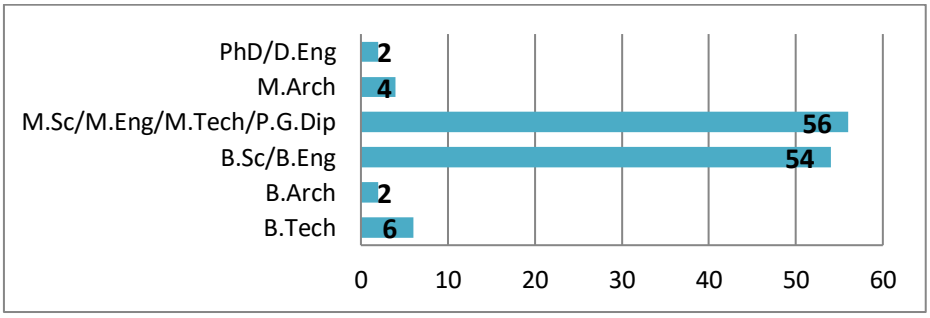



**Figure 4-7: Educational profile of respondents**

Respondents have diverse working experience in the construction industry. Years of working experience of the respondents is shown in Figure 4-8.

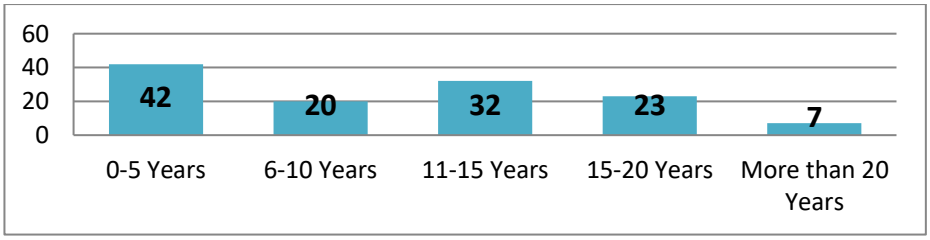
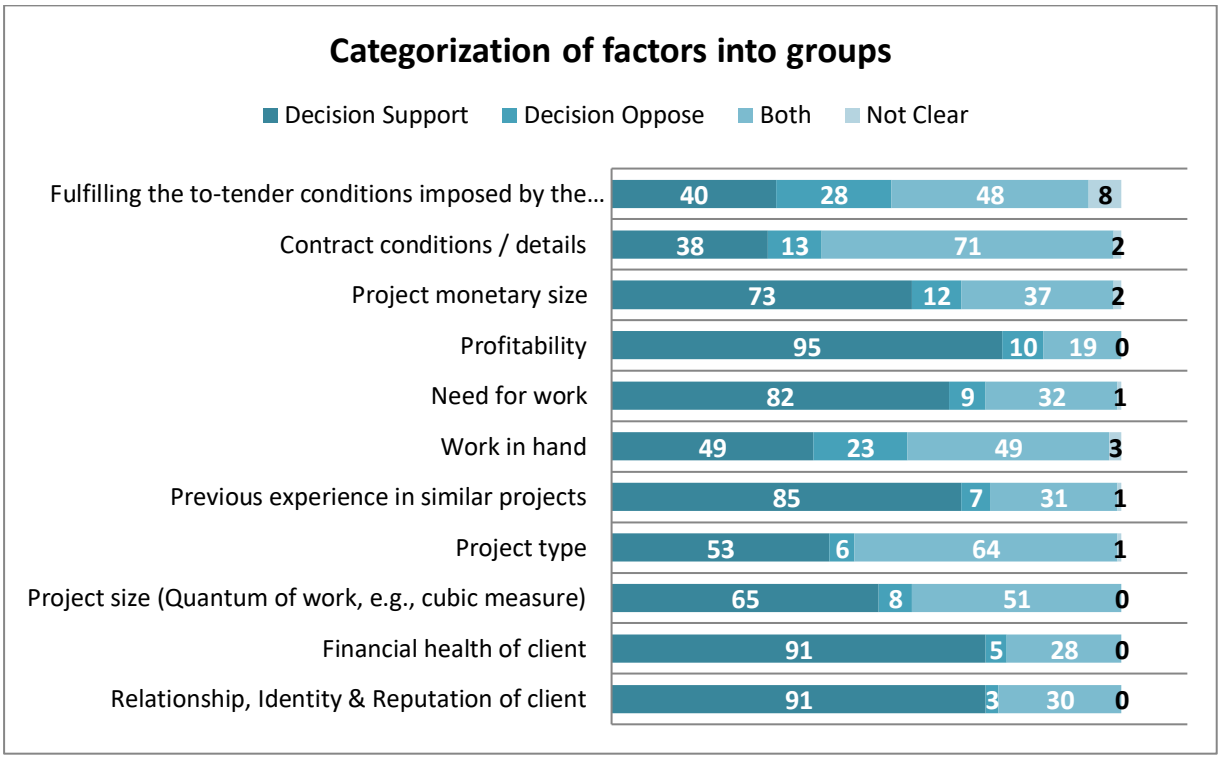



**Figure 4-8: Years of working experience of the respondents**

### 4.4.2 Results of detailed survey

For establishing bid/no bid decision-making equation, all identified factors were ranked according to their number of occurrence in the data set and were treated as decision support, decision oppose, both (decision support + decision oppose) and not clear on the basis of maximum value. The Table 4-2 shows the bid/no bid decision influencing factors ranked by respondents into 4 different groups.

**Table 4-5: Results of detailed survey**




Relationship, identity & reputation of client, financial health of client, project size, previous experience in similar projects, need for work, profitability and project monetary size were

categorized as decision support factors by most of the respondents while project type, contract conditions / details and fulfilling the tender conditions imposed by the client were characterized as decision support as well as decision oppose factors by construction industry professionals on the basis of their severity and high impact on bid/no bid decision making.

Mohammad Wanous et al. (2000) categorized 18 identified critical factors as positive and negative factors. Relationship, identity & reputation of client, financial health of client, previous experience in similar projects and fulfilling the tender conditions imposed by the client were categorized as positive factors while project size and work in hand were categorized as negative factors.Mohammed Wanous et al. (2008) ranked past experience on similar projects, Need for work as the encouraging factors while size of project as the discouraging factors.

## 4.5 Structured Interviews

After detailed literature review, the data was collected through structured interviews from seasoned construction professionals having managerial and decision-making positions in their organizations. Their expert opinion was acquired regarding pairwise comparison of all 11 identified factors. AHP technique was applied for analysis and pairwise comparison matrix of all collected responses were developed, following that normalized matrix & priority vector were developed while in the end, consistency ratio was calculated which check the consistency of the subjective input of the respondents in each pairwise comparison matrix. According to Saaty (2008), consistency ratio of only 0.10 or less is acceptable and if consistency ratio is greater than 0.10 then it shows serious inconsistencies in the data and AHP analysis may not yield meaningful results. So, only those responses were selected for further use having consistency ratio less than 0.1. Out of 34 conducted interviews, responses of only 27 respondents were selected.

### 4.5.1 Demographic profile of the interviewees

Structured interviews were orchestrated from contractor, sub-contractor and project management firm's personnel only. The interviewees were asked to specify the PEC category of the contractor they are working with. The organizational profile of interviewees (Left) and PEC Category of the contractor working with (Right) is shown in Figure 4-9.

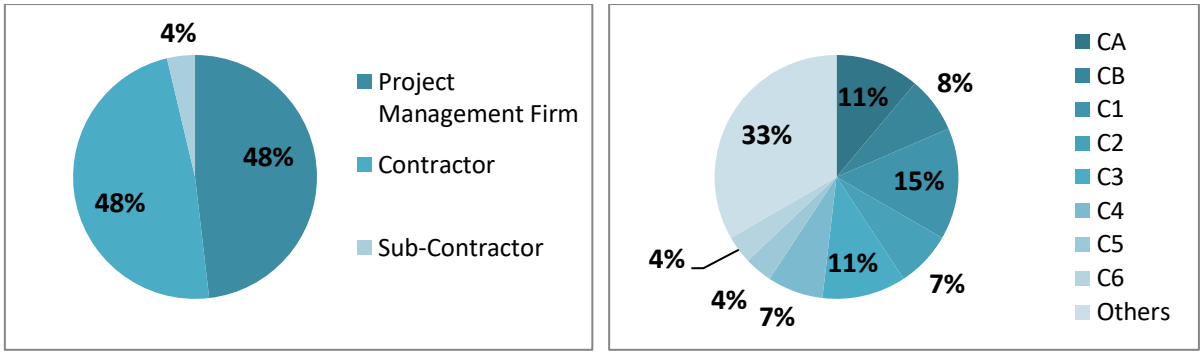



**Figure 4-9: Organizational profile of the interviewees (Left) and PEC category of the contractor working with (Right)**

In total, 52% interviews were conducted from project managers, 11% from owners/managing directors of organizations, contract managers and assistant engineers. Position of respondents in an organization is shown in Figure 4-10.

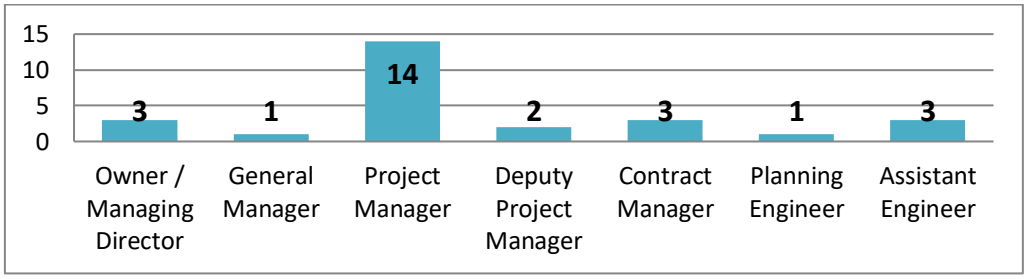



**Figure 4-10: Position of interviewees in an organization**

The interviews were conducted from the interviewees having minimum 16 years of education. Educational profile of interviewees is shown in Figure 4-11.

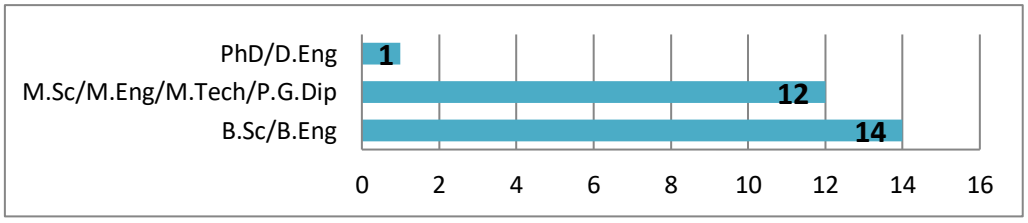



**Figure 4-11: Educational profile of interviewees**

A total of 33% of the interviewees have 11-15 years of working experience while 26% of the interviewees have 6-10 and 14-20 years of working experience in Pakistan construction industry. Years of working experience of the interviewees is shown in Figure 4-12.

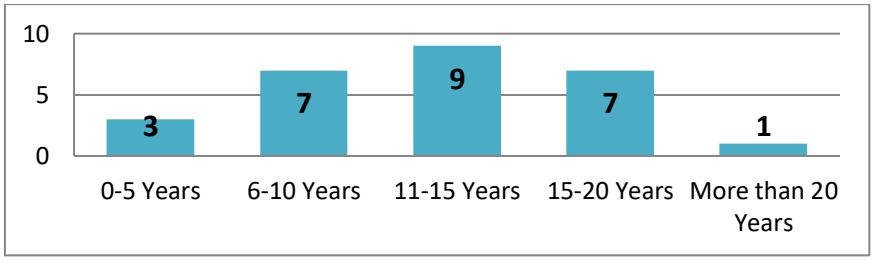



**Figure 4-12: Years of working experience of the interviewees**

### 4.5.2 Results of structured interviews

After obtaining expert opinion of interviewees regarding pairwise comparison of criteria judgment matrixes were made and AHP technique was applied. AHP score of selected interviewees is shown in Table 4-3. The average of recorded responses of 27 interviewees against each criteria was calculated and in the end, percentage of each criteria was obtained which was used in bid/no bid decision-making framework development which would be used by contractors for analyzing all available business opportunities and assist in selection of the best project.

Results show that profitability, need for work and financial health of client were ranked on higher side by the interviewees by giving them 15%, 14% & 11% weighting respectively and were treated as critical most factors while project size (Quantum of work, e.g., cubic measure), project type, fulfilling the tender conditions imposed by the client and relationship, identity & reputation of client were ranked as the factors having low impact on bid/no bid decision-making by giving earlier 3 factors weighting of 7% while a weighting of 6% was given to the last one.

**Table 4-6 Results of structured interviews**

| Criteria ➔ Respondent ⬇ | Relationship, Identity & Reputation of client | Financial health of client | Project size (Quantum of work, e.g., cubic measure) | Project type | Previous experience in similar projects | Work in hand | Need for work | Profitability | Project monetary size | Contract conditions / details | Fulfilling the tender conditions imposed by the client |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 0.044 | 0.080 | 0.060 | 0.093 | 0.071 | 0.101 | 0.107 | 0.161 | 0.077 | 0.105 | 0.101 |
| 2 | 0.091 | 0.091 | 0.091 | 0.091 | 0.091 | 0.091 | 0.091 | 0.091 | 0.091 | 0.091 | 0.091 |
| 3 | 0.065 | 0.112 | 0.125 | 0.096 | 0.091 | 0.105 | 0.093 | 0.088 | 0.084 | 0.059 | 0.082 |
| 4 | 0.100 | 0.081 | 0.093 | 0.075 | 0.076 | 0.094 | 0.094 | 0.100 | 0.088 | 0.099 | 0.100 |
| 5 | 0.034 | 0.108 | 0.071 | 0.059 | 0.084 | 0.120 | 0.182 | 0.155 | 0.090 | 0.053 | 0.044 |
| 6 | 0.027 | 0.111 | 0.056 | 0.058 | 0.073 | 0.117 | 0.192 | 0.161 | 0.080 | 0.086 | 0.039 |
| 7 | 0.037 | 0.115 | 0.050 | 0.042 | 0.064 | 0.106 | 0.192 | 0.160 | 0.082 | 0.115 | 0.039 |
| 8 | 0.037 | 0.114 | 0.049 | 0.042 | 0.064 | 0.106 | 0.191 | 0.160 | 0.085 | 0.114 | 0.038 |
| 9 | 0.026 | 0.115 | 0.047 | 0.057 | 0.071 | 0.125 | 0.190 | 0.159 | 0.083 | 0.089 | 0.040 |
| 10 | 0.026 | 0.111 | 0.053 | 0.052 | 0.083 | 0.121 | 0.191 | 0.173 | 0.081 | 0.071 | 0.037 |
| 11 | 0.026 | 0.113 | 0.055 | 0.054 | 0.085 | 0.123 | 0.193 | 0.159 | 0.082 | 0.073 | 0.038 |
| 12 | 0.037 | 0.114 | 0.049 | 0.042 | 0.064 | 0.106 | 0.191 | 0.160 | 0.085 | 0.114 | 0.038 |
| 13 | 0.079 | 0.150 | 0.076 | 0.084 | 0.084 | 0.084 | 0.084 | 0.084 | 0.084 | 0.084 | 0.108 |
| 14 | 0.106 | 0.111 | 0.046 | 0.061 | 0.039 | 0.048 | 0.116 | 0.209 | 0.130 | 0.067 | 0.067 |
| 15 | 0.055 | 0.095 | 0.058 | 0.042 | 0.069 | 0.069 | 0.248 | 0.163 | 0.075 | 0.065 | 0.062 |
| 16 | 0.049 | 0.179 | 0.05 | 0.053 | 0.044 | 0.078 | 0.169 | 0.156 | 0.093 | 0.074 | 0.055 |
| 17 | 0.038 | 0.086 | 0.070 | 0.100 | 0.144 | 0.089 | 0.118 | 0.115 | 0.076 | 0.082 | 0.082 |
| 18 | 0.118 | 0.118 | 0.074 | 0.074 | 0.122 | 0.081 | 0.050 | 0.139 | 0.068 | 0.075 | 0.081 |
| 19 | 0.077 | 0.116 | 0.096 | 0.084 | 0.084 | 0.1 | 0.127 | 0.084 | 0.074 | 0.076 | 0.084 |

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 20 | 0.042 | 0.114 | 0.047 | 0.042 | 0.063 | 0.108 | 0.189 | 0.160 | 0.084 | 0.114 | 0.037 |
| 21 | 0.103 | 0.108 | 0.042 | 0.057 | 0.035 | 0.042 | 0.110 | 0.241 | 0.130 | 0.066 | 0.066 |
| 22 | 0.083 | 0.078 | 0.059 | 0.047 | 0.031 | 0.035 | 0.161 | 0.234 | 0.142 | 0.080 | 0.050 |
| 23 | 0.045 | 0.083 | 0.086 | 0.094 | 0.096 | 0.087 | 0.107 | 0.098 | 0.104 | 0.105 | 0.095 |
| 24 | 0.057 | 0.064 | 0.068 | 0.068 | 0.110 | 0.161 | 0.131 | 0.158 | 0.058 | 0.058 | 0.067 |
| 25 | 0.066 | 0.12 | 0.076 | 0.076 | 0.092 | 0.092 | 0.128 | 0.119 | 0.076 | 0.095 | 0.061 |
| 26 | 0.108 | 0.113 | 0.066 | 0.060 | 0.040 | 0.038 | 0.117 | 0.198 | 0.117 | 0.071 | 0.071 |
| 27 | 0.091 | 0.091 | 0.091 | 0.091 | 0.091 | 0.091 | 0.091 | 0.091 | 0.091 | 0.091 | 0.091 |
| Average Value | 0.06 | 0.11 | 0.07 | 0.07 | 0.08 | 0.09 | 0.14 | 0.15 | 0.09 | 0.08 | 0.07 |
| %age | 6% | 11% | 7% | 7% | 8% | 9% | 14% | 15% | 9% | 8% | 7% |

After applying AHP on each response of respondent a consolidated matrix was estabilised from where percent weights for each factor were calculated. The average of AHP sccore of each respondent was calculated to get percent weight of 11 critical factors. Profitability, need for work and financial health of client came out as critical most factors having percnt weight of 15%, 14% and 11%, although work in hand, project monetary size, previous experience in similar projects and contract conditions / details were ranked as the medium ones, earlier two shares same percent weight of 9% while last two shares same percent weight of 8%. Project size, project type, fulfiling the tender conditions imposed by the client and Relationship, identity & reputation of client were ranked as low intensity factors having percent weight of 7% while last one ranked as low intense factor having percent weight of 6%. The priorities of the factors derived from structured interviews are shown in Figure 4-13.

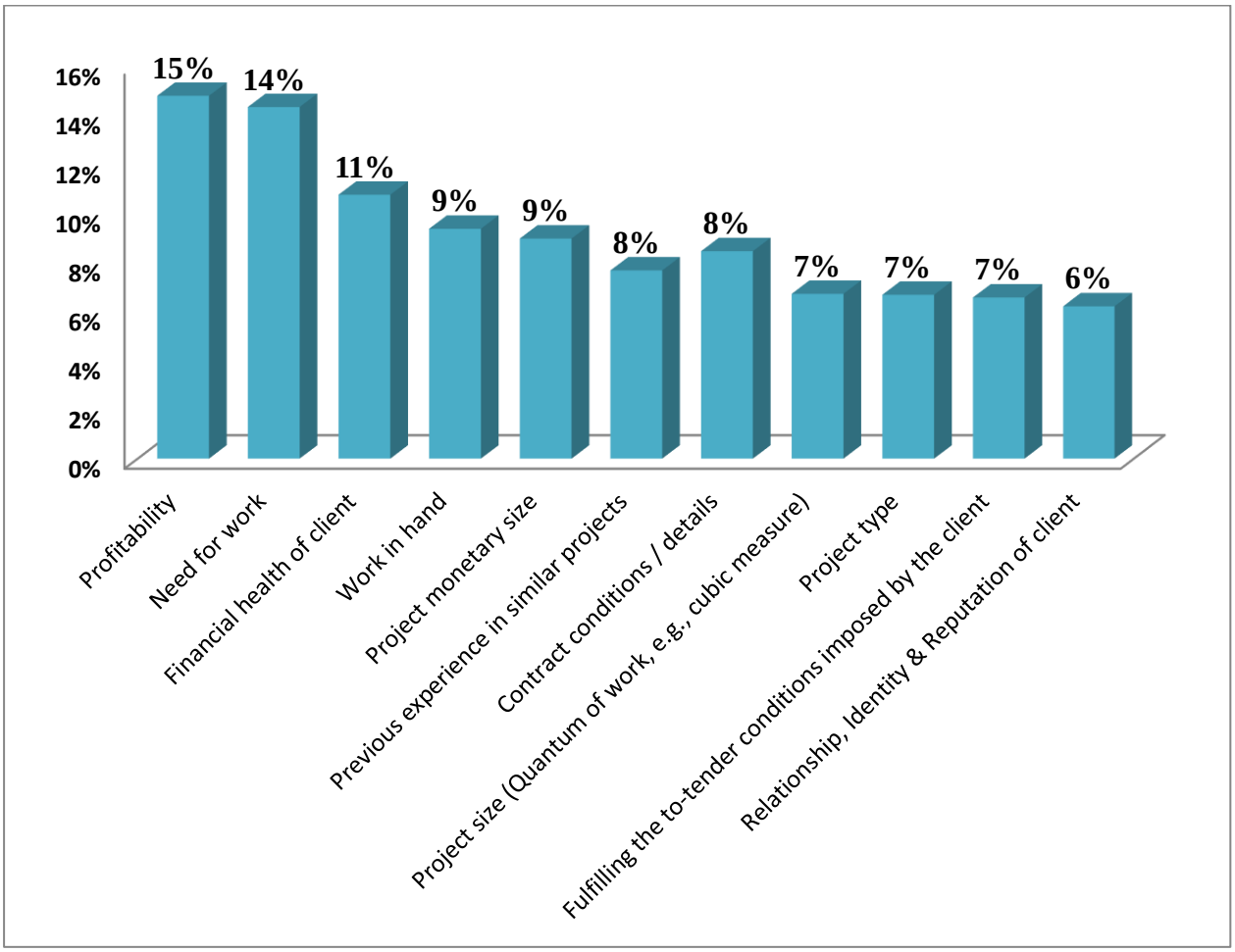



**Figure 4-13: Bar chart of prioritization of factors**

## 4.6 Framework Development

In result of detailed questionnaire survey, all factors were identified as decision support factors (i.e. DS) except project type, contract conditions / details and fulfilling the tender conditions imposed by the client which were distinguished as decision support as well as decision oppose factors by construction industry professionals on the basis of their severity and high impact on bid/no bid decision-making so ultimately a +/- sign was assigned to these factors in framework. By using AHP MCDM technique for analysis of structured interviews, the overall contribution of each factor has been determined which indicates the intensity of importance of each factor in bid/no bid decision making. Table 4-7 shows signage values of 11 factors, along with its severity on bid/no bid decision-making as suggested by interviewees.

**Table 4-7 Factors with signage values**

| Impact | Factors | %age | Sign | DS / DO |
|---|---|---|---|---|
| High | Profitability | 15% | + | DS |
| | Need for work | 14% | + | DS |
| | Financial health of client | 11% | + | DS |
| Medium | Work in hand | 9% | +/- | DS / DO |
| | Project monetary size | 9% | + | DS |
| | Previous experience in similar projects | 8% | + | DS |
| | Contract conditions / details | 8% | +/- | DS / DO |
| Low | Project size (Quantum of work, e.g., cubic measure) | 7% | + | DS |
| | Project type | 7% | +/- | DS / DO |
| | Fulfilling the tender conditions imposed by the client | 7% | +/- | DS / DO |
| | Relationship, Identity & Reputation of client | 6% | + | DS |

Few factors are of positive nature while some other factors are of both positive as well as negative nature as shown in Table 4-7. So setting up all these factors at same margin and to normalize the nature of these factors the measurement scales were developed for measuring bid/no bid criteria practically, which is shown in Table 4-8. Absolute scale was developed for quantitative natured factors while relative scale was developed for factors having qualitative nature. For positive natured bidding factors, a scale was developed having positive limits while a scale having limits from +1 to -1 was developed for factors having dual nature. Absolute scale was used for measurement of project monetary size and profitability only while relative scale was developed for measuring all other criteria.

**Table 4-8 Measurement scale for bid/no bid criteria**

| Sr. No. | Criteria | Evaluation Criteria | Scale |
|---|---|---|---|
| **Absolute scale** | | | |
| **1.** | Profitability | Function of project cost = %age of project cost | Absolute scale |
| **2.** | Project monetary size | Project Cost | Absolute scale |
| **Relative scale** | | | |
| **3.** | Need for work | 1 = High, 0.5 = Medium, 0.1 = Low | Relative scale |
| **4.** | Financial health of client | 1 = Excellent, 0.7 = Very Good, 0.4 = Good, 0.1 = Fair, 0 = Poor | Relative scale |
| **5.** | Previous experience in similar projects | 1 = High, 0.5 = Medium, 0.1 = Low | Relative scale |
| **6.** | Project Size | 1 = Large, 0.5 = Medium, 0.1 = Small | Relative scale |
| **7.** | Relationship, Identity & Reputation of client | 1 = Good relationship & remarkable reputation of client, 0.5 = Positive relationship & good reputation of client, 0.1 = No relationship & average reputation of client | Relative scale |
| **8.** | Work in Hand | 1 = Very High, 0.5 = High, 0 = Medium, -0.5 = Low, -1 = Very Low | Relative scale |
| **9.** | Contract conditions / details | 1 = Highly Friendly, 0.5 = , 0 = Indifferent, -0.5 = Unfriendly, -1 = Highly Unfriendly | Relative scale |
| **10.** | Project type | 1 = Exceptionally aligns with bidders interest and experience, 0.5 = Moderately aligns with bidders interest and experience, 0 = Doesn't aligns with bidders interest and experience, -0.5 = Doesn't aligns with bidders interest and experience & demands the bidder to marginally acquire additional resources, -1 = Exceptionally aligns with bidders interest and experience & demands the bidder to exceptionally acquire additional resources | Relative scale |
| **11.** | Fulfilling the tender conditions imposed by the client | 1 = Able to perfectly fulfill tender conditions imposed by the client, 0.5 = Able to easily fulfill tender conditions imposed by the client, 0 = Not Sure, -0.5 = Unable to fulfill tender conditions imposed by the client, -1 = Extremely unable to fulfill tender conditions imposed by the client | Relative scale |

Graphical representation of measurement scale for bid/no bid is shown in Annexure 2. The framework was developed for multi-criteria bid/no bid decision-making as shown in Figure 4-14. Through Equation 4-2 bid factor was calculated which was the product of ai = coefficients (values from Figure 4-13) and bi = Variables (values from Table 4-8).

$$\textbf{Bid Factor} = \sum_{i=1}^{11} ai \,.\, bi \qquad \textbf{Equation 4-1}$$

For selecting best bidding option out of available projects, bid factor of each project was calcultaed and in the end bid factor of each project was compared with each other and the project having highest bid factor was considered as the best option for bidding i.e. P1>P2>P3.

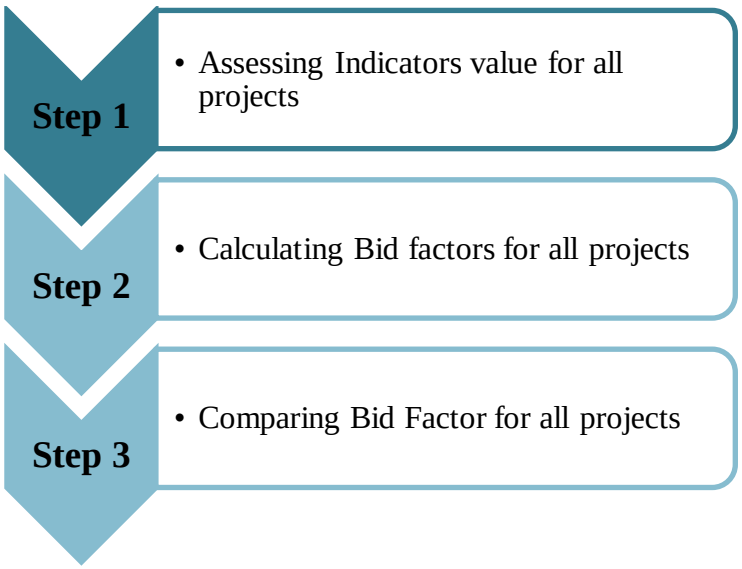



**Figure 4-14: Framework for bid/no bid decision-making**

### 4.6.1 Study validation / Case studies

For validation of the framework developed through literature, survey and structured interviews based findings; case studies have been conducted to evaluate the bid/no bid decision-making in building procurement. Keeping in view the scope of the study, four construction professionals from Pakistan construction industry were requested to give their expert opinion on 4 bidding proposals. Firstly, they were asked to choose the best project out of these 4 available options on the basis of their experience and cognitive abilities while secondly, they were asked to rate each criteria on the basis of measurement scale developed earlier. The analysis was done in the end using Equation 4-2, and a comparison was made between decisions taken on the basis of cognitive abilities and using bid/no bid framework developed. In the following sections detailed discussion of each case study is being shown, all the cost values are given in Pakistani currency unit.

Bidder 1 was of C3 category, Bidder 2 was of C1 category while Bidder 3 and Bidder 4 were of C4 category. For comparison of all four bidding options the cost of all four projects were normalized by dividing each project cost by the max project cost. Profitability was taken as 12% of the project cost by bidder 1, 15% by bidder 2 and bidder 3 while 10% by bidder 4.

Bidder 1 quoted project monetary size of P1, P2, P3 and P4 as 82,752,662, 83,680,197, 154,306,175 and 163,302,089 respectively, these amounts were normalized for further analysis. Out of available four projects, Bidder 1 selected project no. 4 as the best suitable

**Table 4-9 Case studies**

| Bidders | B1 | | | | B2 | | | | B3 | | | | B4 | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Projects → Criteria ↓** | **P1** | **P2** | **P3** | **P4** | **P1** | **P2** | **P3** | **P4** | **P1** | **P2** | **P3** | **P4** | **P1** | **P2** | **P3** | **P4** |
| Profitability | 0.11 | 1 | 1 | 1 | 0.5 | 1 | 1 | 0.5 | 0.5 | 0.5 | 0.5 | 0.5 | 0.5 | 0.5 | 1 | 1 |
| Need for work | 1 | 0.7 | 0.7 | 0.7 | 0.4 | 0.7 | 0.4 | 0.4 | 0.7 | 0.7 | 0.4 | 0.4 | 0.4 | 0.7 | 0.7 | 0.7 |
| Financial health of client | 0.4 | 0.5 | 0.5 | 0.5 | 0.5 | 0.5 | 0.5 | 0.5 | 0.5 | 0.5 | 0.5 | 0.5 | 0.5 | 0.5 | 0.5 | 0.5 |
| Work in hand | 0.5 | 1 | 1 | 0.5 | 1 | 0.5 | 1 | 0.5 | 1 | 0.5 | 0.5 | 0.5 | 1 | 1 | 1 | 0.5 |
| Project monetary size | 0.94 | 0.5 | 1 | 1 | 1 | 0.5 | 1 | 1 | 1 | 0.5 | 1 | 1 | 1 | 0.5 | 1 | 1 |
| Previous experience in similar projects | 1 | 0.5 | 0.5 | 0.5 | 0.7 | 0.7 | 0.7 | 0.7 | 1 | 1 | 1 | 1 | 0.7 | 0.7 | 0.7 | 0.7 |
| Contract conditions / details | 0.5 | 1 | 1 | 1 | 0.5 | 0.5 | 0.5 | 0.5 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| Project size (Quantum of work, e.g., cubic measure) | 0.5 | 0.06 | 0.11 | 0.12 | 0.09 | 0.09 | 0.14 | 0.15 | 0.04 | 0.04 | 0.07 | 0.12 | 0.05 | 0.05 | 0.09 | 0.10 |
| Project type | 1 | 0.51 | 0.94 | 1.00 | 0.63 | 0.58 | 0.94 | 1.00 | 0.32 | 0.31 | 0.57 | 1.00 | 0.46 | 0.47 | 0.93 | 1.00 |
| Fulfilling the tender conditions imposed by the client | 0.5 | 0.5 | 0.5 | 0.5 | 0.5 | 0.5 | -0.5 | -0.5 | 0.5 | 0.5 | 0.5 | 0.5 | 0.5 | 0.5 | 0.5 | 0.5 |
| Relationship, Identity & Reputation of client | 1 | 1 | 1 | 1 | 0.5 | 0.5 | 0.5 | 0.5 | 0.5 | 0.5 | 0.5 | 1 | 0.5 | 0.5 | 0.5 | 1 |
| **Results** | 0.65 | 0.69 | 0.73 | 0.69 | 0.58 | 0.56 | 0.51 | 0.44 | 0.66 | 0.58 | 0.59 | 0.67 | 0.62 | 0.62 | 0.69 | 0.70 |

project for its company goals and objectives. While project no. 3 comes out as the best option, after getting each criteria ranked on the measurement scale by the bidder and analysis done using Equation 4-2. Results show that project no. 3 is better than any other option and its 4% better than project no. 3.

Bidder 2 quoted project monetary size of P1, P2, P3 and P4 as 87,888,520, 81,484,649, 132,169,197and 140,052,607 respectively, these amounts were normalized for further analysis. Out of available four projects, Bidder 2 selected project no. 2 as the best suitable project to attain its company goals and objectives. While project no. 1 comes out as the best option, after getting each criteria ranked on the measurement scale by the bidder and analysis done using Equation 4-2. Although, no such remarkable difference was recorded between bidder's perceptional based decision and calculation based decision, which means that bidder no. 2 is already implementing strong analytical skills.

Bidder 3 quoted project monetary size of P1, P2, P3 and P4 as 50,194,715, 48,133,152, 90,032,200 and 157,360,862 respectively. Out of available four projects, Bidder 3 selected project no. 2 as the best suitable project to attain its company goals and objectives. While project no. 4 comes out as the best option, after getting each criteria ranked on the measurement scale by the bidder and analysis done using Equation 4-2. Remarkable difference was recorded between bidder's perceptional based decision and calculation based decision, which means that bidder no. 3 is not using any strong analytical skills for decision making.

Bidder 4 quoted project monetary size of P1, P2, P3 and P4 as 67,521,920, 68,240,600, 135,280,928 and 145,651,558 respectively. Out of available four projects, Bidder 4 selected project no. 2 as the best suitable project to attain its company goals and objectives. While project no. 4 comes out as the best option, after getting each criteria ranked on the measurement scale by the bidder and analysis using Equation 4-2. Remarkable difference was recorded between bidder's perceptional based decision and calculation based decision, which means that bidder no. 3 is not using any strong analytical skills for decision making. While project 3 and project 4 both are good options for the bidder to submit their bids and to gain these projects.

*Chapter 5*

# *CONCLUSIONS AND RECOMMENDATIONS*

This chapter concludes the research by articulating and summarizing the deductions, findings, impediments, and recommendations. The insight helps understand the crux of the study and parting ways for future endeavors related to this area of research.

## 5.1 Conclusions

Making a bid/no bid decision by contractors in Pakistan construction industry involves a lot of subjectivity and such decisions are majorly made intuitively. This study presents a MCDM based integrated and holistic approach for contractors to make rational decisions against such crucial scenario.

After performing systematic literature review and preliminary survey, the most critical factors influencing the bid/no-bid decision were identified and further grouped into decision support and decision oppose categories. Relationship, identity & reputation of client, financial health of client, project size, previous experience in similar projects, need for work, profitability and project monetary size were categorized as decision support factors while some other factors like project type, contract conditions / details and fulfilling the tender conditions imposed by the client were categorized as decision support as well as decision oppose factors on the basis of their severity and high impact on bid/no bid decision making.

The pairwise comparison based structured interviews followed by AHP analysis was carried out to obtain weights of all the influencing factors. Out of eleven factors, three factors i.e. profitability, need for work and financial health of client were ranked on higher side by the interviewees by giving them 15%, 14% and 11% weight respectively and were treated as critical factors having high impact on bid/no bid decision-making while project size (quantum of work, e.g., cubic measure), project type, fulfilling the tender conditions imposed by the client and relationship, identity & reputation of client were ranked as the factors having low impact on bid/no bid decision-making by giving earlier 3 factors weighting of 7% while a weighting of 6% was given to the last one. Although work in hand, project monetary size, previous experience in similar projects and contract conditions / details were ranked as the medium ones, earlier two shares same weight of 9%, while last two shares weight of 8%.

As a result of categorization of factors into decision support and decision oppose factors, some factors are of positive nature while some other factors are of both positive as well as negative nature as shown in Table 4-4. So setting up all these factors at same margin and to normalize the nature of these factors, the measurement scales were developed for measuring bid/no bid criteria practically, which is shown in Table 4-5. Absolute scale was used for measurement of project monetary size and profitability only while relative scale was developed for measuring all other criteria.

A bid/no bid decision assisting framework was developed. Construction professionals can evaluate any bidding opportunity by using this framework. For its validation, case studies have been conducted to evaluate the bid/no bid decision-making in building procurement. Keeping in view the scope of the study, four construction professionals from Pakistan construction industry were requested to give their expert opinion on 4 bidding proposals. Firstly, they were asked to choose the best project out of these 4 available options on the basis of their experience and cognitive abilities while secondly, they were asked to rate each criteria on the basis of measurement scale developed earlier. Following the analysis process, comparison was made between decisions taken on the basis of cognitive abilities and using bid/no bid framework developed. So, it was concluded that decision-making using developed framework is more precise in winning tenders

## 5.2 Recommendations

A research can be carried out for infrastructure projects compared with the results of this study, also a research can be done for the bid markup estimation and a framework can be developed assisting bidders in estimating bid markup.

## 5.3 Limitations

Small sample size for structured interviews is one of the limitations of this research. This research is restricted to building projects only.

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## *Annexure 1 List of Factors Affecting Bid/No Bid Decision Making*

| Sr. No. | Factor | References | Frequency | Description |
|---|---|---|---|---|
| 1. | Relationship, Identity & Reputation of client | (Odusote and Fellows, 1992), (Shash, 1993), (Hassanein, 1996), (Mohammad Wanous et al., 2000), (Chua and Li, 2000), (Mohammed Wanous et al., 2003), (Bageis and Fortune, 2009), (Jarkas et al., 2013), (Leśniak and Plebankiewicz, 2013), (El-Mashaleh et al., 2014), (Oyeyipo et al., 2016), (Hwang and Kim, 2016), (Leśniak, 2017), (Aznar et al., 2017) | 14 | This item explains the relationship of a contractor with client & reputation of client in the market. |
| 2. | Work in hand | (Odusote and Fellows, 1992), (Shash, 1993), (Hassanein, 1996), (Mohammad Wanous et al., 2000), (Chua and Li, 2000), (Mohammed Wanous et al., 2003), (Egemen and Mohamed, 2007), (Mohammed Wanous et al., 2008), (Bageis and Fortune, 2009), (Jarkas et al., 2013), (Leśniak and Plebankiewicz, 2013), (El-Mashaleh et al., 2014), (Oyeyipo et al., 2016) | 13 | This item explains the present state of the company's workload (current involvement in other projects). |
| 3. | Previous experience in similar projects | (Shash, 1993), (Fayek et al., 1999), (Mohammad Wanous et al., 2000), (Chua and Li, 2000), (Mohammed Wanous et al., 2003), (Egemen and Mohamed, 2007), (Mohammed Wanous et al., 2008), (Bageis and Fortune, 2009), (Jarkas et al., 2013), (Leśniak and Plebankiewicz, 2013), (Oyeyipo et al., 2016), (Leśniak, 2017) | 12 | This item explains the company's past experience and familiarity with this specific experience with type of work. |

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| 4. | Financial health of client | (Odusote and Fellows, 1992), (Mohammad Wanous et al., 2000), (Chua and Li, 2000), (Mohammed Wanous et al., 2003), (Egemen and Mohamed, 2007), (Mohammed Wanous et al., 2008), (Bageis and Fortune, 2009), (Jarkas et al., 2013), (El-Mashaleh et al., 2014), (Shokri-Ghasabeh et al., 2016), (Oyeyipo et al., 2016) | 11 | This item explains the financial stability of the employer, his ability to pay (Credit & worthiness of owner). |
| 5. | Project size (Quantum of work, e.g., cubic measure) | (Shash, 1993), (Mohammad Wanous et al., 2000), (Chua and Li, 2000), (Mohammed Wanous et al., 2003), (Mohammed Wanous et al., 2008), (Jarkas et al., 2013), (Leśniak and Plebankiewicz, 2013), (Oyeyipo et al., 2016), (Hwang and Kim, 2016), (Leśniak, 2017) | 10 | This item explains the Complexity & quantum of works / Size of the project (e.g., cubic measure). |
| 6. | Profitability | (Odusote and Fellows, 1992), (Shash, 1993), (Fayek et al., 1999), (Mohammed Wanous et al., 2008), (Leśniak and Plebankiewicz, 2013), (Shokri-Ghasabeh et al., 2016), (Oyeyipo et al., 2016), (Leśniak, 2017) | 8 | This item explains the financial gain from the project. |
| 7. | Project type | (Odusote and Fellows, 1992), (Shash, 1993), (Hassanein, 1996), (Fayek et al., 1999), (Leśniak and Plebankiewicz, 2013), (El-Mashaleh et al., 2014), (Oyeyipo et al., 2016), (Leśniak, 2017) | 8 | This item explains the type of project (Residential, commercial, industrial or heavy construction projects etc.). |
| 8. | Project duration | (Mohammad Wanous et al., 2000), (Mohammed Wanous et al., 2003), (Bageis and Fortune, 2009), (Leśniak and Plebankiewicz, 2013), (Shokri-Ghasabeh et al., 2016), (Oyeyipo et al., 2016), (Leśniak, 2017) | 7 | This item explains the original project duration. |
| 9. | Time to prepare bid | (Odusote and Fellows, 1992), (Mohammad Wanous et | 7 | This item explains the availability |

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|---|---|---|---|---|
| | | al., 2000), (Chua et al., 2001), (Mohammed Wanous et al., 2003), (Leśniak and Plebankiewicz, 2013), (Oyeyipo et al., 2016), (Leśniak, 2017) | | of time for the preparation of the bid (tendering duration). |
| 10. | Need for work | (Shash, 1993), (Fayek et al., 1999), (Mohammed Wanous et al., 2008), (Jarkas et al., 2013), (Leśniak and Plebankiewicz, 2013), (Oyeyipo et al., 2016), (Leśniak, 2017) | 7 | This item explains the need for work. |
| 11. | Expected number of competitors | (Odusote and Fellows, 1992), (Shash, 1993), (Hassanein, 1996), (Mohammed Wanous et al., 2008), (Bageis and Fortune, 2009), (Shokri-Ghasabeh et al., 2016), (Oyeyipo et al., 2016) | 7 | This item explains the number & type of competitors tendering. |
| 12. | Availability of potential work | (Chua and Li, 2000), (Egemen and Mohamed, 2007), (Mohammed Wanous et al., 2008), (Bageis and Fortune, 2009), (Jarkas et al., 2013), (Oyeyipo et al., 2016) | 6 | This item explains the availability of other similar natured projects within construction market. |
| 13. | Resource availability - local expertise - Labor availability | (Hassanein, 1996), (Mohammad Wanous et al., 2000), (Mohammed Wanous et al., 2003), (Bageis and Fortune, 2009), (El-Mashaleh et al., 2014), (Oyeyipo et al., 2016) | 6 | This item explains the availability of required skilled labor. |
| 14. | Quality of documentation / specification – (Completeness of the bid document) | (Chua and Li, 2000), (Bageis and Fortune, 2009), (Jarkas et al., 2013), (El-Mashaleh et al., 2014), (Oyeyipo et al., 2016), (Hwang and Kim, 2016) | 6 | This item explains the sufficiency of the project's information i.e. completeness of the bid document (drawings & specifications). |
| 15. | Resource availability - Availability of required equipment | (Mohammad Wanous et al., 2000), (Mohammed Wanous et al., 2003), (Leśniak and Plebankiewicz, 2013), (Oyeyipo et al., 2016), (Aznar et al., 2017) | 5 | This item explains the availability of required equipment. |
| 16. | Resource availability - Availability of | (Mohammad Wanous et al., 2000), (Mohammed Wanous et al., 2003), (El-Mashaleh et al., 2014), | 5 | This item explains the availability of materials required for the |

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|---|---|---|---|---|
| | materials required for the project | (Shokri-Ghasabeh et al., 2016), (Oyeyipo et al., 2016) | | project. |
| 17. | Project monetary size | (Hassanein, 1996), (Fayek et al., 1999), (Egemen and Mohamed, 2007), (El-Mashaleh et al., 2014) | 4 | This item explains the monetary size of the project (small, medium, large). |
| 18. | Location of the project | (Bageis and Fortune, 2009), (Leśniak and Plebankiewicz, 2013), (Oyeyipo et al., 2016), (Leśniak, 2017) | 4 | This item explains the locality of the project. |
| 19. | Contract conditions / details | (Shash, 1993), (Bageis and Fortune, 2009), (Leśniak and Plebankiewicz, 2013), (Leśniak, 2017). | 4 | This item explains the contract conditions of the project. |
| 20. | Project expected risk | (Mohammad Wanous et al., 2000), (Mohammed Wanous et al., 2003), (Shokri-Ghasabeh et al., 2016), (Oyeyipo et al., 2016). | 4 | This item explains the risk expected during project procurement. |
| 21. | Availability of work capital required to start the job | (Mohammad Wanous et al., 2000), (Mohammed Wanous et al., 2003), (Bageis and Fortune, 2009), (Oyeyipo et al., 2016). | 4 | This item explains the availability of required cash needed to start the job. |
| 22. | Fulfilling the tender conditions imposed by the client | (Mohammad Wanous et al., 2000), (Mohammed Wanous et al., 2003), (Egemen and Mohamed, 2007), (Oyeyipo et al., 2016). | 4 | This item explains the requirement of the tender conditions imposed by the client. |
| 23. | Payment history of client | (Egemen and Mohamed, 2007), (Jarkas et al., 2013), (El-Mashaleh et al., 2014). | 3 | This item explains the repute of the client in market related to his payment history to contractor. |
| 24. | Resource availability - Resources to tender for the project | (Lowe and Parvar, 2004), (Mohammed Wanous et al., 2008), (Aznar et al., 2017). | 3 | This item explains the company's internal resources to implement the job i.e. human resources. |
| 25. | Quality of documentation - Rigidity of specifications & | (Mohammad Wanous et al., 2000), (Mohammed Wanous et al., 2003), (Mohammed Wanous et al., 2008). | 3 | This item explains the Quality of documentation i.e. Rigidity of specifications & Onerous contract condition. |

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| | Onerous contract condition | | | |
| 26. | Contractor's financial situation | (Egemen and Mohamed, 2007), (El-Mashaleh et al., 2014), (Shokri-Ghasabeh et al., 2016). | 3 | This item explains the contractor's financial health of the firm required to execute a project. |
| 27. | Site accessibility | (Mohammad Wanous et al., 2000), (Mohammed Wanous et al., 2003), (Oyeyipo et al., 2016). | 3 | This item explains the site accessibility. |
| 28. | Degree of constructability - degree of hazard/difficulty | (Hassanein, 1996), (Mohammed Wanous et al., 2008), (Oyeyipo et al., 2016). | 3 | This item explains the technical knowledge of the firm (degree of hazard / difficulty faced during execution of the project). |
| 29. | Site clearance of obstructions | (Mohammad Wanous et al., 2000), (Mohammed Wanous et al., 2003), (Oyeyipo et al., 2016). | 3 | This item explains the obstructions to be faced during site clearance. |
| 30. | Project cash flow / Cash flow requirements of the project | (Mohammed Wanous et al., 2008), (Bageis and Fortune, 2009), (El-Mashaleh et al., 2014). | 3 | This item explains the Project cash flow requirements of the project. |
| 31. | Prestige of the project /Value of the project | (Hassanein, 1996), (Leśniak and Plebankiewicz, 2013), (Leśniak, 2017). | 3 | This item explains the prestige of the project. |
| 32. | Chances of obtaining the job, / likelihood of winning the project | (Odusote and Fellows, 1992), (Fayek et al., 1999), (Oyeyipo et al., 2016). | 3 | This item explains the likelihood of winning the project. |
| 33. | Use of nominated subcontractor - Possible subcontractors | (Leśniak and Plebankiewicz, 2013), (Leśniak, 2017), (Bageis and Fortune, 2009). | 3 | This item explains the availability of possible nominated subcontractors. |

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| 34. | Methods of construction (manually, mechanically) | (Mohammad Wanous et al., 2000), (Mohammed Wanous et al., 2003), (Oyeyipo et al., 2016). | 3 | This item explains the methods of construction (Proportions that can be constructed mechanically or manually) to be used. |
| 35. | Public objection | (Mohammad Wanous et al., 2000), (Mohammed Wanous et al., 2003). | 2 | This item explains the public objection on the project. |
| 36. | Tendering method (selective, open) / tendering procedures | (Shash, 1993), (Lowe and Parvar, 2004) | 2 | This item explains the tendering procedures (selective / open) to be used for selection of appropriate bidder. |
| 37. | Criteria of bid selection | (Leśniak and Plebankiewicz, 2013), (Leśniak, 2017). | 2 | This item explains the criteria to be used for bid selection (Lowest Bid, joint venture, negotiation etc.). |
| 38. | Degree of constructability - Degree of complexity of works | (Leśniak and Plebankiewicz, 2013), (Leśniak, 2017). | 2 | This item explains the technical knowledge of the firm (degree of complexity of works faced during execution of the project). |
| 39. | Resource availability - Availability of qualified staff | (Chua and Li, 2000), (Egemen and Mohamed, 2007). | 2 | This item explains the company's internal resources to implement the job i.e. human resources. (Possessing enough number of qualified management staff). |
| 40. | Soft gains from the projects | (Bageis and Fortune, 2009), (El-Mashaleh et al., 2014). | 2 | This item explains the soft gains achieved from the projects including: Increase the possibility of building a long-term relationship with the client, The benefits expected in terms of the |

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| | | | | equipment's assets of the company, The benefits expected in terms of the project management experience. |
| 41. | Type of contract | (Bageis and Fortune, 2009), (Oyeyipo et al., 2016). | 2 | This item explains the type of contract to be executed after winning project. |
| 42. | Knowledge of site - Familiarity with site condition | (Bageis and Fortune, 2009), (Oyeyipo et al., 2016). | 2 | This item explains the familiarity of the tenderer with site condition. |
| 43. | General (office) overhead | (Bageis and Fortune, 2009), (Oyeyipo et al., 2016). | 2 | This item explains the general (office) overhead of the company in preparing and submitting a bid. |
| 44. | Similar previous experience - Previous experience with the client | (Bageis and Fortune, 2009), (Jarkas et al., 2013). | 2 | This item explains the previous working experience of the contractor with the client. |
| 45. | Anticipated rate of return | (Chua and Li, 2000), (Oyeyipo et al., 2016). | 2 | This item explains the required rate of return on investment. |
| 46. | Uncertainty in cost estimate | (Mohammed Wanous et al., 2008), (Bageis and Fortune, 2009). | 2 | This item explains the uncertainty in cost estimate. |
| 47. | Alternative design | (Lowe and Parvar, 2004), (Bageis and Fortune, 2009). | 2 | This item explains the feasibility of alternative design to reduce cost. |
| 48. | Bidding document price | (Bageis and Fortune, 2009), (Oyeyipo et al., 2016). | 2 | This item explains the bidding document price. |

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| 49. | Competitive advantage - lowest cost | (Lowe and Parvar, 2004), (Aznar et al., 2017). | 2 | This item explains the competitive advantages that a tenderer firm can avail. |
| 50. | Prequalification requirement | (Bageis and Fortune, 2009), (Oyeyipo et al., 2016). | 2 | This item explains the prequalification requirement of the project. |
| 51. | Past experience with the management consultant | (Bageis and Fortune, 2009). | 1 | This item explains the earlier working experience with the management consultant. |
| 52. | Terms of payment (monthly, quarterly, etc.) | (Egemen and Mohamed, 2007). | 1 | This item explains the terms of payment (monthly, quarterly, etc.) to be applied during execution of project. |
| 53. | Financing source | (Hassanein, 1996). | 1 | This item explains the financing source of the project (donor etc.). |
| 54. | Resource availability - Possessing enough number of required plant and equipment | (Egemen and Mohamed, 2007). | 1 | This item explains the availability of required plant and equipment for the project. |
| 55. | Resource availability - External resources (plant, materials and subcontractors) to support the implementation of the project. | (Lowe and Parvar, 2004). | 1 | This item explains the availability of required plant, material and subcontractors to support the implementation of the project. |
| 56. | Resource availability - Capacity to supply resources for | (Fayek et al., 1999). | 1 | This item explains the capacity of the contractor to supply resources for construction. |

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| | construction | | | |
| 57. | Resource availability - Type of required labor | (Bageis and Fortune, 2009). | 1 | This item explains the availability of required skilled labor. |
| 58. | Resource availability - Expertise (having the required technical expertise) | (Aznar et al., 2017). | 1 | This item explains the availability of technical expertise required to execute the project. |
| 59. | Promote the reputation of the firm | (El-Mashaleh et al., 2014). | 1 | This item explains the soft gains from the project as it promote the reputation of the firm. |
| 60. | The project is matching the company strategy and future vision | (Bageis and Fortune, 2009). | 1 | This item explains either the project is matching the company strategy and future vision or not. |
| 61. | Contractor's own strategic objective | (Hassanein, 1996). | 1 | This item explains the strategic objective: a contractor can avail by doing such projects. |
| 62. | Strategic and marketing (non-monetary) contribution of the project | (Lowe and Parvar, 2004). | 1 | This item explains the strategic and marketing (non-monetary) contribution of the project. |
| 63. | Project's possible contribution to increase the contractor firm's classification | (Egemen and Mohamed, 2007). | 1 | This item explains the project's possible contribution to increase the contractor firm's classification. |

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| 64. | Estimating workload | (Odusote and Fellows, 1992). | 1 | This item explains the estimated workload. |
| 65. | Degree of constructability - Degree of difficulty | (Mohammed Wanous et al., 2008). | 1 | This item explains the degree of difficulty to be faced while execution of a project. |
| 66. | Degree of constructability - Technological difficulty of project beyond the capability of the firm | (Oyeyipo et al., 2016). | 1 | This item explains the technological difficulty of project beyond the capability of the firm. |
| 67. | Competitive environment | (Oyeyipo et al., 2016). | 1 | This item explains the competitive environment of the market. |
| 68. | Quality of documentation/specification - Consultants' interpretation of the specification | (Chua and Li, 2000). | 1 | This item explains the consultants' interpretation of the specification. |
| 69. | Time to prepare bid - Time of biding (season) | (Bageis and Fortune, 2009). | 1 | This item explains the time of the season in which bidding take place. |
| 70. | Market competition - Influence of the client in making recommendations in the construction market | (El-Mashaleh et al., 2014). | 1 | This item explains the influence of the client in making recommendations in the construction market. |
| 71. | Market knowledge - familiarity with | (Fayek et al., 1999). | 1 | This item explains the market knowledge of the bidder. |

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| 72. | Market knowledge - Market direction | (Oyeyipo et al., 2016). | 1 | This item explains how much a tenderer has Market knowledge. |
| 73. | Degree of difficulties in obtaining bank loan | (Bageis and Fortune, 2009). | 1 | This item explains the degree of difficulties in obtaining bank loan. |
| 74. | Contractor's financial situation - Financial status of the company (working cash requirement of project) | (Egemen and Mohamed, 2007). | 1 | This item explains the financial status of the company (working cash requirement of the project). |
| 75. | Client reliability | (Hwang and Kim, 2016). | 1 | This item explains how much client is reliable to work with (trustworthy, seriousness, performing consistently well). |
| 76. | Provide client satisfaction | (Odusote and Fellows, 1992). | 1 | This item explains the amount of client satisfaction necessary for bidding. |
| 77. | Original price estimated by the client | (Bageis and Fortune, 2009). | 1 | This item explains the original price of the project estimated by the client. |
| 78. | Owner's requirement / The client requirements | (Bageis and Fortune, 2009). | 1 | This item explains the requirement of the client. |
| 79. | Relations with other contractors and | (Mohammed Wanous et al., 2008). | 1 | This item explains the relations of the contractor with other |

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| | suppliers | | | contractors and suppliers. |
| 80. | Expertise in management and coordination | (Chua and Li, 2000). | 1 | This item explains the expertise in management and coordination of the firm. |
| 81. | Need for continuity in employment of key personnel and workforce | (Chua and Li, 2000). | 1 | This item explains the need for continuity in employment of key personnel and workforce. |
| 82. | Consortium relationship (Consortium: Did the company work with the other members of the consortium before? (in this country or elsewhere) | (Aznar et al., 2017). | 1 | This item explains the consortium relationship (Consortium: Did the company work with the other members of the consortium before? (in this country or elsewhere). |
| 83. | Requirement of bond capacity | (Oyeyipo et al., 2016). | 1 | This item explains the requirement of bond capacity. |
| 84. | The project management system | (Bageis and Fortune, 2009). | 1 | This item explains the project management system to be used by the firm. |
| 85. | Administrative interference | (Mohammed Wanous et al., 2008). | 1 | This item explains the Administrative interference in the bidding process. |
| 86. | Local partner | (Aznar et al., 2017). | 1 | This item explains the availability of local partner required for JV. |

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| 87. | Local competitor (not competing against a local competitor) | (Aznar et al., 2017). | 1 | This item explains the local competitor (not competing against a local competitor) |
| 88. | Governmental division requirements | (Bageis and Fortune, 2009). | 1 | This item explains the Governmental division requirements. |
| 89. | Company's ability in required construction technique | (Chua and Li, 2000). | 1 | This item explains the company's ability in required construction technique. |
| 90. | Technological difficulty of the project being beyond the capability of the firm | (Egemen and Mohamed, 2007). | 1 | This item explains the technological difficulty of the project being beyond the capability of the firm. |
| 91. | Competence of estimators | (Chua and Li, 2000). | 1 | This item explains the competence of estimators. |
| 92. | Bond requirement | (Mohammed Wanous et al., 2008). | 1 | This item explains the bond requirement (i.e. Bid bond, Performance bond & payment bond) of the project. |
| 93. | company's strength / Company's strength in the industry | (Fayek et al., 1999). | 1 | This item explains the company's strength in the industry. |
| 94. | Amount of work the client carries out regularly | (Egemen and Mohamed, 2007). | 1 | This item explains the amount of work the client carries out regularly. |
| 95. | Ability of doing the project | (Bageis and Fortune, 2009). | 1 | This item explains the firm's ability of a doing the project. |

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| 96. | Desire for the project | (Fayek et al., 1999). | 1 | This item explains the need of work. |
| 97. | Size of client | (Bageis and Fortune, 2009). | 1 | This item explains the size of client. |
| 98. | Contract Size / Size of contract in SR | (Bageis and Fortune, 2009). | 1 | This item explains the Size of contract in SR. |
| 99. | Competency – project size | (Lowe and Parvar, 2004). | 1 | This item explains the project size. |
| 100. | The project supervision procedure | (Bageis and Fortune, 2009). | 1 | This item explains the project supervision procedure to be adopted. |
| 101. | The contract includes an "Adjustment for Changes in Cost" sub clause | (El-Mashaleh et al., 2014). | 1 | This item explains either the contract includes an "Adjustment for Changes in Cost" sub clause or not. |
| 102. | Clarity of bidding and contract procedure, | (Hwang and Kim, 2016). | 1 | This item explains the clarity of bidding and contract procedure. |
| 103. | Project's possible contribution to breaking into new markets | (Oyeyipo et al., 2016). | 1 | This item explains the Project's possible contribution to breaking into new markets. |
| 104. | Insurance premium | (Oyeyipo et al., 2016). | 1 | This item explains the insurance premium requirement of the project. |
| 105. | Competitive analysis of the tender environment | (Lowe and Parvar, 2004). | 1 | This item explains the competitive analysis of the tender environment. |

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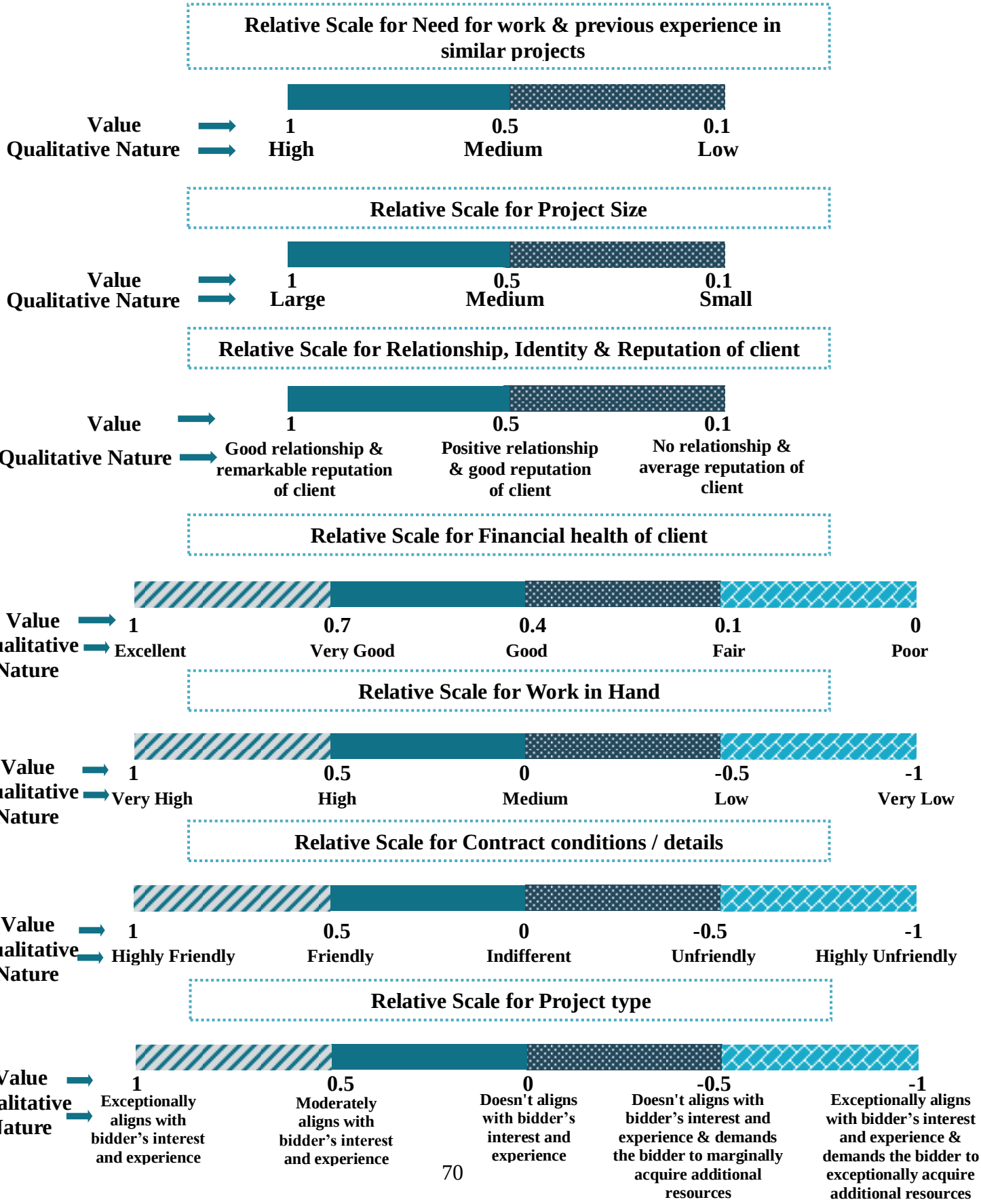
| 106. | Uncertainty due to weather conditions | (Oyeyipo et al., 2016). | 1 | This item explains the uncertainty due to weather conditions. |
| 107. | Government legislation | (Oyeyipo et al., 2016). | 1 | This item explains the Government legislations. |
| 108. | Competitiveness of competitors | (Oyeyipo et al., 2016). | 1 | This item explains the competitiveness of competitors. |
| 109. | Identity of competitors | (Oyeyipo et al., 2016). | 1 | This item explains the identity of competitors. |
| 110. | Owner's requirement | (Oyeyipo et al., 2016). | 1 | This item explains the Owner's requirement for carrying out the project. |
| 111. | Additional order scale | (Hwang and Kim, 2016). | 1 | This item explains the additional order scale. |
| 112. | Portion subcontracted to others | (Oyeyipo et al., 2016). | 1 | This item explains the portion of the project which can be subcontracted to others. |
| 113. | Tax liability | (Oyeyipo et al., 2016). | 1 | This item explains the tax liability. |
| 114. | Value of liquidated damages | (Oyeyipo et al., 2016). | 1 | This item explains the value of liquidated damages to be paid. |

## *Annexure 2 Graphical Representation of Bid/No Bid Criteria*



**Relative Scale for fulfilling the tender conditions imposed by the client**

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| **Value** | **1** | **0.5** | **0** | **-0.5** | **-1** |
| **Qualitative Nature** | **Able to perfectly fulfill tender conditions imposed by the client** | **Able to easily fulfill tender conditions imposed by the client** | **Not Sure** | **Unable to fulfill tender conditions imposed by the client** | **Extremely unable to fulfill tender conditions imposed by the client** |