Optimizing contractor's selection and bid evaluation process in construction industry: Client's perspective

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Abstract
Construction in developing countries is often encountered with multifarious challenges including contractor's performance due to lack of qualification and resources. The lowest bid criterion is binding in public procurements. However, contractors exploit the loopholes in the bid process management system. This paper scrutinizes the prevalent rules for the bid evaluation and investigates the criterion used by both clients and consultants in selecting the contractors during the bids evaluation phase of construction projects in Pakistan. The current research uses the relative importance index and severity index approach to analyze the data. It was discovered that proper planning, credit worthiness, transition plans, plant and equipment holding, financial stability, past performance, and quality, are the most imperative factors, influencing the contractor's selection procedures used by clients and consultants. Likewise, a high probability of success is presaged if the contractors are selected using the multi-criteria method. The study contributes to the body of knowledge by revealing the significant factors impacting the contractor's selection and bid evaluation process, especially in a developing country. Its results and methodology can also be generalized with caution in other developing countries having similar work environment.

Keywords: Contractor's selection, bid evaluation, client's perspective, construction industry, developing countries.

Introduction

The construction industry in developing countries is usually daunted by diverse challenges, such as the contractor's under performance due to lack of qualification and resources (Akcay & Manisali, 2018; Hwang & Kim, 2016). The inefficient contractor's selection criteria, being adopted by the employers for procurement of civil work, result in persistent cost and time overruns and imminent quality issues (Holt, 2010). Resultantly, experienced contractors manage to exploit the loopholes in the existing bid evaluation processes (Mahdi et al., 2002).

The construction projects pass through various complex stages, starting with the primary stage of bidding in which a project is awarded to a contractor. Awarding a project to a suitable contractor is a difficult process (Akcay & Manisali, 2018; Idrus et al., 2011). Alhazmi & McCaffer (2000) argue that the successful completion of a construction project is

directly impacted by the selection of a suitable constructor. Hwang & Kim (2016) argue that a competent contractor is indispensable for the completion of a construction project throughout its project lifecycle. A major issue that hinders the success of a construction project is bid evaluation and contractor's prequalification, faced by numerous construction industries around the world (Forcael et al., 2011; Holt et al., 1993; 1994; Idrus et al., 2011; Kaming et al., 1997; Mahdi et al., 2002). The causes of this issue vary depending on the culture, environment, processes, and organization of the construction industry. Researchers have found that mismanagement within the bidding and procurement process, and the lowest bid criterion cause failure or delay in the completion of construction projects **(**Holt, 2010; Marmolejo Duarte, 2017). Nevertheless, many construction industries in developing countries are still using the lowest bid selection process for awarding the contract.

Though alternative bidding systems are suggested in previous studies to ensure the quality of construction projects, developing countries are slow in adopting them (Palaneeswaran & Kumaraswamy, 2000; San Cristóbal, 2011). Noor et al. (2013) found that outcomes of alternative bidding systems produce high competition in the construction industry, eventually leading to higher performance of the contractors. Thus, developed countries shifted to the best value procurement system. On the contrary, the construction industry is underperforming in developing countries despite research on several solutions. The core reason, that underperformance has become an epidemic in developing construction industries, is the apathy to change and continuous use of the lowest bid selection process (Noor et al., 2013).

Description of the Problem

Construction industries vary in terms of their process of bid evaluation based on the countries they operate in and the environment that industry offers. The process of contractor selection and bid evaluation is reliant on differing decision criteria based on geographic location (Akcay & Manisali, 2018). Research conducted in different construction industries reveals the existence of various decision criteria when it comes to choosing an appropriate contractor. Recognized universal factors considered in the process of assessing a contractor include project packaging, invitation, prequalification, shortlisting and bid evaluation (Holt, 2010; Idrus et al., 2011). Therefore, it has become imperative to understand whether the indicated universal factors influencing the contractor's evaluation during the bid process are equally effective in a specific region or not.

In Pakistan, the government has developed and enforced the Public Procurement Regulatory Authority (PPRA) rules in 2004 for the procurement of public works (Choudhry, 2016). According to PPRA, the "lowest bid" criterion is binding in public procurements, and the guiding factors followed for contractor's selection are experience, past performance, personnel, financial position, plant and equipment, and management capability. Despite, adhering to the recommended procedures, key construction stakeholders still concede that flaws and shortcomings exist in the contractor selection, bid evaluation, and procurement system (Noor et al., 2013). A study conducted by Haseeb et al. (2011) found that 80% of construction projects in Pakistan faced delays, and only 20% were completed within the scheduled time and cost. Based on their analysis, a major portion of the delay in large-scale projects is associated with contractors, such as inadequate experience, improper planning, and poor site management. Others have found that poor contractor selection methods used in the country lead to cost and time overruns causing disputes between clients and contractors (Choudhry, 2016). It is evident that there are specific issues in Pakistan associated with selecting an appropriate contractor during the bidding process for awarding construction projects (Choudhry, 2016; Noor et al., 2013). Moreover, consultants also play a key role in selecting the most suitable contractor during the bidding process.

Of the several universal factors cited in the literature, it is imperative to analyze which of them are essential in choosing a contractor. Therefore, it is important to uncover the essential criteria used for contractor selection and bid evaluation in the construction industry of Pakistan. The current study identifies and examines the contractor selection and bid evaluation criteria through a complete assessment of published literature as well as the criteria stated by PPRA. The study also introduces the analysis of other unique factors that may impact the decision for bid evaluation and contractor selection.

State of the Art

The relevant published literature has identified different sets of criteria and factors that can be used to assess a contractor's appropriateness for a construction project (Vahdani et al., 2013). The influential work of Holt et al. (1994) is noted to be a pioneer in identifying the prequalification requirements using a quantitative model for choosing contractors. In a further study of Holt et al. (1995), it was revealed that choosing a contractor needs to be based on

the value of money instead of automatically selecting the lowest bidder as the primary aim of the process is to identify the most optimum tender and not the lowest bidder. Shrestha et al. (2014) argued that many clients have varied methods of quantifying the criteria, while others resort to a subjective assessment of contractors based on the information solely provided by them. Morkūnaitė et al. (2017) found the same trend in the current times where clients select contractors based on the lowest bid, making the lowest price a dominant requirement in project award. In contrast, Morkūnaitė et al. (2017) argue that only considering the lowest price as a requirement for awarding the contract may cause the client to choose an "unqualified, incompetent, inexperienced, and insufficiently financed contractor". Polat (2016) also asserted that selection of an inappropriate contractor can result in massive additional costs caused from a rework of the project due to "poor quality of work, claims, disputes, litigation, adversarial working conditions, penalties, abandonment of work, and even bankruptcy" (p. 1049).

Some researchers have proposed different selection criteria. El-Sawalhi et al. (2007) identified the main criteria for prequalification and bid evaluation which include financial soundness, management and technical ability, experience and performance of the contractor, availability of resources, quality management, and health and safety management (p. 473). Choi et al. (2006) also identified these additional criteria, as universally accepted, for the selection of contractors and bid evaluation, including primarily financial capability, technical capability, team management, and health and safety track record of the contractor. Other common criteria reported by several studies for contractor evaluation and selection include financial stability, technical qualification and capacity, knowledge of technical personnel, experience, management capacity, relationship with others and past performance, reputation, and health and safety (Banaitiene & Banaitis, 2006; Cheng & Li, 2004; Darvish et al., 2009; Fong & Choi, 2000; Hwang & Kim, 2016; Jafari, 2013; Kaklauskas et al., 2006; Nieto-Morote & Ruz-Vila, 2012; Vahdani et al., 2013; Zavadskas et al., 2008). Some researchers have moved away from the criteria that value financial stability to price or bidder price criteria (Brauers et al., 2008; Marmolejo Duarte, 2017). In addition to the main financial criteria, researchers have introduced few more criteria including physical and human resources (Cheng & Li, 2004; Fong & Choi, 2000; Woo et al., 2017), time (Banaitiene & Banaitis, 2006; Chinyio et al., 1998; Zavadskas et al., 2008), quality (Banaitiene & Banaitis, 2006; Enshassi et al., 2013; Turskis, 2008; Zavadskas et al., 2008), risk (Banaitiene & Banaitis, 2006; Turskis, 2008), and past relationships with clients and other contractors (Fong & Choi, 2000; Zavadskas et al., 2008).

The literature indicates that the selection of a contractor for a construction project varies depending on the client. The priorities and requirements of clients and consultants vary depending on the nature of the project. Chinyio et al. (1998) conducted a study to uncover details of specific requirements that can be used as guidelines for the process of contractor selection. Another study determined the ranking of 35 different criteria followed in the contractor selection process by Ng & Skitmore (1999). The results showed that there is a huge difference in the use of selection criteria as per the ranking of consultants and clients. Similarly, a conceptual model to measure the impact of different criteria for bid evaluation was developed for the construction industry of Saudi Arabia by Alsugair (1999). A single prequalification or selection criterion has different significance depending on the requirements and nature of the selection committee and environment of the specific industry.

Idrus et al. (2011) produced a tabulation of criteria for the selection of main contractors from the literature review. However, it has become outdated, as further research is conducted in this area. There is a need to include the latest literature that has identified some of the universal contractor selection criteria. A continuation of Idrus et al. (2011) is presented in Table 1.

Table 1. Main contractor selection criteria extracted from the literature.

Main contractor selection criteria	Topcu (2004)	Palaneeswaram & Kumaraswamy (2001)	Holt et al. (1995)	Jafari (2013)	Cheng & Li (2004)	Kaklauskas et al. (2006)	Niento-Morote & Ruz-Vila, (2012)	Vahdani et al. (2013)	Darvish et al. (2009)	Fong & Choi (2000)	Zavadskas et al. (2009)	Turkis (2008)	Banaitiene & Banaitis (2006)
Financial stability	■	■		■	■	■	■		■	■	■	■	■
Background of the company	■	■						■	■				■
Technical capacity		■		■	■	■		■	■		■		
Cost	■	■	■	■	■	■	■						■
Performance	■			■	■	■	■	■	■				■
Standard of quality	■	■	■	■	■	■	■				■		■
Occupational health and safety	■	■		■	■	■			■		■	■	■
Time performance	■	■	■	■	■		■		■		■		■
Management capability	■						■	■					■
Failed contract	■										■		
Progress of work	■				■	■		■	■				■
Human resource management					■			■	■		■		■
Level of technology	■				■	■			■				■
Relationship with client		■		■		■	■	■	■		■		■
Relationship with sub-contractors	■							■			■		■
Fraudulent activity	■												
Competitiveness	■				■		■		■				■

Methodology

Data collection

The study uses a representative sample of the population from the construction industry of Pakistan. The participants are derived from client organizations and authorized construction consultants involved in contract awarding activity and are registered with Pakistan Engineering Council (PEC). As PEC has more than 1000 registered consultant firms, a sample size of 200 was considered to be adequate representing the consultants' population (Bageis & Fortune, 2009). Consequently, 200 questionnaires were randomly distributed amongst registered construction consultants and clients. Moreover, only those questionnaires were included in analyses that were completely filled by the respondents.

Questionnaire design

The questionnaire developed for this study comprised of 3 sections. The first section collects the information pertaining to the respondent's company, experience, job title, opinion about contract procurement processes and the effectiveness of the PPRA Ordinance, 2004. The second section comprised of 28 sub-criteria (clustered into 5 main criteria) that may impact the contractor selection and bid evaluation process. Of 28 sub-criteria, 17 were extracted through a comprehensive literature review, summarized in Table 1 (Banaitiene & Banaitis, 2006; Cheng & Li, 2004;

Holt et al., 1995; Kaklauskas et al., 2006; Nieto-Morote & Ruz-Vila, 2012; Palaneeswaran & Kumaraswamy, 2001; Topcu, 2004; Turskis, 2008; Zavadskas et al., 2008), while 11 were included through a pilot study. A five-point Likert scale: (1) least important, (2) slightly important, (3) important, (4) very important, and (5) extremely important, was adopted to judge the severity of each sub-criterion for contractor selection and bids evaluation. The last portion of the questionnaire outlines the items identified as issues associated with successfully completing a construction project. Participants were asked to identify the threshold of the issue, by indicating its rating (severity) from a choice of low, medium, and high. Participants were also asked to indicate the type of evaluation that carries the maximum weight in selecting a contractor on a three-point Likert scale (low, medium and high).

Pilot study

Mora et al. (2018) assert that the pilot study assesses the applicability of the process and research instrument, and it is instrumental in the success of main study. In this context, a pilot study was conducted on ten participants employed in Pakistan's client and consultant organizations registered with PEC. The purpose of conducting the pilot study with these participants was to comprehend the extent of the questionnaire to engage participants and extract viable information. All 17 sub-criteria extracted from the literature were included in the pilot study.

Severson et al. (1994) argue that a research instrument has to derive maximum information from participants which can only be done if the questions are straightforward but targeted to answering the research questions. Moreover, the questions are required to be brief with a direct answer but still be insightful to arrive at meaningful conclusions. Hence, closed-ended questions were asked which limited the respondent's answers with a list of choices (Maqsoom & Charoenngam, 2014). Based on the opinion of experts during the pilot study, the questionnaire was reviewed and adjustments were made by increasing the sub-criteria of contractor selection and bid evaluation to 28.

Results

Treatment of the data

Of 131 filled questionnaires, 12 incomplete responses were excluded from further analysis (Seo et al., 2004). As a result, 119 questionnaires were accepted for analysis. The criterion to exclude an incomplete response was to find a pattern in answering most of the questions. Moreover, four randomly chosen sub-criteria (4, 11, 18, and 26) were treated as quality checks and their answers were cross-checked for their accuracy. A response was removed if answers to all the four sub-criteria were found different from most of the other responses (Zahoor et al., 2017).

Normality test

Following hypotheses were developed to test the normality of collected data:

H_0: The sampled population is normally distributed.
H_1: The sampled population is not normally distributed.

To test these hypotheses, the Kolmogorov-Smirnov (K-S) test for normality was conducted using SPSS. The results of the test are displayed in Table 2. The results show that the population is normally distributed as the K-S statistic values and the significance values are greater than 0.05 (Sig.>0.05). In a normal distribution, the significance value must be greater than 0.05 (Royston, 1982). Therefore, it can be concluded that there is not enough evidence to reject the claims that the sampled population is normally distributed. Therefore, the H_1 hypothesis is rejected and H_0 accepted.

Data reliability and validity

Reliability is a measure that analyzes if the items in a survey questionnaire are reliable to provide consistent results after respective testing in variable environments. Cronbach's Alpha test was performed and value for the complete dataset was measured as 0.855 which ranges between $0.9 \geq \alpha \geq 0.8$. Therefore, collected data can be considered as 'acceptable' or 'good' for further analysis (Netemeyer et al., 2003). The remaining 14 questions in the questionnaire asked the respondents about their experience (i.e. individual and organizational), severity indexes, procurement method preferences, and other questions related to contracts and procurements. The Cronbach's Alpha value for these 14 questions is obtained as 0.845, implying that the collected data is reliable and all items hold a fair internal consistency.

Table 2. K-S Test results for normality of data (Royston, 1982).

Main criterion / category	Sub-criterion	Kolmogorov-Smirnov[1]			Shapiro-Wilk		
		Statistic	df	Sig.	Statistic	df	Sig.
Financial Soundness	Financial Stability	.265	118	.200	.788	118	.700
	Estimated Costs	.297	118	.412	.821	118	.500
	Banking Arrangements	.361	118	.201	.734	118	.400
	Satisfactory Settlement	.261	118	.070	.802	118	.900
	Credit Worthiness	.300	118	.502	.764	118	.820
	Salary Satisfaction	.298	118	.409	.787	118	.500
Technical Ability	Past Experience	.228	118	.080	.806	118	.440
	Plant and Equipment Holding	.299	118	.220	.767	118	.700
	Permanent Work Force	.253	118	.060	.803	118	.900
	Compatibility With Project	.292	118	.510	.792	118	.600
	Quality Assurance	.241	118	.020	.798	118	.440
	Labor Force Retention	.307	118	.330	.780	118	.120
	Proper Planning	.299	118	.050	.754	118	.500
	Methods Of Execution	.250	118	.030	.821	118	.400
Management Capabilities	Past Performance and Quality	.250	118	.800	.794	118	.600
	Organization And Management Capabilities	.261	118	.030	.792	118	.200
	Methodology Of Managing Sub-Contractors	.322	118	.200	.772	118	.360
	Risk Management	.227	118	.700	.803	118	.270
	Transition Plan	.297	118	.700	.763	118	.090
Health and Safety	Attention to Site Welfare and Safety	.278	118	.540	.816	118	.580
	Health and Safety Procedures	.406	118	.080	.661	118	.430
	Accident Rates	.332	118	.420	.763	118	.370
	Management Safety Accountability	.279	118	.603	.798	118	.420
Reputation	Length Of Time In Business	.324	118	.070	.769	118	.050
	Past Failures	.296	118	.095	.786	118	.090
	Past Client-Contractor Relationship	.311	118	.082	.778	118	.300
	Current Reputation	.267	118	.300	.800	118	.070
	Behavior With Staff	.286	118	.900	.796	118	.820

[1]Lilliefors Significance Correction.

Demographic results

Out of 119 returned responses, 87 were received from clients while the remaining 32 were from consultants. The response rate of 59.50% is considered to be a decent response rate. Each respondent was analyzed for their personal experience in the construction industry and the experience of their employer organization. A majority of the respondents (93 in total) had an individual experience of 16 to 20 years. The data reflects that 88 individuals with 16 to 20 years of experience are working for their current organization, whereas only 12 respondents had a personal experience of 6 to 12 years. The composition of experience is illustrated in Figures 1 and 2.

Figure 1. Respondent's organizational experience.

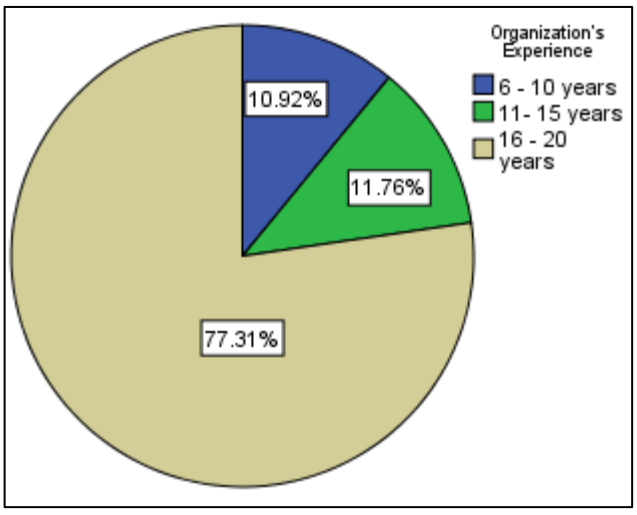
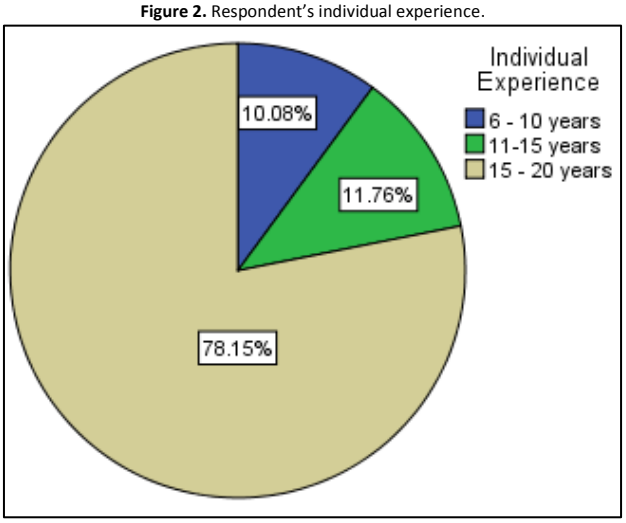


Figure 2. Respondent's individual experience.



Type of procurement (contract) vs. respondents' experience and evaluation method

A key question asked from the respondents was about the type of procurement (contract) offered to contractors in the last five to ten years. The responses as shown in Table 3 indicate that mostly traditional contracts were awarded in the Pakistani construction industry, with 59 respondents indicating this choice on their questionnaire. Design and Build procurement method was adopted by 28 respondents, while the remaining 32 respondents indicated that Turnkey procurement contracts were widely used in the industry over the last ten years.

Table 3. Type of procurement contract vs. respondents' experience.

Respondents' Experience	Procurement Contract			Total
	Traditional Contract	Design and Build	Turnkey	
6-10 years	4	8	0	12
11-15 years	6	8	0	14
16-20 years	49	12	32	93
Total	59	28	32	119

Respondents were also asked to indicate which method of evaluation they believe to be the most effective in selecting the best contractor. The answers are tabulated in Table 4. According to 61 respondents, the multi-criteria method of evaluation provides the clients with the best value from a contractor. On the other hand, 58 respondents indicated that the single-step criterion of the lowest bid price was the best method to evaluate a contractor. Likewise, 41 participants showed a preference for the multi-criteria method while awarding contracts through the traditional procurement method. This is followed by 32 respondents who preferred the single criterion of contractor evaluation while awarding contracts through the Turnkey procurement method.

Table 4. Type of procurement contract vs. method of evaluation.

Method of Evaluation	Procurement Contract			Total
	Traditional Contract	Design and Build	Turnkey	
Single criterion	18	8	32	58
Multi-criteria	41	20	0	61
Total	59	28	32	119

Relative Importance Index (RII) results

The financial soundness was the first category for which RII was calculated. According to Johnson & LeBreton (2004), RII is helpful in finding the contributions of specific variables to the entire system or phenomenon. In order to empirically ascertain the factors that contribute to the implementation and preference of selecting a specific contractor and bid evaluation, RII is used, which is calculated using Eq. 1. Where, *W* is the weight given to each factor by the respondents (ranging from 1 to 5), *A* is the highest weight (i.e. 5 in the current study), and *N* is the total number of respondents.

$$RII = \frac{\sum W}{A \times N} \qquad \text{Eq. (1)}$$

All the sub-criteria were ranked based on RII values. As seen in Table 5, RII of the "credit worthiness" of a contractor was calculated as 0.86, making it the most important main criterion for the contractor selection and bids evaluation. The 'financial stability of contractor', with RII value of 0.84, was identified as the second most important criterion. At the third rank, two criteria 'banking arrangements and bonds' and 'satisfactory settlement of final accounts on past projects', with RII of 0.82 each, are placed.

Table 5. RII Results for financial soundness criterion. Source: Johnson & LeBreton (2004).

S/No	Question	Factor	RII	Rank
1	FS5	Credit Worthiness	0.86	1
2	FS1	Financial Stability of Contractor	0.84	2
3	FS3	Banking Arrangements and Bonds	0.82	3
4	FS4	Satisfactory Settlement of Final Accounts on Past Projects	0.82	3
5	FS2	Estimated Cost of Project/Tender Price	0.79	4
6	FS6	Employee's Satisfaction in Terms of Salary (Monthly Pay)	0.79	4

The next category of the questions pertains to the factors influencing the contractor's technical ability. As per Table 6, the top three factors impacting the technical ability of contractors include 'proper planning' (RII=0.868), 'plant and equipment holding' (RII=0.867), and 'quality assurance' (RII=0.828). It should be noted that 'past experience of contractors', was ranked 6th with RII of 0.812 while 'compatibility of the project' was ranked 7th with RII of 0.807. These findings provide a better insight into what clients and consultants should consider when selecting contractors for a construction project.

Table 6. RII results for technical ability criterion. Source: Johnson & LeBreton (2004).

S/No	Question	Factor	RII	Rank
1	TA7	Proper planning	0.868	1
2	TA2	Plant and Equipment Holding	0.857	2
3	TA5	Quality Assurance	0.828	3
4	TA6	Labor Force Retention	0.823	4
5	TA3	Permanent Work Force (Staff)	0.817	5
6	TA8	Methods for Execution	0.817	5
7	TA1	Past Experience	0.812	6
8	TA4	Compatibility with the Project	0.807	7

Management capability is the third category, analyzed for contractor selection. The responses obtained are summarized in Table 7. The 'transition plan' was ranked first with RII value of 0.863. It was followed by 'past performance and quality' (RII=0.833), 'organization and management capabilities' (RII=0.832), and 'methodology of managing sub-contractors' (RII=0.825). Ranking of these sub-criteria gives a better idea as to which of the variables are significant.

Table 7. RII results for management capability criterion. Source: Johnson & LeBreton (2004).

S/No	Question	Factor	RII	Rank
1	MC5	Transition Plan	0.863	1
2	MC1	Past Performance and Quality	0.833	2
3	MC2	Organization and Management Capabilities	0.832	2
4	MC3	Methodology of Managing Sub-Contractors	0.825	3
5	MC4	Risk Management	0.820	4

The fourth category of health and safety has become an important criterion for the selection of contractors. Britain and Banwell (1964) stated that health and safety requirements in contractor selection have become an imperative variable. The responses are summarized in Table 8. The most important factor for the selection of contractors, based on health and safety, is determined as 'OSHA incident rates (accident rates)' with RII value of 0.823. It was followed by 'health and safety procedures' (RII=0.812), 'management safety accountability' (RII=0.812), and 'attention to site welfare and safety' (RII=0.797).

Table 8. RII results for health and safety criterion. Source: Johnson & LeBreton (2004).

S/No	Question	Factor	RII	Rank
1	HS3	OSHA Incident Rates (Accident Rates)	0.823	1
2	HS2	Health and Safety Procedures	0.812	2
3	HS4	Management Safety Accountability	0.812	2
4	HS1	Attention to Site Welfare and Safety	0.797	3

The last category analyzed for RII values was the reputation of contractors. This category had five variables that needed to be analyzed in order to understand the importance of each factor. Table 9 provides the results of RII analysis. The factor 'behavior with staff' was considered to be the most important with RII value of 0.827. Other factors, in descending order, are ranked as: 'past client-contractor relationship' (RII=0.822), 'past failures (incomplete projects)' (RII=0.817), 'current reputation in the market' (RII=0.815), and 'length of time in the business' (RII=0.805).

Table 9. RII results for reputation criterion. Source: Johnson & LeBreton (2004).

S/No	Question	Factor	RII	Rank
1	R5	Behavior with Staff	0.827	1
2	R3	Past Client Contractor Relationship	0.822	2
3	R2	Past Failures (Incomplete Projects)	0.817	3
4	R4	Current Reputation in Market	0.815	4
5	R1	Length of Time in Business	0.805	5

Severity Index results

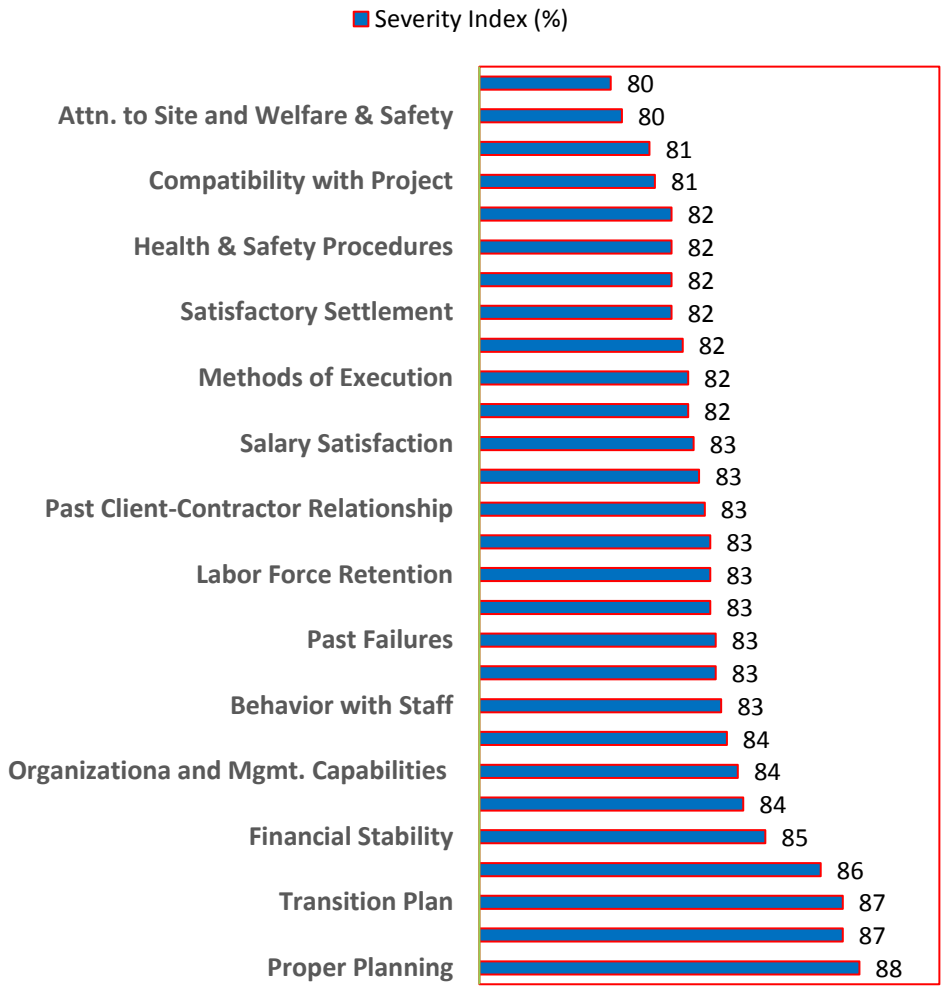
In addition to the RII, many academics in the construction field recommend the application of a 'Severity Index' score that can be used to analyze the responses based on their severity score (Idrus et al., 2011). To further examine the current study's results, the severity index was calculated to analyze the frequency of responses. According to Idrus et al. (2011), Eq.2 can be used to determine the severity of factors.

$$Severity\ Index\ (I) = \frac{[\sum a_i \times x_i]}{[5 \sum x_i]} \times 100\% \qquad \text{Eq. (2)}$$

Where, x_i expresses the frequency of responses for i; in which i is one of the Likert scale responses (i.e. 1, 2, 3, 4 and 5) and a_i is the constant expressing the weight given to the i_{th} response (for i = 1, 2, 3, 4, 5, *value of* a_i is 0, 1, 2, 3, 4).

With the Severity Index, the researchers were able to prioritize all the understudy criteria. The criteria with the highest severity index (5) are ranked as the top criteria, while those holding the least severity index (%) are ranked at the bottom. This was accomplished by transforming the five-point Likert scale to relative importance indices for each of the criteria using Eq. 2 (Idrus et al., 2011). The results of the severity index have been documented in Table 10. It is further illustrated in Figure 3 which provides a visual understanding of the criteria, adopted for contractor selection based on the consultants' and clients' preferences. 'Proper planning' is the top-ranked criterion for contractor selection with a severity index of 88%. Proper planning is found under 'technical ability' in which it ranked 0.868 on the RII index. The next two top-ranked sub-criteria are 'credit worthiness' and 'transition plan' each having a severity index of 87%. The surveyed clients and consultants agreed that both these requirements are equally important when it comes to contractor selection. The next significant sub-criterion is 'plant and equipment holding' with a value of 86%.

Figure 3. Severity index (%) of criteria for selection of a contractor in Pakistan. Source: Idrus et al. (2011).



Discussion

Based on the extensive literature review and data analysis, the study has optimized the criteria for bid evaluation and contractor selection in the Pakistani construction industry. It has interpreted 'financial soundness' to be the most significant main criterion for contractor selection. The significant sub-criteria related to financial soundness are 'credit worthiness', 'financial stability of the contractor', 'banking arrangements and bonds', and 'satisfactory settlement of final accounts on past projects'. These results are in line with the findings of San Cristóbal (2011) in which 'financial stability of a contractor' was suggested as the most important criterion for bid evaluation. El-Abbasy et al. (2013) also established similar results for checking the financial soundness of contractors. Likewise, the financial capacity of a contractor was ranked second by Idrus et al. (2011) for the Malaysian construction industry. The financial capacity of a contractor enables the clients to obtain information regarding the overall financial position of the contractors (Idrus et al., 2011). Though clients still aim for higher profit returns from their construction projects, they are now more concerned with the quality of products and services offered by contractors. Topcu (2004) argued that diligent checks, aimed at assessing the financial capacity of contractors towards fulfilling their contractual obligations are best practices for managing risk in construction projects. Warszawski (1996) asserted that a contractor's financial strength adds to their overall credibility and reputation which positively impacts the perceptions of clients and suppliers. The current study's severity index, as displayed in Table 10 and Figure 3, highlights the 'credit worthiness' as the second most significant sub-criterion with a severity index of 87%. Likewise, 'financial stability' is ranked number four with a severity index of 85% (see Figure 3).

Table 10. Severity Index and ranking of each criterion for selecting the contractor. Source: Eq. (2) & Idrus et al. (2011).

Criteria for Selecting Main Contractor	a_1*x_1	a_2*x_2	a_3*x_3	a_4*x_4	a_5*x_5	$\sum(a_i*x_i)$	$5\sum(x_i)$	Severity Index (%)	Rank
Proper Planning	0	0	30	216	275	521	595	88	1
Credit Worthiness	0	0	45	188	285	518	595	87	2
Transition Plan	0	0	39	204	275	518	595	87	2
Plant & Equipment holding	0	0	54	180	280	514	595	86	3
Financial Stability	0	0	66	188	250	504	595	85	4
Past Performance & Quality	0	0	57	228	215	500	595	84	5
Organizational & Management. Capabilities	0	0	57	232	210	499	595	84	5
Quality Assurance	0	0	72	200	225	497	595	84	5
Behavior with Staff	0	2	45	264	185	496	595	83	6
Methodology of Managing Sub-Contractors	0	2	36	292	165	495	595	83	6
Past Failures	0	0	51	264	180	495	595	83	6
Banking Arrangements	0	0	33	316	145	494	595	83	6
Labor Force Retention	0	0	48	276	170	494	595	83	6
Accident Rates	0	0	42	292	160	494	595	83	6
Past Client-Contractor Relationship	0	0	48	280	165	493	595	83	6
Risk Management	0	0	78	204	210	492	595	83	6
Salary Satisfaction	0	0	54	272	165	491	595	83	6
Permanent Workforce	0	0	69	236	185	490	595	82	7
Methods of Execution	0	4	60	236	190	490	595	82	7
Current Reputation	0	0	66	248	175	489	595	82	7
Satisfactory Settlement	0	0	72	240	175	487	595	82	7
Past Experience	0	0	81	216	190	487	595	82	7
Health & Safety Procedures	0	0	27	360	100	487	595	82	7
Management Safety Accountability	0	0	66	256	165	487	595	82	7
Compatibility with Project	0	0	66	268	150	484	595	81	8
Length of Time in Business	0	0	57	296	130	483	595	81	8
Attention to Site Welfare and Safety	0	2	72	264	140	478	595	80	9
Estimated Costs	0	8	60	268	140	476	595	80	9

Idrus et al. (2011) identified the technical capacity as the third most important criterion. However, the respondents of the current study perceived it to be the second most significant criterion to assess the technical competency of a contractor. The top three sub-criteria needed to achieve 'technical ability' are 'proper planning', 'plant and equipment holding', and 'quality assurance'. In addition, the study has identified 'proper planning' to be the most important sub-

criterion for assessing technical ability, with RII of 0.868 and a severity index of 88%. The study has also identified the top three sub-criteria of 'management capability'. They include 'transition plan', 'past performance and quality', and 'organization and management capabilities'.

The results indicate that the category of 'health and safety' is not given due consideration by the respondents in Pakistan. It should have been the most imperative criterion in contractor selection (Britain & Banwell, 1964). Thus, necessitating to give due weight to the sub-criteria of 'OSHA incident rates (accident rates)' and 'health and safety procedures', while evaluating the performance of contractors. Likewise, the category of 'reputation of the contractor' needs due attention. It can be improved by focusing on the sub-criteria of 'behavior with staff', 'past client-contractor relationship', and 'past failures (incomplete projects).

Conclusions

The construction industry in Pakistan is negatively impacted by poor performance in terms of project delivery. A majority of construction projects are not completed in time and within the allocated resources or budget, thus leading to disputes between clients and contractors. Likewise, with the drastically increasing demands of clients and regulatory agencies, together with high competition among contractors of the construction industry, it has become exceptionally imperative to enforce an effective system for bid evaluation and contractor selection.

Based on the extensive research of previously published literature and data analysis, the current study has investigated the actual criterion used by both clients and consultants in Pakistan for selecting the best contractor during the bids evaluation phase of a construction project. As the decision of accepting a bid for evaluation directly impacts the economic viability of a contractor, it is not recommended to make such a decision solely on the basis of either experience or low bid. Instead, the factors of proper planning, credit worthiness, transition plans, plant and equipment holding, financial stability, past performance, and quality, should be considered while selecting the contractors. These characteristics can be quantified through multi-attribute analysis (MAA) in order to choose a competent contractor. MAA considers a decision alternative with respect to several alternative attributes (characteristics). Therefore, a contractor characteristic represents one feature of a decision with respect to a client's objective (Holt et al., 1995). These characteristics can be measured quantitatively through MAA formula given in Eq. 3, where, ACr_j = aggregate score for contractor j; V_{ij} = variable (characteristic) i score in respect of contractor j; and n = the number of characteristics considered in the analysis.

$$ACr_j = \sum_{i=1}^{n} V_{ij} \qquad \text{Eq. (3)}$$

Through such choice of a competent and qualified contractor, the probability of success would rise significantly, and the contractor would be able to sufficiently achieve the objectives and goals laid out by clients, besides maintaining the constraints of quality, cost, and time.

The current study adds to the literature by optimizing the factors needed for bid evaluation in developing countries. The study's results and methodology can be generalized with caution in other developing countries having similar work environment. The results of the study suggest that it has become imperative for developing countries' construction industries to shift to a multi-criteria method for bid evaluation, especially for contractor selection. The approach proposed in the current research is expected to enable the contract awarding bodies to enhance their managerial decision support system. With better awareness and governmental programs for public procurement, the private sector will also benefit. It would also enable construction stakeholders to compete with transnational and international construction companies that are finding markets in developing countries.

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