

Ranking of the Main Criteria for Contractor Selection Procedures on Major Construction Projects in Libya Using the Delphi Method

Othoman Elsayah, Naren Gupta, Binsheng Zhang

Abstract—The construction sector constitutes one of the most important sectors in the economy of any country. Contractor selection is a critical decision that is undertaken by client organizations and is central to the success of any construction project. Contractor selection (CS) is a process which involves investigating, screening and determining whether candidate contractors have the technical and financial capability to be accepted to formally tender for construction work. The process should be conducted prior to the award of contract, characterized by many factors such as: contractor's skills, experience on similar projects, track- record in the industry, and financial stability. However, this paper evaluates the current state of knowledge in relation to contractor selection process and demonstrates the findings from the analysis of the data collected from the Delphi questionnaire survey. The survey was conducted with a group of 12 experts working in the Libyan construction industry (LCI). The paper starts by briefly explaining the general outline of the questionnaire including the survey participation rate, the different fields the experts came from, and the business titles of the participants. Then the paper describes the tests used to determine when the experts had reached consensus. The paper is based on research which aims to develop rank contractor selection criteria with specific application to make construction projects in the Libyan context. The findings of this study will be utilized to establish the scope of work that will be used as part of a PhD research.

Keywords—Contractor selection, Libyan construction industry, Decision experts and Delphi technique.

I. INTRODUCTION

DURING the last 50 years, the construction sector in Libya has seen dramatic changes in several ways. However, after the oil booming, the construction industry in Libya witnessed real growth and it has been considered one of the significant key roles in the Libyan social and economic development processes. Despite the enormous investment in the construction industry within the last five decades, the Libyan construction industry is still underdeveloped and undergoing major research. In addition, Libya's fragile

O. E. is with the School of Engineering and the Built Environment, Merchiston Campus, Edinburgh Napier University, Edinburgh EH10 5DT, UK and The High Centre for Comprehensive Careers and Prepares Trainers, Civil Engineering Department Sabha, Libya, P.O. Box 19280 (phone: +44-131-455-2249; fax: +44 131-455-2239; e-mail: O.Elsayah@napier.ac.uk).

N. G. is with the School of Engineering and the Built Environment, Merchiston Campus, Edinburgh Napier University, Edinburgh EH10 5DT, UK (phone: +44-131-455-2334; fax: +44-131-455-2239; e-mail: N.Gupta@napier.ac.uk).

B. Z. is with the School of Engineering and Built Environment, George Moore Building, Glasgow Caledonian University, Glasgow G4 0BA, UK (phone: +44-141-331-8660; fax: +44-141-331-3696; e-mail: Ben.Zhang@gcu.ac.uk).

construction domain is facing difficulties and real challenges due to the quick evolution and dependence on foreign exports [12].

The political, social, and environmental situations in Libya are compounded by the lack of experience, shortage of technological resources, long delays, as well as the poor quality of major national projects and of the contractors available. All those factors show that there is an unclear image of the practices that should be utilized in construction management. What are needed are capable and suitable contractors who are able to achieve the highest project performance and able to complete the project in time and on cost according to the quality needed. However, this research will study and provide a solution to the most important problems facing the process of project procurement.

II. BACKGROUND AND HISTORY OF CURRENT CONTRACTOR SELECTION PROCESS

The history of contractor selection process started in the early age of the construction industry, and by the end of the 18th century builders and architects had established the traditional procurement process. This era was hugely important in the evolution of the construction industry and tender process [8]. Reference [10] claims that in the construction industry, experienced contractor is a strong requirement for the project's life. Thus, choosing the right contractor is one of the most key decisions in any project. There are some factors that need to be considered when choosing a contractor such as, contractor's years of service in the construction field and in similar projects; further, contractor's average work volume in the construction field and in similar projects as well as, contractor's average work value with different types of contract; finally, geographical and weather conditions.

One of the most challenging features in the construction industry sector is dealing with a huge number of firms, from small to big multinational firms. To run the business financial stability situation for the company and contractor are very important. Contractors can utilize the company with their own money, but only for a few months, to avoid the failures.

TABLE I
 THE FINAL FRAME WORK OF CONTRACTOR SELECTION

| Main Criteria | Attributes |
|--------------------------------|--|
| Experience | Tender price |
| | Size of project |
| | Length of time in business |
| | Experience in the region |
| | Type of project |
| Financial Stability | Tender price |
| | Banking arrangements |
| | Cash flow |
| Quality | Positive credit rating |
| | Quality work |
| | Quality policy |
| Technical & management ability | Quality assurance |
| | Project manager qualification |
| | Past performance |
| | Company equipments |
| Reputation | Relationship with(Suppliers, sub-contractors, client and local works) |
| | Health and safety |
| Health and safety | Claims and dispute |
| | Safety record |
| | Company safety policy |
| | Experience in noise control |
| Human Resource | staff experience |
| | Staff qualification |

Bankruptcy and provide the cash flow; however, the contractor should receive support by the client in any stage of the contract. In addition, improving the work needs some money to improve conditions for acquiring new equipment or develop new technologies [6].

Similarly, [14] argues that, around the world, health and safety in the construction industry are grave concerns. There have been some efforts by companies to improve their safety by executing their own safety system management; especially the implementation of the latest international standard: Occupational Health and Safety Assessment Series (OHSAS), 18001 which has been adopted only in some countries such as the United Kingdom, Singapore, and Australia?

According to [3], a number of studies agree in that Human resource management (HRM) has become a critical element in most modern organizations. Reference [7] discussed the criteria for contractor selection and found that, the result indicated that the most famous criteria considered by procurers during the selection and prequalification procedure are those relating to financial soundness, technical and management ability, and the health and safety performance of contractors.

Reference [1] published a paper in which they argue that, in construction site, quality and safety are the two specific criteria that should be main concerns in the 21st century. Reference [16] advised that for the construction industry, the implementation of the quality management should not only be at the construction phases but quality should be present throughout the project life cycle.

Aims of Contactor Selection Process (CSP)

The aim of Contactor selection process (CSP) is to make certain that candidates, who complete project needs, can apply for a tendering process. (CSP) is also a selection phase where the minimum abilities, below which any potential contractors would not be considered for the assessment phase, are established [17]. Only contractors who are able should be given the contract [13].

The goal of CSP is to make sure that the candidate, who is recruited for the job, meets the fundamental prerequisites of the job. It is very important to weigh all the odds before recruiting the candidate and all the factors must also be considered. Those who are not capable and competent, do not produce quality work, do not have the required finances and aren't responsible, are eliminated by the owner. The process of prequalification is thus, an assessment of a candidate's skills. It also reduces the danger of any contract being failed and proves to be more satisfactory for the customers [2]. It also helps to reduce and eliminate incompetent, unsuccessful contractors from the bidding process [11].

Reference [4] states the main goal of contractor selection process is to reduce the opportunity of contractor default and in bidding by restricting the numeral of eligible contractors involved. However contractor selection process is an essential task carried out by a contract administrator or clients due to the complexity involved in this process. It is important to avoid or reduce risks of contractor failure and improve client satisfaction in order to optimize the contractor selection in terms of attaining a better balance between price and performance parameters.

III. RESEARCH METHODOLOGY

Qualitative data from Libyan construction sectors were required to form the basis for this study. The survey was conducted with group of experts working in the Libyan construction industry (LCI). This survey was designed to allow experts in the LCI to rank the main criteria for contractor selection, to express their points of view on the suggested framework, and to establish the road map for the framework.

The survey included four main parts. Part one contained a general profile about the participants. Part two asked participants to rank the main criteria. Part three asked participants to express their point of view on the suggested framework. Part four established the road map for the contractor selection criteria framework for the LCI. In order to make the survey process quicker and easier, the questionnaires were sent via email to the designated experts.

IV. QUESTIONNAIRE POPULATION

The selection of experts is one of the most essential parts of the Delphi technique. The participants involved should be interested and knowledgeable about the topic. However, since it is difficult for the researcher to limit the criteria for panel members; for the purpose of this study the participants were limited to those LCI experts who have knowledge and

experience of the LCI and also of the global construction industry.

The survey concentrated on the ranking of the main criteria for contractor selection in the LCI. Twelve diverse professionals were chosen as participants. These included contractors, consultants, clients, and project managers in the LCI. All of the people selected to be part of this survey were familiar with the contractor selection process. The variety of participants was beneficial for the survey because, as [5] pointed out, a heterogeneous group is more reliable than a homogeneous one when it comes to making reliable decisions. Table II shows the response experience rates for the first and second round of the Delphi survey.

TABLE II
 THE PANEL OF EXPERTS

| Number of Participants | Experience and Current Situation |
|------------------------|---|
| 3 | Contractors with 10 to 25 years experience in the LCI |
| 3 | Consultants with 5 to 20 years experience in the LCI |
| 3 | Clients with 5 to 20 years experience in the LCI |
| 3 | Project Managers with 5 to 10 years experience in the LCI |

V. SURVEY VALIDITY

Five professionals were invited to confirm the suitability of the questionnaire. In order to encourage participants to consider questions seriously and answer them appropriately, the shape and the technique of the questions were modified many times to make it easier for them to understand.

VI. SURVEY PILOT STUDY

Five copies of the survey were distributed and then the experts were interviewed. Many had amended the survey by adding or removing questions, reorganising questions, changing the content, and the design and the length of the survey.

VII. THE RESPONSE RATE

Reference [5], citing from [15], argued that the Delphi method should rely on the quality of respondents rather than the sheer number of respondents. On the other hand, [9] stated that the validity of the Delphi technique can be impacted by a reduction in the response rate. Therefore, high quality respondents along with a high response rate are the ideal characteristics of a successful Delphi survey. To get high quality respondents and a high respondent rate, different techniques were used. For example people were contacted by email, letter and telephone. Personal networks with friends and previous colleagues were also used. Table III shows the response rates for the first and second round of the Delphi survey.

TABLE III
 THE RESPONSE RATE FOR THE DELPHI ITERATIONS

| Iterations | Panellists | Response Number | Per cent |
|--------------|------------|-----------------|----------|
| First round | 12 | 12 | 85.714 % |
| Second round | 12 | 11 | 78.571% |

Twelve participations were involved into this study. For the first round of the survey, the respondent rate was very high 100%, while the response rate for the second round was 91.67%, although the reminder procedure. As results, the response rate for this study was high, and the absence of one respondent in the second round of the survey does not influence the outcomes, because they were not distinguished from the rest of the participants. Therefore, the response rate and quality of the panel participants remained high during both survey rounds.

VIII. RESPONSES IN THE FIRST ROUND

A. First Round Consensus

Concept of homogeneity was determined to be a condition of consensus within the judgment of the participant's panellists. To determine whether consensus has been reached or not the Cronbach's alpha value of 0.7 was suggested. Therefore, it was decided that when the required value for Cronbach's alpha (0.7) was obtained, and thus consensus is achieved, then the writing of the results analysis would take place.

TABLE IV
 RELIABILITY STATISTICS

| Cronbach's Alpha | N of Items |
|------------------|------------|
| 0.710 | 12 |

Table IV shows the result of the Cronbach's alpha for the first round 0.710 for the twelve items tested. This indicated that, the level of the Alpha value was acceptable and that there was consensus and homogeneity between the participants regarding their judgments concerning the survey questions.

However, the key characteristic of the Delphi method is iteration and discussion which make participant answers more accurate and reliable. Thus, a second round of the Delphi technique was held to allow the experts the opportunity to re-evaluate their answers in light of the answers of the other participants.

TABLE V
 DESCRIPTIVE STATISTICS

| Category | Items | Mean | Std. Deviation |
|---|-----------------------------------|------|----------------|
| Select and rank the main important criteria | Financial Stability | 3.25 | .965 |
| | Human Resource | 2.08 | 1.443 |
| | Technical & Management Ability | 2.67 | 1.497 |
| | Experience | 3.42 | .793 |
| | Health and Safety | 2.08 | 1.621 |
| | Quality | 2.75 | 1.545 |
| | Reputation | 2.58 | 1.165 |
| | Culture and Weather Consideration | 0.67 | 1.231 |

As can be seen in Table V, the mean value of the experts for the framework is 3.42 and the standard deviation is relatively low at 0.793 thus indicating that there was no considerable variation in participant answers with respect to the framework. Table 4 demonstrates the experts' opinions of how to rank the main criteria for contractor selection. The eight most essential

criteria in the contractor selection were gradually ranked as experience, financial stability, reputation, technical and management ability, quality, human resource, and culture and weather consideration. To relate the mean values back to the scale, 0 to 0.49 = not important at all, 0.50 to 1.49 = low importance, 1.50 to 2.49 = somewhat important, 2.50 to 3.49 = important, and 3.50 to 4 very important. As a result, as can be seen from Table 4, experience factors with a value of 3.42 were considered the most important criterion of all, and cultural and weather considerations were deemed to be the least important criterion.

B. Acceptable Framework

In order to recognize the acceptance degree of the framework, experts were asked about their opinion and overview about the framework. Table VI and Fig. 1 illustrate that among the 12 experts, none of the participants remarked that the framework was unacceptable. However, 1 (8%) of the experts that participated in the survey said the framework was 'acceptable', 2 (17%) of the participants said that the framework was 'good', and 9 (75%) of the experts agree that the framework was 'very good'. This indicates that there was a high level of agreement among the participants about the framework.

TABLE VI
 HOW DO YOU THINK ABOUT THE ABOVE FRAMEWORK?

| Category | Frequency | Per cent |
|--------------|-----------|----------|
| Unacceptable | 0 | 0% |
| Acceptable | 1 | 8% |
| Good | 2 | 17% |
| Very good | 9 | 75.0% |

C. Framework Road Map

As can be seen from Table VII the survey sample was asked about Road map to establish the framework. The results show that none of the experts had mentioned the road map within two to four years, and only 8.3 per cent (1 respondent) of the sample said the road map could be done within six years, 25 per cent (3 respondents) of the sample said the road map could be done within eight years, and the rest (66.7 per cent, 8 respondents) said the road map needed more than eight years. These results indicate that most experts think the framework needs more than eight years to complete.

TABLE VII
 HOW MANY YEARS DOES IT TAKE TO APPLY THIS FRAMEWORK?

| Category | Frequency | Per cent |
|-----------------------|-----------|----------|
| Two years | 0 | 0% |
| Four years | 0 | 0% |
| Six years | 1 | 8.3% |
| Eight years | 3 | 25.0% |
| More than eight years | 8 | 66.7% |

D. Second Round Formulation and Process

The second round of the survey used nearly the same concept as the first round questionnaire did. It also included summaries and notes developed from individuals' observations of the 12, 85.714% participants from the first

round. The total number of responses from the second round was 11, 91.67% of the total participants from the first round. The absence of three respondents did not affect the results because the minimum number of respondents in a Delphi survey should be at least 7 [5]. Moreover, the feedback from each respondent was sent back to the participants to re-evaluate and refine their answers. However, all of the experts were advised to review what they had written and had the full authority to make appropriate modifications

E. Consensus Elicited in the Second Round

The same process as in the first round (Cronbach's alpha) was used to determine the consistencies of the respondents' feedback. In the first round the alpha value was 0.710. In the second round there was a slight increase in the value of the Cronbach's alpha. It increased to 0.723, which is considered to be very good. By interpreting the value produced by the scale, as can be seen from Table VIII, the experts' responses were highly homogeneous.

TABLE VIII
 RELIABILITY STATISTICS

| Cronbach's Alpha | N of Items |
|------------------|------------|
| 0.723 | 11 |

In the second round, as with the first round, in order to identify the degree to which the framework was acceptable participants were asked for their opinion on the framework. Table IX show that, among the 11 experts, none of the participants said that the framework was 'unacceptable' or 'acceptable'. However, 2 (18.2%) of the experts agreed at the framework was 'good', and 9 (81.8%) of the respondents said that the framework was 'very good'. This indicates that there is a great deal of harmony among the respondents regarding the framework.

TABLE IX
 HOW DO YOU THINK ABOUT THE ABOVE FRAMEWORK?

| Category | Frequency | Per cent |
|--------------|-----------|----------|
| Unacceptable | 0 | 0% |
| Acceptable | 0 | 0% |
| Good | 2 | 18.2% |
| Very good | 9 | 81.8% |

In general, the finding in the Table X demonstrated that greater harmony among the participants' opinions was found with slightly increases in the mean values of the respondents. For example, the mean value of experience criterion increased from 3.42 in the first round to a value of 3.55 in the second round, and the mean value of the cultural and weather consideration criterion increased from 0.67 in the first round to a value of 1.09 in the second round.

There was no considerable variation in participants' answers with respect to the framework. The result confirmed the experts' original opinions of how to rank the main criteria for contractor selection. The eight most important criteria for contractor selection were gradually ranked as experience, financial stability, reputation, technical and management

ability, quality, human resource, and culture and weather consideration. The results show that the respondents were nearly all in agreement regarding their answers

TABLE X
DESCRIPTIVE STATISTICS FOR THE FIRST AND THE SECOND ROUND

| Category | Items | First round | | Second round | |
|---|-----------------------------------|-------------|----------------|--------------|----------------|
| | | Mean | Std. Deviation | Mean | Std. Deviation |
| Select and rank the main important Criteria | Financial Stability | 3.25 | .965 | 3.18 | .982 |
| | Human Resource | 2.08 | 1.443 | 2.27 | 1.348 |
| | Technical & Management Ability | 2.67 | 1.497 | 2.82 | 1.250 |
| | Experience | 3.42 | .793 | 3.55 | .688 |
| | Health and Safety | 2.08 | 1.621 | 2.36 | 1.567 |
| | Quality | 2.75 | 1.545 | 2.91 | 1.514 |
| | Reputation | 2.58 | 1.165 | 2.55 | 1.214 |
| | Culture and Weather Consideration | .67 | 1.231 | 1.09 | 1.578 |

TABLE XII
HOW DO YOU THINK ABOUT THE ABOVE FRAMEWORK?

| Category | Frequency | Per cent |
|-------------------|-----------|----------|
| Strongly Disagree | 0 | 0% |
| Disagree | 0 | 0% |
| Undecided | 0 | 0% |
| Agree | 3 | 27.3% |
| Strongly Agree | 8 | 72.7% |

The results from the first round of the Delphi survey indicated that more than two thirds of the experts agreed about the framework and the timetable. However, some experts argued and advised that the framework shouldn't be applied all at once because LCI markets are not fully prepared to implement a framework with such a high-standard. Table XI illustrate that, among the 11 experts, none of the participants said that they strongly disagreed, disagreed, or were undecided about the framework roadmap. However, 3 (27.3%) of the respondents said they 'agree' with the framework, and 8 (72.7%) of the respondents (majority) said they 'strongly agree'. These results indicate that there is a great deal of harmony among the respondents about the framework.

IX. CONCLUSIONS

The outcomes of a Delphi technique were explained in this chapter. The research consensus achieved after two rounds of applied Delphi. The total respondents in the first round were about twelve experts participated, including 3(25%) Contractors, 3(25%) Consultants, 3(25%) clients and 3(25%) Project Manager. The overall response rate of the Delphi questionnaire of the first round was 100%. In the second round eleven of twelve respondent, those included, 2(18.18%) Contractors, 2(27.27%) Consultants, 2(27.27%) clients and 2 (27.27%) Project Manager. The overall response rate of the Delphi questionnaire of the first round was about 91.67%. Therefore, the data analysis of round is based on the 11responded who effectively participated to the round. The experience ranges of the participations were selected between 10 to 20 years of experience.

The outcome of the Delphi survey was used to help to evaluate and build a framework for a new contractor selection process in the LCI. The method was utilized for several important reasons such as the fact that it offers validation of a new way of thinking as well as the ability to argue and discuss the previous techniques and systems of contractor selection. Further, it is useful for identifying the degree of consensus among the decision makers in the LCI.

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