# EXAMINING THE RELATIONSHIP BETWEEN DESIGN-BID-BUILD SELECTION CRITERIA AND PROJECT PERFORMANCE IN LIBYA

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## ABSTRACT

The construction industry's poor project performance has often been attributed to the use of inappropriate procurement methods. This has partly led to previous studies focusing largely on the development of scientific models for the selection of the best method for any given project. To add to knowledge advancement of this subject matter, this paper reports on an aspects of a wider study aimed at exploring the relationship between procurement selection criteria and the key project performance outcomes in the context of the Libyan construction industry. The part of the study reported here involves using a questionnaire survey to explore this link for traditional form of procurement (Design-Bid-Build). The study findings show that only 8 out of the 12 common selection criteria exhibit significant correlations with one or more project performance outcomes (time, cost and quality) as follows: (1) the criteria relating to "certainty of project duration", " cost certainty", "clarity of project functionality" and "involvement of project client" are positively associated with project cost performance; (2) those relating to "design complexity" and "organising and reviewing project activities" are positively associated with time performance; (3) the criterion relating to "project quality level required" is negatively associated with time and cost performance, whilst it is positively associated with quality performance; and finally (4) criteria relating to "controllable project variations" and "clarity of project functionality are a positively associated with quality performance outcome. Although all the existing criteria are important, the results suggest that it would be reasonable for clients to give more attention to controlling those criteria of significant correlation with performance outcomes" when procuring projects with DBB method. The findings also form the basis of further work that is currently being pursued to develop a formalised model for this relationship.

**Key words**: Construction procurement, Design-bid-build, Correlation, Procurement selection criteria, project performance criteria.

## 1. INTRODUCTION

Not only are modern construction and engineering projects characterised by high complexity and uncertainties (Francom et al., 2014; Wardani et al., 2006), they are also increasingly subjected to stringent project performance requirements by clients. Such demands typically call for projects to be delivered under limited resources, at low cost, in short duration and to a high level of quality and safety standard (Love et al., 2012). These requirements have often been difficult to meet in most projects with the results being significant project delays and cost overruns loss of reputation, extensive disputes and litigation between parties. The traditional approach to procuring projects, commonly known as Design-Bid-Build (DBB), has often been blamed for such unfortunate consequences (Love et al., 2012; Rwelamila and Edries, 2007), largely due to its inability to meet changing clients' needs and increased complexity of the interactions in technical, economic and multi-organisational participation at play in modern project execution (Nikou et al., 2014). The need to deal with this problem has resulted in plethora of a wide variety of procurement methods (Doli et al., 2013), with the most common types including Design and Build (DB), Management Contracting, Construction Management, Project Finance Initiative and Partnering.

However, the mere existence of different procurement methods alone is not enough in offering the needed panacea to the problems often perceived as resulting from DBB method. For instance, each of the existing methods cannot be chosen haphazardly for any given project, but must rather be selected carefully to suit the project circumstances, if the objectives of the latter are to be fulfilled (Wardani et al., 2006). Clients now have to grapple with this decision problem, partly because the different methods have different features and processes of implementation (Francom et al., 2014; Love et al., 2012). In addition, the criteria used for selecting the most appropriate method are characterised by implicit interrelationships and complex relationships with project external factors (Luu et al., 2005). The subject of procurement method selection has therefore stimulated numerous studies over the years with majority of them focusing on the development of scientific tools and models for aiding clients to select the most appropriate procurement method for delivering projects (see for example, Jin et al., 2015; Popic and Moselhi, 2014; Griffith and Headley, 2008; Love et al., 2012;). Whilst these tools are generally viewed as being valuable, they have been criticised as being so complex, too time consuming and costly for organisations to implement (Chan, 2007).

Another relevant area of research relates to how aspects of particular procurement methods impact on project performance outcomes. Even though the most appropriate procurement method employed for a given project would result in a successful project performance (Doli et al., 2013), little is known about this relationship and what it entails. A good understanding of this link, such as, the knowledge on how the selection of procurement methods based on existing selection criteria impacts on project performance, will potentially enable construction organisations to direct their focus rightly on which of the criteria need to be controlled if project performance is to be enhanced. To date, there has been limited research attention given to this area (Jin et al., 2015; Mahon, 2011), with the available studies focusing on: the effect that different procurement methods (PMs) have on other performance related factors such as the impact of inter-organizational conflicts in DBB process on project performance (Mohsini et al., 1995); the impact of change orders on cost growth in DB and DBB projects (Ibbs et al., 2003; Perkins, 2009); and the influence of procurement methods on the cost of rework (Love et al., 2008).

In addition, a common limitation of previous studies is that they focused on the effects of only one or few aspects of the procurement related factors on project performance. There is therefore little research that has considered, holistically, the effects of other relevant project delivery factors on project performance for the various procurement methods. As a contribution to addressing this gap, the aim of this paper is to explore the relationship between features or criteria that influence DBB selection and project performance criteria (time, cost and quality). The aim was achieved through, first, conducting a critical review of literature on construction procurement methods and project performance. This was then followed by field surveys comprising of semi-structured interviews and questionnaire survey with the main objective of finding out how the performance of projects procured by Libya's commonly used procurement method are influenced by their selection criteria. The data collected were analysed with the aid of SPSS, in order to find out the existence and nature of this relationship.

This forms part of an on-going wider study aimed at developing a model for predicting the effects that such selection criteria have on project performance. The reason for focusing on DBB procurement method is the fact that it is one of the most commonly used methods within the study area, Libya (Ghadamsi and Braimah, 2012).

The next section of the paper briefly discusses the research methodology used. This is followed by a discussion on the conceptual framework that forms the theoretical basis of this research and elaboration of the independent variables (DBB selection criteria) and dependent variables (project performance criteria). An analysis of the results is then presented, with the last section of the paper outlining the key conclusions drawn from the study findings.

# 2. RESEARCH METHODOLOGY

The aim and objectives of a research are the main criteria for determining the most appropriate research methodology to be used. As noted earlier on, the authors' research seeks to investigate the relationship highlighted in the previous section for existing procurement methods. Whilst numerous forms of procurement methods are used in practice, an attempt to investigate each single one of them would be too wide a scope to realistically focus on in a single study. It therefore became clear early on in this study that the research needed to narrow its scope down to procurement methods that are commonly employed in the Libyan Construction Industry. This requirement of the research is best addressed by employing qualitative research in the first stage as such approach suits instances where there is usually little or no information about the specific phenomenon being investigated (Gill and Johnson, 2002). Thus, the research philosophy adopted in this study is a combination of the positivism and interpretivism approaches. According to Saunders et al. (2007), most research problems can be best be addressed by such merging of these research philosophies.

The methodology employed for the research thus involved using a sequential exploratory strategy as advocated by Creswell (2003), based on an in-depth interview (qualitative) to begin with, as a means of capturing: a sense of the most common procurement methods in use, the criteria followed in selecting them and the project performance outcomes associated with their use. In this regard, semi structured interviews with 30 experts, each of no less than 15 years of working experience in the Libyan construction sector, were conducted. The interviewees had different work responsibilities, experience and positions, which included project managers, design engineers, site engineers, architecture engineers and general supervisors. Each interview lasted between 40 to 45 minutes. A debriefing memo was written after each interview. The selected respondents worked in client and contractor organizations. Contact persons in these organizations were first approached by email or telephone in order to ask if they or other suitable persons in their organizations were willing to participate in the study.

The key findings from this first stage of the data collection revealed, among others, that: DBB method is the most common procurement strategy used to procure construction projects in Libya; the decision to use DBB is often guided largely by the DBB selection criteria commonly reported in the literature including time, cost, and quality. These results were used to fine-tune the study focus and to also devise the most appropriate questions for the second stage, a large scale quantitative questionnaire survey, which had the greater priority in this research. The reason for such priority lies in the fact that quantitative research approach is considered best when it comes to examining the relationship between research variables by deductive approach (Creswell, 2003).

## 2.1. Questionnaire Survey Design

A questionnaire survey strategy was considered the most appropriate for the second stage data collection for a number of reasons. First, it facilitates the determination, with a known level of accuracy, of information about a large defined sample and the generalisation of the results to the study population (Burns, 2000; Gill and Johnson, 2002). It also enables comparisons of the target groups to be made on the same basis (Burns, 2000, p.567), and for this study in particular, the views of contractors, consultants and employers, were of particular interest as they are the main protagonists that deal with construction procurement issues.

Given that the survey respondents were dispersed throughout the whole country, the best way to send out the questionnaires was determined as postal mail, as internet facilities were found not reliable enough to be used to administer the survey, either via email or on-line surveys. Postal surveys are however not fool proof as they typically suffer from low response rate and difficulties of clarifying any ambiguous, incomplete or inaccurate information in the questionnaire (Gill and Johnson, 2002). To address these, the questionnaire was first subjected to intense review by the authors before finalising it. As part of this review, the questionnaire was also translated from English into Arabic, the mother-tongue of the targeted respondents to ensure better understand of the questionnaire. Finally, as a means of testing the suitability and comprehensibility of the questionnaire, a pilot survey was carried out with 20 selected construction

organisations in Libya. The main purpose of the pilot survey was to get useful feedback on the questionnaire with regard to its clarity and practicality of its completion by respondents. In addition, respondents were required to make any suggestions that could enhance the questionnaire. Comments received from this pilot study were largely positive, leading to only slight modifications to the questionnaire, which involved deleting, adding or rewriting of few questions of the questionnaire.

Amongst the different forms of questionnaire, the semi-structured format was used to design the questionnaire. This format has the benefit of reducing or eliminating the disadvantages of both open and closed types of questionnaires, whilst gaining their advantages (Patton, 1990; Creswell, 2003). The questionnaire therefore consisted of a combination of multiple choice questions requiring ticked-box responses and open-ended questions that required participants to present their responses in free text. The respondents were required to complete the questionnaires based on their direct experience with recently completed DBB projects that they are most familiar with, as oppose to their general opinions on projects. The questionnaire was structured in 3 sections, with the main sections asking for the respondents to rank their views (on a 5-point Likert Scale; 1 = "strongly disagree" and 5 = "highly agree") as to the extent to which: (1) each of the identified DBB procurement selection criteria satisfied or were compatible with the requirements and characteristics of these past DBB projects; and (2) those projects achieved their expected performance outcomes. The justifications for using a 5 point Likert scale type question are that, it is: (1) well recognised as the most appropriate instrument for obtaining information about respondents' attitudes and perceptions or analysing particular attributes, compared to asking a long list of individual questions (Bark, 2003); and (2) mostly been recommended by previous studies (see for example, Sekaran, 2000 ) as the most appropriate scale because it is difficult to capture respondents' views on scales higher than 5. It is also much easier to analyse the data as compared to those obtained from 7 or 9 point Likert scales.

## 2.2. Sampling and Data Collection

No specific sampling frame exists for construction organisations with experience in procurement matters in Libya, which thus necessitated the use of non-probability sampling techniques to determine the study sample (Burns, 2000). The process involved, first, selecting a total of 200 construction organisations made up of clients, contractors and consulting firms, using a combination of quota and purposive sampling as described by Patton (1990), from a database developed by the Public Project Authority (Public Project Authority, 2009), the main governmental body responsible for monitoring construction operations in Libya. This database, entitled, "Housing and Infrastructure Project Annual Report", contains details of client, contracting and consulting organisations with significant involvement in all projects executed in the country between 2006 and 2010. The sample selection was based on two main criteria: the need to ensure that the selected firms have relevant experience and also the need for the survey outcomes to be generalizable over the study population.

The questionnaires were posted (on 1$^{st}$ of August 2013) to the managing directors of the selected firms with an attached cover letter to inform recipients of the purpose of the survey, the involvement of respondents and also asking for the questionnaire to be passed onto the relevant staff member with experience in procurement method selection. Respondents were given 45 days to respond to the questionnaire. After a month of sending out the questionnaires, reminders were sent to help increase the survey response rate. Of the total number of questionnaires sent out, 136 questionnaires were returned within the period allowed of which 126 were properly completed and useful for analysis. This represents 68% response rate which is quite suitable since surveys with construction organizations typically achieve between 20-40% response rate (Furtrell, 1994).

The research design described above was fully underpinned by a critical review of literature on procurement and performance, and subsequent development of a conceptual framework which provided a sound theoretical basis to guide the construction of the data collection instruments. A summary of this evaluation of the literature is presented next.

# 3. CONCEPTUAL FRAMEWORK OF THE RESEARCH

The premise underlying this study is based on the principle espoused in literature that the best procurement method chosen for a project, based on the right procurement selection criteria, would result in successful project performance, as noted in the previous section. In order words, the level of project success to be expected depends on how suitable the procurement method used for that project was (Molenaar et al. 1998). It thus follows from this hypothesis that a relationship exists between the extent by which the selection criteria of a given procurement method are compatible or suitable (for the characteristics and requirements of a project) and the performance outcomes of that project. Establishing such relationship in detail would thus offer vital insights into procurement methods selection including *inter alia* knowledge of which selection criteria contribute significantly to improved project performance and for that matter deserve more attention during the selection process. As an initial step towards exploring this relationship, a conceptual framework (Figure 1) was first established to demonstrate the relationship between the research variables involved.

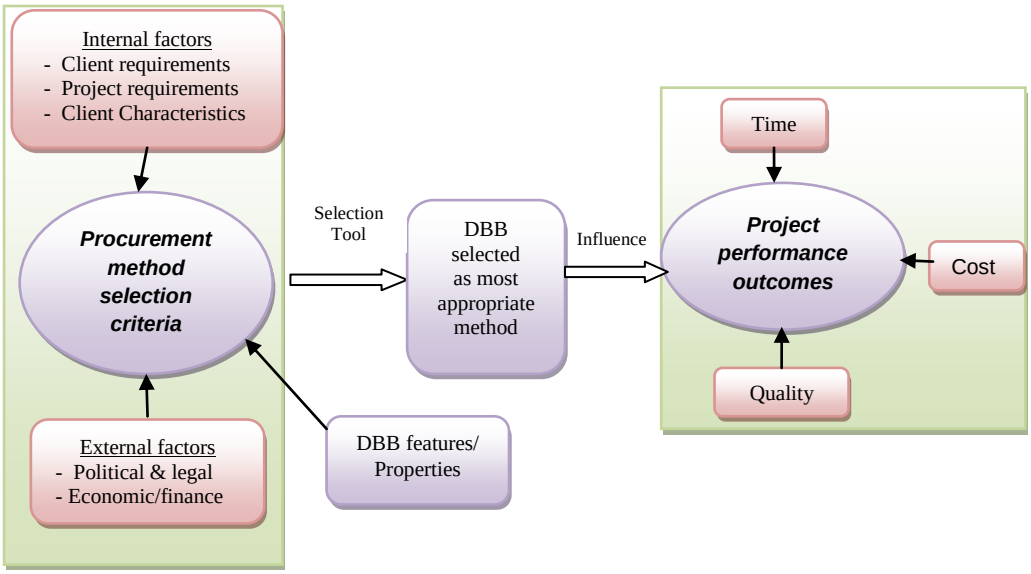


Figure 1. Procurement Selection Criteria and Project Performance - A conceptual Framework

As indicated in Figure 1, the independent variables of the study are represented by procurement method selection criteria, whilst project performance outcomes (time, cost and quality) form the dependent variables. These criteria are well reported in the literature as Table 1 shows, and are known to emanate from two main sources (the external and internal environment of projects) which relate together in a complex fashion (Francom et al., 2014; Ratnasabapathy et al., 2006). The selection process involves first identifying the right selection criteria from these groups and then assessing their compatibility with the features of the procurement method in question (Al Khalil, 2002). As the criteria are quite numerous and multifarious in nature (Love et al., 2012), it was found necessary for this study to identify the most common DBB selection criteria through a critical review of the literature. The scope of the review was also restricted to only studies carried out from 1998 to date based on the fact that earlier studies rarely covered this subject.

As Table 1 shows, the review resulted in the identification of 12 criteria as being the most commonly cited criteria for the appropriate selection of DBB method, if increased satisfaction with project performance is to be ensured. The definition and operationalization of the identified criteria together with their relationships with project performance are discussed further under the results section. The dependent variables of the study were restricted to project performance outcomes based on time, cost and quality criteria. Although these are commonly used to distinguish between good and poor project performance

(Bryde and Brown, 2004), there are other criteria in use, such as environmental impact, health and safety, and innovation (Eriksson and Westerberg, 2011, Bassioni et al., 2004).

Another reason behind focusing on these alone (time, cost and quality) is the fact that they are the main factors used for gauging the success of projects by stakeholders in the construction industry of the study area (Libya), as findings from an initial data collection exercise suggested (Ghadamsi and Braimah, 2012).

**Table 1. Criteria for Selecting DBB Procurement Method**

| | Price competition | Clarity of scope definition | Design complexity | Quality level required | Clear definition of parties responsibilities | Client involvement | Controllable project variations | Cost certainty | Time certainty | Organizing and reviewing project | Planning and estimating project | Project functionality |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Ratnasabapathy et al. (2006 ) | ✓ | - | ✓ | ✓ | ✓ | ✓ | - | - | - | - | ✓ | ✓ |
| Hashim et al. (2008 ) | - | ✓ | ✓ | ✓ | ✓ | - | ✓ | ✓ | - | - | - | - |
| Seng & Yusof (2006 ) | ✓ | ✓ | - | ✓ | - | - | - | - | - | ✓ | ✓ | - |
| Alkhalil (2002) | - | ✓ | ✓ | - | ✓ | ✓ | ✓ | - | - | - | - | - |
| Cheung et al. (2001) | ✓ | ✓ | ✓ | ✓ | ✓ | - | ✓ | ✓ | ✓ | - | ✓ | - |
| Luu et al. (2003) | - | - | ✓ | ✓ | ✓ | - | ✓ | ✓ | - | - | - | - |
| Luu, Ng & Chen (2005) | ✓ | ✓ | - | ✓ | ✓ | ✓ | - | - | ✓ | - | - | - |
| Love et al. (1998) | ✓ | ✓ | - | ✓ | ✓ | - | ✓ | ✓ | ✓ | - | - | - |
| Masterman & Gameson (1999) | - | ✓ | - | ✓ | - | ✓ | - | ✓ | ✓ | - | ✓ | ✓ |
| Hibberd & Djebarni (2010) | - | ✓ | - | - | - | - | - | - | - | ✓ | - | - |
| Edmond et al. (2008) | - | ✓ | ✓ | | ✓ | ✓ | ✓ | - | - | - | - | - |
| Chan et al. (2001 ) | ✓ | - | ✓ | ✓ | ✓ | ✓ | - | - | - | ✓ | - | ✓ |
| Alhazmi & McCaffer (2000 ) | ✓ | ✓ | - | - | ✓ | ✓ | ✓ | - | - | ✓ | ✓ | - |
| Chan (2007) | ✓ | - | ✓ | ✓ | ✓ | - | - | ✓ | ✓ | - | - | - |
| Doloi et al. (2013) | ✓ | ✓ | ✓ | ✓ | ✓ | - | ✓ | ✓ | ✓ | ✓ | - | ✓ |
| Nikou et al., 2014 | ✓ | ✓ | - | - | ✓ | - | ✓ | ✓ | - | - | - | ✓ |
| Jin et al. (2015) | - | ✓ | ✓ | ✓ | - | - | ✓ | ✓ | ✓ | ✓ | - | - |
| Total | 10 | 13 | 10 | 12 | 13 | 7 | 10 | 9 | 7 | 6 | 5 | 5 |

# 4. DATA PRESENTATION, ANALYSES AND DISCUSSIONS

The respondents were asked to complete the questionnaires based on their experience with recently completed projects that they were familiar with. In other words, they were to objectively respond to questions on the research variables regarding those completed projects and their performance, as opposed to asking them to provide their general opinion. Generally, the respondents were to provide their views in respect of the study variables using a 5-point Likert scale. With the aid of Statistical Package for the Social Sciences (SPSS), the results obtained were analysed using descriptive statistics (frequencies), Mann–Whitney test and Spearman's rank order correlation analysis.

Prior to the statistical analysis, the data was first subjected to the test of normality to ascertain whether the distribution of data is normal or not. The Kolmogorov-Smirnov test was used for this test as it is one of the commonly used (and suitable) approaches for testing for departures from normality (Siegel and Castellan Jr., 1988). A distribution is considered significantly different from a normal distribution if the test values obtained are significant with $p < 0.05$. As can be seen in Table 2, each procurement selection criteria has $p < 0.05$ values, suggesting that the distribution of the study data does not follow that of a normal distribution. The non-normal nature of the data confirms the use of non-parametric statistics (such as those listed previously) as the best method for analysing the results (Siegel and Castellan Jr., 1988).

To enhance the validity and accuracy of the data collected, Cronbach's Alpha was used to measure the reliability of the data collection instrument employed. Cronbach's Alpha is an index commonly used to objectively measure the internal consistency of a questionnaire instrument, i.e. the extent to which all the items in a test or scale measure the same concept or construct (Bland and Altman, 1997). Cronbach's Alpha values from 0.70 to 0.95 are often taken as the acceptable range for consistency (Bland and Altman, 1997). Table 2 shows the Alpha values for each procurement selection criteria, each of which is greater than 0.70 with an overall average value of 0.783. The results thus suggest that all the selection criteria are of high reliability, implying that each is capable of measuring the same latent trait on the same scale.

**Table 2. Normality Test and Cronbach's Alpha index for DBB selection criteria**

| DB procurement selection criteria | Kolmogorov-Smirnov[a] | | Cronbach's Alpha |
|---|---|---|---|
| | df | Sig | |
| 1 - Price competition | 121 | .000 | 0.794 |
| 2 - Clarity of scope definition | 121 | .000 | 0.764 |
| 3 - Design complexity | 121 | .000 | 0.793 |
| 4 - Quality level | 121 | .000 | 0.772 |
| 5 - Clear definition of parties' responsibilities | 121 | .000 | 0.748 |
| 6 - Project client involvement | 121 | .000 | 0.779 |
| 7 - Controllable project variations | 121 | .000 | 0.782 |
| 8 - Project cost certainty | 121 | .000 | 0.770 |
| 9 - Project duration certainty | 121 | .000 | 0.753 |
| 10 - Organizing and reviewing project activities | 121 | .000 | 0.743 |
| 11 - Planning and estimating project duration | 121 | .000 | 0.752 |
| 12 - Clarity of project functionality | 121 | .000 | 0.759 |
| The overall Cronbach's Alpha α | | | 0.783 |

## 4.1. Respondents and their Organisations

Descriptive statistics (e.g. frequencies, means, etc.) were first used to analyse data on the respondents' designations, experience and type of projects involved with. According to Field (2005), descriptive statistics are the most appropriate statistical techniques for describing the basic features of a data set in manageable forms, facilitating ease of presentation, clarity, comprehension and checking for any violations. Out of the 126 responses, 45% came from client organisations, 35% from contractor organisations and the remaining 20% were from consulting firms. Table 3 gives detailed breakdown of the questionnaire responses as obtained from only client and contractor organisations, since the focus of this paper is limited to the perceptions of these two groups. The table also shows the designations of the respondents, which indicates a wide range of different roles of specialty with majority serving as project managers.

**Table 3: Breakdown of Responses**

| Types of Construction Organization | Respondent Role/ Designation | Response frequency | Percent (%) |
|---|---|---|---|
| Client Organisation | Project manager | 15 | 11.9 |
| | Site engineer | 6 | 4.8 |
| | Quantity surveyor | 11 | 8.7 |
| | Design engineer | 11 | 8.7 |
| | General supervisor | 10 | 7.9 |
| | Architecture engineer | 6 | 4.8 |
| Construction Firm | Project manager | 14 | 11.1 |
| | Site engineer | 10 | 7.9 |
| | Quantity surveyor | 6 | 4.8 |
| | Design engineer | 4 | 3.2 |
| | General supervisor | 7 | 5.5 |
| | Total | 100 | 80% |

The respondents were asked to indicate their years of experience as far as working in the Libyan construction and civil engineering industry is concerned. As shown in Figure 2, the majority of the respondents (32%) have between 21-25 years of experience, followed by respondents with 16-20 years of experience (21%), and then those with 11-15 years of experience (19%). This high percentage of respondents with many years of experience (at least 11 years), suggests that the respondents were experienced enough to respond or comment on the issues investigated in this study.

Another important respondent detail investigated was the type of projects respondents' organisations are involved in. The response obtained for this are as presented in Figure 3, which show around 42% of the respondents are involved with building projects whereas 16% are involved with sewage and water supply projects and 13% involved with roads projects.

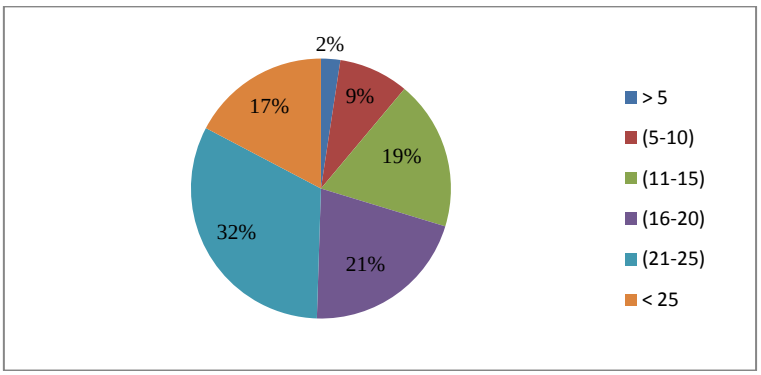

**Figure 2. Year of Experience of the Respondents**

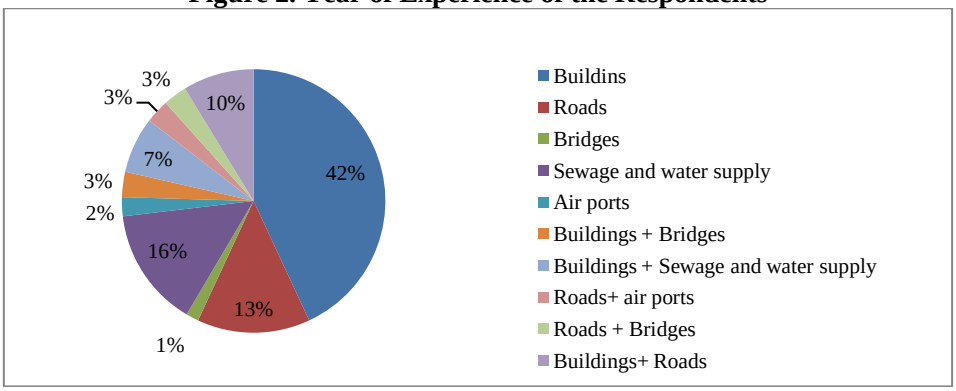


**Figure 3. Types of Projects undertaken by respondents' Organisation**

## 4.2 Influence of Selection Criteria on the Choice of DBB Procurement Method

As highlighted before, procurement method selection criteria form the main basis by which the right procurement method is selected. Investigating the extent to which these criteria did inform the selection of past DBB projects therefore formed an important objective of the research inquiry. As a result, respondents were asked to rate the extent to which the characteristics and requirements those past projects and their delivery were compatible with each of the procurement selection criteria, using a scale of 1-5, where 1 represents "Strongly Disagree" and 5 represents "Strongly Agree". Respondents were also asked to add and rank any other additional criteria that they consider relevant but were not among the list of common selection criteria. The results obtained are as depicted graphically in Figure 4, which shows the average level of agreement as greater than 3 for all the criteria.

In order to test whether or not there are differences between clients and contractors group in their rating of the DBB selection criteria Mann-Whitney U Test was conducted. This test is considered appropriate for determining the existence of any significant differences between two groups of non-parametric data, and has thus been commonly used in such applications (Siegel and Castellan Jr., 1988). The results of this test are as presented in Table 4. As shown, the test values for all the selection criteria are not statistically significant at p value < 0.05, which means that there are no significant differences in the scores assigned to each of the selection criteria by the two groups, i.e. an acceptance of the null hypothesis that there is no real difference between client and contractor groups in their rating of the selection criteria.

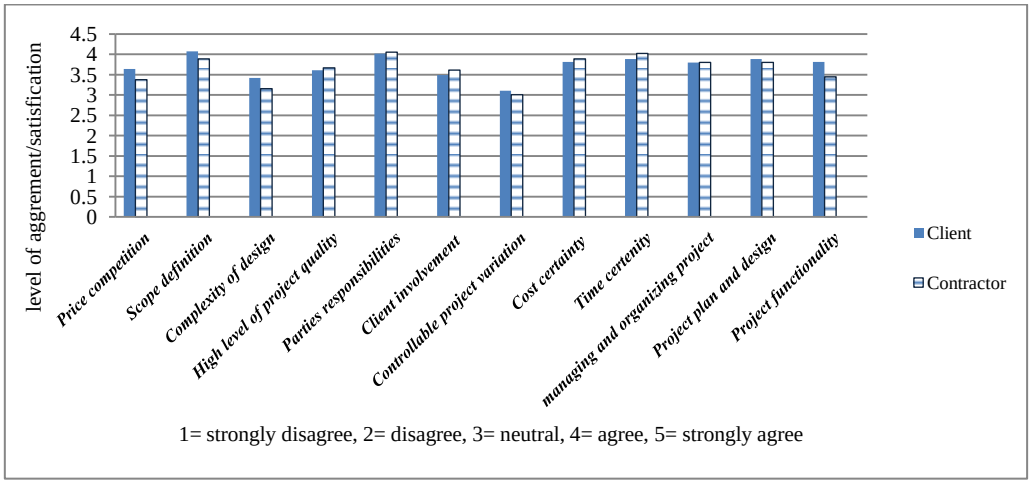


**Figure 4: Extent of Agreement on the Matching of Procurement Selection Criteria with DBB Projects**

**Table 4. Statistical Significance of DBB Procurement Selection Criteria**

| Procurement selection criteria | Z | Probability, *p* |
|---|---|---|
| 1 - Price competition | -1.335 | .182 |
| 2 - Clarity of scope definition | -1.072 | .282 |
| 3 - Design complexity | -1.365 | .172 |
| 4 - Quality level | -0.358 | .721 |
| 5 - Clear definition of parties' responsibilities | -0.434 | .665 |
| 6 - Project client involvement | -0.811 | .418 |
| 7 - Controllable project variations | -0.448 | .654 |
| 8 - Project cost certainty | -0.326 | .744 |
| 9 - Project duration certainty | -0.327 | .743 |
| 10 - Organizing and reviewing project activities | -0.066 | .947 |
| 11 - Planning and estimating project duration | -0.074 | .941 |
| 12 - Clarity of project functionality | -0.184 | .066 |

## 4.3. Influence of DBB on Project Performance

The different procurement methods exert different levels of influence on project performance outcomes (Mohsini et al., 1991; Love et al 1998) but detailed knowledge of this influence is limited in the literature. The respondents were thus asked to indicate the extent to which those DBB projects they were involved with did achieve their expected performance outcomes of time, cost and quality, using a 1-5 scale, as noted before. The results (see Figure 5) show that the extent to which the projects were able to achieve required time and cost performance is quite low as depicted by average scores of 1.6 and 1.7, respectively. However, the average score for performance criterion based on quality is moderate, registering an average value of 3.0.

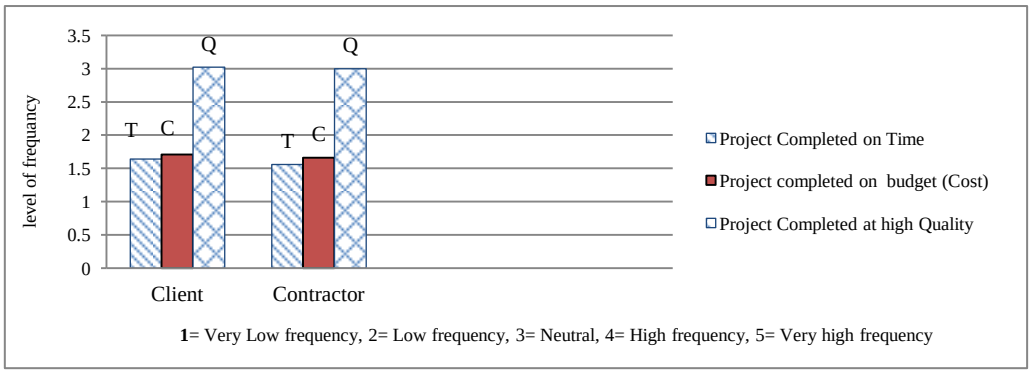


**Figure 5: Extent by which Performance Outcomes are achieved in DBB Projects**

## 4.4. Relationship between Procurement Selection Criteria and Project Performance

To determine the extent of the relationship between procurement selection criteria and project performance, Spearman's rank order correlation for non-parametric data was conducted between the rank data used for Figure 4 and Figure 5. This test was used to determine any possible linear association between the project performance criteria results obtained (as outputs or dependent variables) and the ordinal-scaled procurement selection criteria data (as inputs or independent variables). As typical of any correlation exercise, the strength of the association was measured in terms of coefficients between 0 to ±1; with +1 representing a perfect positive association, -1 as a perfect negative association and 0 representing

no association. Also, as commonly assumed in statistical analyses, a coefficient with p value < 0.05 indicated statistically significant correlation and vice versa.

As can be seen in Table 5, only 7 of the 12 selection criteria exhibited significant correlation with one or more of performance criteria for projects delivered by DBB in Libya. These relationships are summarised in Figure 6 and discussed in detail in the sections following.

**Table 5. Correlation between Procurement Selection Criteria and DBB Project Performance**

| Procurement selection criteria | Statistics | Project performance outcome | | |
|---|---|---|---|---|
| | | Time | Cost | Quality |
| Design complexity | Correlation Coeff. | .176* | _ | _ |
| | Sig. | .048 | _ | _ |
| Quality level | Correlation Coeff. | -.201* | -.245** | .322** |
| | Sig. | .024 | .006 | .000 |
| Project client involvement | Correlation Coeff. | _ | .271** | _ |
| | Sig. | _ | .002 | _ |
| Controllable project variations | Correlation Coeff. | _ | _ | .374** |
| | Sig. | _ | _ | .000 |
| Project duration certainty | Correlation Coeff. | _ | .148* | _ |
| | Sig. | _ | .039 | _ |
| Organizing and reviewing project activities | Correlation Coeff. | .203* | _ | _ |
| | Sig. | .023 | _ | _ |
| Clarity of project functionality | Correlation Coeff. | .671** | .177* | .253** |
| | Sig. | .000 | .048 | .009 |
| Cost certainty | Correlation Coeff. | _ | 221** | _ |
| | Sig. | _ | .009 | _ |

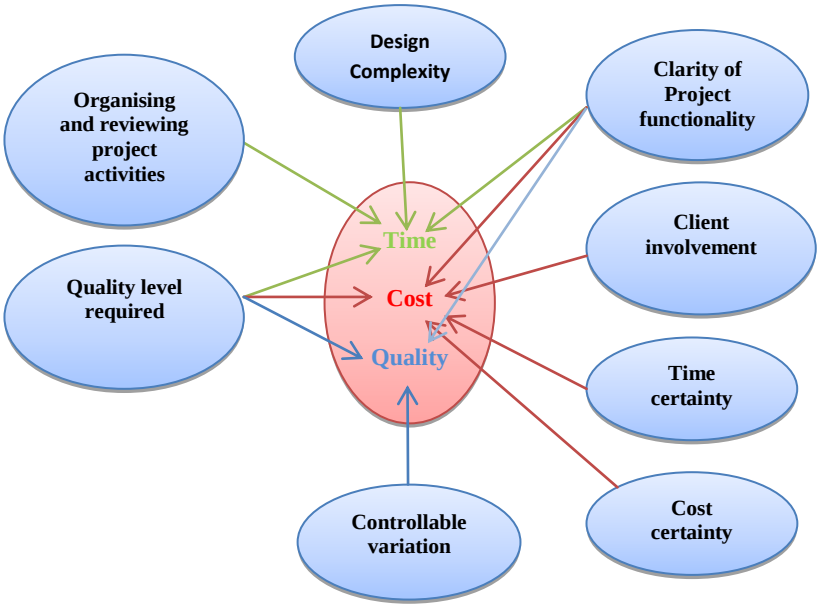


**Figure 6. Selection Criteria that Showed Significant Correlation with Project Performance**

### 4.4.1. Project Design Complexity

Complexity of project design is often characterised by complicated design process and high uncertainties (NEDO, 1986). A common feature of the complexity is also the existence of highly interdependent tasks, requiring among others a central coordinating unit for dealing with the issues involved (Mohsini, et al., 1995). Based on these views, this criterion was conceptualised as the number of different design tasks required to be completed to complete the whole design aspect of the work.

The study demonstrates a significant positive correlation (at $p<0.5$) between this criterion and the time component of project performance. This finding is consistent with views in the literature. For instance, Hashim et al. (2006) and Chan (2007) indicated that this criterion is one of the significant factors required for the successful selection of procurement method and that different levels of complexity usually determine the use of different types of procurement system with DBB method being suitable for a moderately complex project. Although previous studies suggest that complexity of design has an influence on project performance in terms of time, cost and quality (Cheung et al., 2001; Al Khalil, 2002), the study found no correlation between this criterion and the performance criteria of quality and cost.

### 4.4.2. Quality Level Required

To achieve high quality standard in projects requires the need to deal appropriately with many different quality parameters, notably, quality of materials, workmanship and design concept (Thomas et al., 2002; Love et al., 1998). Quality is also described as the extent to which the constructed project can perform the function for which it was designed for (Cheung et al., 2001). This criterion was thus operationalized in terms of quality of workmanship, suitability of the finished project to users and the clients' satisfaction with the final project quality.

The correlation results show that there is a significant negative correlation between this criterion and project performance in terms of time and cost but a significant positive correlation with quality performance criteria. This suggests that DBB is not capable of achieving good time and cost performance for projects requiring high quality standards of the finished work, which is much in line with the views in some previous studies (Hashim et al., 2006; Cheung et al., 2001; Alhazmi and McCaffer, 2000). The reason for such outcome could be explained from the way and manner design and construction teams work within DBB project settings. High quality standard involves dealing with many different quality parameters, notably, quality of materials, workmanship and design concept (Thomas et al., 2002; Love et al., 1998). Such demands require close working collaboration between the designer and the contractor, which tend not to be the case in DBB contracts, unfortunately (Perkins, 2009). On the other hand, this form of procurement often allows clients and consultants to spend considerable amount of time reviewing and developing the project designs in great detail before actual construction works commence (Abdul Rashid et al., 2006; Davis et al., 2008). Such efforts have the high potential of enabling them to properly prepare the contract documents (e.g., design drawings, geotechnical reports, material and technical specifications) to ensure their adequate compliance with, among others, the project quality standard desired.

### 4.4.3. Client Involvement

This involvement typically entails clients working together harmoniously with other project team members to facilitate, among others, smooth communication flow between all members of the project teams (Lim and Ling, 2002). Client involvement could take many different forms, depending on the terms of the contract, including responding to queries swiftly, offering expertise and sufficient resources (Cherns and Bryant, 1984; Lim and Ling, 2002). This selection criterion was therefore operationalized based on the degree by which the client would have to be consulted or kept informed to facilitate smooth delivery of the project.

The results show there is a significant positive correlation between this criterion and project performance in terms of cost only with no correlation with the other performance criteria (i.e. time and quality). This is consistent with a finding from the Poon et al. (2000) study that public clients have the attitude of focussing more on cost performance criteria than any other criteria. Other studies (Lim and Ling, 2002; Al Khalil, 2002) have also observed that clients' involvement in construction project has a positive effect on success or failure of a project. For significant positive effect to be achieved, the involvement should not only be high but should also transpire across the different phases of the project (Poon et al., 2000). For instance, clients' strategic decisions made during early stages of a project help to address uncertainties and risk, resulting in high project satisfaction (Lim and Ling, 2002). High client involvement during planning and

production phases also improves satisfaction as it helps to ensure that the wider set of the project objectives are emphasised continuously for all to concentrate on (Lim and Ling, 2002).

### 4.4.4. Controllable Variation

Variations (or changes) are a common feature of engineering and construction contracts that tend to affect project performance negatively (Ibbs, 2003). The magnitude of this effect largely depends on how flexible it is to accommodate or implement the variation, which in turn depends mainly on the stage of the project at the time of the variation order, complexity of the project, the design process and coordination of activities (Edmond et al., 2008). Thus, as to whether the variation could have been contemplated or otherwise (prior to the project construction stage), has been used to classify variations as "controllable" (e.g., design errors, lack of access, etc.) or "uncontrollable" (Perkins, 2009). In view of these characteristics this selection criterion was operationalized as the extent to which changes experienced in the DBB projects were foreseeable at the preconstruction phase.

Whilst variations are known to impact negatively on project performance in various ways, notably, contributing to both cost and project time overruns (Hashim et al., 2006; Enshassi, et al. 2010), the study did not indicate significant negative correlation between this criterion and time and cost components of performance. It rather found significant positive correlation with the quality component. This finding is consistent with the converse feature of project variation, namely, its potential to yield beneficial impacts as in, for example, variations issued to improve quality standard, implement value engineering or take due advantage of technology change (Ibbs et al., 2003). The achievement of such benefits are however predicated on having a number of measures in place to manage the variation orders carefully, including resolving the variation in a timely manner, knowing the logic and justification behind the proposed variation and having a prior clearer view of its potential impacts (Ibbs et al., 2003).

### 4.4.5. Time and Cost certainty

Knowing project completion date as well as the project cost in advance is invaluable for the client, not least of which is the opportunity it offers for proper planning and prudent use of resources to avoid time and cost overruns (Luu, et al., 2005). The desire for high time and cost certainty has therefore been part of construction clients' top priorities (Luu, et al., 2005) and as such, it is often considered when selecting the best procurement method (Thomas. et al. 2002). In terms of its construct, time and cost certainty refers to the degree of certainty by which a project will be completed by the agreed contractual completion date and budget (Love et al., 1998; Luu, et al., 2005).

These criteria were thus operationalized as the extent to which clear and reasonable project time duration and cost were stipulated and agreed between the client and the contractor at the contract award stage. The results show that there is a significant positive correlation between these criteria and project performance in terms of cost only. This finding concurs with the research of Xiao and Proverbs (2003) (a comprehensive study on the performance and practice of contractors in Japan, the UK and the US) which concluded that time and cost certainty positively influenced cost of projects. Similar position is also held by Thomas et al. (2002) who found that these criteria have a positive effect on project performance.

### 4.4.6. Organising and Reviewing Project Activities

This criterion represents an important component of project management process, specifically as a key element of construction planning function (Gidado, 2004). This aspect of planning is supported or facilitated by the different procurement methods to different degrees, mainly due to the different environment or project settings each method produces (Chan et al., 2001; Seng and Yusof, 2006; Hibberd and Djebarni, 1998) such as, time available for planning, terms of contract, degree of uncertainty and complexity of project and availability of planning information (Chan et al., 2001). This criterion was thus operationalized as the ease by which project activities can be broken down into manageable units and planning them out adequately and subsequently monitoring and controlling their execution.

The results of this study show that there is a significant positive correlation between this criterion and project performance in terms of time only. This is quite understandable since organising and reviewing activities help to determine physical progress and appropriate programme recovery strategies necessary for making good any delays experienced so far (Gidado, 2004). Also, numerous empirical studies on factors responsible for project management success suggest this aspect of planning as a major contributor of project success (Gidado, 2004).

### 4.4.7. Clarity of Project Functionality

Project functionality is one of the success measures that clients tend to be keen on (Ratnasabapathy et al., 2006). It is thus often considered when selecting the construction procurement method (Albert et al., 2002; Ratnasabapathy et al., 2006). Albert et al. (2002) defined "functionality" as the degree of conformance of the project to all technical performance specification. This criterion was thus operationalized as the extent by which the functional and physical requirements of projects were clearly defined before construction commenced.

As the findings show, significant positive correlation exists between this criterion and time and cost performance outcomes, which is consistent with the results of some previous studies (see e.g. Ratnasabapathy et al., 2006; Abdul Rashid et al., 2006). The report on Building Procurement Methods (Davis et al., 2008) sponsored by Cooperative Research Centre for Construction Innovation highlighted that DBB allows "design lead and the client to have a direct influence which can facilitate a high level of functionality and improve the quality in the overall design". A possible reason that explains this outcome is that clarity of project functionality is highly required for defining for instance, the project scope, without which it would be difficult to plan out the project to help prevent problems that are likely to incur time and cost overruns.

## 5. CONCLUSION

This paper forms part of an on-going research aimed at investigating the relationship between procurement selection criteria and the key project performance outcomes (Time, Cost and Quality), towards developing a model that explains or offer insights into such relationship to aid the procurement selection process. The aspect of the study reported here explores the influence that DBB procurement selection criteria have on project performance outcomes.

In general, the project findings contribute new knowledge and invaluable insights into how DBB procurement selection criteria relate project performance, which are useful in a number of ways and have important implications for the selection of construction procurement methods. First, the study provides an indication of the key DBB selection criteria that exhibit significant correlation with project performance outcomes. Industry practitioners can benefit from this by paying close attention to these criteria to help facilitate and control DBB projects procurement effectively. For instance, considering "clarity of project functionality", project client and their consultants can work to clarify project scope and requirements before construction beginning. Even though, PM selection and their use in project delivery are known to affect the performance of projects, there are a number of other factors also responsible for project performance impacts. These factors attributed mainly to the project-related, client-related, contractor-related, consultant-related, project team related, communication and relationships and management related

Secondly, the study shows that these criteria can also be used to predict the likely contribution of DBB procurement method to project success. This is yet to be developed in the next phase of the research and would be based on a formalised regression model. Such a model would hopefully help to further explore and explain, in much more detail, the selection criteria exhibiting significant correlation with project performance, to possibly serve as a predictive tool.

Although the study was carried out based on projects executed in Libya, the procurement selection criteria and success criteria identified and investigated are all relevant to projects elsewhere. Coupled with the similar culture and attitude of practitioners believed to prevail in countries within the sub-region, it is reasonable to assume that the study findings may also be applicable in countries similar to Libya.

## Limitations of the Study

Like with any research, this study has limitations. First, the subjective nature of the research variables could be misinterpreted by respondents based on their own understanding of what each variable means. To address this risk, a glossary of definitions for each variable and how they should be measured using their operational or proxy variables was enclosed in an appendix to the questionnaire for their reference. Another limitation is that the study data came from the respondents' personal assessment of their experience of past projects as opposed to data from actual existing records of these projects. This subjectivity of the respondents' responses was however directed towards specific projects in which they participate actively in procurement selection and delivery, rather than to a hypothetical situation, to improve the reliability of any responses provided. In spite of these limitations, the study results have significant implications on the procurement selection process as it relates to the DBB method, and also set the basis for pursuing the next phases of this research as indicated above.

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