

The Impact of Design-Bid-Build Procurement Methods on Project Performance in Libya

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Abstract: *The use of inappropriate procurement methods to deliver construction projects has long been acknowledged as a major source of poor project performance and is particularly problematic for the Libyan Construction Industry. Poor procurement method selection has been recognised as a major contributory factor to frequent time and cost overruns. This paper offers a way of selecting specific procurement methods to maximize successful project performance. The methodology involves an intensive review of relevant literature, followed by a semi-structured questionnaire survey. The key findings of the study reveal that 11 out of its 12 common selection criteria exhibit a significant contribution to one or more project performance criteria (time, cost and quality). Project clients should therefore prioritise these criteria when selecting a design-bid-build method. Knowledge of the criteria that contribute positively to project performance will also enable clients to work out, prior to and during construction, the best measures and provisions for successful project outcomes.*

Keywords: *Construction procurement, Design-bid-build, Multiple Regression, Procurement selection, project performance criteria*

I. INTRODUCTION

The procurement of construction projects comprises organised procedures and processes by which clients gain construction products such as houses, office buildings, shopping complex, roads, bridges, etc [1]. It is usually a very large-scale enterprise involving the gathering and organising of a multitude of separate individuals and companies to design, manage and build such products [1]. In this context, the arrangement devised and followed to deliver a construction project is often termed procurement method (PM) or strategy [2, 3]. The traditional approach to procuring projects (known as Design-Bid-Build, DBB) typically involves a system whereby the client enters into a separate contractual arrangement with a consulting organisation and a contractor, commissioned to execute the design and construction works respectively [1]. However, the DBB approach has often been blamed for much of the poor project performance in the construction industry, on account of two main developments [4,5]. First, modern construction and engineering projects have not only become highly complex to deal with, but also their nature and delivery processes are fraught with many uncertainties [6, 7]. Secondly, projects are now increasingly subjected to strict performance demands from clients, which typically call for contractors to deliver projects using limited resources over a shorter duration, while retaining a high level of quality [8]. The industry's response towards addressing these challenges has largely been limited to the development and promotion of an array of innovative procurement methods, including design and build (DB), management contracting, construction management, and private finance initiative and partnering among others [6].

In spite of these PMs that are available to deal with the frequent changing clients' needs and increased project complexities [4, 5], the high level of clients' dissatisfaction with the procurement routes utilised in their projects still remains a major concern [9, 1]. A major

source of this problem is the fact that the different PMs have different features and processes [1, 6] which make each appropriate to use under specific project circumstances [10, 11]. However, the construction industry clients and practitioners find the selection of such methods a daunting decision-making task when contemplating the right project delivery strategy [5, 8]. The issue is particularly problematic for the Libyan Construction Industry (LCI), where very little attention is given to appropriate PM selection based on rational decision-making process [12]. A number of studies and Government reports [13, 14] have highlighted this procurement issue as contributing significantly to the frequent time and cost overruns experienced by Libyan projects. Instigated by the crucial need to address this problem, this study was carried out to investigate how the selection of construction procurement methods influence the performance of projects in Libya, based on the direct experience of construction professionals in procuring Libyan projects. This investigation aims to offer a much deeper understanding of which PM selection criteria make a significant contribution to project performance and, hence how the selection process in Libya could be enhanced to help ensure successful delivery of a project. In this study only DBB methods of procurement were considered; this is because the DBB method is the most common type of procurement for delivering construction projects in Libya.

II. METHODS

A total of 200 questionnaires were personally distributed to the managing directors of the main construction organisations (consisting of clients, contractors and consulting firms), identified from a database of firms registered under the Public Project Authority, which is the main body in Libya responsible for monitoring the operations of construction organisations. The selection was done using a

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combination of quota and purposive sampling, as typically described by Patton [15] and Barnett [16]. The criteria used were based on the need to ensure that firms with the relevant experience are involved and that the intended outcomes are nationally applicable. The respondents were professionals actively involved in construction projects in different capacities.

Almost half of the respondents (45%) were from client organisations, 35% were from contractor organisations and 20% were from consultant organisations. Respondents were given 45 days to respond to the survey. To increase the survey response rate, reminders were sent out after a month of distribution. In the final analysis, 136 questionnaires were returned out of which 126 were assessed to have been completed properly and were useful for analysis. This represents a response rate of 68%, which is quite high compared to the norm of 20-40% for surveys of construction organisations [17].

III. CONCEPTUAL FRAMEWORK

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. In other words, the level of project success to be expected depends on the suitability of the procurement method [18]. 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 such as, 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 variables involved.

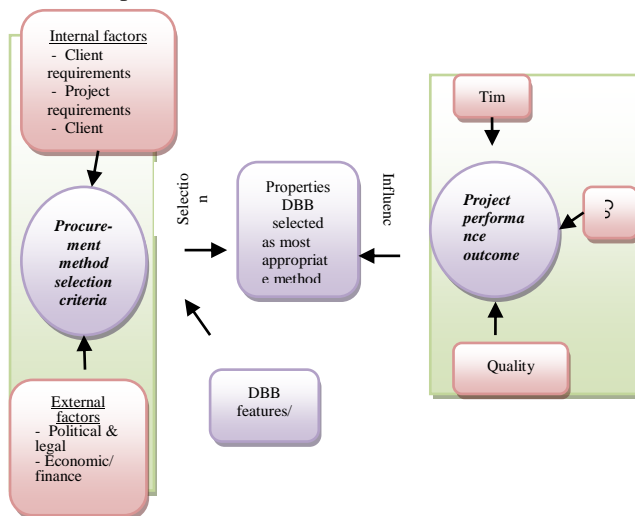


FIGURE I

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. Review of the literature suggests that all the selection criteria emanate from two main groups of factors (from the project's external and internal environment) that relate to each other in a complex fashion [19, 20]. 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 [21]. As the criteria are quite numerous and multifarious in nature [5, 19], 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 studies carried out from 1998 to date based on the fact that earlier studies rarely covered this subject.

The review resulted in the identification of 12 criteria as being the most commonly cited criteria for the appropriate selection of the DBB method, if increased satisfaction with project performance is to be ensured. 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 [22], there are other criteria in use, such as environmental impact, health and safety, and innovation [6, 23].

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 [24].

IV. ANALYSIS AND DISCUSSION

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. Results were analysed using descriptive statistics (frequencies), a relative importance index and regression analysis.

Prior to the statistical analysis, the data were first subjected to the test of normality to ascertain whether the distribution of data is normal or not. This is particularly important in research having a sample size over a hundred, as the data may not keep to a normal distribution. Although the normality of the variables is not usually necessary for analysis, results are usually better if the variables are normal distributed [25]. The two main components of normality are skewness and kurtosis [26, 25]. Skewness refers to the distribution of the variables when the mean of the distribution is not at the centre, while kurtosis refers to the peak of the distribution (whether the distribution of the variables is too peaked or

too flat). In order to ensure the data distribution is normal, it should be checked in terms of skewness and kurtosis to check that data lie within acceptable values of between ± 1.0 [27]. If the values of skewness and kurtosis are zero, then the distribution of the variables is normal. As result, all data were tested and were found to have acceptable values of skewness and kurtosis.

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 [28]. Cronbach's Alpha values from 0.70 to 0.95 are often taken as the acceptable range for consistency [28]. The Alpha values for each procurement selection criterion were 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.

The respondents were asked to indicate their years of experience in the Libyan construction and civil engineering industry. 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. 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. As procurement selection criteria form the main basis by which the right PM is selected, investigating the extent to which these criteria did inform the selection of DBB projects in Libya therefore formed an important aspect of the enquiry into the influence of PMSC on PP. Respondents were asked to rank the extent to which the characteristics and requirement of those past projects and their delivery met each of the PMSC, 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 criteria they feel were relevant but which were not included among the criteria presented. The results indicate that the average level of agreement is greater than 3 for all criteria, which means that the respondents are in agreement with all criteria

In order to determine the relative importance of the criteria from the perspective of clients, contractors and consultants, their relative importance index was computed. The results demonstrate that the criterion of "Clear definition of parties' responsibilities" comes first, followed by "Desiring efficient project planning" and "clarity of scope definition", with "controllable project variations" and "project functionality" at the bottom. To

determine whether there is a degree of agreement among the three groups with respect to their rankings of the criteria, Kendall's W was carried out. The results show that the W value obtained is 0.75 which was significant at 0.05 (Table 1).

TABLE I
Kendall's W for PSC of DBB procurement selection criteria

of cases	126
Kendall's W	0.75
Chi-square χ^2 sample	592.86
Chi-square χ^2 critical (= 0.05)	19.68
df = (N - 1)	11
Asymp. Sig. (P value)	.000

4.1 Completed projects meeting performance standards

The different PMs have varying influences on PP outcomes, often measured using time, cost and quality criteria. Although this principle is well-known, knowledge on the extent to which the methods impact on each of these performance criteria is limited in existing construction management literature. The respondents were thus asked to indicate the extent to which those DBB projects that they were involved with achieved their expected performance in terms of outcomes of time, cost and quality, using a scale of 1 to 5 where 1 represents "very low frequency" and 5 represents "very high frequency". The results show that Libyan construction projects are generally not able to achieve their time and cost performance as depicted by low average values of 2.0 and 2.06, respectively. However, the average score for performance criterion based on quality is moderate, registering an average value of 3.0.

4.2. Modelling the impact of DBB procurement method on project performance

Multiple regression analysis (MAR) has been used to develop them model. MRA can be defined as a statistical technique that allows prediction of score depending on one variable based on previous scores with several other variables [26]. Braimah [29] defined it as a statistical technique used to develop a model for observing and predicting the effect of a number of independent variables upon a dependent variable. A number of different types of multiple regression can be used to explore the relationships between variables such as standard or simultaneous, hierarchical or sequential and stepwise. In this study, standard multiple regression was employed to study the relationships between the PMSC and the PP criteria because it the most commonly used regression analysis technique [26]. This type of regression can be expressed in the form of the following equation:

$$Y_i = b_0 + b_1x_1 + b_2x_2 + \dots + b_nx_n + \epsilon_i; \quad i = 1 \dots N$$

In the regression equation, Y represents dependent variables or project performance criteria (Time, Cost and Quality), b_0 represents the Y intercept (the value of Y when all the X values are zero) while, x_1 , x_2 and x_n are the independent variable (procurement selection

criteria) , b_1, b_2 and b_n are the coefficient of the independent variable and ϵ_i is the difference between the predicted and the observed values of the dependent variable for the i th participant. Before conducting MRA some assumptions should be checked, including multicollinearity, normality, linearity and outliers.

4.3. Evaluating the Model

Table 2 shows the summary of the MR model. The value of R Square indicates the degree of variation of the dependent variable (project performance criteria), which is explained by the model. Tabachnick and Fidell [25] defined R-squared as a statistical measure of how close the data are to the fitted regression line. It is also known as the coefficient of multiple determinations for multiple regressions. The R Square values for all respondent groups in terms of time performance is 0.666 higher than that of cost and quality performance values of 0.620 and 0.50, respectively. This means that the model explains 66.6% of the variance in terms of time, 62.0 % in terms of cost and 50.0% in terms of quality.

TABLE II
Model summary of the regression between DBB procurement criteria and PP in terms of time, cost and quality

Model	Time	Cost	Quality
	R Square	R Square	R Square
Clients	0.769	0.640	0.401
Contractor	0.786	0.590	0.350
Consultant	0.617	0.620	0.785
All groups	0.666	0.620	0.500

5.1. Procurement selection criteria

The results of the multiple regression show that there are five criteria making a significant contribution to PP in terms of time, six making a significant contribution in terms of cost and five making a significant contribution in terms of quality. For instance, : (i) the selection criteria , “clarity of scope definition” and “desiring efficient project planning”, contribute positively to project time performance; (ii) “clear definition of project parties responsibilities” and “cost certainty”, contribute positively to PP in terms of cost; (iii) “complexity of design”, and “controllable project variations” contribute positively to quality performance; (iv) “high price competition” contributes positively to time performance and negatively to quality performance; (v) “client involvement in the project” and “clarity of project functionality”, contribute positively to time and cost performance, and finally (vi) “high quality level required” and “ease of organising and reviewing project activities” showed positive contribute to both cost and quality performance.

The results also show that, in terms of time, the highest absolute value of t and beta come from “project functionality”, with $t = 15.302$ and $\beta = 0.816$. This means that this selection criterion makes the strongest contribution to time performance. However in terms of cost, the highest absolute value of t and beta come from “high quality level required”, with $t = 2.927$ and $\beta =$

0.288, which indicates that this criterion makes the strongest contribution to cost performance. In terms of quality, the highest absolute value of t and beta come from the “accessibility to controllable variations”, with $t = 3.694$ and $\beta = 0.298$, which means that this criterion makes the strongest contribution and impacts on quality performance

5.2. Model Construction

The procedure followed in developing the model includes the following:

- Identifying the types of PMs commonly used (i.e. DBB).
- Identifying the selection criteria used for selection using DBB method.
- Identifying the appropriate criteria used for measuring PP (time, cost and quality).
- Ranking the procurement selection criteria in accordance with characteristics and requirements of past DBB projects by respondents.
- Ranking the PP criteria in accordance with characteristics and requirements of the past DBB/DB projects.
- Application of MRA to determine the criteria of PMs that make the strongest contribution to PP.

Three models have been developed to illustrate the impact of DBB procurement criteria on PP in terms of time, cost and quality in Libya. Based on a significant level lower than probability of 0.05, these models are presented as following:

Regression model on the relationship between PMSC and PP in terms of time:

$$Y_t(\text{Time}) = -0.183 + 0.124 x_1 + 0.118 x_2 + 0.194 x_6 + 0.115 x_{11} + 1.684 x_{12} + 0.426$$

Regression model on the relationship between PMSC and PP in terms of cost:

$$Y_c(\text{Cost}) = 0.723 + 0.254 x_4 + 0.236 x_5 + 0.189 x_6 + 0.257 x_8 + 0.273 x_{10} + 0.422 x_{12} + 0.635$$

Regression model on the relationship between PMSC and PP in terms of quality:

$$Y_q(\text{Quality}) = 2.409 - 0.214 x_1 + 0.173 x_3 + 0.298 x_4 + 0.281 x_7 + 0.231 x_{10} + 0.756$$

VI. Discussion

MRA reduced the criteria of selection of a DBB method for all groups from 12 to 5 in terms of time, six criteria in terms of cost and five criteria in terms of quality. These criteria are as follows:

6.1. High price competition

This criterion relates to the extent to which a procurement method allows for the project to be procured under a competitive price that gives value for money to the client [30, 31]. The usual approach to ensuring this is

often based on the contractor selection method used (i.e. the type of tendering process). Irrespective of the type of procurement, contractor selection may be based on open tendering, selective tendering or negotiation tendering process [6]. The results of the study show that “High price competition” contributes positively with PP in terms of time and quality (p value < 0). This finding is consistent with views in the literature. For instance, Love et al. [5] and Chan [32] indicated that this criterion is one of the significant factors required for the successful selection of PM. The main purpose of competitive tendering is to enhance price competition so as to increase the client’s chance to attain high quality level as well as lower project price, as price quotation tends to be the defining criterion used in selecting contractors [33].

6.2. Clarity of scope definition

A scope of work describes the work to be done or the services to be provided. It demonstrates and clarifies the project tasks, goals, materials, specification, methodologies to be used, costs and the duration of project construction [34]. The scope of work may also define how the job is to be accomplished. Ambiguous scope of work can lead to unsatisfactory performance and overrun in terms of time and cost [34]. “Clarity of scope definition” has a significant influence on PP in terms of time [18]. The regression model shows a positive contribution between this criterion and PP in terms of time, indicating that if the project scope of work is clear and well defined in which the accuracy of the specification, quantity and detailed drawings and designs, these will help to reduce project time [18]. This result was confirmed by Chan and Kumaraswanmy [35], who found that the clarity of scope definition is significantly influence project performance.

For the case of DBB method, clients are able to work closely together with their consultants to prepare contract documents such as drawing, bill of quantities, detailed design and specification before starting construction [36, 37], which offer an opportunity for clients to review these documents and clearly define the scope of work properly before construction commences. Such documentation and clarity subsequently enable contractors to prepare a more accurate tender, which is an important factor that contributes to reduce project duration.

6.3. Complexity of design

“Complexity of project design” is characterised by a complicated design process and high levels of uncertainty [7]. This criterion is always considered for selecting a DBB method [38]. The results of the study shows, there is a significant positive contribution between this criterion and quality component of PP (p value < 0.05). This finding is consistent with views in the literature. For instance, Hashim et al. [39] and Chan [32] indicated that this criterion is one of the significant factors required for the successful selection of a DBB method, and that different levels of complexity usually determine the use of

different types of procurement systems. The DBB method is suitable for a moderately complex project as it allows sufficient time for the design and specification to be fully developed before starting construction works, which reflects positively on the quality of the project. Although previous studies suggest that complexity of design influences PP in terms of time, cost and quality [21, 40, 5, 38], there was no contribution found between this criterion and the criteria of PP in terms of time and cost.

6.4. High quality level required

To achieve a high quality level in projects requires dealing appropriately with three main requirements: quality of materials, workmanship and design concept [38]. These requirements are often expressed in terms of technical specification, function, and appearance [5, 38]. It seeks to reflect the degree to which a procurement strategy facilitates the achievement of these requirements. This criterion was thus operationalised in terms of quality of workmanship, suitability of the finished project to users and the clients’ satisfaction with the final project quality.

“High quality level required” exhibited a significant negative contribution with cost performance whilst exhibiting a significant positive contribution in terms of quality. This suggests that DBB is not capable of achieving good cost performance for projects requiring high quality standards of finished work, which is in-line with the views in some previous studies [8, 39, 5]. The reason for this could be explained by the way and manner of 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 [5, 38], which requires close working collaboration between the designer and the contractor, which tends to be inhibited in DBB contracts [11].

6.5. Clear definition of project parties’ responsibilities

The responsibilities of project parties (client, contractor and consultants) are directly related to the degree of their involvement in the project delivery [21]. The accuracy and clarity of the parties’ responsibilities positively contribute to project success [9]. Important to ensuring this is that each party must be made aware of their clear roles and responsibilities, with no overlap in responsibilities between the parties, which is a recipe for confusion and may subsequently affect PP negatively. The regression results demonstrate that “Clear definition of the project party’s responsibilities” makes a significant positive contribution to PP in terms of cost. For DBB the dichotomy in the design and construction works facilitates clear delineation between the parties’ responsibilities, making this criterion one of the important factors considered in the DBB selection [38]. For instance, the client usually engages different architects or engineers and other consultants to take the responsibility of the design and supervision of works from the pre-tender stage through to the completion stage, and will hold the

contractor responsible for carrying out the construction work; this can reflect positively in reducing project cost [39].

6.6. Client involvement in the project

Client involvement benefits project delivery in many ways, notable of which is the fact that it creates the opportunity for clients to work harmoniously with other project team members, which facilitates, among others, smooth communication flow between all members of the project teams [41, 42]. This inhibits errors/omissions in documents, delays in information requests, poor coordination of various aspects of the work, rework etc and hence contributes to improved project performance [43]. The regression results show that “client involvement in the project” contributes positively with PP in terms of time and cost. This is consistent with the findings of Chan et al. [9] and Al Khalil [21] that public clients have the attitude of focussing more on cost and time performance criteria than any other criteria. Other studies [21, 42] have also observed that clients’ involvement has a positive effect on project success. For a significant positive effect to be achieved, the involvement should not only be high but should also transpire across the different phases of the project [44]. Al Khalil [21] indicates that the client involvement in all project processes, in order to solve problems and take important decisions at the right time without delays, is considered to be the most important aspect that helps to reduce project cost and time.

6.6. Controllable project variations

Controllable variation can thus be defined as the extent to which changes to project can be reduced and controlled at the preconstruction phase [39, 1]. This selection criterion was operationalised as the extent to which changes experienced in the DBB projects were foreseeable at the preconstruction phase. The regression results show that “controllable project variation” contributes positively with PP in terms of quality. This criterion is an important factor to be considered when selecting a DBB strategy, since for this method the project designs, drawings and specifications tend to be fully prepared before tendering processes. This gives an opportunity for the client and consultant to review all these documents properly and therefore is more likely to control or keep variations to a minimum, which reflects positively on the quality of the project [39]. The finding is also 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 technological change [45]. 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 [46].

6.7. Cost certainty

The desire for clients to know the final project cost in advance is considered very important from their perspective [38, 47] as this allows them to anticipate how much projects will cost and hence the right plan to put in place for any eventualities [32, 5]. This criterion represents the extent to which clear and reasonable project costs were stipulated and agreed between the client and the contractor at the contract award stage. The regression results demonstrate that that “cost certainty” makes a significant positive contribution to PP in terms of cost. Most DBB projects are often procured on a competitive tendering basis [48], which allows this procurement method to offer price certainty to clients rather than DB or other methods. Also, under competitive bidding, the contractor tenders for the work on the basis of full project documentation (e.g. bill of quantities), thus ensuring certainty of price. To a client with overriding concerns on price, such certainty would be a considerable feature, therefore making this criterion a key driver in DBB selection [48, 38, 20]. With DBB the cost of the project is known after bid competition and before the contractor commences work, bringing about a high cost certainty of cost by this project delivery method.

6.8. Ease of organising and reviewing project activities

This criterion represents an important component of project management process, specifically as a key element of the construction planning function [7]. This aspect of planning is supported or facilitated by existing procurement methods to different degrees in commensuration for their different project arrangements and the settings they engender [9, 37]. The results of this study exhibited a significant positive contribution between this criterion and PP in terms of cost and quality (at $P < 0.05$). According to Abdul Rashid et al. [1], the DBB method provides more accessibility for clients and consultants to review the design and management of the project. This is quite understandable since the DBB method, design, specification and bill of quantities for the project are developed early on prior to construction work, enabling the client and contractor to discover and address any errors in the detailed design, planning, contract specifications and resources before construction work commences [49]. This can reflect positively on the cost and quality. By virtue of these characteristics, this criterion forms an important factor in selecting DBB project delivery.

6.9. Desiring efficient project planning

Various studies suggest that client objectives in construction projects can be better achieved through improving the efficiency of the construction planning process [50, 7]. The key factors that contribute to ensuring effective planning have been identified from research [50], as increased formalisation, decreased centralisation and increased specialisation. The regression results shows that there is a significant positive contribution between

this criterion and time performance (p value <0.05). Earlier studies have also established that construction planning efforts are influenced by organisational characteristics of construction firms [7]. Past studies on procurement showed that this criterion should be given important consideration when selecting DBB [51], as with the DBB method there are more or less complete contract documents available before construction commences, which avails both client and contractor the opportunity to review these documents and improve the construction planning processes and this normally will reflect positively on time performance. This can be explained as the accuracy of preparing a good plan for the project can increase the possibility of reducing the duration of the project [7].

6.10 Project functionality

Functionality of the project is one of the main criteria that clients tend to use for selecting the DBB procurement method [20]. According to Chan et al. [52], functionality can be defined as “the degree of conformance of the completed project to all technical performance specification”. This criterion was thus operationalised as the extent to which the functional and physical requirements of projects were clearly defined before construction commenced. According to Abdul Rashid et al. [1], the DBB method of procurement ensures a high degree of project functionality. This is because the functionality of DBB projects tends to be well-defined before commencement of construction work. This criterion is therefore often considered when selecting the DBB method. The findings of this study show a significant positive contribution between this criterion and both time and cost performance outcomes, which is consistent with the results of some previous studies [1, 20]. The report by Love et al. [53] 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 project functionality is highly required, such as for defining 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.

VII. Summary

This paper aimed at investigating the influence selection procurement methods have on the key project performance outcomes (Time, Cost and Quality), and to develop a formalised regression model that demonstrates which selection procurement criteria make a significant contribution to the PP. 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 influence project performance, which is useful in a number of ways and has

important implications for the selection of construction procurement methods. First, the study provides an indication of the key criteria for selecting DBB projects that are considered significant in influencing project success. Industry practitioners can benefit from this by paying close attention to these criteria, as it would not only facilitate quick and efficient DBB procurement selection processes but also increase the chances of success with projects. Secondly, it shows that these criteria can also be used to predict the likely contribution of DBB procurement methods to project success based on a formalised regression model. Such a model would hopefully help determine the extent by which each of the criteria are deficient in ensuring success of a project and hence the best ways of enhancing them if success is to be achieved. 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 such countries.

The results of the study exhibited that five criteria have a significant contribution to PP in terms of time, six in terms of cost and five in terms of quality. The largest absolute value of t and β in terms of time and quality was recorded on “project functionality”. However, in terms of cost it was recorded on “High quality level required”. As these criteria make a significant contribution to PP, project clients in Libya should give great attention to them and particularly focus on them when wanting to ensure success with DBB projects.

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