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APPRAISING FACTORS INFLUENCING CONSTRUCTION ENGINEERING COST ESTIMATES

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Abstract

Costs estimations of construction engineering projects are susceptible to inaccuracy (bias) leading to cost overrun. Many studies observed that there has been an increasing evidence of high cost of construction engineering projects in Nigeria. Consequently, this study is conducted with the aim of evaluating factors influencing the accuracy of construction engineering cost estimates. The survey was based on a questionnaire to solicit opinions of professionals within the built environment (architects, engineers, quantity surveyors, and contractors). This was conducted amongst and within organisations, ministries, and private practitioners in various disciplines with experience in the delivery of construction engineering projects and analyzed using influence index value. Factors influencing the accuracy of cost estimates of construction engineering projects have been determined and include: low expertise level of estimator, non-early involvement of estimator, impact of contract type, inaccurate and unreliable cost information, and poor project schedule. The study concluded that 44 most influential factors limiting the accuracy of construction engineering projects can be attributed to: project team related factors (16 sub-factors); estimating procedure related factors (14 sub-factors); and project characteristic related factors (14 sub-factors). These findings will guide stakeholders and professionals on factors influencing the accuracy of cost estimates of construction engineering projects and led a foundation for reducing high project cost. It is recommended that government and relevant organizations should use the findings for improving the cost estimation process and reduce the inaccuracy cost estimation trends in the country.

Keywords: Accuracy, Construction Engineering, Cost Estimate, Nigeria.

1. Introduction

Construction engineering projects have had to meet the demands of increasing complexity in terms of technical challenge, product sophistication and organizational change and its development is affected by a certain level of inaccuracy in cost estimation (Kwakye 1994; Arinmah, 2015). This inaccuracy results in increased cost of project, delays and conflicts. Cost related risk factors usually occur and have the most impact on construction engineering project performance. One of the greatest challenges facing construction engineering project delivery is to manage the risk of cost overruns emanating from inaccurate estimating (Anunike, 2013). Numerous failures of construction engineering projects can be attributed to inaccurate estimating. Inaccurate estimates contribute to the squandering of valuable resources (Onwusonye, 2014; Arinmah, 2015). Tipili and Ilyasu, (2014) observed that the level of accuracy of construction engineering cost estimates vary with the amount of time spent to prepare the estimates.

Reliable cost data are often difficult to obtain during the conceptual stages of a project, particularly if basic design and geographic issues remain unresolved. The importance of cost estimate for construction engineering project is such that without an accurate cost estimate, nothing can be done to prevent a loss, regardless of management competence or financial strength of the client (Hicks,

1992). Therefore, the process of accurate and reliable cost estimating in construction engineering projects is very important since it enables clients to determine a clear and reliable cost of the project capable of achieving value for money (Arif et al., 2010).

Inaccuracy (bias) in the estimate of construction engineering project may arise from two sources, namely, bias associated with the project itself and bias associated with the estimating technique used and the professional expertise of the estimator (Ajibade et al., 2008). Accurate cost estimate is an important piece of information when making decisions at the project planning and design stage and often become the basis for a project's ultimate funding. The importance of accurate estimates during the early stages of complex construction engineering projects has been widely recognized by many researchers (Arif et al., 2010; Osikhena, 2013; Oribuyaku, 2013; and Waziri, 2014). Construction engineering cost estimates are susceptible to inaccuracies (bias) because they are often prepared within a limited timeframe, and sometimes without fully finalized project scope (Ajibade et al., 2008; Onwusonye, 2014). The accuracy of construction engineering project cost estimate is heavily dependent upon the level of professional expertise and extent of use of information technology among other things (Liu and Zhu, 2007; Waziri, 2014). Not only the judgment of such factors is of prime importance but it is also important to measure the accuracy of construction engineering project cost estimates.

For the purpose of this study, cost estimates of construction engineering projects refers to as systematic approach to manage cost estimate of complex construction engineering projects such as high rise buildings, mass housing units, hospitals, schools, highways, dams, bridges, airports and seaports. Pius, (2012) notes that the execution of such projects requires the involvement of architects and engineers not only to design but to assist quantity surveyors in cost plan and control processes in order to achieve value for money. Involving architects, engineers, and contractors in the estimate preparation of mega/complex construction engineering projects can help to prepare more accurate and realistic estimates (AACE International, 2007; Ajibade et al., 2008; Arif et al., 2010; Balogun, 2013). Therefore it becomes imperatives to seek the opinion of these professionals in evaluating issues surrounding cost estimates of such projects with a view to examines influence of various factors on the accuracy of cost estimates. Certain conclusions have been drawn and a number of recommendations have been provided to improve the cost estimation process and reduce the inaccuracy trends in the cost of developing construction engineering project in Nigeria.

1.1 Identification of key factors influencing cost estimates of construction engineering projects

Cost engineering and project cost management are all functions of cost engineers (Rizwan et al., 2009; Oribuyaku, 2013; Osikhena, 2013; Dikko, 2014). Over the years, the public procurement in Nigeria has been grossly abused leading to huge losses of resources (Smith, 1995; Ameh & Ogundare, 2013 in: Joseph, 2015). In an effort to identify factors affecting cost of road construction projects in the country, Ejiofor (2015) has identified the following constraints in order of severity: corruption; inaccurate quantities; poor construction management; construction delay; utilization of foreign contractors; project complexity; poor procurement process; lack of regulation; government

policies; and inflation. Ikubor (2015) reports that assessment of Nigeria's civil engineering infrastructure status shows large financial deficit resulting from under investment and poor maintenance of facilities. Additionally, analysis of factors surrounding infrastructure and service delivery failure in order of severity shows that corruption, misallocation of investments, inadequate maintenance, lack of transparency and accountability, insufficient funding, lack of supportive institutions, inconsistent political, social and economic policies, and lack of suitable technical and managerial skills among others (Garold, 2001; Omoregie et al., 2006 in: Ikubor, 2015). Survey conducted by Ikubor (2015) supports the findings of Kwakye (1994) on the identified factors influencing variations in building projects and include: client characteristics, project characteristics, and project organization factors (design duration, percentage of design completion before tender, procurement and contract type, adequacy of information provided, and number of sub-contractors. Furthermore, the greatest challenge facing construction engineering cost estimation practices in Nigeria is the issue of cost and time overruns (Oribuyaku, 2013; Dahiru, 2013; Tipili and Ilyasu, 2014; Arinmah, 2015). Oribuyaku (2013) reports a study on the major causes of cost overrun on high way projects in Nigeria as: poor contract management, shortages of materials, price fluctuations, and inaccurate estimates. Construction engineering cost estimators sometimes unable to utilize acquired experience and judgment in the application of scientific principles and techniques to problems of estimation; cost control, business planning and management science profitability analysis, project management, planning and scheduling (Oloche and Mbaaeue, 2012; Waziri, 2014; Ejiofor, 2015). Arif et al., (2010) note that reliable cost data are often difficult to obtain during the conceptual stages of a project, particularly if basic design and geographic issues remain unresolved. Several researchers have concluded that inaccuracy in the estimate of construction engineering project may arise from sources such as; bias associated with the project itself, bias associated with the estimating technique used and the professional expertise of the estimator (Dikko, 2014; Ejiofor, 2015; and Arinmah, 2015)

However, these identified factors may likely occur due to inaccurate cost estimate. Occurrence of unrealistic cost estimate on construction engineering projects led to excessive cost and time overrun (Skitmore, 1991; Ikubor, 2015). Therefore, it is against this background that this study is been carried out to identify factors influencing the accuracy of construction engineering cost estimate with a view to avoid excessive project cost and time overrun in Nigeria.

1.2 Research Scope and Objectives

The core objective of the study was to appraise the factors influencing the accuracy of construction engineering cost estimate. The cost data of various construction engineering projects executed in Nigeria were collected for the analysis. These projects were public sector projects most of which were related to infrastructure development. The projects selected were executed in the major cities of the country: such as Abuja, Lagos, Kano, Kaduna, Ibadan, and Port Harcourt as have been the areas where mega/complex construction engineering projects were publically executed.

2. Research Methodology

The methodology of the study was conducted and the procedure is described as follows:

1. A thorough literature review was done as well as expert opinions were taken from a selected cross-section of professionals involved in mega project delivery to identify the key elements of a survey that may provide the basis of judging the accuracy of construction engineering cost estimates.
2. A questionnaire was developed to elicit project cost information and exploring the factors influencing the accuracy of construction engineering cost estimate.
3. A structured survey was conducted for the study.
4. Validation of survey was done via personal interviews with selected personnel.
5. Assessment of feedback from survey was made with a view to determine factors influencing the accuracy of construction engineering cost estimate in Nigeria.

The procedure used is explained as follows. In the first step, a thorough literature review was performed to identify the key elements of a survey that may provide a good means of judging the accuracy of construction engineering cost estimates. The literature review was done through books, conference proceedings, internet, and leading construction management and engineering journals.

Following the identification of the key elements of the survey, expert interviews were conducted from a selected cross-section of professionals involved in mega project delivery, including representatives from general management professionals and project clients. The objective was to identify any elements relevant to the construction engineering cost estimating practices and issues. As a result of the interviews, the components and constituent elements of the survey were finalized.

In the next step, a structured questionnaire consisting of two parts was designed – parts A and B. Part A consisted of questions requesting respondent's personal information (e.g. academic and professional qualifications, work experience, experience as construction engineering cost estimator, etc.) and other information (e.g. type of organization, types of engineering works executed, years in business, annual volume of work, number of permanent employees, locations of operation etc.). Part B consisted of questions requesting project cost information (e.g. project name, type, client, estimated project cost, total project cost, etc.). The questionnaire had also consisted with a list of factors influencing the accuracy of construction engineering cost estimate as highlighted through literature review. Respondents were later asked to rate the level of influence of a certain factor on the particular project for which the cost information have been provided.

The data for this study were collected from the participants through survey. The questionnaire was circulated among construction engineering professionals, cost management experts, contractors, specialty contractors, construction engineering management contractors, and design-build contractors. These respondents came from architecture, civil engineering, building,

and quantity surveying professions and were asked to provide the data of their recently completed projects. The surveys were aimed to be filled by the cost estimating personnel related to the projects surveyed.

In the final steps, based on all the gathered information, a descriptive analysis was performed as to find the accuracy of cost estimates of construction engineering projects in Nigeria. Further, certain important factors that influenced the accuracy of these estimates were identified using weighted analysis. Based on the survey results and analysis, relevant conclusions and recommendations were drawn.

2.1 Survey Response

The response rate (57%) for the survey is shown in Table 1 and is found to be considerably good for construction engineering cost estimating questionnaire survey. A similar survey conducted on the accuracy of pre-tender building cost estimates in Australia by Ajibade *et al.*, (2008) received a response rate of 41%. Therefore, statistically reliable conclusion can be obtained from the collected data.

Table 1: Breakdown of Responses

Total surveys	No response	Total number of potential responses	Total valid responses received	Percentage of valid responses
98	30	68	56	57%

Table 2: Categorization of Respondents Found in the Study Area

Respondents	Frequency	Percentage %	Cumulative %
Architects	13	23.21	23.21
Contractors	15	26.79	50.00
Engineers	14	25.00	75.00
Quantity Surveyors	14	25.00	100
Total	56	100	

3. Analysis and Discussions

Background information on respondents' profile is provided in table 3. This table shows that 17.86% of the respondents have the qualification of PhD, while 19.64% have masters in their respective field area of specialization. 28.57% have first degrees, 25% have either HND or ND in their various fields of disciplines in Nigeria. This summarily shows that majority of the respondents have high qualification in their field of endeavours. More importantly, 100% of the respondents are corporate members of their respective professional bodies (Table 4). In addition, 75% of them have an average of 12 years minimum experience in the construction engineering

cost management system (Table 5). From the foregoing, it can be concluded that the respondents could be relied upon for the information provided for this study for the purpose of analysis.

Table 3: Academic Qualification of Respondents

Respondents	Frequency	Percentage %	Cumulative %
PhD/M.Phil	10	17.86	17.86
MSc/M.Eng/M.Tech	11	19.64	37.50
BSc/B.Eng/B.Tech	16	28.57	66.07
HND/ND	14	25.00	91.07
Others	05	08.93	100
Total	56	100	

Table 4: Professional Qualification of Respondents

Respondents	Frequency	Percentage %	Cumulative %
MNIA	13	23.21	23.21
MNIOB	12	21.43	44.64
MNSE	16	28.57	73.21
MNIQS	15	26.79	100
Total	56	100	

Table 5: Respondents' Experience on the Delivery of Construction Engineering Projects

Respondents	Frequency	Percentage %	Cumulative %
1 – 4 years	03	5.36	5.36
5 – 9 years	11	19.64	25.00
10 – 14 years	14	25.00	50.00
15 – 19 years	16	28.57	78.57
20 – Above years	12	21.43	100

3.1 Factors Influencing the Accuracy of Cost Estimate of Construction Engineering Projects

A list of factors influencing the accuracy of construction engineering cost estimate was developed through literature review and expert opinion as earlier mentioned. This list was divided into three major categories. These were: project team related factors, project characteristics, and estimating procedures. Respondents were asked to rank the influence of these factors over accuracy of cost estimate of the particular project for which the cost information have been provided on a five point scale (1 = very low; 2 = low; 3 = medium; 4 = high; and 5 = very high). Based on all the gathered

information, influence index was used to find the most influential factors limiting accuracy of construction engineering cost estimate.Thus the significance of adopting the influence index is to determine the most influential factor limiting the accuracy of construction engineering cost estimate. This method was previously used by Arif *et al* (2010) in their effort to determine factors influencing the accuracy of cost estimates of construction projects in Pakistan.

The influence index of each factor was calculated using the following formula.

$$Influence\ Index = \frac{\sum(Influence\ score \times Response\ frequency\ at\ that\ influence\ score)}{Total\ Number\ of\ Responses}$$

Table 6: Ranking of Project Team Related Factors Influencing the Accuracy of Construction Engineering Cost Estimates

Project Team Related Factors						
Influential Factors	Influential Index					Rank
	Architects	Contractors	Engineers	Q/Surveyors	Weighted Average	
Low expertise Level of estimator	4.2	4.2	4.3	4.2	4.23	1
Non early involvement of estimator	4.1	4.1	4.2	4.0	4.10	2
Impact of contract type	4.1	3.9	4.1	3.8	3.98	3
Attitude of estimator towards changes	3.9	3.9	3.8	3.6	3.80	4
Level of team integration	3.8	3.7	3.8	3.4	3.68	5
Level of Involvement of client in the estimation procedure	3.8	3.7	3.7	3.2	3.60	6
Expertise Level of designer of the project type	3.7	3.6	3.6	3.1	3.50	7
Financial status of client	3.5	3.6	3.5	3.0	3.40	8
Client's Priority level of the project	3.4	3.5	3.3	2.7	3.23	9
Impact of type of Client	3.4	3.2	3.4	2.7	3.18	10
Client's Experience Level of the project type	3.3	3.3	3.1	2.6	3.08	11
Willingness to Investment in Project	3.1	3.3	3.0	2.4	2.95	12
Involvement of contractor in the pre tender estimation procedure	3.1	3.2	3.1	2.3	2.93	13
Number of other Projects of client	3.1	3.0	3.0	2.3	2.85	14
Attitude of contractor towards changes	3.0	3.0	2.8	2.2	2.75	15
Attitude of client towards changes	2.9	2.8	2.7	2.1	2.63	16

The results in Table 6 shows most of the influential factors limiting the accuracy of construction engineering cost estimates related to project team. Low expertise level of estimator of the project type was found to be the most influential factor (with weighted average (w.a.) 4.23 and ranked 1st). This was seconded by non-early involvement of the estimator with the w.a. of 4.10 and ranked the 2nd influential factor. Impact of contract type (w.a. 3.98) was the 3rd influential factor limiting the accuracy of construction engineering cost estimate. Others include: attitude of estimator towards

changes (w.a. 3.80 and ranked 4th); level of team integration (w.a. 3.68 and ranked 5th); level of Involvement of client in the estimation procedure (w.a. 3.60 and ranked 6th); expertise level of designer of the project type (w.a. 3.50 and ranked 7th); financial status of client (w.a. 3.40 and ranked 8th); client's priority level of the project (w.a. 3.23 and ranked 9th); impact of type of client (w.a. 3.18 and ranked 10th); client's experience level of the project type (w.a. 3.08 and ranked 11th); willingness to investment in project (w.a. 2.95 and ranked 12th); involvement of contractor in the pre tender estimation procedure (w.a. 2.93 and ranked 13th); number of other Projects of client (w.a. 2.85 and ranked 14th); attitude of contractor towards changes (w.a. 2.75 and ranked 15th); and attitude of client towards changes (w.a. 2.63 and ranked 16th).

This has relatively revealed that most of the estimators have low level of expertise and were usually not been fully involved at the early stage of the project resulting in preparing inaccurate and unreliable cost estimate leading to the high cost of the project. The finding gives a clear reflection of the need to involve competent estimator in the early stage of construction engineering project development for improving the accuracy and reliability of the cost estimates. This is because, construction engineering cost estimator is the only reliable expert who is aware of the norms and conditions for engineering cost estimation and has experience on how cost engineering skills and knowledge can be integrated through a work process, specifically the Total Cost Management (TCM) process. Furthermore, the cost estimator is the only expert who knows how cost engineering skills and knowledge about individual resource types are integrated.

Therefore the above finding justified the findings of Oribuyaku (2013) that involvement of a competent cost estimator at the early stage of construction engineering project usually provides the following: the total cost approach takes into account both capital and operating costs so that more effective decisions can be made on the project; initial costs are clear and visible at an early stage; offer advice on an effective procurement procedure; and offer total cost advice, etc.

In addition, early involvement of a competent cost estimator in the development of construction engineering projects provides: accurate cost estimation; cost control, contract planning and management, including problems of project management, planning, scheduling, and profitability analysis of engineering projects and processes (Steven *et al.*, 2003; Ajibade *et al.*, 2008; Balogun, 2013; Dahiru, 2013; Dikko, 2014).

Table 7: Ranking of Estimating Procedure Related Factors Influencing the Accuracy of Construction Engineering Cost Estimates

Estimating Procedure Related Factors						
Influential Factors	Influential Index					Rank
	Architects	Contractors	Engineers	Q/Surveyors	Weighted Average	
Inaccurate and unreliable Cost Information	3.9	4.2	4.1	4.2	4.10	1
Unavailability of cost Information	4.1	3.9	4.0	4.0	4.00	2
Non-application of cost Information	4.0	3.9	3.9	3.8	3.90	3
Standard Procedure for updating the Cost Information	3.8	3.7	4.0	3.7	3.80	4
Time allowed for preparing the estimates	3.7	3.8	3.7	3.6	3.70	5
Alignment of estimate methodology with available project information	3.7	3.6	3.6	3.6	3.63	6
Project Overhead calculation method/procedure	3.5	3.4	3.6	3.5	3.50	7
Method used to determine the contingency	3.4	3.5	3.4	3.3	3.40	8
Profit calculation Method/procedure	3.4	3.2	3.3	3.3	3.30	9
Documentation of information used in preparing the estimate	3.2	3.3	3.1	3.2	3.20	10
Risk assessment method used	3.0	3.1	3.1	3.1	3.08	11
Formality level adopted during the estimation procedure	2.9	3.0	3.1	2.7	2.93	12
Utilization of check list to ensure the completeness of the Estimate	3.0	2.9	2.9	2.5	2.83	13
Use of computerized tools	2.9	2.8	2.8	2.3	2.70	14

Table 7 displays the most influential factors related to estimating procedures which include: inaccurate and unreliable of cost information with the w.a. of 4.10 and ranked 1st; unavailability of cost information (w.a. 4.0 and ranked 2nd); non-application of cost Information (w.a. 3.90 and ranked 3rd); lack of standard Procedure for updating the Cost Information (w.a. 3.80 and ranked 4th); time allowed for preparing the estimates (w.a. 3.70 and ranked 5th); alignment of estimate methodology with available project information (w.a. 3.63 and ranked 6th); project overhead calculation method/procedure (w.a. 3.50 and ranked 7th); method used to determine the contingency (w.a. 3.40 and ranked 8th); profit calculation method/procedure w.a. 3.30 and ranked 9th); documentation of information used in preparing the estimate (w.a. 3.20 and ranked 10th); risk assessment method used (w.a. 3.08 and ranked 11th); formality level adopted during the estimation procedure (w.a. 2.93 and ranked 12th); utilization of check list to ensure the

completeness of the estimate (w.a. 2.83 and ranked 13th); and use of computerized tools (w.a. 2.70 and ranked 14th).

These findings shown in table 7 indicate that the cost information used in the preparation of cost estimate by the estimators were usually not accurate, unreliable and sometimes unavailable during the estimating processes. The fact is that construction engineering cost estimates are sometimes prepared by incompetent professionals (preparing estimate outside the best practices leading to the high level of bias). Thus in many cases compromising the applicability and reliability of the data to the needs of a particular project and this leads to increasing inaccuracy in the estimates. While the findings indicate that availability of cost information couple with understanding of what makes up cost i.e. the basic resources (material, labour, etc.) that are needed to perform an activity is significant to the accuracy of cost estimate. Therefore for an estimate to be accurate and reliable, estimator is competent enough to: understand the distinction between cost elements that are directly applied to the project and those that are indirectly applied; relate the cost elements to the life cycle of the project (acquisition, use, and disposal); and use the understanding of cost elements to further understand how cost is measured, applied, and recorded to arrive at the accurate and reliable cost estimate.

Table 8: Ranking of Project Characteristics Related Factors Influencing the Accuracy of Construction Engineering Cost Estimates

Project Characteristics Related Factors						
Influential Factors	Influential Index					Rank
	Architects	Contractors	Engineers	Q/Surveyors	Weighted Average	
Contract type	4.1	3.9	4.0	4.2	4.05	1
Project schedule	3.8	4.0	3.9	4.0	3.93	2
Completeness of tender	3.7	3.8	3.9	3.8	3.80	3
documents	3.8	3.6	3.7	3.6	3.68	4
Site access availability	3.6	3.5	3.7	3.5	3.58	5
Project need	3.4	3.6	3.5	3.2	3.43	6
Complexity of project	3.5	3.4	3.4	3.1	3.35	7
Project strategy	3.3	3.5	3.2	3.1	3.28	8
Technology required	3.4	3.2	3.1	3.0	3.18	9
Priority of project	3.1	3.1	3.2	2.7	3.03	10
Scope change	3.0	3.2	2.8	2.7	2.93	11
Location of project	2.9	2.8	2.9	2.5	2.78	12
Project duration	3.0	2.8	2.7	2.3	2.70	13
Project location	2.9	2.7	2.8	2.2	2.65	14
Type of project						

The most influential factors limiting the accuracy of construction engineering cost estimate related to project characteristic was found to be: contract type (w.a. 4.05 and ranked 1st); project schedule (w.a. 3.93 and ranked 2nd) and completeness of tender documents (w.a. 3.80 and ranked 3rd); site access availability (w.a. 3.68 and ranked 4th); project need (w.a. 3.58 and ranked 5th); complexity of

project (w.a. 3.43 and ranked 6th); project strategy (w.a. 3.35 and ranked 7th); technology required (w.a. 3.28 and ranked 8th); priority of project (w.a. 3.18 and ranked 9th); scope change (w.a. 3.03 and ranked 10th); location of project (w.a. 2.93 and ranked 11th); project duration (w.a. 2.78 and ranked 12th); project location (w.a. 2.70 and ranked 13th); and type of project (w.a. 2.65 and ranked 14th).

The findings in table 8 indicate that poor contract management, project schedule and inappropriate tender documents were found to be the major influential factors limiting the accuracy of construction engineering cost estimate especially on high way construction projects. In addition to that, tender documents are also prepared inappropriately leading to unrealistic cost estimates.

Effective project management involves coordinating activities such as contract planning and documentations, organizing, implementing, and controlling time and cost. Time control is usually achieved by preparing and using schedules to make the most efficient use of available time. Project scheduling is an important and integral part of the overall planning effort, since the scheduling process forces people to quantify their effort in discrete terms and to place activities in proper relationship to each other. Scheduling provides a basis for management of the work, improves communications, and facilitates coordination. Using a schedule improves the effective use of resources. Therefore project schedule gives the user a baseline to monitor and control the work. AACE International (2007) concludes that scheduling provides a way of contributing input during project execution concerning means, methods, techniques, sequences, or other conditions affecting the plan's outcome. This has relatively shows that scheduling provides a means for obtaining feedback since the development and use is a team effort incorporating the ideas and objectives of those responsible for the work. Therefore schedules are good motivational tools providing intended work plans to those having to perform the work and reporting progress against them. Failure to provide effective project scheduling results in cost estimate bias.

Conclusion

The study has resulted in drawing valuable information regarding the accuracy of cost estimates of construction engineering projects in Nigeria. The major conclusions from the study are as follows.

1. Most of the time the cost estimate of construction engineering projects are inaccurate. This is as a result of project team related factors such as: low expertise level of estimator; non-early involvement of the estimator; impact of contract type; attitude of estimator towards changes; and level of team integration. These are the top five most influential factors related to project team in limiting the accuracy of cost estimate.

2. Top five most influential factors related to estimating procedure in limiting construction engineering cost estimate were attributed to: inaccurate and unreliable of cost information; unavailability of cost information; non-application of cost information; lack of standard procedure for updating the cost information; and time allowed for preparing the estimates.

3. The most influential factors related to project characteristic in limiting the accuracy of construction engineering cost estimate was found to be: contract type; project schedule; completeness of tender documents; site access availability; and project need.

Therefore the survey has discovered that most of the influential factors limiting the accuracy of cost estimates in the development of construction engineering projects were related to: project team related factors (16); estimating procedure related factors (14); and project characteristic related factors (14). The findings will guide the relevant stakeholders on factors influencing the accuracy of cost estimates of construction engineering projects and led a foundation for reducing high project cost.

Recommendations

Based on the conclusions derived from the survey, the following are major recommendation to further improve the cost estimation process and thus improving the accuracy of cost estimates as a means of reducing the problem of high cost of construction engineering projects in Nigeria.

1. Involving competent cost estimator at the early stage of engineering project development can be a good system to consider as a starting framework. Since it will give more expert cost estimates capable of achieving value for money.
2. Sufficient time should be given to the designers and estimators for preparation of tender documents capable of selecting the right contractor.
3. Effective communications among the project team should be established during the estimating process.
4. Involving all stakeholders such as designers, estimators, project manager, subcontractors, material suppliers and manufacturers in the estimate preparation can help to prepare more accurate and realistic estimates.
5. There is a strong need for the professional bodies such as COREN, COBON, and QSRBN to insist on the early involvement of competent estimators in the preparation of accurate and realistic engineering cost estimates. This can improve the understanding of cost elements to further understand how cost is measured, applied, and recorded to arrive at the accurate and reliable cost estimate.

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