# Project Cost Estimation: Issues and the Possible Solutions

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# Project Cost Estimation: Issues and the Possible Solutions

**Benedict Amade, Edem Okon Peter Akpan**

***Abstract*— The process of developing a comprehensive project cost estimate is critical for a project to be adjudged successful on completion. Projects' costing is one of the most critical and most widely used project management tools. The complex nature of Projects and the inherent uncertainty of the financial performance of construction projects, development funding, and the monitoring and controlling of costs and schedules make exact budget needs impossible to forecast accurately. This same characteristic also makes projects to deviate from plans. The main object of this paper is to identify the factors affecting the accuracy of project cost estimation, determine the various methods of carrying out project cost estimation in construction projects within Owerri, Imo State. The study is motivated by the inability of most construction professionals to arrive at a tentative and reliable project cost estimate in project realization which has created obvious problems of project cost overrun and subsequent abandonment. The study sampled the opinion of fifty-three selected project professionals who had worked on related construction outfits in Owerri, Imo State. An objective realization instrument developed using eighteen (18) factors identified in the literature as possible factors affecting the accuracy of project cost estimation were ranked based on a Likert four-point scale. The score of respondents to the factors were analyzed using descriptive and inferential statistics, mean score value and factor analytical approach as the major tool with the aid of SPSS. Firstly, results of the analysis among others shows that the most frequently utilized method for carrying out project cost estimation is the detailed estimating method with a mean score value of 3.491. Secondly, results of the factor analysis among others shows that the type and nature of project is the most critical factor affecting the accuracy of project cost estimation in Owerri. This was followed by in that order; number of bidders tendering, location of project, closure and blockade of borders, scale and scope of construction, materials price availability, contractor's workload, constraints on site, detailed drawings and specifications, conditions of the market, and buildability.**

***Index Terms*— Project cost estimation, factor analysis, mean score value, detailed estimate, conceptual estimate**

## I. INTRODUCTION

The performance of construction projects via the cost, is a key success factor for project funding. Projects, the world over requires budget to set the client's financial commitment and create an avenue for the control of cost and measurement of cost performance during the design process as well as during construction (Baccarini, 2005).

The completion of construction projects within the initial estimate have been challenging for the construction industry. It should be noted that achieving the objectives of a construction project is very crucial to the parties involved, mostly the client. Construction work plans and budget estimates are usually prepared with a view to achieving the desired quality within scheduled completion time and cost (budget) efficiency. According to Akintoye (2000), cost estimating is a critical component of construction contract, providing a template for stating the likely cost of the individual resources being tendered for. Furthermore, Akintoye (2000), opined that the impact of improper cost estimate on contracting concern is significant. He further emphasized that overestimation can result to higher tender estimates being tendered by a contractor thereby leading to the rejection by the client. While on the other hand, underestimation of tender estimates could equally result to the incurring of loss on the part of the contractor. Either way, over estimation and underestimation of tender estimates can create serious consequence and dent the opportunity of a contractor in a construction contract.

The importance of cost estimation as stated by Akintoye (2000) is that, "without an accurate cost estimate, nothing short of an act of God can be done to prevent a loss, regardless of managemnt's competence, financial strength of the contractor, or know how". Be that as it may, cost estimating is referred to as the procedure of examining a specific scope of work and forecasting the cost of completing the work (Choon and Ali,2008) while Butcher and Demmers (2003) see cost estimating as a well formulated prediction of the likely cost of a specific construction project.

According to Shane, et al. (2009), large construction projects have been bedeviled by incidences of cost and schedule overruns which in most cases; the final project cost becomes higher than the initial estimate earlier prepared during the initial planning, preliminary activities, final design or even during the conception of design process. This assertion was also collaborated by Doloi, (2003) where he opined that the factors that influence cost during the conception and design stages in a construction project has been largely attributed to cost estimating practices. Love, et al. (2013) however opined that cost overruns have also been attributed to misrepresentation of information during the preparation of cost estimates. Ssemwogerere, (2011) in his study, opined that the construction industry is faced with numerous challenges one of which is that most of the projects are usually completed at a cost of about 25-35 percent increase of the initial cost earlier budgeted thus leading to cost overruns. Ssemwogerere (2011), further concluded that in as much as contingency is usually included in construction project

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estimates, such projects still end up being completed higher than their initial cost estimates. These and many other reasons led this researcher to find out how most project cost estimates are carried out during estimating and the manner in which contingency sums are established with a view to correcting the above mentioned anomalies ensuing there from.

The main aim of this research work entitled "Project Cost Estimation-Issues and the Possible Solutions" is to;

1. To identify and evaluate factors affecting the accuracy of cost estimates in the area of study
2. To identify and evaluate types of cost estimation models/methods applicable in the area of study

## II. Literature Review

### A. *Cost Estimation*

Cost estimating, according to Choon and Ali (2008) usually involves the collection, analyzing, and summarizing of data readily available for a construction project. This normally involves taking into cognizance certain elements of labour, materials and plant unit cost of the individual items of work as specified in the bill of quantities and work specifications. Enhassi, et al. (2007) opined that estimating is an important and key step in construction process as its reliability in terms of accuracy from the conceptual stage to the final stage determines the success or failure of a project. Furthermore, Odusami and Onukwube (2008) stated that cost estimating is usually not a precise technical and analytical process but rather a subjective process where the estimators consider other factors relevant to the success of a construction project. An estimate is a judgment, opinion, forecast or prediction, Enhassi, et al. (2007). Cost estimating is crucial and critical to a construction project, providing a basis for establishing the probable cost of resource elements of a tender for a construction project. The construction industry according to Enhassi, et al. (2007) is unique, in the sense that is highly risky due to the fact that most of the projects must be bidded for before they are constructed. This in order words, makes the construction industry different from other industries due to reasons of known selling prices and manufacturing costs.

### B. *Purpose of Cost Estimation*

According to Elhag and Boussabaine (1998), the main function and purpose of cost estimation is to arrive at an accurate and dependable cost forecast of a construction project. In other words, the cost to be forecasted lies solely on the requirements of a client and the information and data available to develop the estimate. In some instance, an owner/client or contractor may demand to know the lowest tender price at some stage or the final project cost at the completion stage. This whole idea is an important factor that clients consider when embarking on a construction project, it determines the feasibility of the project and also provides a basis for budget control when tendering and constructing.

### C. *Types of Cost estimating Methods*

Cost estimating varies as a result of several imposing factors on the estimate. According to Elhag and Boussabaine (1998), the attractiveness of each of the methods includes the ease of its application, familiarity and speed together with a tolerable level of accuracy and reliability. They include;

- ❖ Functional Unit
- ❖ Cube Method
- ❖ Superficial Area
- ❖ Superficial Parameter
- ❖ Storey Enclosure
- ❖ Approximate Quantities
- ❖ Elemental Analysis
- ❖ Interpolation
- ❖ Resource Analysis
- ❖ Cost Engineering

These methods above, according to Elhag and Boussabaine (1998) are deficient as a result of their disadvantages in the areas of lack of precision and uncertainty. Their deficiency also lies in their inability to make allowances for client characteristics, consultant and design characteristics, contractor's characteristics, contract procedures and procurement methods and external factors and marketing characteristics. Ashworth, (2004), identified the following types of estimating as;

- ❖ Preliminary
- ❖ Feasibility
- ❖ Viability
- ❖ Authorization
- ❖ Final Budget
- ❖ Control

Other cost estimating methods include; linear/dynamic programming, regression analysis, simulation/risk analysis, and expert systems, Elhag and Boussabaine (1998). Unfortunately, these methods lack the abilities to deal with problems such as;

1. Imprecision and uncertainty of data and variables affecting cost of construction projects.
2. Unknown combined effects and interrelationships of cost influencing factors.
3. Complex and vagueness of input-output relationship which cannot fit in nicely and successfully into a quantitative description.

Basically, cost estimation according to Butcher and Dermmer (2003), falls into two groups namely conceptual estimates and detailed estimates.

### D. *Conceptual Estimates*

Sometimes called parametric or preliminary estimates, is the process of establishing a project's cost usually before any graphical representation of the facility has to be developed. According to Clough, (1986), is usually the first form of estimating that involves predicting the future costs of a project. It is sometimes called "topdown", order of magnitude, ball park, feasibility, quickie, analogous and pre-design estimate. Clough, (1986), further opined that, this type of estimate is usually carried out as part of a feasibility study at the commencement of a project. At this point, the estimate is prepared with minimum data as regards to the project's scope with little design and specification details. In a nutshell, the conceptual estimate gives the client a clue on how much is expected of the project before further decisions could be made to proceed with the project.

*E. Detailed estimate*

This is also known as, bid or quantity take-off estimates. The detailed estimate is the product of a process where the cost of a proposed construction project is predicted. The estimate is prepared by splitting the work packages in an orderly and logical form by determining the cost of each work package from experience and summarizing the total. Butcher and Dermmer (2003). Hendrickson, (2000), opined that an elaborate estimate is usually formed when the entire scope of work is clearly spelt out and a detailed form portraying the entire process visible. Hegazy, (2002), stated that the main difference between the conceptual estimate and detailed estimate is that the detailed estimate can be carried out only when individual work packages are identified and take-off of their quantities are made possible. Hegazy, (2002), further stated that the a detailed estimate requires an analysis of the method of construction to be used, the quantities of work, resources rates of production and any other factor that affects each of the sub-items.

*F. Factors Influencing Cost estimation Accuracy*

One very important factor for a successful realization of a construction project is the preparation of provision of an accurate cost estimate which is capable of influencing project feasibility to profitability. Enhassi, et al. (2007). The level of accuracy of an estimate does vary depending on the amount of information that is available with regards to the project. Enhassi, et al. (2007). Elhag, et al. (2005), opined that the most significant factors affecting cost estimation are qualitative in nature, and they include; methods of procurement, market conditions, and the level of construction activities and the client's priority as regards to construction time. While Odusami and Onukwube, (2008) identified the details of design, labour and material availability, expertise of the estimator, market conditions, nature of design complexity, the period of tender and project team experience. While, Akintoye, (2000), identified complexity of a project, scope of construction, market conditions, method used in construction, constraints on site, client's financial standing, and buildability and location of project as factors influencing project cost estimate.

*G. Research Gap Analysis*

Although extensive research has been carried out on factors involving project cost estimation issues in construction projects, very little of this research contains information appropriate to the factors within our immediate environment, Owerri. A cursory look at some previous author's contributions in this area will help create an enabling environment to treat our case.

Oladokun, et al. (2011) in a study, examines the accuracy of pre-tender cost estimates of consultant quantity surveyors for building projects in Nigeria. Quantitative research approach was adopted in the study. Data was collected from 81 building projects by consultants from 2005 to 2008. The results showed that pre tender cost estimates that are over estimated are incorrect by a larger margin than pre tender cost estimates that are underestimated, the bias of pre tender cost estimates varies according to the project size and sector, estimates of smaller project are more biased than the larger ones and projects that are from the public sector are more biased than those from the private sector, cost estimates for the projects are biased and are over estimated by an average of 2.43% with a coefficient of variation of 9.55.

Enshassi, et al. (2013) conducted a study on factors affecting the accuracy of pre-tender cost estimating from the perspective of clients and consultants. A survey questionnaire was used to elicit professionals' views on and experiences with factors affecting the accuracy of pre-tender cost estimates; a total of 70 organisations operating in the Gaza Strip, responded to the survey. The results of analysing a total of 64 factors considered in the questionnaire reveal that the top five factors affecting the accuracy of pre-tender cost estimating are materials (prices/availability/supply/quality/imports), closure and blockade of borders, project team's experience in the construction type, the experience and skill level of the consultant and clear and detailed drawings and specifications. Kendall's coefficient of concordance was used as a measure of agreement between the two groups of respondents (i.e., clients and consultants) who ranked various factors and it appears that they are generally in agreement.

Azman, et al. (2012) did a study on the accuracy of preliminary cost estimates prepared by Public Works Department in Malaysia. The study attempts to understand Quantity Surveyors' estimation accuracy in relation to public projects. The study analysed 83 projects of estimates and tender bids. The analysis included three estimating targets i.e. lowest bid, accepted bid and mean of the bids. To broaden the study, 344 Quantity Surveyors' involved in the procurement answered the questionnaires. Linear multiple regression analysis on project characteristics shows that project size, number of bidders, location and type of schools affect the bias. Contract period affects the consistency. The use of mean of the bids is the best-fit target to explain the bias in terms of adjusted R.

Enshassi, et al. (2007), carried out a case study on cost estimation practice of a construction project implemented by a local contractor in Gaza Strip. The findings obtained from the case study showed that the most five important factors that affect contractors' cost estimate are financial status of owner, type of project, contractor workload, location of project, and method of paying Value Added Tax (VAT). Excluding VAT from the quotation analysis sheet will provide more accurate and obvious bid estimates. Therefore, clients and owners are encouraged to advertise their projects based on zero VAT rating.

Akintoye, (2000) carried out a study on the factors influencing contractors' cost estimating practice. The study was achieved through a comparative study of 84 UK contractors classified into four categories, viz, very small, small, medium and large firms. The initial analysis of the 24 factors considered in the study indicate that the main factors relevant to cost estimating practices are complex nature of the project, scale and scope of construction, conditions of the market, construction method, constraints on site, financial position of client, buildability and location of the project. Analysis of variance, which tests the null hypothesis that the opinions of the four categories of companies are not significantly different, shows that except for the procurement route and contractual arrangement factor there are no

difference of opinion, at the 5% significance level, on the factors influencing cost estimating. Further analysis, based on a factor analytical approach, reveal that the variables could be grouped into seven factors; the most important factor grouping being project complexity followed by technological requirements, project information, project team requirement, contract requirement, project duration and, finally, market requirement.

## III. Methodology

The objective of this study was achieved through administration of structured questionnaire and personal interview to obtain information from key project stakeholders on factors affecting the accuracy of project cost estimation. Key participants in construction related projects were the targets of the survey. Self-administered and e-mailed questionnaires were randomly distributed to target respondents and they include Architects, Engineers, Project Managers, Builders, Quantity Surveyors and other related professionals in the construction related as well as government agencies, private property developers, project consultants and main contractors with abundant hands-on experience in project cost estimation within Owerri metropolis, Imo State. The research adopted a thorough and deterministic method by way of responses. The list of factors affecting the accuracy of project cost estimation were obtained from the literature as potentially influencing cost estimating for the respondents to provide opinion on the extent of influence of each of the factor on a four-point Likert-type scale viz; (4-strongly agree, 3-agree, 2-disagree, 1-strongly disagree). The principal component for data collection is the questionnaire and interviews where sixty (60) respondents were sampled from a valid response, while fifty-three (53) responses from the respondents was actually used for the analysis with a response rate of 88.3%. Eighteen (18) factors affecting the accuracy of project cost estimation in the construction industry were used in developing the questionnaire. In addition, the data collected were also used to compare the opinions between clients, organizations, project consultants and main contractors in factors affecting the accuracy of project cost estimation approaches. Results from the questionnaire survey were analyzed to investigate the respondents' views and opinions on factors affecting the accuracy of project cost estimation by using different statistical techniques with the aid of SPSS 17.0. Firstly, a descriptive statistics of the demographic concerns about the respondents in terms of their frequency as regards the type of organization, designation of respondents, organization's years of experience, number of projects executed, as well as the value of projects executed were presented. Secondly, the respondents were asked to rank the different methods of project cost estimations used in their organizations by way of ranking using their Mean Item Score. Thirdly, the second analysis was intended to detect in clear terms the underlying factors affecting the accuracy of project cost estimation using factor analytical approach.

Factor analysis is a method of quantitative multivariate analysis whose sole aim is to represent the interrelationships among a set of continuously measured variables (usually represented by their interrelationships) by a number of underlying linearly independent variables called factors. The principal component analysis for factor extraction is used in the analysis, the distinctive characteristic of this tool is its data-reduction capability. (Amade, 2012, (SPSS 17.0), (Landau & Everitt, 2004), (Guar & Guar, 2009), (Akintoye, 2000). Factor analysis therefore seeks to collapse the numerous operating variables into fewer dimensions of interrelated attributes called principal components. The eigenvalue determines the principal components, which are orthogonally varimax, rotated to obtain more evenly distributed variables among the components. Various tests are required for the appropriateness of the factor analysis for the factor extraction, including the Kaiser Meyer Olkin (KMO) statistic, and Barlett test of sphericity. The results of these tests are shown in this work.

### IV Data Analysis

Demographic Statistics of the Respondents

## IV. Data Analysis

Demographic Statistics of the Respondents.

**Table I: RESPONDENTS TYPE OF ORGANISATION**

| RESPONDENTS TYPE OF ORGANISATION | | | | | |
|---|---|---|---|---|---|
| | | Frequency | Percent | Valid Percent | Cumulative Percent |
| Valid | CONSULTANCY | 15 | 28.3 | 28.3 | 28.3 |
| | PROJECT MANAGEMENT | 16 | 30.2 | 30.2 | 58.5 |
| | OTHER CONSULTANCY | 4 | 7.5 | 7.5 | 66.0 |
| | BUILDING/CIVIL CONTRACTOR | 18 | 34.0 | 34.0 | 100.0 |
| | Total | 53 | 100.0 | 100.0 | |

Source: Researcher's Field Survey, 2014.

From the table above, (34.0%) 18 respondents are from the building/civil contracting firm. This is closely followed by Project Management firm (30.2%) 16, Consultancy and Other Consultancy based firms (28.3%) 15 and (7.5%) 4 respectively.

**Table II: DESIGNATION OF RESPONDENTS**

| DESIGNATION OF RESPONDENTS | | | | | |
|---|---|---|---|---|---|
| | | Frequency | Percent | Valid Percent | Cumulative Percent |
| Valid | ENGINEER | 16 | 30.2 | 30.2 | 30.2 |
| | PROJECT MANAGER | 13 | 24.5 | 24.5 | 54.7 |
| | QUANTITY SURVEYOR | 14 | 26.4 | 26.4 | 81.1 |
| | ARCHITECT | 10 | 18.9 | 18.9 | 100.0 |
| | Total | 53 | 100.0 | 100.0 | |

Source: Researcher's Field Survey, 2014.

From the table above, (30.2%) 16 respondents are Engineers, (24.5%) 13 are Project Managers, (26.4%) 14 are Quantity Surveyors, while Architects are made up of (18.9%) 10. This

is an indication that the key professionals in the construction industry were consulted.

**Table III: EXPERIENCE OF ORGANISATION IN CONSTRUCTION BUSINESS**

| NUMBER OF PROJECTS EXECUTED IN 5 YEARS | | | | | |
|---|---|---|---|---|---|
| | | Frequency | Percent | Valid Percent | Cumulative Percent |
| Valid | LESS THAN 10 | 13 | 24.5 | 24.5 | 24.5 |
| | FROM 11 TO 20 | 32 | 60.4 | 60.4 | 84.9 |
| | FROM 21 TO 30 | 8 | 15.1 | 15.1 | 100.0 |
| | Total | 53 | 100.0 | 100.0 | |

Source: Researcher's Field Survey, 2014.

From the table above, majority of the construction firms 32 (60.4%) have executed from 11 to 20 projects in the last 5 years. While 13 (24.5%) have executed less than 10 projects, and 8 (15.1%) executed between 21to30 projects. This is an indication that the professionals in the aforementioned firms have been busy all year around, keeping themselves abreast with latest happenings within the construction industry and they are fit to make meaningful contributions to the survey.

**Table V: METHODS FOR PROJECT COST ESTIMATING**

| S/N | METHODS FOR PROJECT COST ESTIMATION | MEAN SCORE VALUE | RANKING |
|---|---|---|---|
| 1 | DETAILED ESTIMATE | 3.4906 | 1ST |
| 2 | CONCEPTUAL ESTIMATE | 1.5849 | 2ND |

Source: Researcher's Field Survey, 2014.

Table V depicts the methods used by the construction firms for conducting project cost estimating as perceived by the respondents in the study area. The analysis revealed that the most frequently utilized method for conducting project cost estimation is the detailed estimate method with a mean score value of 3.491 and ranked first. This is followed by the conceptual estimate method which was ranked second with a mean score value of 1.585.

**Table VI: FACTORS AFFECTING THE ACCURACY OF COST ESTIMATE**

| S/N | Factors that affect the accuracy of a cost estimate |
|---|---|
| 1 | Materials/ prices /availability/supply/quality/imports |
| 2 | Closure and blockade of borders, |
| 3 | Project team's experience in the construction type |
| 4 | The experience and skill level of the estimator, |
| 5 | Clear and detailed drawings and specifications |
| 6 | Project size, |
| 7 | Number of bidders, |
| 8 | Financial capability of client, |
| 9 | Type of project, |
| 10 | Contractor's workload, |
| 11 | Location of project, |
| 12 | Method of paying tax. |
| 13 | Complex nature of the project, |
| 14 | Scale and scope of construction, |
| 15 | Conditions of the market, |
| 16 | Constraints on site, |
| 17 | Buildability |
| 18 | Construction method, |

The estimation of the possible intensity of the factors affecting the accuracy of project cost estimation is done using the communality extraction as shown in Table VII. The least extraction of 0.575 is associated with factor Contractor's workload, while the highest extraction of 0.871 factor Buildability. It therefore shows that each of the factors has indicated high potentials of affecting project cost estimation.

**Table VII: COMMUNALITIES**

| Communalities | | |
|---|---|---|
| | Initial | Extraction |
| Materials/ prices/availability/supply/quality/imports | 1.000 | .721 |
| Closure and blockade of borders, | 1.000 | .825 |
| Project team's experience in the construction type | 1.000 | .796 |
| The experience and skill level of the estimator, | 1.000 | .814 |
| Clear and detailed drawings and specifications | 1.000 | .780 |
| Project size, | 1.000 | .708 |
| Number of bidders, | 1.000 | .731 |
| Financial capability of client, | 1.000 | .635 |
| Type of project, | 1.000 | .579 |
| Contractor's workload, | 1.000 | .575 |
| Location of project, | 1.000 | .651 |
| Method of paying tax. | 1.000 | .781 |

| | | |
|---|---|---|
| Complex nature of the project, | 1.000 | .771 |
| Scale and scope of construction, | 1.000 | .850 |
| Conditions of the market, | 1.000 | .807 |
| Constraints on site, | 1.000 | .817 |
| Buildability | 1.000 | .871 |
| Construction method, | 1.000 | .640 |
| Extraction Method: Principal Component Analysis. | | |

Source: Researcher's Field Survey, 2014.

Using the scores generated based on the maximum likelihood extraction of the Factor Analysis tool of SPSS. A total of seven (7) principal components have been extracted. These seven components generated cumulative variance explanation of 74.179% as shown by the extracted sums of square loading in table VIII.

**Table VIII: Total Variance Explained**

| Total Variance Explained | | | | | | |
|---|---|---|---|---|---|---|
| | Initial Eigenvalues | | | Extraction Sums of Squared Loadings | | |
| Component | Total | % of Variance | Cumulative % | Total | % of Variance | Cumulative % |
| 1 | 3.862 | 21.453 | 21.453 | 3.862 | 21.453 | 21.453 |
| 2 | 2.427 | 13.483 | 34.936 | 2.427 | 13.483 | 34.936 |
| 3 | 2.138 | 11.879 | 46.815 | 2.138 | 11.879 | 46.815 |
| 4 | 1.406 | 7.813 | 54.628 | 1.406 | 7.813 | 54.628 |
| 5 | 1.285 | 7.136 | 61.765 | 1.285 | 7.136 | 61.765 |
| 6 | 1.163 | 6.460 | 68.224 | 1.163 | 6.460 | 68.224 |
| 7 | 1.072 | 5.954 | 74.179 | 1.072 | 5.954 | 74.179 |
| 8 | .857 | 4.760 | 78.938 | | | |
| 9 | .733 | 4.075 | 83.013 | | | |
| 10 | .639 | 3.553 | 86.566 | | | |
| 11 | .581 | 3.230 | 89.795 | | | |
| 12 | .419 | 2.327 | 92.123 | | | |
| 13 | .355 | 1.975 | 94.098 | | | |
| 14 | .323 | 1.796 | 95.894 | | | |
| 15 | .261 | 1.450 | 97.344 | | | |
| 16 | .193 | 1.075 | 98.418 | | | |
| 17 | .143 | .797 | 99.215 | | | |
| 18 | .141 | .785 | 100.000 | | | |
| Extraction Method: Principal Component Analysis. | | | | | | |

Source: Researcher's Field Survey, 2014.

The eighteen (18) identified factors affecting the accuracy of project cost estimation were reduced to seven (7) principal components for easy analysis based on the similarities in their latent characteristics as per the Principle Component analysis (PCA) adopted; illustrated in Tables VIII above. The component names arrived at reflects aspects of all the variables classified under them. These are Components 1 to 7. The total variance explained by each component extracted are as follows: The first principal component (component 1) accounted for 21.45% of the total variance whilst the second principal component (component 2) explained 13.48% of the remaining variation not explained by the first component. The third component (component 3) accounted for 11.88%, of the remaining variation not explained by the first two components. The fourth principal component (component 4) explained 7.81% of the remaining variation not explained by the third component, the fifth principal component (component 5) explained 7.14% of the remaining variation not explained by the fourth component, the sixth principal component (component 6) explained 6.46% of the remaining variation not explained by the fifth component, the seventh principal component (component 7) explained 5.95% of the remaining variation not explained by the sixth component, Together, the 7 extracted components cumulatively explained 74.18% of the variation in the data set, and this meets the cumulative proportion of variance criterion, which says that the extracted components should together explain at least 50% of the variation. Table VIII above and IX below presents an overview of extraction processes.

*A. Factor Loading*

The results of the factor loading indicate that the 18-factors can be grouped in seven (7) decision matrix (components) affecting project cost estimation. However, 6-principal components were extracted for effectiveness. In the first component, 4 factors Type of Project, Number of Bidders, Location of Project and Closure and Blockade of Borders, in that order loads positively maximally, in the second component, 3 factors; Scale and Scope of Construction, Materials Prices and Availability, and Contractor's Workload, loads positively maximally. In the third component 1 factor Constraints on Site loads positively maximally. While in the fourth component, 1 factor Detailed Drawings and Specifications loads positively maximally. In the fifth component 1 factor Conditions of the Market loads positively maximally. In the sixth component 1 factor Buildability loads positively maximally.

**Table IX: Factor Loading Matrix**

| Component Matrix[a] | | | | | | | |
|---|---|---|---|---|---|---|---|
| | Component | | | | | | |
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| TOP | .712 | | | | | | |
| PRS | | | | | | | |
| NOB | .659 | | | | | | |
| MPT | | | | | | | |
| LOP | .551 | | | | | | |
| PTE | | | | | | | |
| SOC | | .753 | | | | | |
| MPA | | .620 | | | | | |
| CNP | | | | | | | |
| COW | | .577 | | | | | |
| CBB | .540 | | | | | | |
| ESE | | | | | | | |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| COS | | | .562 | | | | |
| CNM | | | | | | | |
| COM | .500 | | | | .570 | | |
| BUL | | | | | | .534 | |
| DDS | | | | .509 | | | |
| FCC | | | | | | | |
| Extraction Method: Principal Component Analysis. | | | | | | | |
| a. 7 components extracted. Loadings of 0. 50 and above were considered significant. | | | | | | | |

Source: Researcher's Field Survey, 2014.

**Table X: Test of Reliability - KMO and Bartlett's Test**

| KMO and Bartlett's Test | | |
|---|---|---|
| Kaiser-Meyer-Olkin Measure of Sampling Adequacy. | | .556 |
| Bartlett's Test of Sphericity | Approx. Chi-Square | 341.617 |
| | df | 153 |
| | Sig. | .000 |

## V. RESULTS AND DISCUSSIONS

### *A. General Issues on Respondents*

The respondents of the questionnaires were majorly from the building/civil contracting firm with 34.0%, this was closely followed by the project management firms with 30.2%. Most of the respondents are engineers, 30.2%, while quantity surveyors made up 26.4% percent of the respondents. On the aspect of the experience of the firms, the respondents opined 58.5% have put in more than 10 years in the construction business, while 28.3% equally did put in between 6 to 10 years. Most of the construction firms (60.4%) have executed from 11 to 20 projects in the last 5 years. While (24.5%) have executed less than 10 projects, and (15.1%) executed between 21to30 projects. The result from the demographic and related issues shows that the contractors involved in projects cost estimation have had an appreciable level of understanding based on jobs handled and ample experience gained with as a result of years they have put in practicing.

### *B. Level of understanding of project cost estimation*

The analysis on project cost estimation revealed that the most frequently utilized method for conducting project cost estimation is the detailed estimate method with a mean score value of 3.491 and ranked first. This is closely followed by the conceptual estimate method which was ranked second with a mean score value of 1.585. This verdict implies that detailed estimates are built-up estimates representing hypothetical offeror's bid prices, including all direct costs and indirect costs (i.e., project overheads, business overheads, profit, and bonds) to perform the work required by the solicitation.

### *C. Factor analysis of the factors affecting project cost estimating accuracy*

In estimating the possible intensity of the factors affecting the accuracy of project cost estimation using the communality extraction as shown in Table 9. The least extraction of 0.575 was associated with factor contractor's workload, while the highest extraction of 0.871 factor buildability. It therefore means that each of the factors has indicated a high level of potentials of affecting the accuracy of project cost estimates.

A total of six (6) principal components were extracted from the eighteen (18) original factors after being subjected to the principal component analysis. The initial seven components generated cumulative variance explanation of 74.179% as shown by the extracted sums of square loading. In the same vein, the results indicate that the eighteen (18) factors that were grouped into six (6) decision matrix (components) affecting the accuracy of project cost estimates leading to the extraction of 6-principal components for purposes of effectiveness. In the first component, 4 factors, type of project, number of bidders, location of project and closure and blockade of borders, in that order loads positively maximally, Akintoye, (2000) opined that type of project (complexity) can be looked at in terms of size of a task, speed of production, extent of repetition, number of operations, incidence of different kinds of work and extent of predictability of operations. In the second component, 3 factors; scale and scope of construction, materials price availability, and contractor's workload, loads positively maximally. In the third component 1 factor constraints on site loads positively maximally. While in the fourth component, 1 factor detailed drawings and specifications loads positively maximally. In the fifth component 1 factor conditions of the market loads positively maximally. In the sixth component 1 factor buildability loads positively maximally.

### *D. Reliability and validity*

The Kaiser-Meyer-Olkin (KMO) measure of sampling accuracy, anti-image correlation, and measure of sampling activities (MSA) as well as the Bartlett's Test of Sphericity in table 12 showed the following; the KMO value of 0.556, is satisfactory for factor analysis because of its ability to equate to 1. In a nut shell, it shows that factor analysis (principal component analysis) is appropriate for the analysis. The Bartlett's test of sphericity value of 341.617 with an associated significant level of 0.000 indicates that the population correlation matrix is not an identity matrix. The correlation matrix of the factors affecting project cost estimation shows that they all have a significant correlation at a 5% level of significance, implying the need not to exclude any of the variables from the principal component analysis.

## VI. CONCLUSION

Based on the results of the analysis, the following conclusions were arrived at;

1. Mean-scores value of 3.491 for the detailed estimate indicated that the professionals in the industry are conversant with the implication of not adhering to more detailed design by splitting individual work packages into different cost item for purposes of realizing an ideal and accurate cost estimate.
2. The six (6) principal components factors based on the (18) decision are factors affecting the accuracy of project cost estimate of construction projects in Owerri, Imo State.

3. The use of the six principal component factors explains 74.179% of the factors affecting the accuracy of project cost estimates in construction projects in Owerri, Imo State.
4. The study was aimed at investigating factors influencing the accuracy of project cost estimate in construction projects. Using the exploratory factor analysis technique, six factors; specifically, type of project, scale and scope of construction, constraints on site, Clear and detailed drawings and specifications, conditions of the market, and buildability were extracted as the key factors that influence the accuracy of project cost estimate.

The instrument developed for this research work can be used as a diagnostic tool for divulging broad areas of providing a reliable and accurate cost estimate within the industry by adhering to the result of this study as a guiding tool. The six dimensions of accuracy in project cost estimation may greatly assist project managers and other professionals in the construction industry. The dimensions provide information on which factors require attention in an effort to improve cost estimating practices.

Based on the conclusions arrived at from the study, it is pertinent to set up a comprehensive project budget with an accurate estimate as a necessary condition for the project to be considered successful on completion. The project budget is modified as the project progresses from the initial/conceptual phase to the "check estimate" or bid phase. Construction professionals in Imo State specifically can borrow from a leap from this study as a way of creating the platform for the realization of their project cost estimation objectives in a bid to meeting up their estimation challenges.

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