Evaluation of Factors Affecting Construction Cost Estimation Methods in Nigeria

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ABSTRACT
The amount envisaged to finish a construction project is important in many ways. First it is important for job scheduling and defining milestones. Secondly, it can be used for monitoring and evaluation and thirdly, it can be used in planning stage to evolve workable design.

Construction cost estimation methods can play important roles in the success or otherwise of the delivery of projects. Various methods are adopted in Nigeria. Meta data analysis methods will be engaged to evaluate the factors affecting construction cost estimating methods adopted in Nigeria. Despite the efforts of cost consultants and professionals in arriving at reliable estimates, more works still need to be done to achieve estimation objectives. The use of computer and computer software in estimating are still rudimentary in Nigeria. Data are still difficult to get because different construction activities are not coordinated. Professionals will need to network more and do more market survey to arrive at reliable figures.

INTRODUCTION
Construction cost estimate is the amount envisaged to finish a construction work. It is the probable amount that is computed to complete a construction work. It is a prediction of the amount of a project based on available data at the time of prediction. Cost estimate was defined by Business Dictionary (2013), as an “approximation of the probable cost of a product, program, or project, computed on the basis of available information”. So the more information is provided on a project, the more the estimate tends to accuracy. It is important in many ways.

According to Business Dictionary (2013), “Four common types of cost estimates are: (1) Planning estimate: a rough approximation of cost within a reasonable range of values, prepared for information purposes only. This is also called ball-park estimate. (2) Budget estimate: an approximation based on well-defined (but preliminary) cost data and established ground rules. (3) Firm estimate: a figure based on cost data that is reliable enough for entering into a binding contract. (4) Not-to-exceed/Not-less-than estimate: the maximum or minimum amount required to accomplish a given task, based on a firm cost estimate”.

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There are more benefits in estimating the cost of a potential construction job than in not estimating before commencement. Cost estimate, to a client, is necessary in cash flow management. To an investor, it is necessary to support evaluation of project feasibility and to assess the scope of work. To a consultant, construction cost estimate can serve as a basis for job performance measurement (Baccarini 2004), in contractor selection, as an exhibit in construction contract disagreement, and in post-work evaluation of completed jobs (work audit), and to a contractor, it is the determinant of job procurement (in bidding for construction jobs) and on cash flow management.

It is a guide because cost estimate is different from contract sum and actual cost of construction and may not be equal. Contract sum is the amount of compensation stated in the Contract Agreement for the performance of the work. The contract sum may be adjusted only by change order. A lump sum contract is normally used in the construction industry to reduce design and contract administration costs. It is called a Lump Sum because the contractor is required to submit a total and global price instead of bidding on individual items. A lump sum contract is the most recognized agreement form on simple and small projects, for example, projects with a well-defined scope or construction projects where the risk of different site conditions is minimal.

Several techniques of construction cost estimation abound from analog to digital, manual to computerized and traditional to modern. A method or technique can be adopted or a combination of two or more than two of these methods and techniques may be used to estimate a prospective construction development. The basis for these methods of cost estimation, their natures, benefits and shortcomings are the basis of this paper.

**Benefits and Shortcomings of Construction Cost Estimating Methods**

From time immemorial, estimation has been done in construction though there are occasions when construction works have been embarked upon without estimations. “The success or failure of a construction project is dependent on the accuracy of several estimates done throughout the course of the project” (Ahuja et al, 1994). The consultant early involvement in cost planning and control is very important in any project. Construction project is a very complex task involving huge sum and numerous inputs. Therefore, the preparation of cost estimate of the project is one of the most difficult tasks in project management because it must be done before the work is accomplished (Oberlender 1993).

“Pre-tender cost estimating is simply the final costing of the works carried out by a consultant (i.e. quantity surveyor or engineer) on behalf of their client before tenders are received” (Odusami and Onukwube, 2008). Pre-tender cost is the budgeted cost of a construction project through which evaluation of bids are made. “In the business of design and construction, profitability is based on accurate and complete cost estimation” (Bastian, 2013).
“Cost estimating is employed as one of the main tools of successful cost management. Once an
initial budget has been established, it is important to test its assumptions by employing a series of
increasingly precise cost estimating techniques that coincide with further development of design
and construction details” (National Institute of Building Sciences, 2013).

There are various methods of construction cost estimating available from literature. Some are
different from each other in principle, while others are only different as a matter of terminology;
their processes are still the same. For example, Yoner (2001), cited analogy, parametric, expert
opinion, engineering, and extrapolation as techniques. Yoner (2001) techniques are not different
from Department of Energy Cost Estimating Guide except that Yoner (2001) did not list Trend
Analysis as a technique. Yoner’s engineering technique and Department of Energy Cost
Estimating Guide’s Bottom-Up technique are the same. Yoner’s extrapolation technique and
Department of Energy Cost Estimating Guide’s cost review and update technique are also the
same.

According to Society of Cost Estimating and Analysis (SCEA) (2013), there are four (4) basic
types of cost estimates. These are: (1) Empirical or Detailed or Engineering-based. This is
algorithm of costs. (2) Comparative (3) Statistical and (4) Standard. Bastian (2013) talked on
ROM (Rough Order of Magnitude) Estimates which is:

- Used in strategic or preliminary planning, proforma analyses
- Used to assist go/no-go decisions
- Low level of accuracy, general in scope and

Detailed Costs Estimates which has:

- Increased accuracy
- Used to define tasks and schedules
- Based on assemblies and systems.

National Institute of Building Sciences (2013) said that construction cost estimates can be
categorised into three: 1) preliminary; 2) Intermediate and 3) Final.

Construction cost constitutes only a fraction, though a substantial fraction, of the total project
cost. However, it is the part of the cost under the control of the construction project manager.
The required levels of accuracy of construction cost estimates vary at different stages of project
development, ranging from ball park figures in the early stage to fairly reliable figures for budget
control prior to construction. Since design decisions made at the beginning stage of a project life

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cycle are more tentative than those made at a later stage, the cost estimates made at the earlier stage are expected to be less accurate. Generally, the accuracy of a cost estimate will reflect the information available at the time of estimation.

According to Project Management for Construction (2013) “Construction cost estimates may be viewed from different perspectives because of different institutional requirements. In spite of the many types of cost estimates used at different stages of a project, cost estimates can best be classified into three major categories according to their functions. A construction cost estimate serves one of the three basic functions: design, bid and control. For establishing the financing of a project, either a design estimate or a bid estimate is used”. Control estimate is used for monitoring and evaluation during the execution of the project. Project management for Construction (2013) categorized construction estimates into:

1. **Design Estimates.** For the client or its designated design professionals, the types of cost estimates encountered run parallel with the planning and design as follows:
   - Screening estimates (or order of magnitude estimates)
   - Preliminary estimates (or conceptual estimates)
   - Detailed estimates (or definitive estimates)
   - Engineer's estimates based on plans and specifications

   For each of these different estimates, the amount of design information available typically increases.

2. **Bid Estimates.** For the contractor, a bid estimate submitted to the client either for competitive bidding or negotiation consists of direct construction cost including field supervision, plus a markup to cover general overhead and profits. The direct cost of construction for bid estimates is usually derived from a combination of the following approaches.
   - Subcontractor quotations
   - Quantity takeoffs
   - Construction procedures.

3. **Control Estimates.** As a tool for monitoring the project during construction, a control estimate is derived from available information to establish:
   - Budget estimate for financing
   - Budgeted cost after contracting but prior to construction
   - Estimated cost to completion during the progress of construction.

**Design Estimates**

In the planning and design stages of a project, various design estimates reflect the progress of the design. At the very early stage, the *screening estimate or order of magnitude* estimate is usually...
made before the facility is designed, and must therefore rely on the cost data of similar facilities built in the past. A preliminary estimate or conceptual estimate is based on the conceptual design of the facility at the state when the basic technologies for the design are known. The detailed estimate or definitive estimate is made when the scope of work is clearly defined and the detailed design is in progress so that the essential features of the facility are identifiable. The engineer's estimate is based on the completed plans and specifications when they are ready for the owner to solicit bids from construction contractors. In preparing these estimates, the design professional will include expected amounts for contractors' overhead and profits.

The costs associated with a facility may be decomposed into a hierarchy of levels that are appropriate for the purpose of cost estimation. The level of detail in decomposing the facility into tasks depends on the type of cost estimate to be prepared. For conceptual estimates, for example, the level of detail in defining tasks is quite coarse; for detailed estimates, the level of detail can be quite fine.

As an example, consider the cost estimates for a proposed bridge across a river. A screening estimate is made for each of the potential alternatives, such as a tied arch bridge or a cantilever truss bridge. As the bridge type is selected, e.g. the technology is chosen to be a tied arch bridge instead of some new bridge forms, a preliminary estimate is made on the basis of the layout of the selected bridge formed on the basis of the preliminary or conceptual design. When the detailed design has progressed to a point when the essential details are known, a detailed estimate is made on the basis of the well defined scope of the project. When the detailed plans and specifications are completed, an engineer's estimate can be made on the basis of items and quantities of work.

**Bid Estimates**

The contractor's bid estimates often reflect the desire of the contractor to secure the job as well as the estimating tools at its disposal. Some contractors have well established cost estimating procedures while others do not. Since only the lowest bidder will be the winner of the contract in most bidding contests, any effort devoted to cost estimating is a loss to the contractor who is not a successful bidder. Consequently, the ‘hungry’ contractor may put in the least amount of possible effort for making a cost estimate if it believes that its chance of success is not high.

If a general contractor intends to use subcontractors in the construction of a facility, it may solicit price quotations for various tasks to be subcontracted to specialty subcontractors. Thus, the general subcontractor will shift the burden of cost estimating to subcontractors. If all or part of the construction is to be undertaken by the general contractor, a bid estimate may be prepared on the basis of the quantity takeoffs from the plans provided by the owner or on the basis of the construction procedures devised by the contractor for implementing the project. For example, the cost of a footing of a certain type and size may be found in commercial publications on cost data which can be used to facilitate cost estimates from quantity takeoffs. However, the contractor may want to assess the actual cost of construction by considering the actual construction
procedures to be used and the associated costs if the project is deemed to be different from typical designs. Hence, items such as labor, material and equipment needed to perform various tasks may be used as parameters for the cost estimates.

**Control Estimates**

Both the owner and the contractor must adopt some base line for cost control during the construction. For the owner, a *budget estimate* must be adopted early enough for planning long term financing of the facility. Consequently, the detailed estimate is often used as the budget estimate since it is sufficient definitive to reflect the project scope and is available long before the engineer's estimate. As the work progresses, the budgeted cost must be revised periodically to reflect the estimated cost to completion. A revised estimated cost is necessary either because of change orders initiated by the owner or due to unexpected cost overruns or savings.

For the contractor, the bid estimate is usually regarded as the budget estimate, which will be used for control purposes as well as for planning construction financing. The budgeted cost should also be updated periodically to reflect the estimated cost to completion as well as to insure adequate cash flows for the completion of the project. The categorizations are similar except that Project Management for Construction (2013) categorized Detailed Estimate and Engineering Estimate differently under Design Estimate. In this categorization, detailed estimate is definitive, while engineering is based on Engineering drawings and specifications. It is more definitive.

For this paper, the methods or techniques of estimation listed by Department of Energy Guide on Estimating will be adopted. These include: Bottom-up technique, Specific Analogy technique, Parametric technique, Cost Review and Update technique, Trend Analysis technique and Expert Opinion technique. These techniques will be discussed as follows:

**Bottom-up technique:** Bottom-up method is generally done with work statement and set of drawings known as working drawings or specifications to “take off” the quantities of materials needed to do the project. It is an algorithm of costs which is done based on work breakdown structure (WBS). From the quantities surveyed, direct labour, equipment and overhead costs are derived and added to the material cost. Construction project can be pre-determined and predicted. The *estimate* is prepared by breaking down the items of work in an orderly and logical basis. The foundation for a successful estimate relies upon reliable identification (takeoff) of the quantities of the various materials involved in the project.

**Advantages**

1. It gives a detailed estimate.
2. The cost of each item and system that make-up the project can be identified.
3. It is the most reliable for cost control.
4. It can be easily used for job schedule.
Disadvantages

(i) It may take time to compute because of the numerous items.
(ii) It is costlier and takes time than other methods.
(iii) It involves voluminous documents.

Specific Analogy technique: This technique depends on known cost of an item used in previous but recent construction as a basis for determining the cost of similar item in a new construction. An estimate of costs based on historical data of a similar (analog) item. It is a conceptual estimate giving rough idea of cost. Adjustments are usually made to the known costs to make up for differences in relative complexities of uses, design and functional features. The analogy method compares a new or proposed system with one analogous (i.e., similar) system, that was typically acquired in the recent past, for which there is accurate cost and technical data. There must be a reasonable correlation between the proposed and “historical” system. The estimator makes a subjective evaluation of the differences between the new system of interest and the historical system. The analogy method is typically performed early in the cost estimating process, such as the pre-Milestone A and Milestone A stages of a program. This is early in the life of a potential acquisition program when there may be a limited number of historical data points and the cost estimator may be dealing with technology experiencing rapid technical change. The analogy method is also a very common technique used for cross checking more detailed estimates (i.e. sanity check).

Advantages

(i) Estimating by analogy may be the best technique for estimating the cost of state-of-the-art systems such as a space vehicle, next-generation submarine, a future computer, or a proposed microprocessor.
(ii) The analogy method tends to be relatively reliable, fast and inexpensive way of estimating program costs and can be done at a high level of the Work Breakdown Structure with relatively little technical detail about the new system.
(iii) It is a faster method of estimating than bottom-up.

Disadvantages

(i) A key disadvantage of the analogy method is the subjectivity inherent in quantifying the cost of the technical and other differences between the historical item and the new item. For example, one technical expert may believe that the fuselage differences will lead to a 30% increase in costs for the new item compared to the old, while another may think that costs will only increase by 10%.
(ii) It is less accurate.
(iii) It is based on sense of judgment of the estimator.

**Parametric technique:** This requires historical data based on similar systems or subsystems. Data is derived from the historical information or is developed from building a model scenario. Statistical analysis is performed on the data to find correlations between cost drivers and other system parameters, such as design or performance parameters. The analysis produce cost equations or cost estimating relationships that can be used individually or grouped into more complex models. This technique is useful when the information available is not very detailed. Example is unit cost method (length for trenches, square metres for tiling or cubic metres for space).

Advantages

(i) It saves tangible time that would be wasted in detailed estimate
(ii) Data obtained can be tested.
(iii) This method can make up for missing data where adequate data on project is not available.

Disadvantages

(i) Not as reliable as detailed estimate.
(ii) The estimates derived are not as accurate as bottom-up estimates.
(iii) Cannot be used at the final estimate.

**Cost Review and Update technique:** An estimate is constructed by examining previous estimates of the same internal arrangements, scope completeness, assumptions and estimating methodology used and updating them with changes due to difference in time. Interest rate, inflation rate, exchange rate and other economic factors that may affect costs over time are considered.

Advantages

(i) It is faster than bottom-up technique.
(ii) This technique is good for planning estimate.

Disadvantages

(i) Accuracy of estimate obtained depends on accuracy of the previous estimate.
(ii) This technique is erroneously assuming that only economic factors can affect costs.

Political factors, social factors like language barrier and cultural difference,
technological factor, legal factor, environmental factors (for example health issues) and security and safety factors can also affect costs.

**Trend Analysis technique:** This method adopt the use of Contractor Efficiency Index (CEI). A Contractor Efficiency Index is obtained by comparing originally projected contract costs against actual cost on work performed to date. The index is used to adjust the cost estimate of work not yet completed. It is a forecast of cost based on the trend in the construction sector. In construction trend analysis is a mathematical technique that uses historical results to predict future outcome. This is achieved by tracking variances in cost and schedule performance. Trend analysis can be done graphically or through regression.

**Advantages**

(i) May be used for rough order of magnitude (ROM) estimate.
(ii) Desirable where trend is predictable.
(iii) Fast method of estimating.

**Disadvantages**

(i) It is not a reliable estimate especially for final estimate.
(ii) Trends are not easily predicted.

**Expert Opinion technique:** This method is usually adopted when other methods or data are not available. Different numerous specialists like engineers, tillers, roof specialists, plumbers etc are contacted repeatedly until a consensus cost estimate is determined. Opinions of experts are sought on a project to get a reasonable estimate. Expert opinion as a technique of estimation is frequent in litigation and arbitration concerning construction works.

**Advantages**

(i) Gives estimate that cannot be gotten by other techniques.
(ii) Saves time and cost.

**Disadvantages**

(i) Accuracy of estimate cannot be tested.
(ii) It is only based on personal judgment of experts.

**Computer Aided Cost Estimation Methods**

The practice of cost estimating precedes the use of computers. Because of this legacy, many of its original methods persisted even after computers were introduced. Computers are today an
integral part of the business, used not only in actual calculations, but also in the storage, organization, retrieval and reporting of data, as well as a collaboration tool between different disciplines. As a result, estimates are now much more accurate and detailed, and the industry’s requirements have also increased accordingly. There are thousands of software packages in the market, ranging from simple “excel-like” spreadsheet programs to complete corporate solutions. Pricing also varies widely with the complexity of the software. One of the greatest challenges is to migrate ‘field knowledge’ to the computer. Experienced field professionals often rely on others to operate estimating software.

•Types:
– Simple spreadsheet calculation software.
– Integrated systems.

•Features:
– Databases for unit cost items.
– Databases of expected productivity for different components types, equipments, and process.
– Version control, Flexible reporting formats, import and export utilities, archive of past projects.

•Advantages of computer in estimating: Rapid cost estimation and with less efforts.
Filing/storage of documents is easy. Retrieval is also easy, while sending of document is faster. Others include:

- Level of detail (depth of work) is more
- Accuracy (takeoffs, calculations done faster)
- Better Work Breakdown Structure (WBS) structure
- Ease of navigation (from general view to individual tasks)
- Automated recalculations (less chance for error)
- Cascading updates
- Online pricing and specification databases
- Systems integration (design, documentation specifications, estimates, construction)
- Field experience vs. computer literacy

Whether with manual or computer, construction cost estimating involves pricing materials, labor, overhead, subcontractors and equipment needed to complete a project.

**Estimating Materials**

Construction materials range from the big items such as concrete, steel, timber, gravels, blocks, electrical and plumbing to small basics like steel hangers, nails and screws. A good technique is to buy as much material as possible from one supplier to have leverage to negotiate an overall lower cost. Buying timber from a yard, blocks from a block-maker and nails from a hardware store may lead to greater overall costs. Always include enough coverage to cover lost materials from anticipated waste, pilfering and possible uninsured theft. Material prices, especially in
today's current market, fluctuate up and down. The estimator must both understand and anticipate the frequency and extent of the price variations and the timing of the buying cycle. Material prices may be affected by:

- purchase at a peak or slack time of the year for the manufacturer
- material availability and scarcity
- the size of the order
- the delivery timeframe requirement
- physical requirements for delivery, such as distance, road size, or site access
- payment terms and history on previous purchases
- sole-source items
- exchange rates (if the material will be imported from outside)
- interest rate (if the materials have to be bought with credit facility)

**Estimating Labour**

The labor rate is the cost per hour for the craftsmen on the project. To determine any craft rate, whether union or open shop, the estimator starts with the basic wages and fringe benefits. Labour is the biggest expense on any construction job. When estimating, assume a margin for overtime and also lost time because of adverse weather. Balance the cost of sufficient labor to meet specified deadlines with fewer workers working additional overtime. Labor costs consist of more than just the hourly wage. A single worker laboring through overtime might be less expensive than two workers laboring during regular hours. Labor hour amounts can be developed by crew analysis or applied on a unit man-hour basis. The use of a labor rate, amount of naira per unit of work is popular. The estimator must make allowance for the varying production capability that will occur based upon the complexity of a project.

**Estimating Overhead**

Overhead costs such as securing permits, deposits for utilities, connecting utilities, job site insurance and extraneous expenses (security, fencing, etc.) should also be factored in to the estimate. Some items, such as office operations, buying newspapers or mandated workers' compensation payments, are considered the "cost of doing business," and it is up to the estimator to balance what to absorb and what to add to the estimate to ensure getting the job.
**Estimating Subcontractors**

Just as the estimator is working for the customer, subcontractors—plumbers, electricians, painters etc—are working for the estimator. Receive all quotes with specific terms and deadlines. Insist on penalties for missed contract terms. When including subcontractors’ costs in the final estimate, estimator should calculate reasonable markup for profit. A subcontractor quote, like the general estimate, contains labor, material, equipment, indirect costs, and profit. It is dependent upon having the quantities, labor hours, hourly rate, etc., prepared in a reliable manner just like any other part of an estimate. The amount of the subcontractor quote is also dependent upon the payment terms of the contract, and previous payment history between the subcontractor and general contractor. Bonding costs should also be considered.

**Estimating Equipment (Plant and Machinery)**

Equipment Costs: Equipment rates depend on the project conditions to determine the correct size or capacity of equipment required to perform the work. When interfacing with other equipment, cycle times and equipment capacity control the costs on the project. Costs will also differ if the equipment is owned by the contractor or third party (rented).

Construction is a combination of numerous tasks that require specialization that a general contractor cannot own all equipment. Crane, skid steers, forklifts, generators, pneumatic tools and compressors and power lifts are examples of rented equipment. Include in the estimate the time needed to complete the job plus a reasonable markup for profit.

**Estimating Direct Costs**

In the initial stages of project development, estimates must be derived by using various relationships. As the project develops and more detail is available, the estimate also will be in more detail. The general step involve in estimating direct costs include:

- Material takeoff
- Pricing the material and equipment
- Labour
- Sub-contractors
- Others like waste management, transportation, statutory environmental management for example cost of Environmental Impact Assessments (EIA).
Estimating Indirect Costs

Indirect costs consist of labor, material, and equipment items required to support the overall project. For the owner: design fees, permits, land acquisition costs, legal fees, administration costs, etc. For the contractor and subcontractor: mobilization, staffing, on-site job office, temporary construction, temporary heat/cooling, and temporary utilities, equipment, small tools and consumables, etc.

The following are examples of how indirect costs are treated in an estimate:

- Creating Indirect Cost Account: Indirect cost may be treated as part of the code of accounts for a project. One method to estimate the indirect costs is to assign a cost to each cost account. This must be based on the size and type of contract and may be a long list. This method needs a great deal of experience and a working knowledge of the construction industry.

- Percentage: A percentage can be developed as a multiplier from a local data base or from published cost manuals and applied to direct cost to get indirect cost.

- Government statutory requirements like notice boards; public relations etc should also be added.

  Special conditions: Where there are more than one project on a site, costs should be shared among them so that there is no “double-dipping”.

Data Collection and Normalisation Method

During estimation, cost data is collected. Data may be collected from similar projects data bases (data archives), and published reports. The basis of the cost data should be documented as part of the detailed back up for the estimate. The amount of data collected will depend on the time available to perform the estimate and the type of estimate, as well as the budget allocation for the estimate’s preparation.

When using the collected cost data, the construction cost estimator must take cognizance of the source of the data, date of collection and type of data and make adjustment where necessary. Data from one project may not be consistent or comparable with data from a different project. For example, if historical costs data is used, the costs may not be applicable due to escalation
(caused by inflation over a considerable period), statutory changes, or location difference. The data should be reviewed and adjustments (normalization) made before usage.

**Guide for Estimating Management Cost**

Management cost estimate is a continuous process from the start to finish of project. This estimate includes:

- Construction Manager (CM) who is in charge of construction.
- Project Manager who is in charge of the supervision of the project and act as the client’s agent on site.
- Construction co-ordination which involves the field Engineers.
- Quality/Quality Control Engineer: The job of the Quality/Quality Control Engineer should be defined and the man-hour negotiated. The estimate will depend on the quality level required of the project, the amount of materials to be procured (not the contract sum) and the level of the Quality/Quality Control Engineer.
- Health and Safety Manager: The function of the Health and Safety Manager is to review and approve the design of the site as well as the safety audits and health environment surveillance throughout the period of the project. Factors like complexity of the operation area of project, presence of radiation or contaminants like asbestos, and any other special health and safety requirement.
- Site Cleaners: The cleaning of the site must be negotiated with professional cleaners.
- Others: Other fees like public relation to fasten approval must be considered and negotiated.

**Basis of Estimating Construction Cost**

- The basis of estimating construction cost is to determine a probable amount that can complete a project. The more accurate an estimate is, the better it meets its objectives. Without an estimate, a project is bound to suffer cash-flow problem, bad scoping, suffer from the three constraints of time, quality and cost and eventually may be abandoned. An estimate may also be inaccurate and fail to achieve its objectives. According to Aibinu and Pasco (2008), “Inaccuracy in the estimate of a project may arise from two sources, namely, bias associated with the project itself and bias associated with the estimating
techniques used and the operating environment”. Accurate estimation of construction costs is heavily dependent upon the availability of quality historical cost data and the level of professional expertise among other things. Kwashagi (2011), said “nothing in life is indeterminable if adequate data is provided”.

- The limited information available at the early stages of a construction project may mean that the quantity surveyor must make assumptions about the design details of a project, which may not eventuate as project design, planning, and construction evolve (Liu and Zhu, 2007). Professional estimators have access to reliable cost and productivity references for estimating labor, material, equipment and other major work components. These major cost items have a high visibility factor and consequently receive adequate attention in the preparation of the pre-tender estimate.

- There are factors affecting the estimate accuracy such as culture, procurement form and contract arrangement which should be taken into consideration in the preparation of pre-tender estimates. Unfortunately, these factors are either entirely overlooked or sadly neglected by estimators. Identification of these factors is very important in order to improve the overall performance of the construction industry. Construction cost estimates are built using direct costs, indirect costs, fixed costs and variable costs. These costs can be on material, labour, plant and machineries, and others.

- “Pre-tender cost estimating which sits somewhere between cost planning and the post-contract cost control, provides an indication of the probable construction cost prior to awarding contract, and involves collecting, analyzing and summarizing all available data related to the construction of the project” (Holm et al., 2005). Hence, for the contractors to secure a job, their cost estimates must be as accurate and competitive as possible (Marjuki, 2006). Evidently, inadequate estimating invariably leads to misallocation of scarce resources (Flyvbjerg et al. 2002).

Factors that can Influence the Accuracy of Estimates in Nigeria

Various studies have explored and attempted to identify the factors that have some influence on the accuracy of estimating the costs of construction work. Based on previous studies, Gunner and Skitmore (1999) identified twelve factors. These are: building function, type of contract, conditions of contract, contract sum, price intensity, contract period, number of bidders, good/bad years, procurement basis, project sector (public, private or joint), number of priced items and number of drawings.

Ling and Boo (2001), using data from 42 projects in Singapore, came out with similar results when they compared five variables against Gunner and Skitmore’s work. Skitmore and Picken (2000) studied the effect of four independent variables (building type, project size, sector and year) on estimating accuracy and tested these variables against 217 projects from a Quantity
Surveyor based in the USA. They concluded that bias existed in project size and year, and consistency errors existed in project type, size and year.

By reviewing 67 construction projects around the world, Trost and Oberlender (2003) identified and grouped a total of 45 factors, contributing to the accuracy of early stage estimates, into 11 orthogonal factors. Of these 11 factors, the five most important are: process design, team experience and cost information, time allowed to prepare estimates, site requirements, and bidding and labor climate.

Elhag et al, (2005), propounded that technological and project design, contractor’s expertise and management ability, and the client’s desired level of construction sophistication play an important role in determining the cost of the project. According to them, most of the significant factors affecting project costs are qualitative such as client priorities (i.e. completion time, procurement methods, market conditions, etc).

Enshassi et al (2007), studied cost estimating practices in contracting companies operating in Gaza Strip. Their study revealed that the most important factors that affected contractors cost estimate are: financial status of client, type of current contractor workload and project location relative to hostile ‘hot-spot’ areas. According to Liu and Zhu (2007), there are two types of factors that influence and contribute to the cost of a project, control factors and idiosyncratic factors.

Control factors are the factors that can be controlled by estimators to improve the performance of estimation while idiosyncratic factors influence cost estimation but outside the control of the estimators including market condition,- project complexity, weather, size of contract, site constraints, resource availability, type of procurement system, contract work type, etc. (Liu and Zhu, 2007). Considering the non-stable political and economic conditions in Gaza Strip, idiosyncratic factors can be considered as more relevant factors influencing cost estimation in this part of the world.

The accuracy of a cost estimate is highly dependent on the level of details given by the client and adequacy of project scope because they are definitions of the client's requirements for space, function, and quality of the proposed project (Akintoye, 2000; Trost and Oberlender, 2003; Babalola and Aladegbaiye, 2006; Dysert, 2006; Liu and Zhu, 2007: and Odusami and Onukwube, 2008).

In Nigeria, factors that can affect accuracy of estimates include:

1. **Political factor:** Construction cost estimates are more accurate in time of political stability than in time of instability.
2. Economic factors: Interest rate regime, inflation and forces of demand and supply.
3. Government policy: Government policy bordering on procurement, importation, the use of local content, expatriate quota etc can also affect construction cost estimate.
4. Time: Construction is season-sensitive. Estimates can be affected by weather. Dry seasons are more suitable for construction than rainy season.
5. Location of the project: Estimates are based on inputs like materials, labour and plant. Location will determine the costs of these items. Environmental factors like topography and geology of the site will also affect the estimate.
6. Legal factors like litigation and government policies including taxes and other statutory payments.
7. Security: Risks which include both the insurable and non-insurable are factored into construction estimates and can affect them. For example a construction project in Jos will be estimated higher than a construction job in a peaceful city.
8. Year of project: There are good years and bad years for construction. For example, any year preceding election year in Nigeria is usually a good year. Politicians spend money on capital projects in election years than in non-election years. These are due to two reasons; one, they want to use the projects as a campaign tool and two; they want to empower loyalists who will finance their campaigns.
9. Nature of job (whether public or private): Public projects have more interests to be protected than private projects. There are factors like political party of the state awarding the contract that must be taken care of, party members are also encouraged to serve as sub-contractors or their interest factored in the cost estimate. In the public sector, estimates are carried out bearing in mind the interest of awarding the contract. In some cases it is 10% which, at times, have to be paid in advance.
10. Complexity of job: The simpler the working/engineering drawings of a project, the more accurate the cost estimate tend.
11. Experience of the contractor also counts in determining the accuracy of construction cost estimates.
12. Detail of project brief given the consultants by the client also influence accuracy of cost estimate.
13. Corruption: High level of corrupt practices will affect the accuracy of estimates. For jobs to be done on time, the estimator in a corrupt environment has to set aside some amount for “public relation’, “mobilization” and “tipping” which are not receipted.

**Emerging Issues in Construction Cost Estimating**

The emerging issues in construction cost estimating include:

1. Cost Escalation and Variation
2. Differential Mark-up, Profits and Overheads by contractors
3. Determination of bid winner
4. Transparency and Accountability
5. Contingency

Cost Escalation and Variation

Claims for price adjustments are made based on cost escalation and cost variation. According to The Indian Express of Thursday, May 25, 2006, “A contract cost variation of up to Rs 110 crore or 40 per cent was approved in BMC standing committee on Tuesday amid protest by MNS corporator Sandip Deshpande. The Rs 487-crore contract for an 11.85 km water tunnel from Maroshi to Parel has been awarded to HCC. When the project began in 2008, the contract was worth Rs 377 crore. Additional municipal commissioner Aseem Gupta said the proposal was for cost escalation in the contract and not cost variation”. Cost escalation is different from cost variation.

Cost escalation is defined as changes in the cost or price of specific goods or services in a given economy over a period. This is similar to the concepts of inflation and deflation except that escalation is specific to an item or class of items (not as general in nature), it is often not primarily driven by changes in the money supply, and it tends to be less sustained. While escalation includes general inflation related to the money supply, it is also driven by changes in technology, practices, and particularly supply-demand imbalances that are specific to a good or service in a given economy. For example, while general inflation (e.g., consumer price index) in the US was less than 5% in the 2003-2007 time period, steel prices increased (escalated) by over 50% because of supply-demand imbalance. Cost escalation may contribute to a project cost overrun but it is not synonymous with it. Avots (1983) stated that cost escalation is the substantial increase of project cost than originally budgeted. Expressed as a percentage of estimated cost, this is often termed cost escalation, cost overrun or cost growth, and occurs as a result of many factors, some of which are related to each other, but all are associated with some forms of risks.

Cost escalation and cost variation are at times used interchangeably. For example Aziz (2012), said cost overrun, cost escalation and cost variation are sometimes used interchangeably. But as professionals in the built environment, we all know that they are different.

Variation means cost adjustment in construction due to change in scope. They are price increases not caused by economic factors. Variations to the scope of construction works are necessary because no project is impeccable and changes are required to meet unforeseen circumstances or changed requirements. Thus, variation can be in the form of additions, omissions or substitutions. Increase in scope of work, double-handling of materials, wrong interpretation of...
Variation clauses are a common feature in construction contracts. It is useful to note, at the outset, that the proprietor (client) is not entitled, as of right, to direct variations (Ashwell Nesbitt v Allan & Co (1912) Hudson's Building Contracts (4th ed.) Vol 2 at page 462). Hence, the need for a variation clause. Secondly, they ensure that contractors can recover payments for variations properly directed (Knight Gilbert Partners v Knight (1968) All ER 248).

Broadly, problems concerning variations arise in three facets:

1. scope (was it a variation or was the contractor bound to do it anyway?);
2. non-compliance with procedural requirements (negligence, oversight or inevitable); and
3. valuing the variations.

Whether the variation work is within the scope of the contract will depend, firstly, on the terms of the contract, which sometimes beg the question: what is the contract? In many cases, the documents forming the contract are defined. An example is clause 1.1 of PC-1 (PC-1, 1988 Project Contract by Property Council of Australia) which provides:

The contractual relationship between the parties is constituted by:

(a) the Formal Agreement to which these Conditions of Contract are attached;
(b) these Conditions of Contract;
(c) the Contract Particulars;
(d) the Works Description; and
(e) the other documents (if any) referred to in the Contract Particulars.

A cost overrun is called escalation or not whether it is implied or necessary works. As indicated, whether a particular work is a variation will depend on whether it comes within the general scope of the contract. Some works, although not specifically described, are nevertheless considered as implied or form a necessary part of the contract. An early case on this point is Williams v Fitzmaurice (1858) 157 ER 709. In that case, the contractor undertook to provide 'the whole of the material mentioned or otherwise in the foregoing particulars necessary for the completion of the work' and 'to perform all works of every kind mentioned and contained in the foregoing specifications for the sum of 100.00 pounds'. Flooring was not specifically mentioned and the issue was whether it was included in the contract. The court held that it was.

Similarly, in Walker v Randwick Municipal Council (1929) SR (NSW) 84 the contractor agreed to 'do and perform the whole of the works required in or about the construction of a concrete retaining wall'. In performing the works, Walker had to remove a sandbank to construct the retaining wall. The plan (which was not incorporated in the contract) showed the bank to be 6 feet wide. Walker claimed the bank was in fact 12 feet wide and claimed for work and labour in
removing the extra 6 feet. The majority of the court held that the contract was an entire one to build a retaining wall at a fixed price and that the risk lay with the contractor.

**Differential Mark-up, Overheads and Profits by contractors**

Mark up is the amount added to labour and materials in bidding. Once a contractor has come up with his estimate of “hard” costs to complete the job, he will mark up his costs to determine the bid price. The hard costs – the money paid out for labour and materials — is marked up to cover overhead and profit.

Overhead includes all the “soft” costs incurred by being in business that are not associated with a specific job – for example, trucks, tools, and equipment; office expenses, bookkeeping and accounting; advertising, training, legal, insurance, and other costs of being in business. If a contractor does not charge enough to cover his overhead, he will not be in business for long.

The other component of markup is net profit, often referred to simply as “profit.” Net profit is amount left for the owner after paying all hard and soft costs to complete the job (gross profit net profit plus overhead). If the company owner works part-time of the job, his labor cost while swinging a hammer is treated as a hard cost of that job. If he works in the office and pays himself a salary, his office pay would be counted as overhead. If the job is profitable, the owners would earn profits in addition to any wages paid to them by their company.

Many contractors do not know their exact job costs, equipment costs and overhead budget, and consequently, many do not know how much profit they should make on any given job. Without an understanding of your numbers, you will end up busy and broke instead of productive and profitable.

A problem occurs when companies don’t properly job charge field costs to their respective jobs. When you don’t establish separate job accounts for every job, you cannot look back to see if you are bidding the right unit prices for your work. Also, when all your equipment is paid for out of your overhead budget, you do not know if owning equipment makes you any money. Even worse: when field employees are not charged to individual jobs, you never really know what it takes to build a project or whether you are making a profit.

When you bid work, your field labor rates include employee burden costs, taxes and insurance. For example, a worker who earns N200 per hour with a 50-percent burden expense is bid out at N300 per hour. When all burden costs are paid as part of your overhead costs, your job cost accounting does not give you a clear picture of how well your job did upon completion because your fixed costs are lumped together with the costs that vary by job. The same is true with field equipment. Even though you may bid out equipment at fair market rates, company owners often do not know what equipment costs to own. To make matters worse, some contractors do not charge jobs for the use of their equipment. This makes it impossible to know whether they are making money on projects.
Determination of bid winner

In construction bid, winners are determined using laid down rules. Aziz (2012) said that lowest bidding procurement is rampant. In most competitive bidding exercises, the rule is that bid winners are chosen through the lowest bid. Overtime, clients and their consultants have found out that hungry bidders may try to under-bid in order to win contract even at ridiculously low price.

The University of California Facilities Manual (2013) stated that “Public Contract Code secs. 10500 - 10560 require that University construction contracts in excess of $50,000 be competitively bid, and be awarded to the lowest responsible bidder or, on the refusal or failure of such bidder to execute a tendered contract, be awarded to the second-lowest responsible bidder or, on that bidder's refusal or failure to execute a tendered contract, be awarded to the third-lowest responsible bidder, unless it is determined that the acceptance of a responsible bid is not in the best interests of the University, in which case all bids shall be rejected”.

Selection of contractors is cost-based and is done as if cost is the only factor that can be used to measure contract’s performance. Time and quality are as important in contract execution as cost. Time is money. Public Procurement Act 2007, Section 93 states that “The Procuring Entity shall carry out the bid evaluation in two phases : (a) a Preliminary examination and (b) Detailed Evaluation and Comparison of Bids, in accordance with the evaluation criteria stipulated in the bid document, in order to select the lowest responsive cost bid”.

The “lowest responsive cost bid” should be reviewed to “responsive bid” to include time and quality. In some cases time has been used to determine bid winner. Example is UBA House, 57 Marina, constructed by Bouygues Nigeria Limited and completed in 1994 which reduced the basement of the house to a floor from two to save two years from the duration of construction.

Transparency and Accountability

Transparency and accountability are emerging issues affecting construction cost estimates. At the 3rd Building and Construction Round Table (BCERT3), a two-day workshop organized by the Quantity Surveyors Registration Board of Nigeria (QSRBON), with the theme “Enforcing Transparency and Accountability in the Nigerian Building and Construction Sector”, held at Musa Shehu Yar’ Adua Centre, Abuja, on Thursday, May 23 and Friday, May 24, 2013, the issue of transparency and accountability in the construction industry were discussed. The workshop held that lack of accountability is the major challenge to construction sector in Nigeria, which can only contribute a paltry 2.0% to the Gross Domestic Product (GDP). The communiqué said that Quantity Surveyors are construction cost consultants from the beginning of a project to the end and implored them to always live above board.
The issue of Contingency in Construction Cost Estimate

The cost performance of construction projects is a key success criterion for clients. Project cost overruns are commonplace in construction (Touran 2003). This has, in many cases led to disagreement and litigation. “Cost contingency is included within a budget estimate so that the budget represents the total financial commitment for the project sponsor. Therefore the estimation of cost contingency and its ultimate adequacy is of critical importance to projects” (Baccarini, 2004).

There are three basic types of contingencies in projects: tolerance in the specification, float in the schedule, and money in the budget (CIRIA 1996). There is no standard definition for contingency as Patrascu (1988:115) observes, "Contingency is probably the most misunderstood, misinterpreted and misapplied word in project execution. Contingency can and does mean different things to different people”. Contingency has been defined as “the amount of money or time needed above the estimate to reduce the risk of overruns of project objectives to a level acceptable to the organization” (PMI 2000: 199).

Some authors distinguish between ‘contingency’, ‘allowance’ and ‘management reserve’. Allowance is for specific, known but undefined items (Clark and Lorenzoni 1985, Patrascu 1988, Querns 1989, Rad 2002). Management reserve is a provision held by the project sponsor for possible changes in project scope and quality (Wideman 1992). The management reserve should also be expected to cater for extraordinary, unforeseen external risks e.g. currency-exchange fluctuation, force majeure (Yeo 1990).

Attributes of Contingency

An analysis of various literatures identifies the following key attributes of the concept of project cost contingency:

• Reserve – Cost contingency is a reserve of money. A reserve is a provision in the project plan to mitigate cost risk (Aibinu and Jagboro, 2003; PMI, 2000).


• Risk Management – Contingency is a remedy to risk. There is a range of risk treatment strategies for managing risk in projects such as risk transfer, risk reduction, and financial treatments for retained risks e.g. contingency. So contingency is used in conjunction with other
risk treatment strategies. Risks in construction can be discussed under PESTLES, where P is political risk; E is environmental risk; S is social risk like ethnicity, culture, workforce diversity and language barrier; T is technological risk, L is legal risk, change in government policy and laws E is economic risk like inflation, increase in exchange rate, inflation and scarcity, and S is security and safety risks.

• **Total Commitment** - Cost estimates are prepared and contingencies added in order to indicate the likely total cost of the project. The inclusion of contingencies within a budget estimate means that the estimate represents the total financial commitment for a project. Contingency should avoid the need to appropriate additional funds and reduces the impact of overrunning the cost objective.

• **Project Outcomes** - Contingency can have a major impact on project outcomes for a project sponsor. If contingency is too high it might encourage sloppy cost management, cause the project to be uneconomic and aborted, and lock up funds not available for other organisational activities; if too low it may be too rigid and set an unrealistic financial environment, and result in unsatisfactory performance outcomes (Dey et al 1994).

**Cost Estimation and Project Objectives – An Evaluation**

A *construction cost estimate* serves one of these three basic functions: design, bid and control. Wide disparity in construction cost estimate with the actual cost does not mean that the project has failed. There are instances when there is wide disparity between an estimate and the actual cost and time due to change in scope and the project is still regarded as successful. Example is the Scottish Parliament in Holyrood, Edinburgh, Scotland built between 1999 and 2003. It has time-overflow of 3.5 years and cost escalation from £50million to £300million.

The National Institute of Building Science classification:

- Preliminary Estimates (20% - 25% margin of error acceptable)
- Intermediate Estimate (10% - 15% margin of error acceptable)
- Final Estimate (2% - 3% margin of error acceptable).

Where margin of error = \{((Budgeted cost – Actual Cost)/Actual Cost)\} x 100.

The shortcomings of cost estimates include the fact that the process is perceived as another burden on the cost of construction. Because of the long list of materials, bill of quantity may be ambiguous. Cost estimate is sometimes the basis of litigation because of the disparity between estimate and actual cost (Cost overrun). A cost overrun or cost increase or budget overrun, is an
unexpected cost incurred in excess of a budgeted amount due to an underestimation of the actual cost during budgeting.

Cost overrun should be distinguished from escalation, which is used to express an anticipated growth in a budgeted cost due to factors such as inflation, increase in exchange rate and increase in interest rate. Many big construction jobs have incurred cost and time overruns. The Suez Canal which was started in 1858 and completed in 1869 cost twenty (20) times as much as the earliest estimates; even the cost estimate produced the year before construction began underestimated the project’s actual cost by 33.33%. It was eventually terminated before completion.

The objectives of construction cost estimate include ensuring construction projects are executed within time, within cost and with acceptable quality. Cost estimate aim to be accurate so that there would not be cost and time overruns. Achieving these objectives will forestall disagreements between clients and contractors to a large extent. According to a research by Flyvbjerg (2002) made on cost overrun in global construction, it was found that 9 out of 10 projects had overruns, overruns of 50–100% were common, and overrun had been constant for the 70 years for which data were available.

The Sydney Opera House in Australia cost fifteen (15) times more than was originally projected, and the Concorde supersonic aeroplane cost twelve (12) times more than predicted. The Channel Tunnel between the UK and France had a construction cost overrun of 80 per cent and 140 percent financing cost overrun. Integrity of the project construction team is greatly required in project work. The directive of federal government of Nigeria stopping variation beyond 15% may not be economical, effective and efficient (may not ensure value for money).

In Nigeria construction industry, variation claim is usually a big challenge. Most contractors will like to claim the contingency even where it is not necessary. They therefore solicit the help of their Cost Estimators to make claims. This has led to litigation or arbitration in many cases. It is due to this situation that there have been various reviews in the United Kingdom construction industry, Latham 1994 (Constructing the Team), Egan 1998 (Rethinking Construction) and Construction Excellence/Wostenholme Report 2008 (Never Waste a Good Crisis) advocated improvement in the construction industry.

The Simon Committee Report 1944 to Construction Excellence/Wostenholme Report 2008 did not pinpoint cost estimate as the major problem of the industry but it is a part. Government fiscal policies, government negligence of the construction industry, high level of corruption, unstable economy, high capital flight, little understanding of the process of construction among contractors and clients, and unacceptable high number of quacks leading to fraud and building collapse are more debilitating than the issue of construction cost estimate.
Successful Estimating Attitude

Construction cost estimators walk a tight rope of losing the job or getting the job and not making loss or inadequate gain. A successful estimator is confident, thorough and—most important—has the integrity to do both the company and the customer right. Approach each estimate with the attitude of providing the best price to satisfy everyone associated with the project. Network with colleagues and be up to date in current projects and cost data.

CONCLUSION

Cost estimate is a predictive amount that parties believe should cover the construction expenditure of a project. Cost estimate for the same construction project prepared by a contractor may differ from the one prepared by a client. That of the consultants may also differ from those prepared by the client and contractor. Depending on the procurement method, cost estimate may be difficult to prepare. It is intended to forestall disagreements between client and contractor, but in most times, it has caused disagreements and litigations. This disparity between budgeted cost and actual cost often experienced is not enough to say that cost estimate has failed in its objectives.

Despite inaccuracies of some cost estimates against actual costs, it is better to have an estimate than to do without one. Construction cost estimation involves pricing materials, labour, plant and equipment and contingency. It also includes pricing the known unknowns (things that an estimator knows will happen but cannot be identified) and the unknown unknowns (things that an estimator does not know will happen but should be planned for). Contingency is a reserve for use in case of unforeseen situation.

A good estimator must have versatile construction industry experience, up-to-date in construction cost data and have adequate published manuals on material prices. To reduce corruption, cost estimators must be ethical. The use of software for estimating is in wide price now especially with the introduction of computer aided design (CAD). This practice hinges its success on the experience of the estimator as the data garbage in will be garbage out. The software still needs data on prices of materials, labour, overheads, equipment etc for processing.

A good estimator must be aware of all the factors that can affect the accuracy of an estimate and be able to manage all these factors in order to arrive at accurate estimate and to satisfy the stakeholders. Time of construction, that is, whether it is an election year (on year) or not (off year) or government policy especially those that affect budget will surely affect estimate.

Contractors and client need understanding about the functions of cost estimates. It is neither the actual cost of construction, so client should not be deviant in adding more money in case of inadequacy; nor the price of a product purchased, so the contractor should not target spending
all. The issue of contingency should also be explanatory and seen by contractors as a separate amount from construction cost but an amount which serves as reserve or for use in case of the occurrence of the unforeseen.

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Evaluation of Construction Cost Estimation Methods in Nigeria (7444)
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