Construction Work Items' Unit Rate Estimation Model for Building Contractors' Projects Pricing in Nigeria

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ABSTRACT: Contractors' success amongst other things relies on how they are able to relate and **estimate** the **cost** of their resources as a basis in determining their projects **price** in a competitive market. Construction project pricing is highly exorbitant in Nigeria. Wrong methods of estimation and flaws discovered in the unit rates of some completed building projects raises questions on the accuracy of the cost estimates arrived at by consultant quantity surveyors. Moreover, the discrepancy in the plethora of literatures on cost estimation makes estimation complex and confusing. The study therefore aims at establishing a construction work items unit rate estimation model for building contractors project pricing in Nigeria. This study uses historic survey methods through an extensive literature search. The foremost thing to consider when building unit rate is to establish the **prime cost** for each work item. Unit rate is the summation of the prime cost, overhead charges and profit for each work items in a project. Therefore, **Unit Rate =N + (N×Z)**; where N-is prime cost and Z-is % overheads and profits. Mathematically; $\mathbf{N}= \mathbf{M_C}+\mathbf{L_C}+\mathbf{P_C}$. Numerical contribution of each constituent per unit of work is: $\mathbf{M_c} \geq 0$; $\mathbf{L_c}$ □ 0; $\mathbf{P_c} \geq 0$ and; $\mathbf{Z_c}$ □ 0. The model is comprehensible, its applicability is compatible with any circumstance, it facilitates error free rates and can improve productivity. The model can be use: for effective management of construction project; for teaching and understanding the basic principle in rate computation and; in attaining uniformity in unit rate computation in the construction industry.

Key words: Contractors', Cost, Estimation and Pricing Model, Unit Rate, Value
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INTRODUCTION

Contracting is a business (Harris and McCaffer, 2005); it owners' are referred to as contractors'. Their participation in building construction projects in the construction industry can be in the form of ***Main/General Contractors'***, ***Sub-contractors'*** or ***Prime contractors'*** (Laryea and Mensah, 2010; Onwusonye, 2002; Ricketts, 2000). The concept of ***'general contracting'*** as reported by Laryea and Mensah (2010) refers to the professional practice or system where an organization or individual undertakes to supply the resources and services required to executes a project in accordance with the contract document. ***General contractors*** usually assume responsibility for an entire construction project, but may subcontract to ***Subcontractors'*** all of the actual construction works or those portions requiring special skills or equipment (Popescu, *et al.,* 2003; Ricketts, 2000). Legally; ***Subcontractors'*** are in contract with the ***General contractors'*** rather than the client even when the client has stipulated which subcontractor is to be used (Baily, *et al.,* 2008; Popescu, *et al.,* 2003; Onwusonye, 2002; Ricketts, 2000). The essence of subcontracting according to Baily, *et al.,*

(2008) is to augments the general contractor's limited resources and skills while enabling the general contractor to concentrate on their main area of expertise. Sometimes (Ricketts, 2000), in addition to a general contractor, the owner's (client's) contracts separately with specialty contractors, such as electrical and mechanical contractors, who perform a substantial amount of the work required for a building. Such contractors are called **prime contractors'.** Their work is scheduled and coordinated by the general contractor, but they are paid directly by the owner (Ricketts, 2000). Basically contractors' are required by virtue of their business to provide materials or a service to another (clients') for a set of fee (The New International Webster's Pocket Business Dictionary, 2002).

From the foregoing explanation it is clear that a contractor runs a business enterprise that is established to provide a product or service in the hope of earning a profit and such enterprise may be sole proprietorship, a partnership or a corporation (for detail see: Harris and McCaffer, 2005; Hillebrandt, 1991). At the heart of every construction business (Roper and McLin, 2005), is project execution and the quest for attaining project success in the construction industry involves many parties amongst which are contractors' (Usman *et al*., 2012; Gollenbeck, 2008); they are one of the major parties concerned with the monitoring and control of projects in construction and as such responsible for executing the works that form the contract (Idoro, 2012).

However, the complexity of the construction industry is a fundamental issue that must be understood for any business within its domain to succeed (for detail see: Hamilton, 2006; Ashworth and Willis, 1994). This complexity poses serious management problems for the operatives of the industry. Hamilton (2006), therefore opines that caution must be properly guided if an organizational objective is to be achieved Besides, the management of enterprise resources is very fundamental to the achievement of any enterprise objectives (Omole, 2001). In a construction firm, as in any other firm, the primary responsibility of management is to ensure that all resources namely, manpower, machinery, materials and money are employed optimally to produce maximum profit for the investors in the enterprise (Olateju, 1992 cited in Fagbenle *et al.*, 2011). According to Smith (1986) the aspect of resource management to a construction contractor is in twofold: resources required for running the enterprise and; resources required for the execution of a project (contract). The ability of the contractor to relate and ***estimate*** the ***cost*** of these two resources as a basis in determining its project ***price*** in a competitive market is very fundamental in attaining success in a construction contracting business.

The issue of pricing in any business organization is very fundamental; it is the basis in meeting the business economic, social and human objectives. The most important of these objectives is the economic objective which all other objectives depend on. This objective is for business to make financial return (money) and it is the first reason why businesses exist. This objective enables the business to generate money to: pay profit to those who invest their money in the business; pay wages and salaries to workers and; keep the business going, as there must be money to buy materials, more machines and expand to meet the growing needs of customers (Adeagbo, 2005). To measure the level of meeting this objective (economic), a

contractor must be able to evaluate the cost he incurs in the course of his business, so as to enable the firm establish a competitive project price. However, construction projects pricing in Nigeria is highly exorbitant and as such, portrays the country as having the highest cost of construction in the world, consequently, it has been of serious concern to scholars of development economics (Anago, 2012; Dikko, 2012; NIQS, 2003). It is often said that there is total absence of value-for-money in Nigeria's project development matrix (Dikko, 2012; NIQS, 2003). Some stakeholders attributed this to the importation of materials and equipments, while on the contrary NIQS (2003) and Anago (2012) argue that the importation of materials and equipments does not warrant the excessive price differentials. Other countries, in Africa and the rest of the third world NIQS (2003) exclaim, do import some materials and equipments used in construction projects in their country and yet they do not record high cost of projects compare to Nigeria. Perhaps the high cost of project amongst other reasons might be due to: wrong method of projects estimation; complexity in cost estimating and; lack of a simplified method of estimating construction projects cost (Nasiru, *et al*., 2012; Adindu, 2012; Popescu, *et al*., 2003; Bennett, 2003). This study therefore, aims at establishing a construction work items unit rate estimation model for building contractors project pricing in Nigeria.

METHODOLOGY, SCOPE AND DELIMITATION

Buys (2004) admitted that facts are needed to solve any research problem. These facts, or data, contain desirable aspects of the truth (Buys, 2004 cited Leedy, 1993). The data for this research is exclusively extracted from written records. According to Leedy (1993) cited in Buys (2004) for any data extracted there are certain methodologies to be used, for written records the most appropriate methods is the historic methods. Historic methods are used for data that are documentary in nature .These data are studied to reconstruct the past accurately and without bias in order to ascertain, document, and interpret their influences (Leedy, 1993 in Buys, 2004). This study solely uses historic survey methods through an extensive literature search. It involves the synthetic review of literature to ascertain the primary role of contractors and the resources they use in discharging their contractual obligation. It also explore and identify the underlying principle involve in contractors' project costing and pricing. The scope of the study is the establishment of a model for computing unit rate for building construction work items and the model can be better applied where the building design is detailed or where the scope of the work involve in a project is appropriately described, however, it does not involve the cost of risks and contingency.

CONCEPT OF COST, PRICE AND VALUE IN THE CONSTRUCTION INDUSTRY

According to Ashworth (2010) the terms cost, price and value will represent different interpretations to different people. The New International Webster's Pocket Business Dictionary (2002) defines these terms: cost; price and; value as:

- ***Cost:*** *The capital, time, exertion, etc. associated with a course of action; the amount to be paid for something, as an asset, material or service; the expense to manufacture a given item.*
- **Price*:*** *The amount of money or other consideration asked for something, or the amount for which it is traded.*

- **Value:** *The equivalent worth of a thing in money or some other medium of exchange; the amount at which assets are recorded and reported; the price at which goods are sold; the relative worth of goods to a buyer.*

The particular meaning of cost, price and value according to Ashworth (2010) generally lies in the context in which they are being used and when used within the context of the construction industry has a special interpretation appropriate only to the industry. For instance, the term project cost relative to a building contractor or building client are two different things; they are not the same. Cost, to the building contractor, represents all those items included under the heading of his expenditure while, cost to the building client, is the price offered to him by the building contractor. Price represents the rate at which exchange may or does take place and it apply to all resources and factors of production (Hillebrandt, 1991). Price from the perspective of contractor-client business relation (Ashworth, 2010), is the amount a building contractor charges the client for the work he carries out, and when this is received it becomes his income. Price is the contractor's offer that is accepted by the client in a contract, it is what the client exchange for services rendered by the contractor to satisfy a condition for validating a contract, which is refers to as consideration. From the contractors' point of view (Ashworth, 2010), cost relates to manufacture while, price relates to selling and the difference between the contractors' price and cost is his profit.

Value according to Ashworth (2010) is a much more subjective term than either price or cost. From an economic perspective, an object must be scarce relative to demand to have value (Ashworth, 2010). In a more explicit term value is a measure (Ashworth, 2010), of the relationship between supply and demand. According to Smith and Jaggar (2007) value is the open market price for an asset, goods and services at a particular time. Although, they warn that value is a difficult concept to define in advance of the market determining it specific value. The subjective nature of value makes it difficult to define and this subjectivity is better understood from Aristotle's value classification itemized in Ashworth (2010) as: economic; social; political; religious; and; judicial and of all these classes, however, economic value may be seen to as the more objective consideration, since it is measurable in terms of money.

Maximum value is assumed to be found when a required service or function is attained and when the cost of providing that service or function is at a minimum. Value in this context can be measured objectively (Ashworth, 2010), but any solution found through such a procedure risks sub-optimization. According to Ashworth (2010) any increase above the required level of either service or function, often be perceived by clients as a better value. Value within the context of the built environment combined four components (Ashworth, 2010):

- **Use value.** This is the benefit attached to the function for which the item is designed
- **Esteem value.** This attribute measures the attractiveness or aesthetics of item
- **Cost value.** This represents the costs to produce or manufacture the item and to maintain it over its period of possession or life
- **Exchange value.** This is the worth of an item as perceived by others who are primarily interested in its acquisition.

THEORETICAL FRAMEWORK

Buildings (i.e. Housing, Office blocks, Hospitals, Factories, Schools, Universities and other Educational buildings) account for about 70% of the construction sector in Nigeria (Omole, 2000). The task of a building contractor in any construction project depends on the type of contractual arrangement (procurement methods) adopted by the Building client. In Nigeria, approximately half (48.08%) of construction projects are executed using variants of traditional procurement method (Babatunde, *et al*., 2010). The method imposes a contractual and organizational separation between design and construction (Dada, 2012). At the design stage consultants' (Architects; Engineers; Quantity Surveyors; etc) are responsible for all the necessary tasks required (Babatunde, *et al*., 2010; Ojo *et al*., 2006), while at the construction stage the contractor is responsible for the construction of the facility as designed and specified by the consultants (Babatunde, *et al*., 2010; Ojo *et al*. , 2006).

According to Babatunde, *et al*., (2010) the traditional procurement method separates the design, tendering process and construction as separate tasks and this separation of activities also led to sequencing of activities in which design is completed before construction commences. The tendering process connects these two distinct but interrelated activities by producing the contractor for the execution of the work. On the award (Babatunde, *et al*., 2010), the successful contractor executes the work as designed under the supervision of the consultants. This procurement variant (Traditional procurement) has the singular advantage of competitiveness, which often results in low tender mark up (Wahab, 1987cited in Ojo *et al*., 2006).

In vying for an award to execute a building project in traditional procurement methods a contractor offer's his price in the form of a tender and this is used amongst many other factors as a basis in the evaluation of the contractor in a tendering process. To arrive at his tender (price) the contractor will be provided with two or more of the followings as part of tender documents: firm bill of Quantities; bill of approximate quantities; drawings and specifications; or schedule of basic work items (Smith, 1986; Ramus, 1981), and these documents will also be coupled with instruction to tenderers', conditions of contract, and standard form of contract (Buchan *et al*., 1993 cited in Laryea, 2010). Using any of these documents the contractor through his estimating department identify his work items (tasks), evaluate his expenditure in executing this tasks and add up his mark up as recommended by its management and these becomes his tender (price). His expenditure will be the cost of the resources involved in executing his tasks in the contract. This cost is divided into two (Popescu, *et al*., 2003; Bennett, 2003; Onwusonye, 2002; Smith, 1986): direct; and indirect.

To arrive at a tender price, each of the work items unit cost must be calculated with an additional percentage of mark up to each unit work item and summed or mark up added as a percentage to the summation of all work items. As such pricing in construction can be **gross** (the former) or **net** (the latter) (Ayeni, 1986). However, the task of pricing a project is still posing a problem in the industry in Nigeria. Musa, *et al* (2011) in a documentary analyses conducted on seventeen completed project files in Nigeria revealed that the rates in the bill of quantities (BOQ) for the same items

at different locations and levels are priced the same. This according to them is not in conformity with some provisions of the standard methods of measurements (SMM) format which the BOQ was based. These findings raises questions on the accuracy of the cost estimates arrived at by the consultant quantity surveyors for the projects considered.

Moreover, there are probably as many different estimating procedures as there are estimators. Individual estimators develop and mould procedures to fit their own context and to suit their own preferences (Clough et al., 2000 cited in Bennett, 2003). These have made the plethora of literatures on cost estimation and pricing, more complex and confusing with each given it own methods in arriving at a project price (see: Ashworth, 2010; Harris and McCaffer, 2005; Popescu, *et al.,* 2003; Bennett, 2003; Mullin, 2000; Onwusonye, 2000; Smith, 1986; Ayeni, 1986). There is therefore a need to present a model for unit rate pricing that will be simple to comprehend and use in any situation, which will also reflect the mathematical relationships and the numerical contributions of the constituents of each work items that can be applicable to all work items in a building project. This becomes imperative because a contractor who has the ability to obtain construction contracts that can be executed for a modest profit in an intensely competitive market is said to be successful (Popescu, *et al.*, 2003). Moving toward this goal, general contractors and subcontractors of building construction projects require an efficient and practical cost estimating tool in developing contracts or controlling project costs (Popescu, *et al*., 2003).

UNIT RATE ESTIMATION PRICING MODEL FOR BUILDING PROJECTS

Cost estimating is crucial to construction tendering; it provides a basis for establishing the likely cost of resource elements of the tender price for construction work (Akintoye , 2000 cited in Musa, *et al.,* 2011). The cost estimated must be accurate since business and individuals in an organization depends on this accuracy (Holroyd, 2000 cited in Musa *et al.*, 2011).The cost estimated is arrived at through the computation and summations of unit rates of the various work items involved in a project.

Inuwa (2006) defines unit rate as the cost of work item or task in a construction project. The foremost thing to consider when building unit rate for a project is to establish the ***prime cost*** for each work item; synonymous of the words ***prime cost*** in the Oxford Advanced Learner's Dictionary (2010) is 'the cost of something calculated by adding the cost of materials used to make it and the cost of paying somebody to make it, but not including costs that are connected with running a business, such as rent and electricity'. Simply put, prime cost is the cost of production not including overhead charges and margin for profit. The summation of the prime cost, overhead charges and profit for each work items in the production of a building gives the unit rate of the work item.

Therefore, for any unit rate computation, its components relate mathematically as:

UNIT RATE= N + OH + P ... ... Eqn. 1

Where: **N**- prime cost; **OH**- overheads; **P**- profit.

However, overheads and profits are merged and charged as a percentage on the

prime cost for each work item (gross pricing) or on the summation of all work items prime cost in a project (net pricing) (Popescu, *et al., 2003;* Smith, 1986; Ayeni, 1986). From equation 1, Inuwa (2006) establishes unit rate computation for any work item when pricing gross mathematically as:

UNIT RATE = N + (N×Z) ..... Eqn. 2

Where; Z- Percentage (%) overheads and profits/unit of work

Inuwa (2006) further sub-divided prime cost in relation to work items for a building project into three (3): cost of materials; cost of labour; and cost of plant (machinery and equipments). Hence,

Mathematically, $\mathbf{N= M_C+L_C+P_C}$

Where: $\mathbf{M_C}$- the cost of materials/unit of work; $\mathbf{L_C}$ - the cost of labour/unit of work; $\mathbf{P_C}$ - the cost of plant/unit of work. (For detail on how to arrive at these costs/unit of work see: Popescu, *et al.,* 2003; Smith, 1986; Ayeni, 1986). Numerical contributions of constituent parts of the prime cost, overheads and profits in the unit rate computation are defined by (Inuwa, 2006): $\mathbf{M_C \geq 0}$; $\mathbf{L_C > 0}$; $\mathbf{P_C \geq 0}$ **and**; $\mathbf{Z > 0}$

The foregoing numerical contribution of each constituent's parts of prime cost of unit rate shows that material and plant could be zero in the unit rates computation. For instance unit rate in the bill of quantities for top soil excavation or excavating of trench using manual labour will not require materials and plants; only labour, overheads and profits will be reflected in its rate computation. Whereas for concrete mixed with a mixer the contribution of the constituents part of prime cost in the rate computation will all be greater than zero. It should be noted that the contribution of labour, overheads and profit in any circumstances when computing unit rate are always greater than zero (Inuwa, 2006).

CONCLUSION AND RECOMMENDATION

The price estimation model arrived at from the preceding analysis itemises the basic constituents of unit rate as: materials; labour; plants; overheads and; profits. In addition, the numerical contributions of each of the constituents per unit of work are given as: $\mathbf{M_c \geq 0}$; $\mathbf{L_c}$ □ 0; $\mathbf{P_c \geq 0}$ and; $\mathbf{Z_c}$ □ 0. The numerical contribution establishes the extent of each constituent's involvement in the computation of unit rate. The model is simple, comprehensible and its applicability is compatible with any circumstance. The model is capable of improving the productivity in unit rates computation and can facilitate the production of an error free rate.

The study recommends that the model can be use: as a basis for developing software for the computation of unit rates; as a tool for an effective management of construction project, with specific attention on project duration; for teaching and understanding the basic principle involves in rate computation, which can extend to development of other rates like, day work and star rates and; as a basis in attaining uniformity in unit rate computation in the construction industry.

REFERENCES

Adeagbo, D. O. (2005, April 15-25). University of Jos M.Sc Construction/Project Management Lecture Note. Jos, Plateau State, Nigeria.

Ashworth, A. (2010). *Cost Studies of Buildings, 5th edn.* England: Pearson Education Ltd.

Babatunde, S. O., Opawole, A., & Ujaddughe, I. C. (2010). An Appraisal of Procurement Methods in the Nigerian Construction Industry. *Civil Engineering Dimension. 12 (1)* , 1-7.

Bennett, F. (2003). *The Managementt of Construction: A life Cycle Approach.* Oxford: Butterworth-Heinneman.

Dada, M. O. (2012). Predictors of procurement Selection: An Investigation of Traditional and Integrated Methods in Nigeria. *Journal of Construction in Developing Countries. 17 (1)* , 69-83.

Harris, F., & McCaffer, R. (2005). *Modern Construction Management, 5th edn.* Accra: EFP Books Services.

Hillebrandt, P. M. (1991). *Economic Theory and The Construction Industry, 2edn.* London: Macmillan Academic and Professional Ltd.

Hornby, A. S. (2010). *Oxford Advanced Learner's Dictionary: International Student Edition, 7th edn.* Oxford: Oxford univeristy press.

Inuwa, I. I. (2006). *Unit Rate Software Development for Effective Time Management for Construction Projects in Nigeria.* Jos: Unpublish MSc Thesis Univerity of Jos.

Laryea, S. (2010). Contractor Project Estimates vs. Consultant Project Estimates in Ghana. *The Construction, Building and Real Estate Research Conference of the Royal Institution of Chartered Surveyors (COBRA).* Held at Dauphine Universite, Paris, on 2-3 september, 2010.

Laryea, S., & Mensah, S. (2010). The Evolution of Contractors in Ghana. *West Africa Bult Environment Research Conference (WABER)*, (pp. 88-93). Held on 27-28, July, 2010 in Paris.

Mullin, C. J. (2000). Construction Cost Estimating. In F. S. Merritt, & J. T. Ricketts, *Building Construction Design and Handbook* (pp. 19.1-19.14). New York: McGraw-Hill.

Nasiru, Z. M., Kunya, S. U., & Abdurrahman, M. (2012). Assessment of Factors That Affect Cost Control by Nigerian Construction Contractors. *Journal of Engineering and Applied Science* , 71-79.

Ojo, S. O., Adeyemi, A. Y., & Fagbenle, O. I. (2006). The Performance of Traditional Contract Procurement in Housing Projects in Nigeria. *Civil Engineering Dimension. 8(2)* , 81-86.

Omole, A. O. (2000). Framework for a Code of Procedure for Open and Competitive Tendering. In NIQS, *Open and Cmpetitive Tendering in the Procurement of Public and Private Sector Projects* (pp. 20-36). Lagos: NIQS.

Onwusonye, S. I. (2002). *Tendering, Estimating and Contractual Arrangement in Building Projects:Practice and Principle.* Owerri: Intercontinental Educational Books and Publishers.

Popescu, C. M., Phaobunjong, K., & Ovararin, N. (2003). *Estimating*

Building Costs. New York: Marcel Dekker, Inc.

Ramus, J. W. (1981). *Contract Practice for Quantity Surveyors.* London: Longman.

Ricketts, J. T. (2000). Systems Fundamentals. In F. S. Merrits, & J. T. Ricketts, *Building Design and Construction Handbok, 6th edn* (pp. 1.1-1.41). New York: McGraw-Hill.

Smith, J., & Jagger, D. (2007). *Building Cost Planning for The Design Team, 2edn.* Oxford: Butterworth-Heinemann.

Smith, R. G. (1986). *Estimating and Tendering for Building Works.* London: Longman.

The New International Webster's Dictionary. (2002). USA: Trident and Press International.

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