An Evaluation of the Proportion of the Components of Production Cost of Building Projects in the South-South Geo-political Zone of Nigeria

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Abstract: This study evaluates the proportion of the components of production cost of building construction projects with a view to improving estimation accuracy for project planning and control in the South-South geopolitical zone of Nigeria. Secondary data of selected building elements of public storey building projects completed within a 10 year period of 2009 and 2018 are obtained for this study. This consists of cost data of 240 projects retrieved from archives of building construction contractors. Data collected which include production costs of materials, labour, plant and equipment of the selected building projects are analyzed using descriptive statistics and analysis of variance (ANOVA). Results of the study indicate that production cost of materials is highest while cost of equipment is the least among the selected building. Window and door elements have the highest cost of materials at 77.17%; staircase, floor and upper floor elements have the least cost at 52.98%. Mechanical installations and finishing elements have the highest production cost of labour at 35% while windows and door elements have the least total elements cost of 20.49%. Framework has the highest proportion of cost of equipment of 15.02% and the least is windows and door elements at 2.34%. The proportion of production costs are 52.98% to 77.17%, 20.49 to 35% and 15.02% to 2.34% for material, labour and equipment components respectively. The study establishes that the proportion of the selected components of the building elements are not the same across the selected elements evaluated (p-value < 0.05). The study recommends the adoption of the results of this study in ensuring accuracy of estimation of construction building projects.

Keywords: Building elements, costing, production components, production cost.

I. INTRODUCTION

Studies have shown that cost is among the major considerations throughout the project life cycle and can be regarded as one of the most important parameters and driving forces of project success (Memon, Rahman, Abdullah and Azis, 2010; Choge and Muturi, 2014). Cost is defined as a monetary value of all the goods and services used in order to perform an operation (Yaman and Taş, 2007). Within the context of construction, cost is referred to as the portion of hard costs usually associated with the construction contract, including cost of materials, labour and equipment costs necessary to put those elements in place (Windapo, Odediran, Moghayedi, Adediran and Oliphant, 2017). Building construction stakeholders and society are concerned with construction costs in various ways, due to project objectives and diverse expectations of stakeholders. Other parameters in measuring project performance, such as time and quality performance are important but cost has greater implication. In addition, most clients put priority on construction cost because of the management and allocation of project resources. There seem to be a strong relationship between project performance and the extent to which objectives of the project are achieved in terms of cost. These therefore make the process of estimation of construction cost in the achievement of project objectives a critical task in the industry. Construction project estimating is described as the market worth that results from previous, existing and future quantities, or even later than the incident under consideration (Odusami and Onukwube, 2008). It is the technique for forecasting and predicting cost and expenditures of a future project (Flyvbjerg, Holm and Buhl, 2002). The singular importance of construction estimate in any project is its accuracy (Ashworth, 2004). However, construction cost estimation rarely produces accurate estimates due to many intricacies (Ubani, Omajeh and Okebugwu, 2015) which include complex relationship among the cost elements. An agreed tender sum which is established based on estimated cost should reflect final cost but rather includes other costs such as variation cost, modification cost, legal claims, and many other external contingency factors which could have been captured at planning stage to achieve an accurate estimate (Chan and Chan, 2004). Evidences from various project outcomes show that project cost estimates are consistently inaccurate and that has been a serious problem for the stakeholders in the industry both in the developed and developing countries (Azhar, Farooqui and Ahmed, 2008). It is not uncommon for final costs of projects to exceed the predetermined cost prepared during planning (Shane, Keith and Stuart, 2009). Azhar *et al*. (2012) also affirm that it is rare for projects to be completed within an anticipated budget.

Production of accurate estimate in construction is crucial in order to achieve project objectives and give maximum value for money. Accurate estimate is also important as it serves as a basis for controlling project expenditure, budgeting and resource allocation (Rostiyanti, Anondho and Soeleiman, 2005). It is noteworthy to mention that accurate cost estimation is as important as the project itself. Major critical decisions regarding project award and contract implementation are subject of cost estimate and therefore need to be as realistic as possible. Accuracy of estimating can be defined as the level to which the end price outcome of a project may differ from the single point value which used in estimating the project estimated cost (Dysert, 2006). It is a common term to express validity of construction cost estimates; anything short of this can be regarded as inaccurate. According to Akintoye (1998) cost estimation inaccuracies are twofold - overestimation and underestimation. Over estimation is where estimated cost is higher than the actual cost of completing a project, while underestimation is where the actual cost significantly exceeds the estimated cost (Ubani *et al*., 2015). Clients are only interested in accurate estimates that ensure completion of projects within cost. Haplin and Boliver (2005) however, advocate for a consistent procedure or set steps for preparing an estimate in order to minimize errors and achieve dependable and accurate estimates. In response to this, many studies have been carried out in ensuring accuracy of project estimate (Creedy, 2006; Odusami and Onukwube, 2008; Ubani *et al.,* 2015). The cost estimation exercise is very challenging as most cost estimates are inaccurate. Regrettably, researches on this subject have not produced maximum satisfactory result and as such, considerable efforts in this regard are still on-going. Similarly, efforts toward improving overall construction cost has also been advocated by researchers (Enshassi, Mohamed and Abdel-Hadi, 2013; Memon *et al.,* 2010; Chan and Park, 2005; Bubshait and Al-Juwairah, 2002). To complement these efforts, research on production cost in order to produce accurate estimate as well as achieving overall project performance has also been advanced (Adu and Akpan, 2016).

Production cost is the total direct and indirect construction costs involved in the execution of various project activities (Chitkara, 2008). The importance of this cost and its components have been mentioned in the literature as major significant cost factors which the contractors consider during pricing (Warsame, 2006; Onukwube, Adenuga and Enang, 2009; Brook, 2004). Researchers have attributed the success of any project to prior and adequate provision of project resources that constitute the cost (Chitkara, 2008; Rahman, Memon, Azis and Abdullah, 2013). These resources include materials, labour, plant and equipment. They are referred to as the key drivers of construction costs in any project (Windapo *et al.*, 2017). Construction organisations are expected to ensure that all these resources are employed optimally to produce maximum profit for the investors (Olateju, 1992) and to the satisfaction of other stakeholders. The current study observes that inaccurate estimation of these resources can jeopardize the chance of winning at bidding stage and successful completion of a project. In addition, inaccurate estimates could results in time and cost overruns, litigation, insolvency, project abandonment and even project failure. Warsame (2006) shares the same view based on the result of findings which reveal that the major reason for low level of construction activities in Sweden is as a result of escalation of production cost. Similarly, literature shows that ineffective management of production resource-related factors is the major cause of construction delay (Hensey, 1993). This is in agreement with the study of Ogunlana, Krit and Vithool (1996) that reveals that inadequate supply of some of these resources are among the major causes of construction delay in Thailand. Other studies also reveal that most of the factors causing cost overrun of construction projects are attributed to production cost-related factors (Enshassi, Al-Najjar and Kumaraswamy, 2009; Koushki, Al-Rashid and Kartam, 2005; Omoregie and Radford, 2006; Ameh, Soyingbe and Odusami, 2010 and Nyabwari, 2013). There is a dearth in the study on production cost and proportion of components of this cost among building elements. The main concern of this study is how cost prediction of building project at planning stage can be improved in order to ensure a continuous project performance through production of accurate project estimate. The objective of the study is to determine the proportion of components of production costs of the selected building elements. The results of this study should assist stakeholders in the building industry, especially project managers and quantity surveyors in ensuring accurate estimation of building projects.

II. LITERATURE REVIEW

Components of Construction Production Cost

The study observes that despite the importance of production cost in a construction project, researchers have not agreed on a universal set of inputs or resources that constitute the cost. Views differ from one project to another as well as the assumptions that form the basis of the cost. This also relates to the prevailing economic conditions, type of project, supplier structure and the size of the construction market. Rahman *et al.* (2013) recognise materials, manpower (labour), machine (plant and equipment), and finance as significant resources of construction project. Zayed, Amer and Pan (2008) consider production cost under three construction resources which include: materials, labour, and equipment. Similarly, Meikle (2001) describes production cost as contractor's construction costs which is an aggregate of costs of materials, labour, and equipment to undertake the work. In addition, the author also adds contractor's finance, management and various site and office overheads as the component part of production cost. Haron and Mutalib (2012) are not certain of the component parts of the cost but refer to it as the contractor's expenditure which includes all the resources involved during production, excluding profit. Azhar *et al.* (2008) classify the cost as cost of construction which basically includes the cost of materials, the cost of labour and the cost of management. Windapo and Iyagba (2007) on the other hand identify the cost as building cost, capital/finance, cost of land, foreign exchange rates, cost of infrastructure, and labour cost. Chitkara (2008) has a different view of the cost but categorizes it as cost of resource inputs at the project site to include men, materials, machine, and money. Li (2009) stressed the importance of manpower, materials and machine (plant and equipment) as the major inputs consumed by construction project. In the light of the above, materials, labour and equipment being the intermediate inputs in the production process are considered and adopted in this study as components of production cost of building construction project. This consideration is further buttressed by the fact that the resources are the basic and indispensable requirements in the production process excluding cost of land, profit and overhead (Borcherding and Liou, 1986; Chau and Wang, 2003).

The proportion of this cost varies among projects and depends largely on some external and internal factors in the industry. External factors are the factors that are outside the control of the management of the organization while the internal factors are the factors that are related to the production factors originating within the organization but are also under the control of project managers and some stakeholders. In the construction industry these factors are dynamic in nature and seem difficult to predict. These include the complex nature of projects, large number of parties involved, inadequate infrastructure (like roads), construction method, waste ratio and management, project location, price of energy (fuel), delivery cost, quality of materials, labour shortage, labour productivity level, availability and state of tools and equipment, scarcity of equipment, skill of equipment operator (Windapo and Iyagba, 2007; Assaf, Alkhalil and Harris (1995); Rahman *et al*., 2013; Sweis, Hammad and Shboul, 2008; Rahshid, Haq and Aslam, 2013).The three components of production cost identified in this study, that is, material, labour (manpower) and equipment are further discussed in the sub-section below.

Construction Material Cost

Material is one of the major intermediate components of construction resource in any construction project (Li, 2009).Raw materials are heavily used in the construction industry and their cost greatly impacts on the construction sector, which both affects and is affected by the economy in terms of its indicators such as Gross Domestic Product (GDP) (Bassioni, Elmasry, Ragheb and Youssef, 2012). Studies show that the amount of materials used in any particular project relates closely to the project itself and this is relatively rigid. According to Okorocha (2013) materials constitute 30% to 70% of the cost of construction project. Ibrahim, Roy, Ahmed and Imtiaz (2010) state that materials account for 50-60% of the total project cost in construction projects. Okupe (2000) points out based on the study carried out in Nigeria that the cost of materials and associated components could be as much as 75% of construction cost. These could be approximately 40 percent of contractors' costs in multi-family housing projects but this figure could be lower due to discounts on bulk material. However the industry has resulted into general shortage of almost all building materials because of its usage (Akinluyi and Adeleye, 2013).

Construction Labour Cost

Labour cost is one of the most contentious factors among all the factors that affect construction costs. However, labour is an indispensable input in construction and one of the largest parts of construction cost (Nwachukwu and Emoh, 2011). Labourers and other non-professional manpower personnel are critical and important assets in construction project management success. Wahab (1991) views labour as an important resource in construction because it is the one that combines all the other resources namely materials, plant equipment and finance in order to produce the various construction products. The relative importance of manpower resource varies among projects and the type of work involved. Some factors have more significance for buildings and perhaps less impact on heavy civil work (roads, dams, power plants, and others) which tends to be done by larger firms using more capital intensive methods. Apart from this heavy civil engineering work, construction projects are mostly labour based with basic hand tools and equipment, as labour costs comprise 30 % to 50 % of overall project cost (Shashank, Sutapa and Kabindra, 2014). Labour productivity is crucial in achieving aggregate tasks and successful completion of construction projects. In recent times, productivity of construction labour resource has imposed a lot of risk on cost and time performance of construction projects. In developing countries, poor labour productivity is a serious problem (Kaming, Olomolaiye, Holt and Harris, 1997). Mwakali and Hansson (2007) affirm that the problem of overrun in the construction industry is greatly associated to productivity problem. Expected construction progress can only be achieved only through the attainment of effective man-hour effort meeting scheduled milestone dates. Continuous improvement on manpower or human resource is therefore not negotiable in ensuring a successful construction project.

Construction Equipment Cost

Construction equipment plays a significant role in the execution of modern high-cost time-bound construction projects (Chitkara, 2008). Construction equipment is an indispensable resource in achieving project objectives. It produces output at accelerated speed and therefore enables completion of tasks in a limited time as it can work under adverse circumstances continuously. Equipment saves manpower which is becoming scarce, costly and more demanding day-by-day. According to Goodrum and Haas (2002) equipment technology is a key factor in long-term improvement of productivity of construction projects. Equipment improves productivity, quality and safety especially if the selection and utilization of equipment in a project are properly integrated part of the total plan. The type and number of the equipments required in any project depends on the nature of the project and available technology. Equipment cost becomes more expensive as new technology or special equipment is requested. Most heavy equipment is run by diesel fuel and as the price of diesel fuel increases, the cost of equipment also increases significantly. The technological changes in construction equipment have impacted construction sector over the years. Most construction works are still being carried out manually and crudely in the developing countries like Nigeria, with less involvement of mechanical devices. This can be attributed to heavy initial capital outlay for acquiring equipment but in the long run, equipment adds to the profitability by reducing the overall costs, provided the equipment is properly planned, technically scrutinized, economically procured and effectively managed (Chitkara, 2008).

III. RESEARCH METHODOLOGY

The research was carried out in the south-south geopolitical zone of Nigeria, which consists of six states. The states are namely; Akwa Ibom, Bayelsa, Cross River, Delta, Edo, and Rivers State. The study population comprises of project data of completed public storey building projects in the study area. The sampling frame for this research was 465 archives of completed public storey building projects out of which 240 project data representing 52% was purposely sampled. The project data collected covered the period between 2009 and 2018. The period is considered to have probably experienced almost the same economic climate. A prepared data analysis sheet (inventory sheet) was used in the preparation and collection of data from the registered small and medium building contractors. The data on the total production costs of completed storey building project of material, labour, plant and equipment on eight key elements of storey building project are collected. These include substructure, frame (including upper floors and staircase), roof, external and internal walls, windows and doors, finishing (walls finishing, floor finishing and ceiling finishing), electrical installation, and mechanical installation. Data on gross floor areas of the buildings are collected to establish the cost per gross floor area (₦/m^2) of the buildings. Information on the demographic characteristics of respondents is also collected in order to achieve the objective of the study. Data collected are analyzed using descriptive analysis in order to reveal the contribution of each of the production components to production cost which included mean costs of each cost component, the standard deviation, and percentage of each component to their overall total production costs of each element.

Data collected are processed using Statistics Package for Social Sciences (SPSS) and Microsoft Excel. Analysis of Variance (ANOVA) with p-value $\leq 0.05$was used to test the three hypotheses of the study. The decision rule was that when the p-value is greater than the set significance level (0.05) or the calculated F value is less than the value in the F distribution table, the null hypothesis of no significant difference was accepted, otherwise it was rejected and the alternate hypothesis was accepted (Udofia, 2011). The three hypotheses postulated are stated as follow:

Ho_1: There is no significant difference in the proportion of material component of production cost of the selected building elements in the zone.

Ho_2: There is no significant difference in the proportion of labour component of production cost of the selected building elements in the zone.

Ho_3: There is no significant difference in the proportion of plant and equipment component of production cost of the selected building elements in the zone.

IV. DATA ANALYSIS AND DISCUSSION OF FINDINGS

The study used data from 240 public storey building projects to determine the proportions of the building components of production cost in the selected building elements. The results of the analysis show the production resources, the standard deviation, average cost (₦/m^2), mean cost (₦/m^2) and percentage contribution of each resource component to total cost of each of the element. The results are presented in Table 1 and further illustrated Figure 1.

Table 1: Proportions of the Components of Production Costs in Selected Building Elements

Building Element	Production Resource	Std. Deviation	Average Cost (N/m^2)	Mean Cost (N/m^2)	Percent (%)
Substructure	Material	2157	1,047,282.30	17,455.00	59.81%
	Labour	1007	492,160.82	8,202.70	28.11%
	Plant	431	211,477.75	3,524.60	12.08%
Staircase, Floor and Upper Floor	Material	2325	1,207,372.23	20,123.00	52.98%
	Labour	1403	729,259.23	12,154.00	32.00%
	Plant	658	342,303.64	5,705.10	15.02%
Roof	Material	536	275,996.73	4,599.90	59.18%
	Labour	305	157,032.62	2,617.20	33.67%
	Plant	64.7	33,309.95	555.17	7.14%
External and Internal Walls	Material	857	418,703.63	6,978.40	58.00%
	Labour	517	252,665.98	4,211.10	35.00%

	Plant	103	50,533.20	842.22	7.00%
Windows and Doors	Material	1661	804,046.81	13,401.00	77.17%
	Labour	415	213,512.56	3,558.50	20.49%
	Plant	112	24,346.46	405.77	2.34%
Wall, Floor and Ceiling Finishing	Material	1875	817,533.84	13,626.00	58.00%
	Labour	1132	493,339.39	8,222.30	35.00%
	Plant	226	98,667.88	1,644.50	7.00%
Electrical Installation	Material	1409	483,295.91	8,054.90	64.21%
	Labour	693	237,686.51	3,961.40	31.58%
	Plant	92.4	31,691.53	528.19	4.21%
Mechanical Installation	Material	775	376,180.37	6,269.70	61.00%
	Labour	445	215,841.20	3,597.40	35.00%
	Plant	50.8	24,667.57	411.13	4.00%

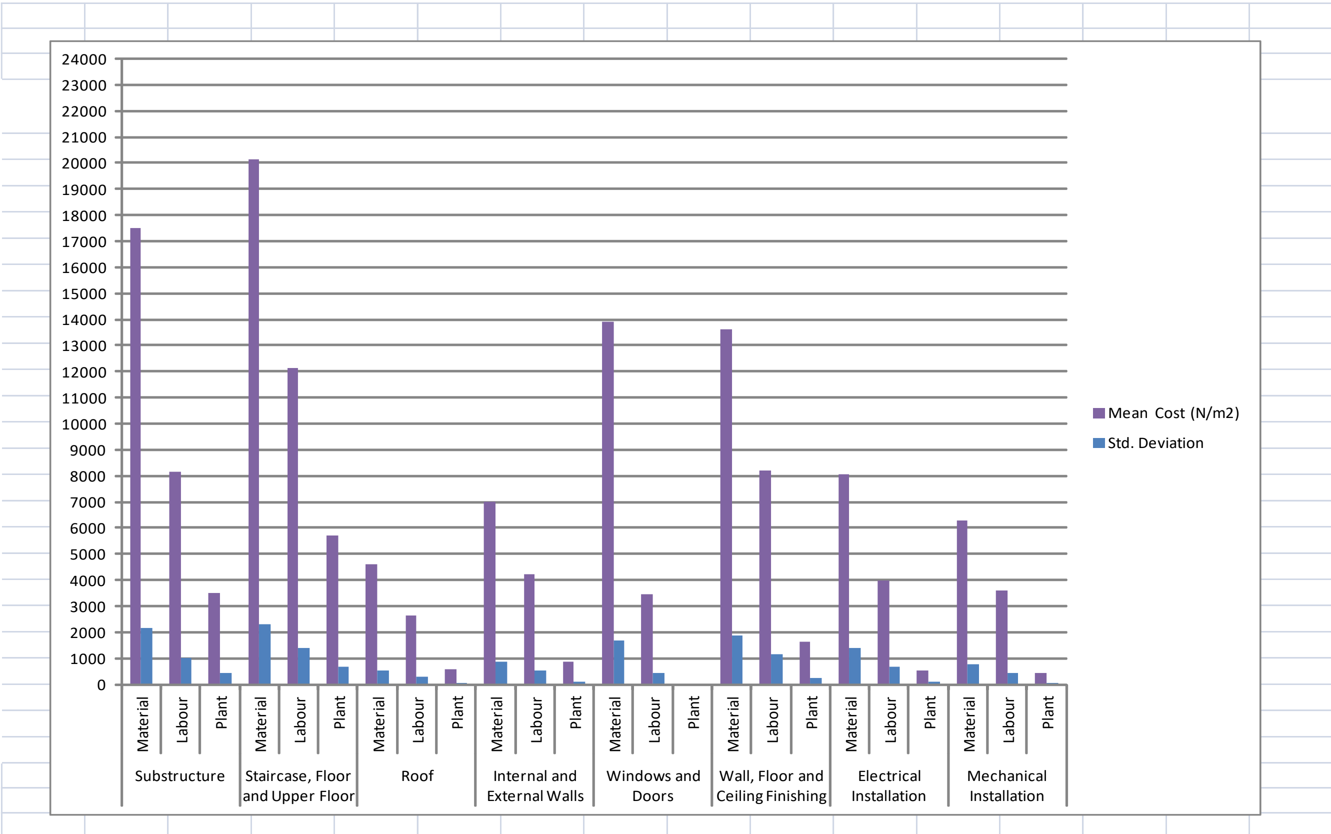

Figure 1: Bar Chart showing the Mean Cost (N/m^2) and Standard Deviation of Proportion of Components of Production Cost of Selected Building Elements

A descriptive analysis of the results of the study shows the proportion of the three components of production costs of selected storey building elements which include material costs, labour costs, and equipment costs. The first element as presented in Table 1 is the substructure with associated proportion of production cost of the three resources – material, labour and equipment. Out of the three resources, material cost has the highest with 59.81% of the total cost. The next resource is labour cost with estimated proportion of 28.00% of the total cost while the plant and equipment component has the lowest with a proportion of 12.08%. This is not surprising as sub-structural work which serves as foundation requires some quantum of materials in order to give support to both lateral and vertical loads of the building. Following the first element is the frame structure which consists of staircase, floor and upper floor. The proportion of material component of frame structure is 52.98% of the total cost followed by labour cost with proportion of 32.00% proportion with 15.02% of the cost for equipment. The third element in Table 1 is the roof structure with highest proportion of the cost being material cost of 59.18% of total cost. This is followed by labour which is 33.67% of the cost; equipment has the least proportion of 7.14%. Of the production cost of the fourth element - external and internal walls, material cost constitutes the highest with 58.00%, followed by labour 35% and equipment components having 7.00% of the total cost of external and internal walls. In the same vein, the total production cost of materials indoors and windows is the highest with proportional cost of 77.7%. The costs of labour and equipment seem so low with estimated contribution of 20% of labour while plant stands at 2.34% of the total production cost of doors and windows. The sixth element is finishing which consists of other sub-components, namely: wall, floor and ceiling. Analysis of total production cost of the finishing indicates that material component assumes 58% followed by labour with 35.00% while equipment stands at 7.00% of total come. The electrical installation components of storey buildings in the zone indicates that materials have 64.21% followed by labour, 31.58% and next component which is plant and equipment estimated at 4.21% of total cost. The final building element considered in the study is mechanical installation with material component of 61.00% of the total production cost, followed by labour of 35% and that of plant 4.00%.

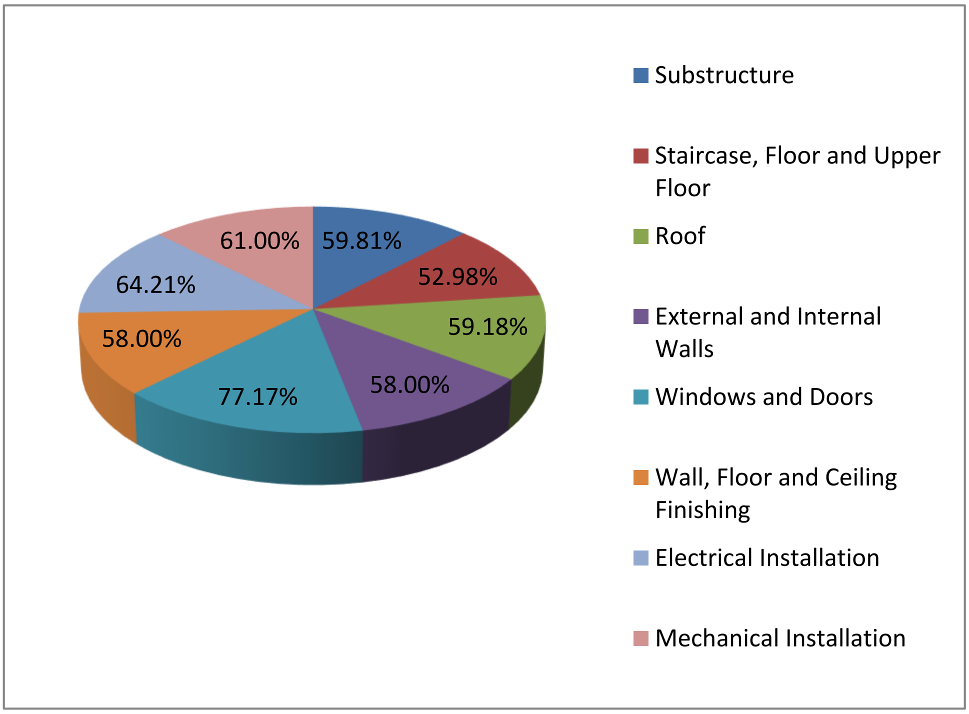

Figure 2: Material Proportion

Further comparison of results of the analysis in Figure 2 reveals that the group of elements that has the highest is Windows and Doors with 77.17% followed by Electrical Installation with 64.21%. Production cost that has the least cost among the elements considered in this study is Staircase, Floor and Upper Floor with 52.98%. In addition, material resource is the highest in all the eight elements of building projects that are considered in this study. The results also indicate that production costs of material components of building projects range between 52.98% and 77.17% of total cost in a project. This conforms to the results of Bertelsen and Nielsen (1997) with materials having highest of 50 percent in the social housing schemes in Denmark followed by labour 30 percent, heavy equipment 5 percent, construction management and supervision 15 percent. This implies that material cost is a major determinant of production costs as it is also significant to the overall project cost. It is impossible to complete any particular task without availability of required materials and according to Chau and Wang (2003) it is the major component of intermediate input in building projects. The prices of materials are determined in the open market with the influence of forces of demand and supply. A change in price of construction materials prices was noted by Marzouk and Amin (2013) to have a great impact on the cost of construction projects. Factors affecting the cost should be given adequate consideration in order to deliver the budget as planned.

Results in Figure 3 reveal that labour component of mechanical installation and finishing (wall, floor and ceiling finishing) have the highest production cost among all the elements with 35.00% of the cost. The least among the element is Windows and Doors with proportion of production cost of 20.49%. This is an indication that the proportion of production cost of building elements range between 20.49% and 35.00%. The result is consistent with the findings of Zolkafli, Zakaria, Yahya and Lia (2010) which reveal that construction workers make up 30-50% of the overall production cost, which is a fairly good portion of the total cost of a project.

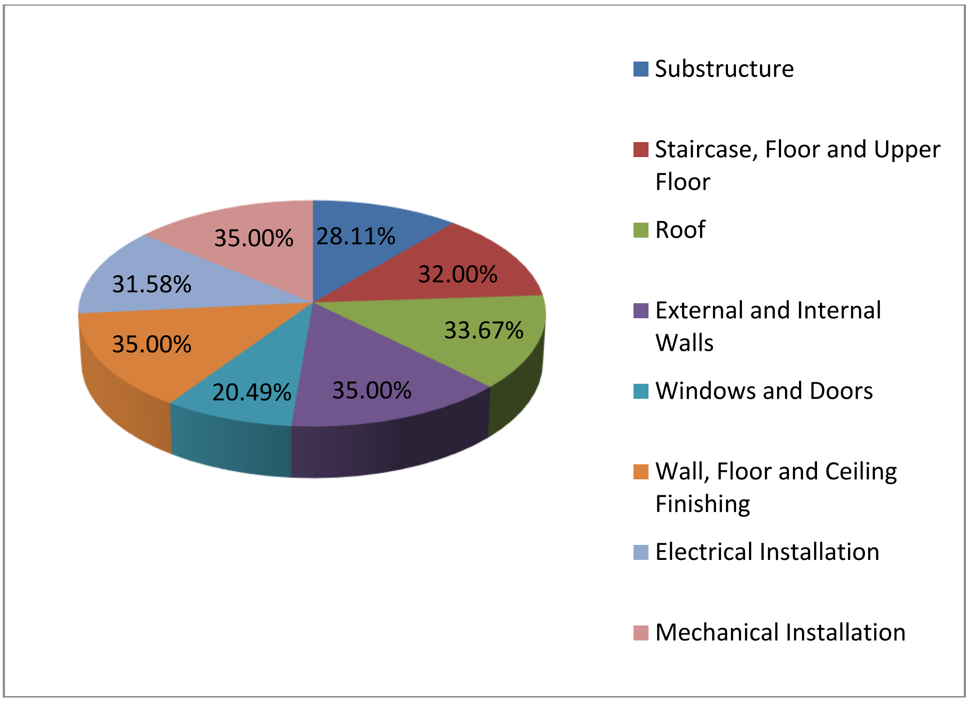

Figure 3: Labour Proportion

Figure 4 indicates that the element that has the highest proportion of equipment among the elements is framework (including upper floor and staircase) estimated at 15.02% while the proportion of windows and doors is the least with 2.34% of the production cost. The result implies that the level of utilization of plant and equipment in all the elements of storey building structures in the area is low compared to expected level of technology in meeting the needs of clients in the construction industry in terms of productivity and speedy delivery of projects. The entire construction process depends heavily on modern day construction equipment. Over dependence on crude method of project implementation among other factors may increase project duration and further result to shortage of labour which is already scarce in the industry.

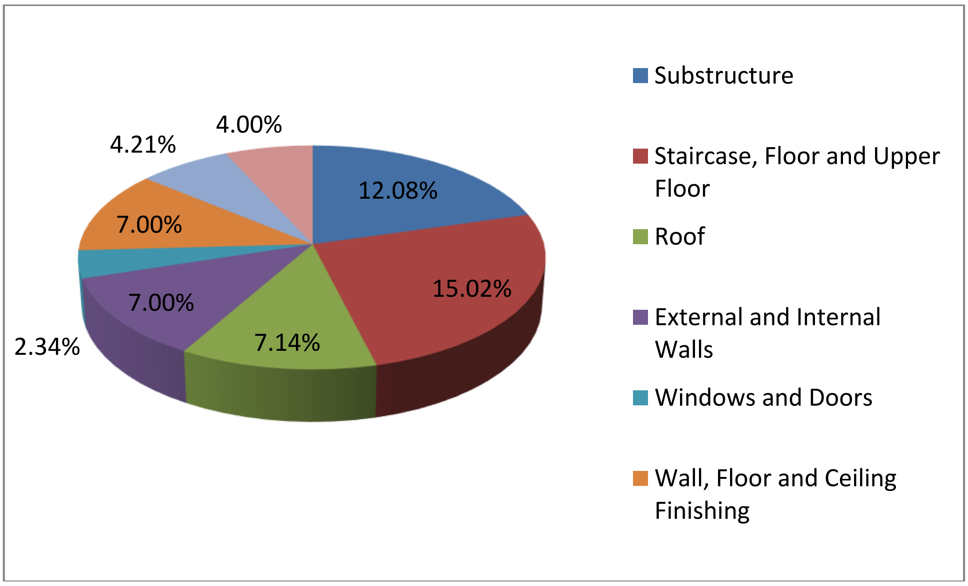

Figure 4: Equipment Proportion

Test of the First Hypothesis

In order to achieve its objectives, the study establishes empirically whether or not there is a difference in the proportion of the material component of production cost of the selected building elements in the zone. This became necessary in order to ascertain whether the proportion of material cost of building projects executed in the zone could be generalized among the eight selected building elements. To achieve this, hypothesis one which was earlier advanced was tested using ANOVA with p-value ≤ 0.05. The result of the test is presented in Table 2.

Table 2: Difference in the proportion of material component of production cost of the selected building elements

Project

Resource		Sum of Squares	df	Mean Square	F	Sig.	Decision
Material	Between Groups	1.350E10	5	1.928E9	702.097	.000	Reject
	Within Groups	1.296E9	234	2746203.721			
	Total	1.479E10	239				

The result in Table 2 above represents as F (5, 239) = 702.097; P < 0.01. the P value (sig.) for the F ratio of 702.097 is listed as 0.000, which means that it is less than 0.05, therefore the null hypothesis, H_0 which states that no significant difference in the proportion of material component of production cost of the selected building elements in the zone is rejected and the alternative hypothesis which state that there is significant difference in the proportion of material component of production cost among the selected building elements in the zone is accepted. These results indicate that general proportion of component of materials cannot be used for each of the elements identified in this study. This result is in agreement with Damodara (1999) who confirms that material resource contribute 40-60% contribution of material resource of the total project cost which is relatively similar to production cost. The result of the study by Skoyles (2000) also confirms that the proportion of materials in building construction projects vary from 55% to 65%.

Test of the Second Hypothesis

The second hypothesis in this study is also tested for difference in the labour components of production cost among the selected eight building elements of storey building projects in the study area using Analysis of Variance (ANOVA) with p-value ≤ 0.05. The result of the test is presented in Table 3.

Table 3: Difference in the proportion of labour component of production cost of the selected building elements

Project Resource		Sum of Squares	df	Mean Square	F	Sig.	Decision
Labour	Between Groups	4.676E9	5	6.679E8	964.078	.000	Reject
	Within Groups	3.270E8	234	692831.762			
	Total	5.003E9	239				

The result in Table 3 above represents as F (5, 239) = 964.078; P < 0.01. the P value (sig.) for the F ratio of 964.078 is listed as 0.000, which means that it is less than 0.05, therefore the null hypothesis, H_0 which states that no significant difference in the proportion of labour component of production cost of the selected building elements in the zone is rejected and the alternative hypothesis which states that there is a significant difference in the proportion of labour component of production cost of the selected building elements is accepted. These results from Table 3 indicate that general proportion of component of labour cannot be used for each of the elements identified in this study. The study by Hanna, Taylor, and Sullivan (2005) indicates that labour cost in construction industry is estimated to be about 33%-50% of the entire project cost. Chitkara (2008) was not really certain about the labour proportion in construction projects but asserts that direct manpower constitutes 75% to 90% of the total manpower employed at the project site.

Test of the Third Hypothesis

Similarly, the third hypothesis is tested for difference in the plant and equipment components of production cost across the selected eight building elements of storey building projects in the zone using Analysis of Variance (ANOVA) with p-value ≤ 0.05. The result of the test is presented in Table 4.

Table 4: Difference in the proportion of equipment component of production cost of the selected building elements

Project Resource		Sum of Squares	df	Mean Square	F	Sig.	Decision
Plant	Between Groups	1.568E9	5	2.240E8	1207.696	.000	Reject
	Within Groups	8.753E7	234	185443.760			
	Total	1.655E9	239				

The result in Table 4 above represented as F (5, 239) = 1207.696; P < 0.01. the P value (sig.) for the F ratio of 1207.696 is listed as 0.000, which means that it is less than 0.05, therefore the null hypothesis, H_0 which states that no significant difference in the proportion of equipment component of production cost of the selected building elements in the zone is rejected and the alternative hypothesis which state that there is significant difference in the proportion of plant component of production cost of the selected building elements in the zone is accepted. These results also indicate that general proportion of component of plant and equipment cannot be used for each of the elements identified in this study. Chitkara (2008) also establishes the direct cost of plant and equipment costs to vary between 5% to 10% in mechanized building projects and put highway construction projects as high as 40% of project direct cost.

V. CONCLUSION AND RECOMMENDATION

The study established the proportion of three major components of production costs of eight selected elements of storey building projects in the south-south geopolitical zone of Nigeria. Based on the results the study concluded that production cost of materials is highest while equipment is the least among all the building elements considered. Window and door elements have the highest production cost of material at 77.17% while staircase, floor and upper floor elements have the least cost of 52.98%. Similarly, mechanical installations and finishes have the highest production cost of labour of 35% while window and door elements have the least cost at 20.49% of total cost. In addition, framework element has the highest cost of equipment cost of 15.02% with the least being window and door element of 2.34%. The study observed that building contractors in the study area are dependent on crude methods of project utilization with little involvement of equipment and new construction technology as against the needs of clients in terms of productivity and speedy delivery of projects. The study also concludes that the proportion of components of production costs of project resources of selected building elements are not the same. Therefore, for the purpose of project planning and control, same proportion of each of the production components cannot be generalized for costing of each of the building elements. The study recommends that to achieve effective resource management and desired objective of performance of construction projects in terms of cost, time and quality, the proportion of production costs of building elements established in this study which include the cost of materials, labour, and equipment must be optimally employed. Contractors and costing engineers can improve the accuracy of their cost estimates by adopting the proportions of production costs of components of each building element evaluated in this study.

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