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Analysis of Elemental Cost Variation of Building Construction Projects in Nigeria

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ABSTRACT

Cost performance is the fundamental criteria for success of any project. Most projects face huge amount of cost variations in Nigeria construction industry. Its performance is based on the three major parameters which include, cost, time and quality. This research was carried out to analyze elemental cost variation in building construction projects in Abuja Nigeria. Secondary data was obtained for the study and analysed using ANOVA, correlation, and regression. The result shows that the most critical factors that contribute to cost variation include unstable economy, improper planning, inaccurate estimate and fraudulent practice. The study finally recommended the best way of a averting the problem which include stabilization of the economy by the government through monitoring of price, stability of cost of labor and building materials. Contractors should employ qualified and experience staff in order to be able to follow the different technical and managerial aspects of the project. The study has concluded that there was no significant difference amongst the variation in the costs of selected groups of building elements. This was based on analysis of variance results. This meant that notwithstanding the magnitude of changes to elemental costs, no single element could be isolated as being exceptional in terms of cost variations. It was concluded that in terms of degree of influence on change in initial contract sums, the Services elements was ranked 1st, based on an R^2 value of 25.2%. Substructure had the least influence on changes in the initial contract sum (R^2 value of 6.71%).

Keywords : Sustainability, Building analysis, Cost Evaluation, Building Construction, Contract Sum

I. INTRODUCTION

Construction projects, an element of infrastructure development, are key drivers of economic growth of a country. In countless ways, the pace of financial development of any country can be measured by the advancement of physical bases, for example, structures, streets and scaffolds (Takim and Akintoye, 2000). The Construction Industry represents around 10% of the world's GDP and provides 7% of global employment (Fiona, 2007). As indicated by Chitkara (2004), the construction industry in numerous nations represents 6-9% of the Total national output (Gross domestic product); and as indicated by Bhimaraya (2001); it comes to up to 10% of the Gross domestic product of generally nations. The level of accomplishment in completing construction project advancement exercises will depend vigorously on the nature of the administrative, budgetary, specialized and hierarchical performance of the separate gatherings, while thinking about the related risk management, the business environment, and financial and political security (in the same place). The completed item in any industry requires fulfilling a specific standard to give consumer loyalty and worth to cash. In the construction industry, accomplishing nature of the completed item is no not exactly in some other industry (Chan and Cap, 2000).

A construction project is recognized as fruitful when it is finished on time, inside spending plan, and as per particular and in agreement agreeable to partner (Takim and Akintoye, 2002). This dissertation basically looks at measurement of time and cost performance of government residential buildings in Abuja, Nigeria.

The disappointment of construction projects has been talked about by numerous authors, who have not concurred on a solitary strategy to gauge accomplishment in a project. In any case, Morris and Hough (1987) proposed three unique measures to perceive if a project is effective or not. Firstly, they specified the project usefulness which implies that the project ought to work in fact and fiscally. Also, the authors proposed a second measure about the management of the project, which demonstrates if the project meets the financial plan and timetable targets. At long last, the project ought to be assessed relying upon the performance of the temporary workers which examine on the off chance that they give benefits that advantage the project. Then again, numerous different authors measure the accomplishment of a construction project surveying the time performance, cost performance and the last nature of the project (Chan et al., 2004). Along these lines, there is not an exceptional method for deciding accomplishment in a project; be that as it may, time and cost performance is a basic issue to be considered in the achievement or disappointment of project.

II. METHODS AND MATERIAL

2.1. INTRODUCTION

This chapter on research methodology describes the broad orientation that was adopted for this research work. It provides the incremental steps to be followed in collecting a suitable sample of data to be analysed in a manner that enables realization of the aim and objectives of this research. The chapter comprises the following subsections: research design, population of the study, sampling size, sampling techniques, as well as data collection instrument and data analysis techniques.

2.2. RESEARCH DESIGN

A research design was evolved for this study after careful consideration of the following factors:

i. The means of obtaining information;
ii. The nature of the problem to be studied
iii. The availability of resources (skills, time and money) for the research work. Kothri (2004), stated that at the minimum, a research design must contain;

a) A clear statement of the research problem
b) Procedures and techniques to be used for gathering information
c) The population to be studied, and
d) Methods to be used in processing and analysing data.

The problem of this research is to determine the variation between ICS and FCS using final account documents of sampled projects. For this purpose, a quantitative design approach is proposed to be used. The data for this research would be collected from construction firms and federal government agencies (federal capital development authority, federal ministry of housing, and so on), who has documents of completed projects.

2.3. DATA COLLECTION

The data collection procedure of the study involved the following;

i. Identification of the population of the study
ii. Choosing of an appropriate sampling technique and sampling size, and

iii. Design of appropriate research instruments to collect relevant data from the identified sample.

2.3.1 Population of the study

The population of this study was arrived based MNIQS's assertion that its total member strength currently stands at more than 9,000 made up of fellows, corporate members, probationers, technicians and students; about 25% of this number works within Abuja (NIQS Abuja, 2016). This translates to a study population of (25/100) x 9,000 = 2250.

Abuja was chosen as a study area based on the fact that;

a. The headquarters of federal government agencies, involved in construction projects are located there.
b. About 22% of QS consulting firms in Nigeria are located in Abuja (NIQS Membership diary, 2015).

2.3.2 Sample size

Sampling size is the actual number of sampling made on the total population; in other words, it is the actual number of samples extracted from the total population. Standard sample derivation formulae helps in the determination of how large a sample would be taken. According to Gay and Diehl (1992), the number of respondent acceptable for a study depends on the type of research involved-descriptive, correlational, or experimental. For descriptive research, the sample should be 10% of population. In correlational research, at least 30 subjects are required to establish a relationship. Hill (1998), suggested 30 subjects per group, as the minimum for experimental research. Isaac and Michael (1995), provided conditions where research with large samples is essential and also where small samples are justifiable.

Apply a confidence level of 95%, level of precision 70%, level of variability 50%, and a random sampling method with N=2250 professionals to Yamane (1967)'s sample termination formula, the sample size was arrived at ;

$$n = N/1+N\,(e)^2$$

When n is the sample size, N is the population, and e is the level of precision.

$n = 2250/1+2250\,(0.1)^2 = 96$

This represents the number of QS's to be approached, based on the expectation that one final account can be obtained from each QS. The QS's to be served will, as have been mentioned earlier, be identified and selected randomly.

2.3.3 Sampling technique

The sampling technique is a method of selecting elements that forms part of the population (Kothari, 2014). Snowball sampling, which is a probability sampling technique, was adopted to select the needed number of QS's from whom final account can be obtained. Specifically, contact would be made with QS's where they work or hold meetings. All available QS's will be sampled, and sampling would be discontinued once the required number of final account is obtained.

2.3.4 Research instrument

This study employed the use of personal contacts with QS's to obtain final accounts. The final accounts are needed in other to elicit data that are final and are agreed upon, which can be compared from respondent to respondent.

2.3.5 Response rate

The field work component of this study is carried out in the month of May 2016, between the first and third week of the month. Organisations visited include;

i. FCDA
ii. Federal ministry of power, works and housing
iii. Federal airport authority of Nigeria (building and civil department).
iv. Aeroprecisan
v. Bouygues

vi. Macha

At the end of the exercise, data for a total of 21 projects where realized and collected. This represents 22% of the projected sample size.

2.4. METHOD OF DATA ANALYSIS

The data that was obtained from the survey of final accounts will be analysed using descriptive and inferential analysis, to be carried out with the aid of statistical package for social science (SPSS).

2.4.1 Descriptive analysis

The use of tables will be employed in this study, for data presentations. The analysis of the collected data will be carried out using standard change formulae. These formulae measure change in a particular variable.

2.4.2 Inferential analysis

Procedures that allows the drawing of inferences about a population from a sample are known as inferential analysis, while inferential statistics are techniques that allow the use of samples to make generalizations about populations from which the samples are drawn. Test of significance provides the probability that the results of the analysis could have occurred by chance when there is no relationship at all between the variables studied in the population.

2.4.2.1 Simple and Multiple Regression Analysis

According to Lucey (2002) regression analysis is a statistical technique which can be used for medium term forecasting which seeks to establish the line of "best fit "to the observed data and the data can be shown as a scatter diagram with various free-hand attempts at the fitting line.

Regression analysis regression is a powerful tool that is used t demonstrate casualty; that is, it shows that an independent variable causes a change in a dependent variable. The simplest thing that can be done with two variables that are related is to draw a scatter gram. A scatter gram is a simple graph that plots values of our dependent variable Y and independent variable X. normally the dependent variable is plotted on the vertical axis and the independent variable on the horizontal axis. The general equation for a line in a simple linear regression is described as:

$Y = a + bX$,

where *a* is the intercept and *b* is the slope.

Lucey (2002) define multiple regression models as models which incorporate several independent variables. The general formula for multiple regression models is:

$$Y = a + b_1X_1 + b_2X_2 + b_3X_3 + \ldots\ldots\ldots + b_nX_n$$

Where Y = Dependent variable

a = Constant

b = Beta/Gradient for each independent variable

x_1, x_2 ……………….. ,

x_n = independent variables

2.4.2.2 Correlation Analysis

The technique of correlation is used to test the statistical significance of the association between two variables. Correlation makes no a *priori* assumption as to whether one variable is dependent on the other(s) and is not concerned with the relationship between variables; instead it gives an estimate as to the degree of association between variables. In fact, correlation analysis tests for interdependence of the variables.

III. RESULTS AND DISCUSSION

ANALYSIS OF DATA AND DISCUSSION OF RESULTS

3.1. INTRODUCTION

This chapter dealt with the presentation and analysis of the data collected for the study. The data was analyzed using tabular presentations, analysis of variance (ANOVA), correlation and ranking of parameters. The results obtained were discussed in the light of reviewed literature and inferences were drawn. Bar charts were used to show graphical representation of the data.

3.2. DETERMINATION OF NET CHANGES IN COSTS OF BUILDING ELEMENTS

This section dealt with the changes that were observed in the data collected. A change is represented by either additions or omissions to the planned costs of elements. The net change is the result of subtracting value of omission items from value of addition items. The sum of net changes affecting an element shows to what extent the element has been impacted.

TABLE 4.1. MEAN SCORE ESTIMATE ON THE ESTIMATED LEVEL OF NET CHANGES IN COST OF BUILDING PROJECTS

Element	Mean	Std Dev	Median	Count		
Finishing	19.40	6.23	17.04	14.00	[illegible]	[illegible]
Opgs/Fttgs	16.95	26.78	19.75	35.00	-95.34	61.00
Roof	8.55	5.61	7.91	7.00	0.75	19.75
Services	6.39	28.76	14.25	17.00	-79.19	32.39
Substructure	-601.21	3487.34	2.40	28.00	-18368.92	706.71
Superstructure	37.78	68.98	52.81	15.00	-139.69	134.23

The net changes to the costs of elements when taken as a percentage of contingency sums were summarized in Table 4.1. The mean values of net changes to the costs of elements ranged between -601.21% for the Substructure element to 37.78% for the Superstructure. Similarly, Openings/Fittings had the highest frequency of changes to elemental costs (35 incidences) compared to Roof, which had the lowest frequency (7 incidences).

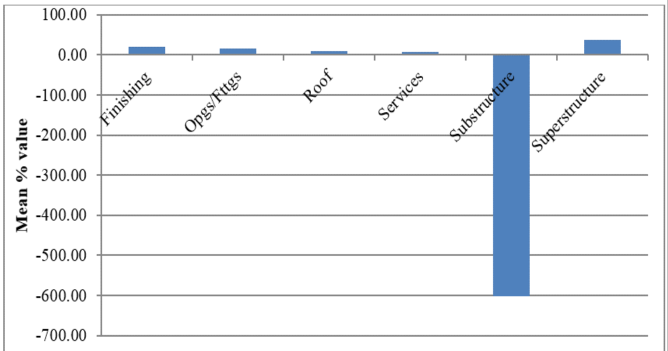

Fig. 4.1: Mean values of elemental cost variations

This shows the graphical representation of mean values of elemental cost variations with substructure having the lowest value with -601.21% and superstructure with the highest with 37.78%.

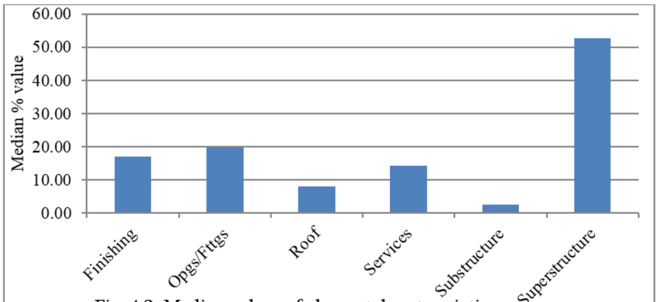

Fig. 4.2: Median values of elemental cost variations

Median values represents the midpoint of the data when arranged in ascending other. In the case of elemental cost variations substructure had the lest median value (2.40) while superstructure had the highest (52.81).

3.3. COMPARISON OF COST CHANGES ACROSS SELECTED GROUPS OF BUILDING ELEMENTS

This section applied analysis of variance technique to determine whether difference existed amongst the different elements considered in this study. The results were presented in table 4.2.

TABLE 4.2. ANALYSIS OF VARIANCE (ANOVA) OF COST CHANGE ACROSS SELECTED GROUP OF BUILDINGS

Analysis No	Variables (Mean values)					Observations				Inferences
	-	3	8.	1	2	6.	Para	F_c	F	P	Rmk

	601.25	5.44	71	6.97	8.699	380	meter tested	al	cab	value	
1	Substructure	Superstructure	roof	Openings/Fittings	Services	Finishing	Net Value as % of Contingency	0.553	2.29	0.736	NS

Key: SS = Statistically Significant NS = Not Significant

The outcome of the analysis of variance (ANOVA) statistics revealed that p-value is 0.736, which is greater than 0.05 alpha value, and F-calculated equals to 0.553, which is lower than the value of f-critical 2.29. This therefore shows that there is no significant difference of cost changes across selected groups of building elements. The null hypothesis is thereby accepted.

3.4. RELATIONSHIP BETWEEN ELEMENTAL COST CHANGES AND CHANGE IN INITIAL CONTRACT SUMS

This section applied correlation technique to determine whether similarities existed between the different elements considered in this study and changes in the initial contract sum. The results were presented in table 4.3.

TABLE 4.3. RESULT OF CORRELATION BETWEEN ELEMENTAL COST CHANGES AND CHANGES IN INITIAL CONTRACT SUM

Analysis No	Mean Values		Pearson Correlation (R)	R^2-values (%)	P-value	Strength of Relationship	Remark
	X	Y					
2	FCS - ICS	Cost change in Finishing	.411	16.89%	.114	Very weak	NS
3	FCS - ICS	Cost change in openings and fittings	.381	14.52%	.022	Very weak	SS
4	FCS - ICS	Cost change in roof	-.295	8.70%	.520	Very weak	NS
5	FCS - ICS	Cost change in services	-.502	25.20%	.028	Very weak	SS
6	FCS - ICS	Cost change in substructure	.259	6.71%	.167	Very weak	NS
7	FCS - ICS	Cost change in superstructure	-.477	22.75	.062	Very weak	NS

Key: SS = Statistically Significant NS = Not Significant

In the case of finishing, a very low value of 16.89% was observed for the coefficient of determination (R^2); the p-value was higher than 0.05, which was the level of error set for the analysis. These observation led to consideration of the relationship between cost change in finishing and change in initial contract sums as non-significant.

In the case of opening and fittings, a very low value of 14.52% was observed for the coefficient of determination (R^2); the p-value was lower than 0.05, which was the level of error set for the analysis. These observation led to consideration of the relationship between cost change in opening and fittings and change in initial contract sums significant.

In the case of roof, a very low value of 8.70% was observed for the coefficient of determination (R^2); the p-value was higher than 0.05, which was the level of error set for the analysis. These observations led to consideration of the relationship between cost change in roofing and change in initial contract sums as non-significant.

In the case of services, a very low value of 25.20% was observed for the coefficient of determination (R^2); the p-value was lower than 0.05, which was the level of error set for the analysis. These observations led to consideration of the relationship between cost change in finishing and change in initial contract sums as significant.

In the case of substructure, a very low value of 6.71% was observed for the coefficient of determin0ation (R^2); the p-value was higher than 0.05, which was the level of error set for the analysis. These observations led to consideration of the relationship between cost change in finishing and change in initial contract sums as non-significant.

In the case of superstructure, a very low value of 22.75% was observed for the coefficient of determination (R2); the p-value was higher than 0.05, which was the level of error set for the analysis. These observations led to consideration of the relationship between cost change in finishing and change in initial contract sums as non-significant.

3.5. RANKING OF ELEMENTAL COST CHANGES ACCORDING TO DEGREE OF INFLUENCE ON CHANGE IN INITIAL CONTRACT SUMS

This section of the chapter presented the ranking of elemental cost changes according to degree of influence on change in initial contract sums. Tabular presentation was employed.

TABLE 4.4

RESULT OF REGRESSIONS RANKING OF ELEMENTAL COST CHANGES ACCORDING TO DEGREE OF INFLUENCE ON CHANGE IN INITIAL CONTRACT SUMS

Element	Mean % of contingency	Std Dev	R	Sig. Value	N (number of cases)	R 2 %	Rank (Influence on ICS change)
Services	6.39	28.76	-0.50	0.03	19.00	25.20	1
Superstructure	37.78	68.98	-0.48	0.06	16.00	22.75	2
Finishing	19.40	6.23	0.41	0.11	16.00	16.89	3
Openings/Fittings	16.95	26.78	-0.38	0.02	36.00	14.52	4
Roof	8.55	5.61	-0.30	0.52	7.00	8.70	5
Substructure	-601.21	3487.34	0.26	0.17	30.00	6.71	6

From table 4.4, it was observed that the services elements was ranked 1st in the degree of influence changes in the cost of the element had on changes in the initial contract sum; this was based on an R2 value of 25.2%. Superstructure was ranked 2nd while substructure had the least influence on changes in the initial contract sum.

3.6. DISCUSSION OF RESULTS

Analysis of variance technique was applied to determine whether differences existed amongst the variation in the costs of the different elements considered in this study. The outcome revealed that there was no significant difference of cost changes across selected groups of building elements. This was based on the F-calculated value of 0.553, which is lower than f-critical value of 2.29.

Correlation was also employed to determine whether similarities existed between the different elements considered in this study and changes in the initial contract sum. All observed R^2 values were low; four out of the six elements considered had non-significant relationships with changes in the initial contract sum.

Elements with non-significant relationships with changes in the initial contract sum included finishing, (16.89%); roof, (8.70%); substructure, (6.71%); superstructure, (22.75%). Elements with significant relationships with changes in the initial contract sum were opening and fittings, (14.52%) and services, (25.20%).

The ranking of elemental cost changes according to degree of influence on change in initial contract sums revealed that the Services elements was ranked 1st; this was based on an R^2 value of 25.2%. Superstructure was ranked 2nd while Substructure had the least influence on changes in the initial contract sum (6.71%).

3.7. SUMMARY OF FINDINGS

1. There was no significant difference of cost changes across selected groups of building elements.
2. In terms of similarities that existed between the different elements considered in this study and changes in the initial contract sum, all observed R^2 values were low; four out of the six elements considered had non-significant relationships with changes in the initial contract sum.
3. Elements with non-significant relationships with changes in the initial contract sum included finishing, (16.89%); roof, (8.70%); substructure, (6.71%); superstructure, (22.75%).
4. Elements with significant relationships with changes in the initial contract sum were opening and fittings, (14.52%) and services, (25.20%).
5. The ranking of elemental cost changes according to degree of influence on change in initial contract sums revealed that the Services elements was ranked 1st; this was based on an R^2 value of 25.2%. Substructure had the least influence on changes in the initial contract sum (6.71%).

IV. CONCLUSION

CONCLUSION, RECOMMENDATION AND AREAS FOR FURTHER STUDY

4.1. CONCLUSION

The study has concluded that there was no significant difference amongst the variation in the costs of selected groups of building elements. This was based on analysis of variance (ANOVA) results. This meant that notwithstanding the magnitude of changes to elemental costs, no single element could be isolated as being exceptional in terms of cost variations.

The second conclusion of this study was only two elements had significant correlations with changes in the initial contract sum. These were opening and fittings, (R^2 value of 14.52%) and services, (R^2 value of 25.20%). Four out of the six elements considered had non-significant relationships with changes in the initial contract sum. These were finishing, (16.89%); roof, (8.70%); substructure, (6.71%); superstructure, (22.75%).

It was concluded that in terms of degree of influence on change in initial contract sums, the Services elements was ranked 1st, based on an R^2 value of 25.2%. Substructure had the least influence on changes in the initial contract sum (R^2 value of 6.71%).

4.2. RECOMMENDATION

1. Although magnitude of changes to cost of elements does vary among elements, it was not recommended that quantity surveyors should focus attention on any particular element. For instance, substructure, services and finishes appear to be notorious for cost changes. However, in residential construction, this study recommends that each element must be treated on its own merit.
2. In residential constructions, quantity surveyors need to be aware that (i) opening and fittings and (ii) services are more likely to significantly influence changes in contract sums than other elements. It was recommended that particular attention should be paid to these two elements.

4.3. CONTRIBUTION TO KNOWLEDGE

The result from the analysis shows that, factors such as unstable economy, inadequate planning, inaccurate estimate and fraudulent practice are the top factors that cause cost variation in Nigeria. Therefore, Attention should be paid to these factors as they cause considerable increase in the cost of the project initially estimated.

4.4. ROLE OF QUANTITY SURVEYORS

The Quantity Surveyor should conduct early evaluations of issued variations for the following reasons:

(a) To enable close monitoring of the final contract sum;
(b) To identify early any potential claims related to the variations;
(c) To provide the Contractor as early as possible with the Quantity Surveyor’s assessed amount of the variation to allow him to carry out cost control of his own domestic sub-contracts,

4.5. AREAS FOR FURTHER STUDY

Current study has focused on construction professionals which include architects, quantity surveyors, builders and engineers. Other stakeholders especially construction managers, clients and contractors can also be surveyed for their perspective as to these cost variation factors and their patterns. Their input can be useful to have a holistic picture of cost variation on construction projects in Nigeria.

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