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On Cost Performance of Public Building Projects: Determining the Effect of Errors in Bills of Quantities in North Eastern Nigeria

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Abstract

Construction cost performance is one of the major criteria by which success of building projects are measured. However, numerous factors were reported by researchers to be responsible for extreme poor cost performance, among which is inaccurate cost estimate. Preceding researches focused largely on: identifying and categorizing errors in Bills of Quantities (BOQ) as a document that provides cost estimate, errors in construction contract document at large, and sustainability of the application of BOQ despite the faced challenges. It is therefore necessary to determine the level of effects of errors in BOQ as a component of contract document on cost performance of public building project in order to augment the effectiveness of cost performance in North Eastern Nigeria. Positivist research approach was used where 140 questionnaires were administered to quantity surveyors (QSs): consultants' QSs, contractors' QSs and public servants' QSs whom were selected using simple random sampling technique. 112 were returned and 105 were used for the analysis with 7 invalids, this resulted to response rate of 75%. The effect of errors was measured using multiple regression analysis. The results indicated that errors in BOQ contributes to poor cost performance with statistically significant effect size of 6.8%. This research is limited to errors in BOQ in North Eastern Nigeria. It should serve as a wake-up call to stakeholders in Nigerian construction industry on the consequences of errors in BOQ for enhancing effective cost performance for national economic development.

Keywords: Cost Performance, Errors, Bills of Quantities

Introduction

Construction cost performance is one of the major criteria by which success of building projects are measured (Abusafiya & Suliman, 2017; Gligorea, 2014). Ikechukwu, Emoh, Fidelis, and Kelvin (2017) as well as Prajapati, Gupta, and Pandey (2016) opined that effectiveness of cost performance of construction projects rises property and service production for the nation and reduces adversarial relationship among projects stakeholders. However, researchers like AbdulAzis, Memon, Rahman, and Karim, (2013); Ali and Kamaruzzaman (2010); as well as Offei-Nyako, Tham, Bediako, Adobor, and Asamoah (2016) have reported poor construction cost

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performance across the globe, which is severe in developing nations (including Nigeria) where it goes over 100% of the predictable cost of construction projects. These results to project abandonment, decrease in building activities, budget shortfall of project owners, lost of profit for the contractors, tarnishing of the reputation of the professionals, decrease in rate of national growth, rework, frustration on stakeholders, delay, and higher price to the end user among others (Abusafiya & Suliman, 2017; Dosumu & Adenuga, 2013; Ikechukwu et al., 2017; Prajapati et al., 2016).

Numerous factors as reported by many researchers were responsible for cost overrun which basically result to poor cost performance of building construction projects. Shehu, Endut, Akintoye, and Holt (2014) stated that cost overrun is the negative cost variance such that final project cost exceeds contract sum. In their research, Wanjari and Dobariya (2016) reported that price escalation of raw material, delay in planning activity and lack of co-ordination among construction parties are the top three (3) factors causing poor cost performance. Whereas, political situation, fluctuation of prices of materials, level of competitors, currency exchange, and economic instability are the top five (5) factors as reported by Prajapati et al. (2016). On the other hand, Alumbugu, Ola-awo, Saidu, Abdullahi, and Abdulazeez (2014) as well as Memon, Abdul Rahman, and Abdul Azis (2011) opined that 'inaccurate time and cost estimate as well as inaccurate quantity take-off are among the factors responsible for poor cost performance. In addition, Ali and Kamaruzzaman (2010) ascribed poor cost performance to underestimation of construction projects cost. Hence, effective construction cost estimate is very critical in improving construction project's cost performance.

Construction cost estimates especially in the context of traditional procurement system, are derived mainly from Bills of Quantity (BOQ). According to Abdul Rashid, Mustapa, and Abd Wahid (2006) and Davis, Love, and Baccarini (2009) this documents are prepared mainly by professional quantity surveyors. BOQ is one of the crucial element of construction contract documents because it addresses cost, time and quality, which are the three most essential aspects of any construction projects (Gunathilaka & Senevirathne, 2013). Effective BOQ should no doubt improve the performance of construction cost. However, Dosumu and Iyagba (2013); Jalam, Gambo, Dahiru, and Aliyu (2018) stated that the major contest of this document is the professional errors which are regularly found in construction documents in which if not addressed will affect its sustainability.

Errors in BOQ were investigated by many researchers across the globe. In their research conference paper, Gunathilaka and Senevirathne (2013) testified the existence of errors in BOQ, they categorized the identified errors in BOQ as BOQ preparation errors and BOQ pricing errors. The BOQ preparation errors were found to be: Incorrect quantities, including irrelevant preliminary items, including unnecessary specifications, insufficient information with descriptions, tender BOQ is invariably silent about the actual items of temporary works, and omission and miss discrepancies between drawings and the BOQ. The first six identified BOQ pricing errors are: Careless consideration of work method, assume output of a crew based on past performance, decide labour payment disregarding changing factors, consideration of finished in place quantity of material, estimators' experiences and education level, and not having clear policy as regard to tendering policy.

Similarly, Zhang, Wu, and Zhao (2016) exposed the errors in BOQ at three (3) stages thus; preparation stage, compilation stage, and review stage. According to them, the most frequent error

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in BOQ at preparation stage are: quality of design drawing, inadequate depth of design drawing, and inadequate design depth of the construction organization. At the compiling stage are: wrong and/or missing item in BOQ, inaccuracy of project quantity calculations, and inaccurate item characterization in description. While at the revising stage include: governing system absence of the compiling unit, implemented review system, and technical level and responsibility of BOQ compiling units. Despite the presence of errors in BOQs, according to the research however, BOQ still serves as an effective financial decision making document. Furthermore, Juszczyk, Kozik, Lešniak, Plebankiewicz, and Zima (2014) analysed the most frequent errors in design documentation, according to these researchers, bills of quantities formed part of the scope of design documentation in Poland. They classified the errors committed in BOQ as formal errors and calculation errors. They also testified that errors in BOQ are committed right from title page of BOQ, list of BOQ sections, and in table of BOQ.

In Nigeria, Dosumu, and Adenuga (2013) investigated causes of errors in construction document. They found out that in BOQ (which is one of the component of construction document), errors are mainly caused by lack of adequate documentation, poor communication between the professional and the client, and negligence of the professional. Moreover, Dosumu and Iyagba (2013) appraised the factors responsible for errors in Nigeria's construction document. They categorized the factors as: Consultant's factors, Management's factors and Client's factors. They concluded that consultant's factors were found to be more responsible in the generation of errors in construction document. Furthermore, Musa, Ibrahim, and Ibrahim (2011) employed document analysis to uncover errors in BOQ that results to inaccuracy of cost estimate in Nigeria's construction industry. In addition, Jalam et al. (2018) assessed the severity of errors in BOQ in Nigeria's construction industry, the researchers categorized errors in BOQ as preparation errors and pricing errors. The former, was found to be 0.777 (77.7%) on the severity index rank, while the later was 0.743 (74.3%) severe.

Despite attempt by many researcher to address the issue of errors in BOQ, yet there is scarcity of literature that investigated the effect of errors in BOQ on cost performance. Hence, it became necessary to determine the level of effects of errors in BOQ on cost performance of public building project in order to augment the effectiveness of cost performance in North Eastern Nigeria for national economic development.

Methodology

Positivist approach was used in this research; extensive literature review (exploratory) and describing some phenomena as a result of facts acquired by the use of questionnaire (descriptive) (McNabb, 2009). The data for this research were gathered through the use of questionnaire. One hundred and forty (140) questionnaires were administered to three (3) categories of quantity surveyors (QSs) i.e Contractor's QSs, Consultants' QSs, and Public servants' QSs in Bauchi and Gombe states of north eastern region of Nigeria and were selected using simple random sampling technique. QSs are the professionals in charge of the preparation and pricing of bills of quantities and payment of final account at different capacities (Davis et al., 2009). The two states contained the largest number of practicing QSs which is up to 74% of the entire QSs in the region (NIQS, 2017). The population of these two states was 9,794,276 represents up to 37% of entire population 26,263,866 of the region (NPC and NBS, 2016). Furthermore, they cover land area of 64,605

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square kilometre which represent 23% of 280,416 square kilometre of the region (Nyako, 2015). A total of one hundred and twelve (112) questionnaires were returned, where one hundred and five (105) were used for the analysis, this was as a result of invalidation found with seven (7) of the questionnaire.

Data collected from field through the structured questionnaire were analysed using both descriptive and inferential statistics. According to Kothari and Garg (2014) descriptive statistics concern with the development of certain indices from the raw data while inferential statistics concern with the process of generalization of results. Frequencies and percentages were used as descriptive statistics tool, while in inferential statistics; multiple regression was conducted. Statistical package for social science (SPSS) version 20 (IBM 20) was used in the analysis. SPSS for windows is quite easy to use and contained variety of statistical analysis methods (Morgan, Leech, Gloeckner, & Barrett, 2004, p.viii).

Data analysis and Result

Prior to analysis of data collected for this research, wrong posting and missing value check, questionnaire response rate analysis as well as reliability test was conducted. According to Pallant, (2011, p. 43), it is of great importance for a researcher to ensure that data collected are free from errors before subjecting to analysis. All values assigned for a scale were carefully checked and all wrongly posted values were corrected. However, after frequency analysis for the data, some missing values were identified in the demographic data of respondents. This was as a result of none provision of options that would have taken care of the possible answers for the questions. The table below shows the missing value items encountered.

Table 1: Missing Values in Demographic Data of Respondents
Missing Values in Demographic Data of Respondents *(N=105)*

Items	**Number of response**	
	Valid	**Missing**
Your membership of NIQS	103	2
When did you start using computer for preparation of bills of quantities?	92	13

Source: Author's field work (2018)

Option as "None" and "Never" were introduced appropriately for the respective questions. Hence, all the missing value identified were replaced and cleared.

As stated earlier, this research administered 140 questionnaires to respondent in the study area, 72 questionnaires were distributed to respondents in Bauchi while 68 were distributed in Gombe as shown in the table below.

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Table 2: Number of Questionnaire Administered

Study Area	Number of questionnaires distributed	Number of questionnaires returned	Number of questionnaires valid for analysis
Bauchi	72	62	58
Gombe	68	50	47
Total	**140**	**112**	**105**

Source: Author's field work (2018)

Questionnaire response rate is the number of respondents who completed a questionnaire i.e number of questionnaires returned divided by the total number of respondents who were asked to fill in the questionnaire i.e total number of questionnaire distributed (Centre for Disease Control and Prevention, CDC, 2010). Thus;

$$\text{Response rate} = \frac{\text{No. of questionnaires returned}}{\text{No. of questionnaires distributed}} \text{ x } 100$$

Using the above formula, the questionnaire return rate for this study was 80% while the response rate was 75%. This tremendous rate was achieved as a result of the face-to-face method of questionnaire administration used, simplicity of language and soliciting mode used in the questionnaire, patience and perseverance showed by the researcher. Comparing this response rate with response rate of other researches similar to this, this response rate was higher than that of Dosumu and Adenuga (2013) which recorded response rate of 49%, Dosumu and Iyagba (2013) with response rate of 33%, Akinsiku and Iyagba (2014) that has response rate of 70%, Abusafiya and Suliman (2017) with 72% response rate and Alumbugu et al. (2014) with response rate of 65%.

This research as well conducted internal consistency test on the questionnaire to test its reliability using Cronbach's coefficient alpha. Cronbach's alpha which is the most extensively used reliability measurement of questionnaire, provides an internal consistency of a scale or test which ranges from 0 for completely unreliable test to 1 for completely reliable test (Hinton, McMurray, & Brownlow, 2014; Tavakol & Dennick, 2011). According to Hinton et al. (2014) the alpha score above 0.75 is generally regarded as highly reliable, from 0.50 to 0.75 is generally accepted as moderately reliable, while score that is less than 0.50 is generally taken as a scale of low reliable. The table below presents the scores of Cronbach's alpha and their explanation.

Table 3: Cronbach's Alpha Score and Explanation

Cronbach's Alpha Score	Explanation
Less than 0.50	Low Reliability
From 0.50 to 0.75	Moderate Reliability
Above 0.75	High Reliability

Source: Hinton et al. (2014)

Internal consistency describes the extent to which all the items in a test measure the same concept or construct and hence it is connected to the inter-relatedness of the items within the test.

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It also shows the amount of measurement error in a test. In essence, squaring the correlation of a test with itself and subtracting from 1.00 produces the index of measurement error. Assuming a test has a reliability of 0.85, this means there is 0.28 error variance or random error in the scores;

- $0.85 \times 0.85 = 0.72$;
- $0.72 = 0.28$ (Kline, 1994; Tavakol & Dennick, 2011).

With reference to table 3 above, this research adopted a value of 0.70 Cronbach's alpha score as a yardstick for the measurement of reliability of the constructs. The table below shows the Cronbach's alpha scores and their corresponding grade of each construct.

Table 4: Reliability Test of Research Construct

Research Constructs	No. of Items	Cronbach's α Score	Error Variance	Reliability Grade
Preparation Errors	10	0.76	0.43	High
Pricing Errors	10	0.83	0.32	High
Cost Performance	20	0.79	0.38	High

Source: Author's field work (2018)

From table 4 above, all the measured research construct attained the level of high reliability with Cronbach's alpha score of more than 0.70 and error variance of less than 0.50 each.

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Table 5: Demographic Data of Respondents

	Frequency	Percentage
Classification of QSs		
Consultant QS	20	19.0
Contractor's QS	32	30.5
Public Servant QS	53	50.5
Total	**105**	**100**
Membership Grade of QSs		
Technician	3	2.9
Probationer	47	44.8
Corporate	55	51.4
Fellow	1	0.9
Total	**105**	**100**
Academic Qualifications		
HND	25	23.8
B. Tech/B. Sc	54	51.4
M. Tech/M. Sc	22	21.0
Ph. D	4	3.8
Total	**105**	**100**
Working Experience		
Less than 6 years	15	14.28
6 – 10 years	25	23.83
11 – 15 years	37	35.23
Over 15 years	28	26.66
Total	**105**	**100**

Source: Author's field work (2018)

Table 6: Summation of Years of Working Experience

Working Experience	MV (X)	Freq. (F)	%	FX
Less than 6 years	3	15	14.28	45
6 – 10 years	8	25	23.83	200
11 – 15 years	13	37	35.23	481
Over 15 years	15	28	26.66	420
Total		**105**	**100**	**1,146**

Source: Author's field work (2018)

$$\text{MWE (years)} = \frac{1146}{105} = 10.9 \cong 11\text{yrs}$$

The results from table 5 shows that more than 50% of the respondents were working in public sector, with 30.5% working under contractors while the remaining were working as consultants; this showed that the research trapped all the classification of QSs desired in public building construction projects with a balanced views. More than half of the QSs also were corporate members in the Nigerian Institute of Quantity Surveyors' (NIQS) membership upgrade,

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and slightly less than half were probationer; this as well indicated that the respondents have the recognition of NIQS as such, their judgement should be reliable. With regards to academic qualifications, more than 50% of the QSs have first degree, 23.8% have HND, and 21% obtained master degree while 3.8% were PhD holders; this together with their mean years of experience of 11yrs proves that the respondents were intelligently acceptable to respond to this research.

Multiple Regression Analysis

As earlier stated, multiple regression was conducted to determine the effect of errors in BOQ on cost performance of public building projects in North Eastern Nigeria. Before interpreting the model, it is also important to check for some assumptions for the output of multiple regression as recommended by Pallant (2011, p. 157). The first assumption was the multicollinearity of the variables involved in the analysis, this is to ensure at least reasonable correlation between independent variables and the dependent variable. As in table 7 below, the independent variables which comprised of *Preparation errors* and *Pricing errors* at least showed reasonable relationship with the dependent variable *Cost Performance,* and the values of 0.290 and 0.281 for correlation between **prep errors** and **cost perf** and between **pricing errors** and **cost perf** respectively did not exceed the preferable value of 0.3 (Pallant, 2011). Furthermore, the relationship between the independent variables themselves was not too high, the correlation was 0.532 which is lower than 0.7. To support this, the values displayed by Tolerance and VIF also were substantial as well, with all the independent variables having 0.464 and 2.153 respectively. The tolerance value of 0.464 is far above the cut-off value of 0.1 and 2.153 of VIF is below 10 as suggested by Pallant (2011). Hence, the recommended values were not exceeded which indicated normal relationship among the research constructs.

The normality and linearity of data used in the analysis showed reasonably normal as in figure. 1. This indicated that there was agreement between the opinions of the respondents which reduced the occurrence of outliers.

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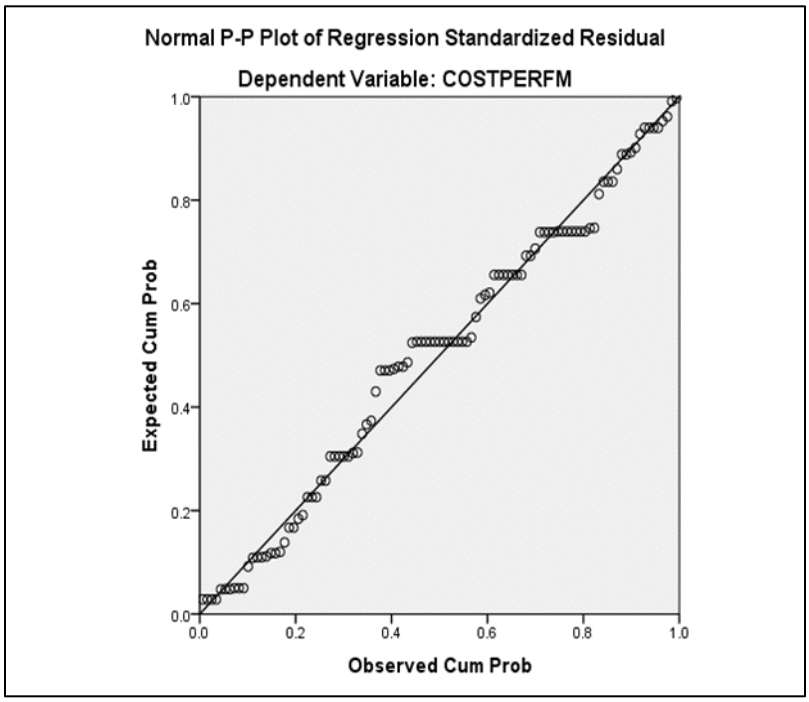

Figure 1. Normal P-P Plot

Source: Author's Field work (2018)

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Table 7: Multiple Regression Model Summary

Correlation					Model Summary			ANOVA		Coefficients					
		Cost Perf.	Prep. Errors	Pricing Errors	R	R^2	Adj. R^2	F	Sig.		Standardized Coefficient			Collinearity Statistics	
Pearson Correlation	Cost Perf.	1.000	0.290	0.281	0. 293	0.069	0.068	4.803	0.010		Beta	t	Sig.	Tolerance	VIF
	Prep. Errors	0.290	1.000	0.532											
	Pricing Errors	0.281	0.532	1.000											
Sig. (1- tailed)	Cost Perf.	-	0.001	0.032						Constants		9.551	0.000		
	Prep. Errors	0.001	-	0.000						Prep. Errors	-0.339	-2.437	0.017	0.464	2.153
	Pricing Errors	0.032	0.000	-						Pricing Errors	0.067	.479	0.633	0.464	2.153

Source: Author's Field Work (2018)

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From table 7, the value of R Square tells how much of the variance in the dependent variable ***Cost Perf*** is explained by the model of the independent variables ***Prep Errors*** and ***Pricing Errors***. The adjusted R square value was 0.068; this indicates that the effect of the two independent variables ***Prep Errors*** and ***Pricing Errors*** on the dependent variable ***Cost Perf*** was 6.8%. Note that this research used adjusted r square value instead of normal r square value, this is because the sample size was not large enough, precisely one hundred and five (105) (Pallant, 2011). Table 7 also shows the statistical significance level of the model, the significance value $P = 0.010$ ($P < 0.05$); this means that there is agreement among the respondents on the effect of errors in BOQ on cost performance. It explains that the effect is noteworthy and need to be address.

Furthermore, considering the same table 7, the beta value indicates the level of unique contribution of each independent variables in the prediction of the dependent variable. From the table, pricing errors has the largest beta value of 0.067 however, not significant ($P = 0.633$; $P > 0.05$) while preparation error has the beta value of -0.339 but is significant ($P = 0.017$; $P < 0.05$). This explains that the unique contribution of pricing errors on the level of cost performance is more than that of preparation errors, however, the significance of contribution of preparation error is far more than that of pricing error.

Discussion of Result

The objective of this research paper is to determine the effect level of errors in BOQs on cost performance of public building projects in North Eastern Nigeria. Multiple regression analysis revealed the adjusted R square value of 0.068; this indicates that the variance in cost performance was explained by 6.8% of preparation errors and pricing errors in BOQs. The effect size of 6.8% might seem to be not large, this ensures that there are numerous factors affecting cost performance other than errors in BOQ. The effect however reached substantial significance level. Significant value from the ANOVA was found to be $P = 0.01$ (which means $P < 0.05$); this explains that the model reaches statistical significance level that is noteworthy and need to be urgently addressed. These results indicates that there is agreement between the respondents that preparation errors and pricing errors have 6.8% effect size on the cost performance of public building projects. Furthermore, the beta value under standardized coefficient shows that preparation errors was -0.339 at significant level $P = 0.017$ ($P < 0.05$), while the pricing errors was 0.067 at significant level $P = 0.633$ ($P > 0.05$). This indicates that there is agreement between respondents that preparation errors contributes negatively to cost performance, however, there is no agreement between respondents that pricing errors contributes more to cost performance of public building projects.

Conclusion and Recommendation

This research was conducted to determine the effect of errors in BOQ on cost performance of public building project in the North Eastern Nigeria. The results of the analysis revealed that the effect of errors in BOQ on cost performance amount to significantly 6.8%. Hence, this research concluded that; errors in BOQs, as other factors do, also contribute significantly to the poor cost performance of public building projects in the North Eastern Nigeria. It is therefore recommended that: the Nigerian government in collaboration with NIQS should provide policy that will ensure only experienced QSs are engaged in any construction projects, proper budget planning and cost control should be necessary for any construction project prior to its commencement and as the project

progress, and project stakeholders should impose some moderating strategy that will reduced the effect of errors to its insignificant minimum level.

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