THE ACCURACY OF PRE-TENDER COST ESTIMATES OF CONSULTANT QUANTITY SURVEYORS IN NIGERIA

Michael G. Oladokun
Department of Building, University of Uyo, Uyo, Nigeria
michael.oladokun@gmail.com

Adeyinka A. Oladokun
Department of Building, University of Lagos, Akoka, Yaba, Lagos, Nigeria
sopade_adeyinka@yahoo.com

Isaac A. Odesola
Department of Building, University of Uyo, Uyo, Nigeria
isaacodesola@yahoo.co.uk

The construction procurement process relies heavily on an adequate level of financial management to maintain commercial feasibility and smooth operations. This paper examined the accuracy level of pre-tender cost estimates of consultant quantity surveyors on building projects in Nigeria. A quantitative approach was used for the research. The data for the research were obtained from a consulting quantity surveying firm practising in Nigeria for eighty two (82) building projects carried out between 2005 and 2008. The results of the study showed that the accuracy of pre-tender cost estimates of the consultant quantity surveyors varies according to the project size and the sector when the pre-tender cost estimates were compared with the contract sums. It was revealed that smaller projects are more biased than the larger ones and at the same time projects that belong to the public sector are more biased than those that belong to the private sector. Overall, the average deviation (error in %) is 2.11% with a standard deviation of 10.15. A model was then formulated to predict the contract sums from the known values of the quantity surveyor's pre-tender cost estimates by the use of linear regression analysis. This was then verified and validated by collecting data of ten (10) building projects that have been awarded from an independent consulting quantity surveying firm practising in Nigeria. It was found out that the accuracy level of the model is between 1.72% and -5.83%.

KEYWORDS: accuracy, Nigeria, pre-tender cost estimate, regression analysis, quantity surveyors.

INTRODUCTION

One of the most important aspects of construction procurement process is the management of client expenditure in the form of budgetary control. This is done throughout the procurement period. One aspect of client expenditure management that has received some attention by researchers is the accuracy of pre-tender cost estimate. A

pre-tender cost estimate is an important piece of information required when feasibility of building projects are being evaluated and decisions on design and construction issues are to be made (Aibinu & Pasco, 2008). Ideally (i.e. in purely deterministic world) costing of the construction implications of design decisions; taking into consideration the effects of trade-offs against any indirect value effects such as time for completion, construction quality, resale or letting values; suppose to be accurate (Skitmore & Picken, 2000). In the practical situation, however, this is almost completely not so. Estimates have to be as accurate as possible because these form the basis for tender comparison or negotiation and if these are grossly inadequate, award decisions may be extremely difficult. To this end, it is required of quantity surveyors to improve on the accuracy of their pre-tender estimates in order to ensure clients satisfaction (Odusami & Onukwube, 2008). In Nigeria, however, much attention has not been given to the accuracy of pre-tender estimates and it is against this background that this study intends to carry out an evaluation of the accuracy level of pre-tender cost estimates of consultant quantity surveyors in Nigeria and develop a model to predict the contract sum from the estimates of the consultant quantity surveyors. The study has the capability of contributing to the body of knowledge in the area of pre-tender cost estimates forecasting. The study can as well form a baseline for further studies.

Previous Studies on the Accuracy of Pre-tender Cost Estimates

Issues relating to the accuracy of pre-tender cost estimates have blessed construction management literature over the decades. Odusami and Onukwube (2008) while referring to Morrison (1984) defined the accuracy of the quantity surveyors' estimates as the deviation from the lowest acceptable tender received in competition for a project. Skitmore (1986) analysed 36 medium-large projects in the UK and found an average error of 1.29% with a coefficient of variation of 5.88. In a similar research carried out by Tan (1988) for 103 building projects in the UK, it was reported that the average error is 11.50% while coefficient of variation is 15.00%. Cheong (1991) sought the opinions of quantity surveyors regarding the level of accuracy of pre-tender cost estimates prepared by the consultant quantity surveyors in Singapore and reported that the level of accuracy is between 5% and 10% deviation from the contract sum. He further analysed 88 projects from one quantity surveying firm in Singapore and found out that the difference between estimates and contract sum ranges from over-estimates of 33.79% to underestimates of 31.30%. Gunner (1997) carried out an analysis of pre-tender estimate of 86 projects in Singapore and an average error of 3.47% was found with a coefficient of variation of 8.46. 181 projects estimated by one quantity surveying firm in Singapore were analysed by Gunner and Skitmore (1999) and an estimating accuracy of 10% was found. Skitmore and Picken (2000) got a coefficient of variation of 7.82% when they carried out the analysis of the pre-tender estimating performance of a USA consulting organisation where 217 projects were analysed. They further ascertained that there is a positive correlation between year by year changes of pre-tender cost estimates and the USA annual inflation rate. Skitmore and Drew (2003) carried out an analysis of pre-tender building price forecast (estimates) made by a Hong Kong consulting organisation for building projects from 1995 to 1997 and used Analysis of Variance (ANOVA) to detect significant difference in the errors grouped according to building size (value), building size (area), forecasting (estimating), method (approximate quantities and superficial),

nature of the work (new build and alteration work), and type of project. Aibinu and Pasco (2008) examined the important project characteristics influencing the accuracy of pre-tender building cost estimates in Australia. Their research, based on the data from 56 building projects and a questionnaire survey of 102 quantity surveying firms, revealed that the accuracy of estimates is influenced by project size. In a similar research carried out by Gunner (1997), Gunner and Skitmore (1999), Skitmore and Picken (2000), a dramatic change was noted when the effects of Type, Size and Year were partialled out. They all identified the Year as being the underlying variable responsible for systematic bias and inconsistency in forecasting by cost consultants. A number of researchers have worked on the factors affecting the accuracy of pre-tender cost estimates (Sey & Dikbas, 1990; Shash, 1993; Akintoye, 2000; Enshassi, Mohammed & Madi, 2007; Odusami & Onukwube, 2008). From the reviews carried out, research on the accuracy of pre-tender cost estimates in Nigeria has not received much attention. The work of Odusami and Onukwube (2008) only focussed on the factors affecting the accuracy of pre-tender cost estimate in Nigeria. But the accuracy level of pre-tender cost estimate in Nigeria is yet to be studied. This paper intends to close this gap and contribute to the body of knowledge in the area of the accuracy of pre-tender cost estimates in Nigeria.

Research Methods

The data for the research were obtained from a consulting quantity surveying firm practising in Nigeria for eighty two (82) projects carried out between 2005 and 2008. The approach used for the research is a quantitative one. The author went into the database of the firm to retrieve the consultant quantity surveyor pre-tender cost estimates (QSE) prepared and the contract sum (CS) of those projects. Information gathered include project type, sector to which the projects belong and year of estimates/awards. From the data retrieved, the deviation of QSE from CS (called 'Error' here) was calculated in percentage form with the use of Microsoft Excel 2007 (MS Excel) software as follows:

$$Error\ (\%) = \frac{(QSE - CS)}{CS} * 100\% \quad \ldots\ldots\ldots\ldots\ldots (1)$$

The positive value of Error (%) indicates that QSE are being overestimated while negative value means QSE are being underestimated. The authors made use of the CS instead of the lowest acceptable tender sum in order to establish the relationship between QSE and CS. It should be noted, however, that the contractors' bids are supposed to be the same thing as the QSE, as both are estimates of the same market price which will then lead to CS once accepted.

Data Analysis and Results

The obtained data were analysed with the use of Statistical Package for Social Sciences (SPSS) and MS Excel. Deviation of the QSEs from CSs was obtained from MS Excel by inputting the equation 1 above. For the entire 82 projects analysed, Figure 1 and Table 1 gave the summary of distribution of Error (%). It can be observed from the Figure that the distribution is normally distributed with a mean of 2.11 and standard deviation of

10.15. Also, Table 1 showed the descriptive statistic analysis carried out. The skewness and kurtosis of the variable, error (%) are 0.604 and 4.748 respectively.

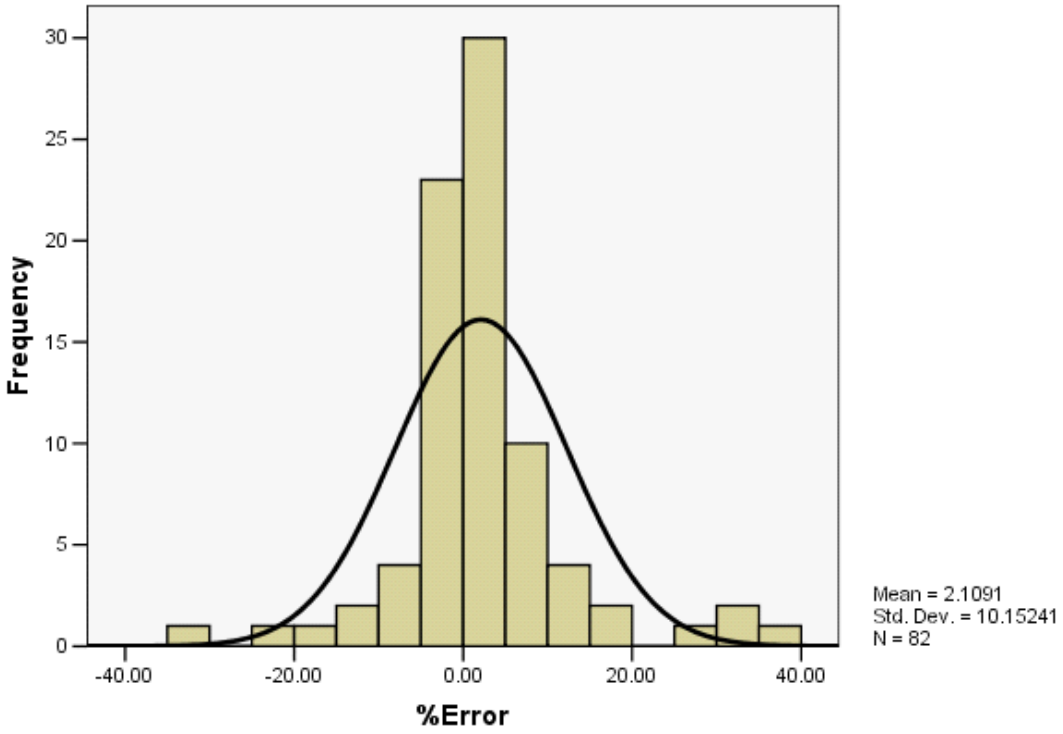

Figure 1. Histogram showing the distribution of Error (%)

Table 1. Statistic showing the distribution of Error (%)

Statistic	Value
Standard Deviation	10.152
Skewness	0.604
Kurtosis	4.748
Minimum	-34.010
Maximum	36.73

Of interest is the minimum and maximum percentage deviation (Error in %) shown in the Table 1 to this study. It showed that the difference between QSEs and CSs ranges from underestimates of 34.01% and overestimates of 36.73%. Overall, the projects were overestimated on the average by 2.11% (Mean error = 2.11%).

Table 2. Project Size Results

Project Value Range (Naira)	No of Projects	Maximum Error (%)	Minimum Error (%)	Mean Error (%)	Standard Deviation
<50m	20	36.73	-34.01	6.29	18.02
50m - 100m	7	10.50	-24.11	-0.86	11.76
100m - 200m	12	9.43	-3.73	0.91	5.97
200m - 500m	17	7.47	-6.59	0.89	4.11
500m - 1b	17	5.79	-3.71	1.5	2.81
>1b	9	1.55	-0.42	0.18	0.58
Overall	***82***	***36.73***	***-34.01***	***2.11***	***10.15***

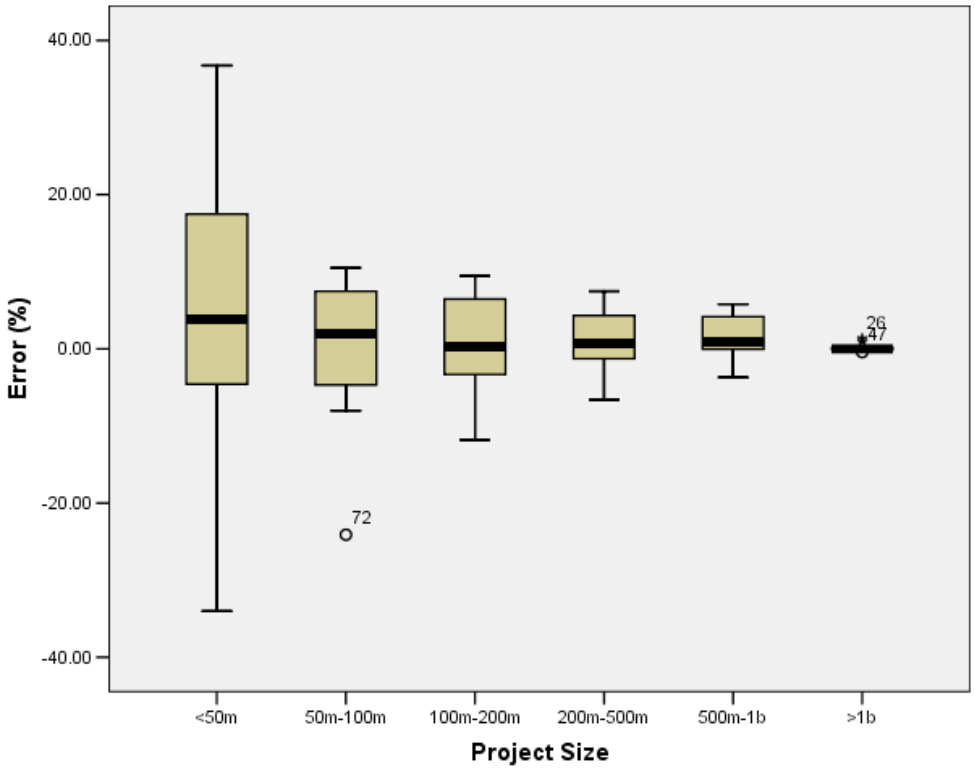

Figure 2. Boxplot Chart for Error (%)

It is necessary to study, in a greater detail, the pattern exhibited by the results generated. Tables 2, 3, and 4 gave the results based on Project Size, Project Type and Sector respectively. Table 2 reported errors (%) for the project size. Twenty (20) out of 82 projects are less than ₦50 million (m), seven are between ₦50m and ₦100m, eleven are between ₦100m and ₦200m, seventeen are between ₦200m and ₦500m, seventeen are between ₦500m and ₦1billion (b), and the remaining nine projects are of the value greater than ₦1b. Maximum and minimum error (%) values including the mean error (%) and standard deviation for each project value range are also given in the table. The results

have it that for projects that are less than ₦50m, consultant quantity surveyor (CQS) overestimated by 36.73% and underestimated by 34.01%. Also, for projects between ₦50m and ₦100m, CQS overestimated by 10.50% and underestimated by 24.11%. Not only that, for projects between ₦100m and ₦200m, an overestimated and underestimated of 9.43% and 3.73% are witnessed by the CQS. Others are as shown in Table 2 and Figure 2. In order to have a better insight into the pattern exhibited, a boxplot chart (Figure 2) was used to depict the spread of the values gotten. A boxplot chart provides the medians, quartiles, and ranges in a single chart. It also provides information on outliers. As depicted by Figure 2, the estimates of smaller projects are more biased than the estimates of larger projects by looking at the ranges. It will be seen that project 72 for project value between ₦50m and ₦100m is an outlier. In all, it can be said that the accuracy of estimates is influenced by the project size.

Table 3. Project Type Results

Project Type	No of Projects	Maximum Error (%)	Minimum Error (%)	Mean Error (%)	Standard Deviation
Educational	13	33.60	-8.00	6.69	13.32
Residential	29	6.04	-10.15	0.48	3.64
Offices	11	13.04	-2.90	1.62	4.49
Health	11	36.73	-11.78	6.14	14.69
Commercial	5	7.47	-0.27	2.60	3.37
Other	13	15.15	-24.11	-2.01	14.92
Overall	***82***	***36.73***	***-24.11***	***2.11***	***10.15***

The results based on Project Type are shown in Table 3. It can be seen from the table that 'health' projects is overestimated by 36.73% and underestimated by 2.90%. 'Educational' projects are being overestimated by 33.60% and underestimated by 8.00%. Also, 'offices' projects are overestimated by 13.04% and underestimated by 2.90%. 'Residential' projects overestimated by 6.04% and underestimated by 10.15% while 'other' projects are overestimated by 15.15% and underestimated by 24.11%.

Table 4. Sector Results

Sector	No of Projects	Maximum Error (%)	Minimum Error (%)	Mean Error (%)	Standard Deviation
Public	34	36.73	-34.01	3.71	15.12
Private	48	9.13	-10.15	0.98	3.67
Overall	***82***	***36.73***	***-10.15***	***2.11***	***10.15***

From the results gotten, projects belonging to the public sector are overestimated by 36.73% and underestimated by 34.01% (Table 4). Private sector projects are overestimated by 9.13% and underestimated by 10.15%.

Model to Predict Contract Sum from Consultants Quantity Surveyors' Pre-tender Estimates

In order to generate a model to predict CSs from the CQSs estimates, a linear regression analysis was used. The model to be generated will be in the form of equation 2.

$$CS_i = \beta_0 + \beta_1 * QSE_i + \varepsilon_i \ldots\ldots\ldots\ldots\ldots\ldots (2)$$

The results from linear regression analysis showed a *F* value of 271239.51 and $p<0.01$(as revealed by the ANOVA table) which means that the model is significant at 99% confidence level. R Square for the model was checked. R Square for CS_i is 1.000 meaning that 100% of variation in the dependent variable, CS_i can be explained by the independent variable, QSE_i. Adjusted R Square (in the model summary table) was checked to give a superior explanation of the proportion of variance in the dependent variable that can be explained by the independent variables. This is still 1.000 which means that 100% of variance in the CS_i can be explained by the independent variable, QSE_i. The normal P – P plot of the regression-standardized residual (Figure 3) for the model showed that the normality assumption of the linear regression is reasonably satisfied. So, the model generated is shown in equation 3.

$$\boldsymbol{CS_i = -3574398 + 1.002QSE_i \ldots\ldots\ldots\ldots\ldots\ldots (3)}$$

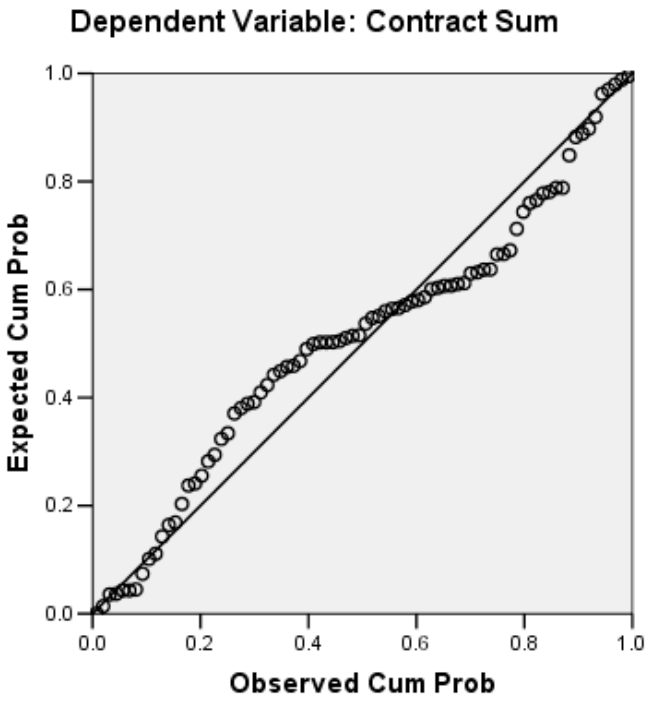

Figure 3. Normal P-P Plot of Regression Standardized Residual

Model Verification and Validation

It is important to carry out the verification and validation of the model generated. In order to verify and validate the model, data for ten (10) building projects that have been awarded were retrieved from a separate consulting quantity surveying firm practising in Nigeria. The data captured are the consultant quantity surveyor's pre-tender estimates and the corresponding contract sums. An MS Excel template was then designed based on the model generated. For each value of the consultant quantity surveyor's pre-tender cost estimate, a predicted contract sum was generated and this is compared with the actual contract sum awarded the project in order to generate the percentage deviation from the actual contract sum. It was found out that the accuracy level is between 1.72% and -5.83% (Table 5).

Table 5. Model Verification

Consultant Quantity Surveyor Pre-Tender Sum (₦)	Actual Contract Sum (₦)	Predicted Contract Sum (₦)	Deviation (%)
359,218,461.74	363,602,548.01	356,362,500.66	-1.99
434,396,060.63	436,685,012.74	431,690,454.75	-1.14
699,065,326.85	691,376,504.26	696,889,059.50	0.80
209,719,598.05	211,864,204.86	206,564,639.25	-2.50
253,609,925.26	251,739,032.18	250,542,747.11	-0.48
154,519,708.87	148,697,023.53	151,254,350.29	1.72
495,897,165.80	491,067,984.08	493,314,562.13	0.46
599,679,020.56	596,638,259.46	597,303,980.60	0.11
1,072,825,767.77	1,071,857,401.94	1,071,397,021.31	-0.04
132,441,413.86	137,119,746.02	129,131,898.69	-5.83

Limitation of the Model

The model is limited in the sense that the data captured are from only a consulting quantity surveying firm practising in Nigeria. These were the ones used in the development of the model, which are considered a bit small to a very accurate predictive model. Nonetheless, the model is capable of forming a baseline for further studies and guide in predicting the accuracy of pre-tender cost estimates in Nigeria.

DISCUSSION

In the analysis carried out, it was discovered that the estimates of smaller projects are more biased than that of larger ones. This is in consonance with the work of Aibinu and Pasco (2008) in Australia. This can be attributed to the fact that the consultant quantity surveyors are not thorough in the preparation of pre-tender cost estimates of smaller projects compared to that of larger ones. The lack of adequate information on the project could be responsible for this result. It was also found out that public projects are more biased than the ones owned by the private entities. This reflects in the fact that private

sector are more manager of funds that the public. The corruption level in public projects is more intense in the country, even with the era of 'due process' method of procuring public projects. Private sector is more informed than the public entity. This reflects in the treatment given to the projects belonging to the two entities. Consultant quantity surveyor could be rest assured that if they do not perform as expected on private projects, it is possible for them to have the consultancy job revoked. But for public projects, it is not impossible to say that the officials in charge of the project will even mandate the quantity surveyor to tamper with the estimates in order to make provision for their 'kickbacks'. Odusami and Onukwube (2008) identified some factors affecting the accuracy of pre-tender cost estimates in Nigeria. Those factors could also be attributed to the results of this study. The seven most ranked factors in descending order according to Odusami and Onukwube (2008) are: expertise of consultants; quality of information and flow requirements; project team's experience of the construction type; tender period and market condition; extent of completion of pre-contract design; complexity of design and construction; and availability and supplies of labour and materials. Expertise of consultants here means special skills or knowledge in estimating. This factor is very important in obtaining a very accurate pre-tender estimate. Also, the amount of details available on the project as well as the cost data used by the quantity surveyor goes a long way in affecting the accuracy of the pre-tender estimate. Project team's experience of the construction type as well as the tender period and market condition are other factors that are very crucial to quantity surveyors while preparing their pre-tender cost estimates. The authors believe that all these factors are among the factors responsible for the results of this study.

CONCLUSION

The construction procurement process relies heavily on an adequate level of financial management to maintain commercial feasibility and smooth operations. This paper has described the analysis of pre-tender estimating performance of a Nigerian consulting firm. It is shown that the accuracy level achieved by the firm is between 36.73% and -34.01%. But overall on the average an accuracy level of 2.11% with a standard deviation of 10.15 was achieved. One cannot say that this accuracy level is the best because so much work still needed to be done.

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