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An assessment of current preliminary cost estimating practice in Nigeria

Dele Samuel KADIRI

Department of Quantity Surveying, Obafemi Awolowo University, Ile-Ife
deleskadiri@yahoo.com

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Abstract
The study assessed the preliminary cost estimating practice in Nigeria with a view to determining the methods in use, the level of accuracy of preliminary cost estimates and the factors influencing their accuracy. A structured questionnaire was used to elicit data from 60 randomly selected qualified Quantity Surveyors in the 156 consulting firms in Lagos State. The data collected were analysed using mean scores, percentages and Factor Analysis. The results indicated that the predominant methods of preparing preliminary cost estimates by consulting Quantity Surveyors were approximate quantities and superficial (floor area) methods. The study also showed that while low rise buildings were under estimated by 8.87%, high rise buildings were over estimated by 23.43%. On overall, building projects were overestimated by 14.36% of their actual costs with project team factors, tendering-related factors, contractor organizational factors, competence-related factors, and project information factors mostly responsible for inaccuracy of preliminary cost estimates.

***Keywords*:** Estimating accuracy, Factor Analysis, Preliminary cost estimates, Preliminary cost estimating methods

Introduction

For all major works, it is wise to know before hand the probable cost of construction (Dutta, 1989 and Lock, 2003). The estimated cost of construction works may be required to ascertain the level of funding and to determine project viability (in the case of commercial properties). It is also useful for managing cash flow and to prepare tender prices (Kelly *et al*; 2002). Preliminary cost estimating is therefore an attempt to give an approximate estimate of the cost of construction at a very early stage so that a client is aware of his financial commitments before embarking on detail design (Jagboro, 1995; Ferry *et al*,1999). It is a technique employed during the formative stages of a capital expenditure programme when there is lack of verifiable information for the initial evaluation of a project.

Ashworth and Hogg (2007) affirmed that because estimates will always be subject to some degree of error, the typical degree of accuracy expected in the construction industry is $\pm$10%. According to Ashworth (1996), the difference between an early price estimate of a consultant and the accepted tender from a contractor represents an inaccuracy. The purpose of a preliminary cost estimate is therefore to anticipate the amount of the contractor's tender. The disparity between a preliminary estimate and a tender sum therefore remains the major index for measuring the accuracy of the Quantity Surveyor's estimate. Therefore, preliminary cost estimates must be as much as possible close to tender sums for accuracy to be achieved.

The importance of accurate preliminary cost estimates to construction projects cannot be over emphasized. According to Odeyinka and Lowe (2002), in spite of the quantity of research efforts, accuracy of pre-tender forecasts is still a major problem largely due to risks and uncertainties inherent in construction. However, Dysert (2006) argued that by nature, an estimate involves assumptions and uncertainties and is therefore associated with some level of error. According to the study, this level of error and uncertainty can correlate to probabilities of overrunning or under-running the predicted cost. Given this probabilistic nature of an estimate, it should really not be regarded as a single point number of cost. Instead, an estimate actually reflects a range of potential cost outcomes, with each value within this range associated with a probability of occurrence.

Aibinu *et al*., (2011) affirmed that pre-tender estimates are susceptible to inaccuracies (biases) because they are often prepared within a limited time frame and with limited information about project information. Skitmore (1991) cited in Aibinu *et al*. (2011) described the *accuracy of early stage estimates as comprising* of two aspects, namely, bias and consistency of the estimate when compared with the contract sum or accepted tender price. Bias is concerned with the average difference between actual tender price and forecast while consistency of estimates is concerned with the degree of variation around the average. Kim *et al.,* (2004) argued that accurate estimation of construction cost is a critical factor in the success of any project. This opinion agreed with that of Babalola and Adesanya (2009) who claimed that accurate cost estimates were of great importance to both the client and the contractor.

Ling and Boo (2001) observed that over-estimation of funds for a project means lesser funds are available for other business opportunities. Under estimation, on the other hand, may lead to difficulty in award decisions or in some cases unrealistic negotiation targets. In agreement with the above, Leung *et al.* (2008) affirmed that under estimation of projects cost will cause financial difficulties for clients and contractors with limited budgets and may also cause projects to become unviable. Similarly, Aibinu *et al*. (2011) opined that underestimation could lead to a non viable project being pursued by the project owner which may lead to project failure while over estimation could lead to a viable project being dropped or re-tendered when there is no bid close enough to permit project award.

It has become increasingly necessary to execute construction projects at optimum cost, time and quality. This is not only because these have been identified as project success indicators (Idoro, 2009) but also because of the progressive threat to the value of money, increasing complexities of construction projects and the effects of time on cost and on profitability. Longitudinally, there has been no remarkable improvement on the accuracy of early stage estimates in the construction industry, generally. For example, Bowen (1982) reported an inaccuracy level of $\pm$13% while Babalola and Adesanya (2009) reported an inaccuracy level of $\pm$13.6%. Similarly, Ashworth (1996) reported that preliminary cost estimates' inaccuracy level was +34.3%, on the aggregate, in the United Kingdom (UK). Gould and Joyce (2013) and Lock (2003) claimed levels of inaccuracy of between $\pm$15% and $\pm$25%. Brook (2001) and Al-Hamidi and Mohammed (2008) reported levels of inaccuracy of between $\pm$10% and $\pm$15%.

It was therefore from the fore going that this study investigated the preliminary cost estimating practice in Nigeria with a view to determining the dominant methods in use, the levels of accuracy of preliminary cost estimates and the factors influencing their accuracy. The achievement of the above aim and objectives will enhance the accuracy of future estimates prepared by Quantity Surveyors in Nigeria.

Overview of pre-tender cost estimating practice

A number of researches exist in the area of pre-tender cost estimating. Enhassi *et al., (*2013) studied the factors affecting the accuracy of pre-tender cost estimates in the Gaza Strip, Palestine from the perspectives of clients and consultants. The study involved 46 client organizations and 24 consultants made up of construction Engineers and Managers with not less than 20 years experience in tendering and estimating. Using severity index and Kendall's coefficient of concordance, the study reported that clients and consultants were in agreement that materials prices, closure and blockade of borders, project team experience, project scope definition and fluctuation in exchange rates of currency were the major variables which influenced the accuracy of pre-tender estimates. The study recommended that attention be focused on these top variables to develop effective strategies for ensuring accurate cost estimates.

Reporting on the accuracy of preliminary cost estimates of Public Works Departments (PWD) projects in Peninsular Malaysia, Azman *et al.*(2012) observed the findings of earlier works as follows: "Bias and consistency improves with size (Morrison and Stevens, 1993; Skitmore and Tan, 1998; Gunner and Skitmore, 1999); Consistency reduces with size (0gunlana and Thorpe, 1991); Bias increases with size (Skitmore and Drew, 2003; Kiew, 2009); and Bias reduces with size (Aibinu and Pasco, 2008)". Similarly, "Estimates lower with more bidders (Harvey, 1979; Flanagan and Norman, 1983); Consistency decreases with additional number of bidders (Skitmore, 2002); and High value contracts were underestimated and low value contracts overestimated (Gunner and Skitmore, 1999; Skitmore and Drew, 2003)"

Similarly, Odusami and Onukwube (2008) using 50 randomly selected consulting firms of Quantity Surveyors investigated the factors affecting the accuracy of pre-tender cost estimates in Nigeria.

The study used descriptive statistics and Analysis of Variance to analyse the acquired data and concluded that consultants' expertise, quality of information and information flow requirements, and project teams' experience of the construction type were the top factors affecting accuracy of pretender estimates. Aibinu and Pasco (2008) examined the accuracy of pre-tender building cost estimates in Australia using 56 projects and questionnaire survey of 102 Quantity Surveying firms. The study documented that accuracy was mainly influenced by project size as small building projects were more biased than large projects. On overall, the study concluded that pre-tender costs of building projects were more overestimated than underestimated in Australia.

Shash and Ibrahim (2008) surveyed design variables in early cost estimates in Saudi Arabia. The objectives of the study were to investigate the early cost estimating techniques in use for residential buildings and the procedures adopted by Architectural and Engineering firms in accounting for design variables in early cost estimates. Severity index was used to analyse the data received from 19 firms out of 30 firms administered with the survey instrument. The study reported that superficial (floor area), data base of similar projects, approximate quantities and unit rates, in that descending order, were the methods in use for the preparation of early cost estimates. It also concluded that the top six determining factors in the choice of the method used were size of project, information available, client, and project type. Others were, time available and experience of estimator.

Using a sample size of 41 Quantity Surveyors, Ling and Boo (2001) compared the accuracy of actual approximate estimates of building projects with practitioners' expectations in Singapore. The study which used projects executed between 1992 and 1998 reported an accuracy of 1.09% with quality and sufficient design information to prepare estimates being mostly responsible for that level of accuracy. Skitmore and Picken (2000) analysed the accuracy of pretender building price forecast using different project types executed in the United States of America (USA). The study reported coefficient of variations for commercial projects (2.98), civil projects (4.78), offices (5.92), car parks (6.16) and others (6.22).

Research methodology

The study surveyed the opinions of registered Quantity Surveyors in Lagos State using structured questionnaire. Lagos State was selected due to its economic status in Nigeria. Ameh and Odusami (2009) claimed that Lagos State is one of the cities in Nigeria with the highest number of registered construction organizations and professional institutions in Nigeria. Besides, a large proportion of Quantity Surveying consulting firms in Nigeria operate from the State. From the sample frame of 156 consulting firms of Quantity Surveyors in Lagos State, 60 consulting firms representing about 38.5% were sampled randomly and the survey instrument was administered on one registered Quantity Surveyor each in the sampled firms. This sample size was considered adequate going by the recommendation of Trochim (2007) that 10-30% sample size was sufficient for a population of less than 150,000. The background information of respondent Quantity Surveyors is summarized in Table 1.

The Questionnaire elicited information on the existing preliminary cost estimating method(s) being used by the firms, the levels of accuracy of the preliminary estimates prepared by them as well as the factors which influenced the accuracy of preliminary cost estimates, generally. The data collected were analysed using mean scores, percentages and Factor Analysis. Preliminary cost estimating practice variables (such as the methods of preliminary cost estimating and the causes of inaccurate preliminary cost estimates) were presented to respondents who were asked to score them on a scale of zero (0) to 10 in terms of their degree of importance, with 'zero' indicating 'not important' and '10' indicating 'most important'. Data analyses were done using the Statistical Package for the Social Sciences (SPSS). The analysis for preliminary cost estimating methods in use dealt mainly with the ranking of the methods based on their mean scores. Although the list of possible methods reported by literature for the preparation of preliminary cost estimates are several, only four (unit, superficial, elemental and approximate quantities) methods were used for the study.

Other methods like the cube and storey enclosure were discarded having become obsolete and unpopular in Nigeria. This was established from a pilot study of principal partners of frontline Quantity Surveying firms in Lagos State. On the levels of accuracy, archival data on preliminary cost estimates and contract sums of 176 executed projects were used to establish the bias. For the factors influencing accuracy, the variables which were identified in literature to influence accuracy were first ranked based on their mean scores. They were also subjected to Factor Analysis to determine the

few significant factors which influenced the accuracy of preliminary cost estimates in Nigeria. To test the appropriateness of the data received for Factor Analysis, Kaiser-Meyer-Olkin (KMO) measure of sampling adequacy and the Bartlett's test of sphericity were carried out.

Field (2005) recommended that the KMO of a set of data should be close to one (1) for Factor Analysis to yield distinct and reliable factors. From Table 2 it is shown that the least KMO value of the preliminary estimating methods was 0.660. It was therefore concluded that Factor Analysis was appropriate for the data obtained for the study. The results of Bartlett's test of sphericity were also highly significant. The least was (x_2=1.050; p<0.05) which also confirmed that Factor Analysis was suitable for the data analysis.

Table 1 : Summary of Background Information of Respondents

Category	Classification	No.	%
Academic Qualification	HND	22	36.7
	B.Sc./B.Tech	19	31
	M.Sc./M.Tech	18	30
	Ph.D	1.0	1.6
	Total	**60**	**100**
Professional Qualification	MNIQS	29	48.3
	FNIQS	4	6.7
	RQS	22	36.7
	MRICS	5	8.3
	Total	**60**	**100**
Years of Experience	0-5	7	11.7
	15-20	15	25
	>20	9	15
	5-10	7	11.7
	Total	22	36.7
	Mean=13.9 years	**60**	**100**

Methods of preliminary cost estimating

Table 3 shows the methods of preliminary cost estimating in use in the study area. On aggregate, the methods predominantly used by consulting firms of Quantity Surveyors in Nigeria for preparing preliminary cost estimates were approximate quantities, superficial (floor area), elemental (cost analysis) and unit methods in that descending order. The Table 3 suggests that as project design information available increases in scope the methods used tend to move from single-rate to multiple-rate. It could be explained that the reason behind this is the need to get more accurate estimates of proposed projects. This is expected as the estimate can now be based on firmer design decisions than would be the case at the very earlier stages of design development where the interpretation of the client's requirement will still be very fluid. However, it would have been expected that the use of elemental (cost analysis) method scored higher than the superficial method. This is because cost analysis data from executed projects will be more accurate in forecasting the cost of proposed projects than the superficial (floor area) method will provide. By implication, this means that about 43% of practicing firms of Quantity Surveyors in Nigeria use the single rate methods as against 57% who use the multiple rates methods to prepare preliminary cost estimates.

Table 2 : Results of KMO and Bartletts Tests for Estimating Methods

Estimating methods	KMO Test	Bartletts Test
UM	0.752	1.050
SM	0.676	1.096
EM	0.760	940.413
AQM	0.672	1.210

Table 3 : Quantitative Usage of Preliminary Cost Estimating methods for the stages of RIBA Plan of Work

Estimating methods	Inception	Feasibility	Outline proposal	Scheme design	Aggregate	Rank
UM	1.83	1.75	1.43	1.35	1.59	4
SM	3.20	3.17	2.92	2.73	3.01	2
EM	2.77	2.62	3.02	3.10	2.88	3
AQM	3.17	2.98	3.22	3.50	3.22	1

Key: UM = Unit Method; SM = Superficial Method; EM = Elemental Method; AQM = Approximate Quantities Method.

Levels of accuracy of preliminary cost estimates

In Table 4, it is shown that the mean percentage deviation of accepted tenders from preliminary cost estimates of high rise buildings was -8.87. This means that high rise buildings were underestimated by 8.87 %, on the aggregate. Similarly, the Table 4 shows that low-rise buildings were over estimated by 23.43 %. Overall, the percentage mean deviation of preliminary estimates from contract sums was +14.56. This means that building projects executed between 2002 and 2011 in Nigeria were overestimated by 14.56 %. This level of inaccuracy is not acceptable going by the recommended tolerable level of accuracy of between $\pm$5 and $\pm$10 % recommended for the construction industry. However, this result compares well with +13.6 % found by Babalola and Adesanya (2009) for services installations executed in Nigeria.

Tab le 4: Levels of Accuracy of Preliminary Cost Estimates

Type of building Project	No	Aggregate (%) Deviation	Mean	Aggr.
High-rise Buildings	9	-21.25	-2.36	
Commercial				
Industrial	4	+24.95	+6.24	
Office	15	-26.93	-1.79	
Religious	3	+6.00	+2.00	
Residential	20	-89.24	-4.46	
School	2	-17.00	-8.50	**-8.87**
Low-rise Buildings				
Commercial	24	+74.00	+3.08	
Industrial	17	-4.64	-0.27	
Office	18	+116.68	+16.48	
Religious	18	+56.00	+3.11	
Residential	26	+98.30	+3.78	
School	20	+145.11	+7.25	**+23.43**

Aggr = + 14.56

Variables influencing accuracy

Table 5 shows the mean scores of the variables influencing the accuracy of preliminary cost estimates based on their quantitative contributions. The Table shows that all the variables were significant with the lowest scoring 5.32 on overall. However, the respondents were in agreement that the top nine variables which influenced the accuracy of preliminary cost estimates in Nigeria were time elapsed between initial estimate and tender date (6.33), inadequate project scope definition (6.33), lack of review of cost estimates by management (6.33), level of diligence of estimator (6.25) and difference in estimate padding (6.19). The others were poor communication between project team (6.13), number of bidders on competitive tenders (6.12), lack of understanding of project requirements (6.11) and lack of adequate guidelines for estimating (6.02).

Analysis of factors influencing the accuracy of preliminary cost estimates in Nigeria were presented first on method by method basis and then on overall. For the unit method of preliminary cost estimating, Table 6 showed that Factor Analysis identified four variables to be mostly responsible for inaccuracy of preliminary cost estimates with the first dominant variable accounting for 46.67 % of the observed variance and with all the four variables together accounting for 79.27 % of the observed variance. This means that the four variables identified by Factor Analysis can be said to significantly affect the accuracy of the unit method of preliminary cost estimating in Nigeria.

Table 5 : Summary of Quantitative Contribution of Factors Affecting the Accuracy of Existing Methods of Preliminary Estimating in Lagos State

Factors	Estimating Methods					
	UM	**SM**	**EM**	**AQM**	**Overall**	**Rank**
Quality of cost data available	6.10	5.08	6.39	5.25	5.71	14
Stability of market conditions	6.80	6.83	6.44	4.12	6.05	7
Familiarity with project type	5.71	5.92	4.00	4.00	4.91	17
Skill, judgment and experience of the estimator	5.66	6.89	4.26	4.14	5.24	16
Time available to prepare estimate	7.48	6.22	3.81	5.94	5.86	13
Project scope definition	6.79	7.03	4.50	6.15	6.12	5
Level of diligence of estimator	7.75	6.41	4.54	5.26	5.99	8
Level of analysis of project risk factors	5.81	6.33	4.81	5.33	5.57	15
Similarity of projects	7.30	7.20	4.05	5.33	5.97	9
Time elapsed between initial estimate and tender date	5.54	7.39	6.86	4.88	6.17	2
Number of bidder on competitive tenders	4.92	7.33	6.23	5.96	6.11	6
Lack of understanding of project requirements	7.18	4.83	6.83	5.94	6.20	1
Poor communication between project team	6.53	6.06	5.50	5.64	5.93	10
Lack of review of cost estimate by management	7.50	5.75	7.20	4.14	6.15	3.5
Difference in estimate padding	6.56	5.50	6.85	4.75	5.92	11
Poor feedback on accuracy of previous estimates	6.13	6.86	7.20	4.40	6.15	3.5
Lack of adequate guidelines for estimating	6.08	7.17	5.00	5.33	5.90	12

Key: UM = Unit Method; SM = Superficial Method; EM = Elem ental Method; AQM =Approximate Quantities Method

Table 6 : Total Variance Explained (Unit Method)

Component	Initial Eigenvalues			Extraction Sums of Squared Loadings			Rotation Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	7.935	46.676	46.676	7.935	46.676	46.676	6.016	35.390	35.390
2	3.290	19.353	66.029	3.290	19.353	66.029	2.737	16.099	51.490
3	1.230	7.238	73.267	1.230	7.238	73.267	2.484	14.609	66.099
4	1.021	6.006	79.273	1.021	6.006	79.273	2.240	13.175	79.273
5	.911	5.360	84.633						
6	.639	3.761	88.395						
7	.568	3.343	91.738						
8	.378	2.210	93.948						
9	.262	1.542	95.490						
10	.198	1.164	96.654						
11	.167	.985	97.639						
12	.120	.705	98.344						
13	.091	.537	98.811						
14	.074	.433	99.314						
15	.049	.289	99.603						
16	.046	.270	99.873						
17	.022	.127	100.000						

Extraction Method: Principal Component Analysis.

Table 7 shows how the variables loaded to factors after rotation while Figure 1 shows the scree plot of loadings for the unit method. The cumulative percentage of variance explained by the first four variables is 79.27 % which means that 79.27% of the common variance shared by the 17 variables can be accounted for by the four variables.

Table 7 : Rotated Component Matrix for Unit Method

Items	Components			
	1	2	3	4
Lack of adequate guidelines for estimating	.922			
Time elapsed between initial estimate and tender date	.919			
Level of analysis of projects risk factors	.874			
Familiarity with project type	.865			
Number of bidders on competitive tenders	.861			
Skill, judgment and experience of the estimator	.803			
Difference in estimate padding	.785			
Quality of cost data available	.727			
Stability of market conditions		.879		
Similarity of Projects		.866		
Poor feedback on accuracy of previous estimates		.628		
Lack of understanding of project requirements			.867	
Poor communication between project team			.826	
Time available to prepare estimate			.576	
Level of diligence of estimator				.928
Lack of review of cost estimates by management				.819

After rotation, four factors were extracted to affect the accuracy of the unit method of preliminary cost estimating. These factors are labelled as presented in Table 8

Table 8: Extracted Unit Method Accuracy Factors using Factor Analysis

1.	Tendering related factors
2.	Project information factors
3.	Project team-related factors
4.	Contractor's organisational factors

From Figure 1, it can be seen that Factor Analysis gave two distinct factors for the unit method of preliminary cost estimating. It should be noted that the first two factors with Eigenvalues of 7.935 and 3.290 accounted for 66.03% of the observed variance.

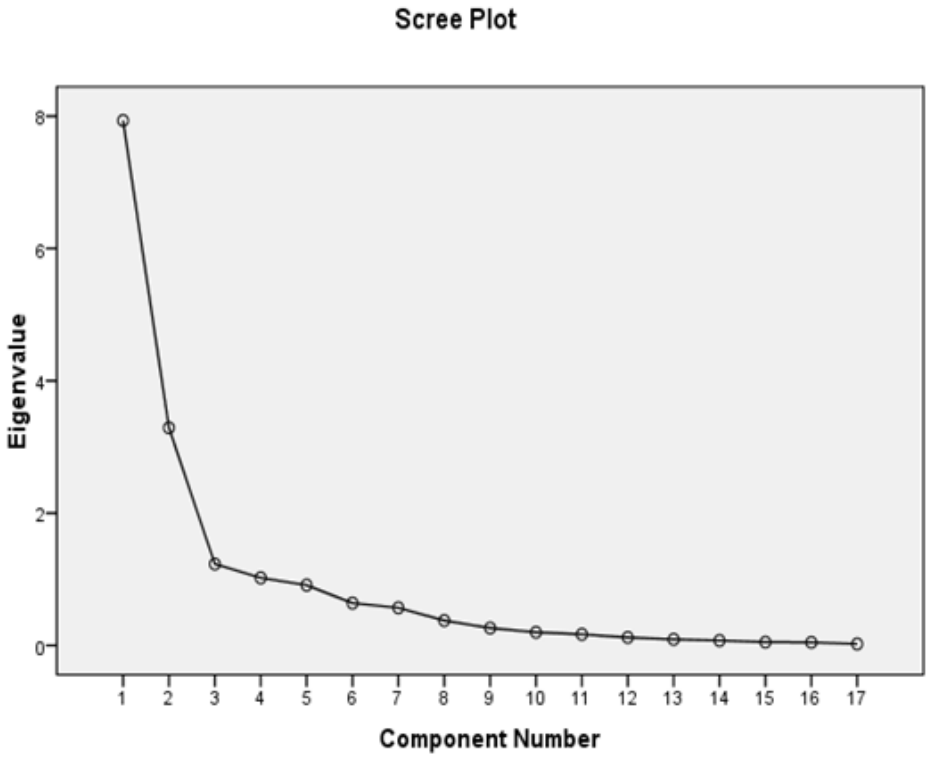

Figure 1: Scree Plot for examining the loadings of the items to factors (Unit Method)

For the superficial (floor area) method, Table 9 shows that Factors Analysis identified five variables with the first dominant variable accounting for 44.88 % of the observed variance and all the five variables accounting for 84.23 % of the observed variance. This means that these five variables can be said to significantly affect the accuracy of the superficial method when used to prepare preliminary cost estimates.

Table 10 shows how the items loaded to factors after rotation while Figure 2 shows the scree plot of loadings for the superficial method of preliminary cost estimating. The cumulative percentage of variance explained by the first five variables is 84.23 % which means that 84.23 % of the common variance shared by the 17 variables can be accounted for by the five variables.

After rotation, five factors were extracted to affect the accuracy of the superficial method of preliminary cost estimating. These factors are labelled as presented in Table 11.

Table 9 : Total Variance Explained (Superficial Method)

Component	Initial Eigenvalues			Extraction Sums of Squared Loadings			Rotation Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	7.630	44.884	44.884	7.630	44.884	44.884	3.752	22.072	22.072
2	2.949	17.346	62.230	2.949	17.346	62.230	3.395	19.968	42.040
3	1.393	8.194	70.420	1.393	8.194	70.424	3.006	17.682	59.721
4	1.281	7.534	77.958	1.281	7.534	77.958	2.271	13.361	73.083
5	1.066	6.272	84.231	1.066	6.272	84.231	1.895	11.148	84.231
6	.728	4.283	88.514						
7	.541	3.181	91.695						
8	.361	2.125	93.820						
9	.299	1.758	95.577						
10	.216	1.270	96.847						
11	.148	.872	97.719						
12	.137	.809	98.528						
13	.098	.579	99.107						
14	.063	.373	99.480						
15	.051	.302	99.782						
16	.022	.128	99.910						
17	.015	.090	100.000						

Extraction Method: Principal Component Analysis.

Table 10 : Rotated Component Matrix for Superficial Method

Items	Components				
	1	2	3	4	5
Project scope definition	0.859				
Similarity of projects	0.850				
Lack of adequate guidelines for estimating	0.767				
Stability of market conditions	0.721				
Time elapsed between initial estimate and tender date	0.714				
Familiarity with project type	0.559				
Difference in estimate padding		0.925			
Lack of review of cost estimate by management		0.870			
Quality of cost data available		0.832			
Lack of understanding of project requirement		0.601			
Project scope definition			0.795		
Poor communication between project team			0.740		
Time available to prepare estimate			0.708		
Skill, judgment and experience of estimator				0.926	
Number of bidders on competitive tenders				0.786	
Level of analysis of project risks factors					0.755
Level of diligence of estimator					0.709

Table 11: Extracted Superficial Method Accuracy Factors using Factor Analysis

1. Project information factors
2. Tendering-related factors
3. Project team-related factors
4. Competence-related factors
5. Contractor's organizational factors

From Figure 2, it can be seen that Factor Analysis gave two distinct factors for the superficial method of preliminary cost estimating. It should be noted that the first two factors with Eigenvalues of 7.630 and 2.949 account for 62.23 % of the observed variance.

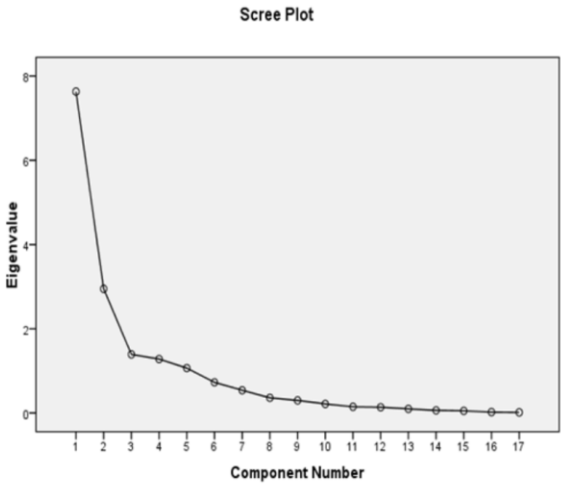

Figure 2: Scree Plot for examining the loadings of the items to factors (Superficial Meth od)

For elemental (cost analysis) method, Table 12 shows that Factor Analysis identified four variables with the first dominant variable accounting for 45.87 % of the observed variance and all the four variables accounting for 76.68 % of the observed variance. That is, these four variables can be said to significantly affect the accuracy of preliminary cost estimates prepared using the elemental method.

Table 13 shows how the items loaded to factors after rotation while Figure 3 shows the scree plot of loadings for the elemental method of preliminary cost estimating. The cumulative percentage of variance explained by the first four variables is 76.68 %, this means that 76.68 % of the common variance shared by the variables can be accounted for by these variables.

After rotation, four factors were extracted to affect the accuracy of elemental method of preliminary cost estimating in Nigeria. These factors are labelled as presented in Table 14.

From Figure 3, it can be seen that Factor Analysis gave two distinct factors for the elemental method of preliminary cost estimating. It should be noted that the first two factors with Eigen values of 7.798 and 2.643 accounted for 61.41 % of the observed variance.

For approximate quantities method, Table 15 shows that Factor Analysis identified four variables with the first dominant variable accounting for 47.93 % of the observed variance and all the four variables accounting for 79.85 % of the observed variance. That is, these four variables can be said to significantly affect the accuracy of preliminary cost estimates prepared using the approximate quantities method.

Table 16 shows how the items loaded to factors after rotation while Figure 4 shows the scree plot of loading for the approximate quantities method of preliminary cost estimating. The cumulative percentage variance explained by the first four factors is 79.85 %, this means that 79.85 % of the common variance shared by the 17 variables can be accounted for by these factors.

Table 12 : Total Variance Explained (Elemental Method)

	Initial Eigenvalues			Extraction Sums of Squared Loadings			Rotation Sums of Squared Loadings		
Component	**Total**	**% of Variance**	**Cumulative %**	**Total**	**% of Variance**	**Cumulative %**	**Total**	**% of Variance**	**Cumulative %**
1	7.798	45.872	45.872	7.798	45.872	45.872	5.028	29.576	29.576
2	2.643	15.545	61.417	2.643	15.545	61.417	2.941	17.302	46.878
3	1.418	8.339	69.756	1.418	8.339	69.756	2.811	16.535	63.413
4	1.178	6.930	76.686	1.178	6.930	76.686	2.256	13.273	76.686
5	.975	5.735	82.421						
6	.817	4.805	87.225						
7	.482	2.837	90.062						
8	.373	2.196	92.258						
9	.357	2.101	94.359						
10	.318	1.872	96.231						
11	.158	.928	97.158						
12	.127	.745	97.904						
13	.098	.577	98.481						
14	.082	.485	98.965						
15	.079	.464	99.429						
16	.054	.316	99.745						
17	.043	.255	100.000						

Extraction Method: Principal Component Analysis.

Table 14: Extracted Elemental Method Accuracy Factors using Factor Analysis

1. Project team-related factors
2. Economic related factors
3. Tendering-related factors
4. Competence-related factors

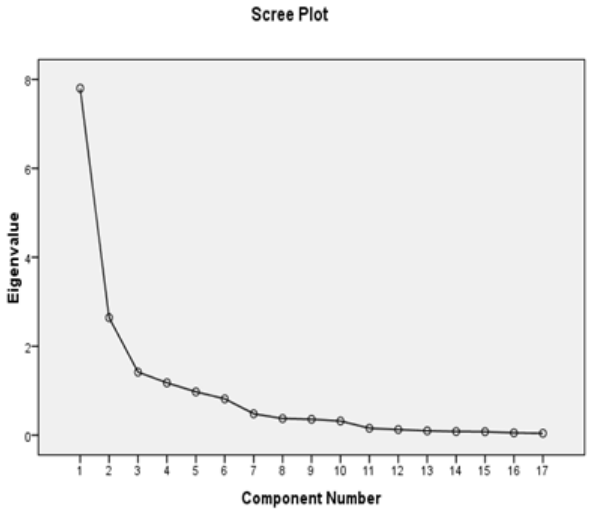

Figure 3: Scree Plot for examining the loadings of the items to factors (Elemental Method)

Table 15 : Total Variance Explained (Approximate Quanti ties Method)

Compo-nent	Initial Eigenvalues			Extraction Sums of Squared Loadings			Rotation Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	8.149	47.935	47.935	8.149	47.935	47.935	5.860	34.468	34.468
2	3.185	18.737	66.672	3.185	18.737	66.672	3.265	19.205	53.673
3	1.171	6.887	73.559	1.171	6.887	73.559	2.462	14.483	68.156
4	1.070	6.294	79.854	1.070	6.294	79.854	1.989	11.698	79.854
5	.937	5.510	85.364						
6	.599	3.526	88.890						
7	.575	3.382	92.272						
8	.391	2.298	94.570						
9	.280	1.647	96.216						
10	.185	1.091	97.307						
11	.135	.796	98.103						
12	.105	.615	98.719						
13	.080	.471	99.190						
14	.060	.353	99.543						
15	.049	.287	99.830						
16	.023	.134	99.964						
17	.006	.036	100.000						

Extraction Method: Principal Component Analysis.

Table 16 : Rotated Component Matrix for Approximate Quantities Method

Items	Components			
	1	2	3	4
Lack of adequate guidelines for estimating	0.917			
Familiarity with project type	0.900			
Poor feedback on accuracy of previous estimates	0.900			
Time elapsed between initial estimate and tender date	0.894			
Similarity of projects	0.866			
Stability of market conditions	0.829			
Lack of review of cost estimates by management	0.667			
Number of bidders on competitive tenders		0.880		
Skill, judgment and experience of the estimator		0.836		
Lack of understanding of project requirement		0.774		
Time available to prepare estimator		0.755		
Level of analysis of project risks factors			0.796	
Level of diligence of estimator			0.651	
Quality of cost data available			0.623	
Difference in estimate padding			0.613	
Poor project definition				0.872
Poor communication between project team				0.607

Table 17: Extracted Approximate Quantities Method Accuracy Factors using Factor Analysis

1.	Time related factors
2.	Competence related factors
3.	Contractor's organisational factors
4.	Project team related factors

After rotation, four factors were extracted to influence the accuracy of approximate quantities method of preliminary cost estimating in Nigeria. These factors are labelled as presented in Table 17.

From Figure 4, it can be seen that Factor Analysis gave two distinct factors for the approximate quantities method of preliminary cost estimating. It should be noted that the first two factors with Eigen values of 8.149 and 3.185 accounted for 66.67 % of the observed variance.

Table 18 shows the summary of extracted preliminary cost estimating accuracy factors. In Table? project team-related factors (100 %) were shown to rank highest among the extracted factors. They were followed by tendering-related factors (75%), contractor's organizational factors (75%), and competence-related factors (75%). Others were project information factors (50 %), economic-related factors (25%), and time-related factors (25%).

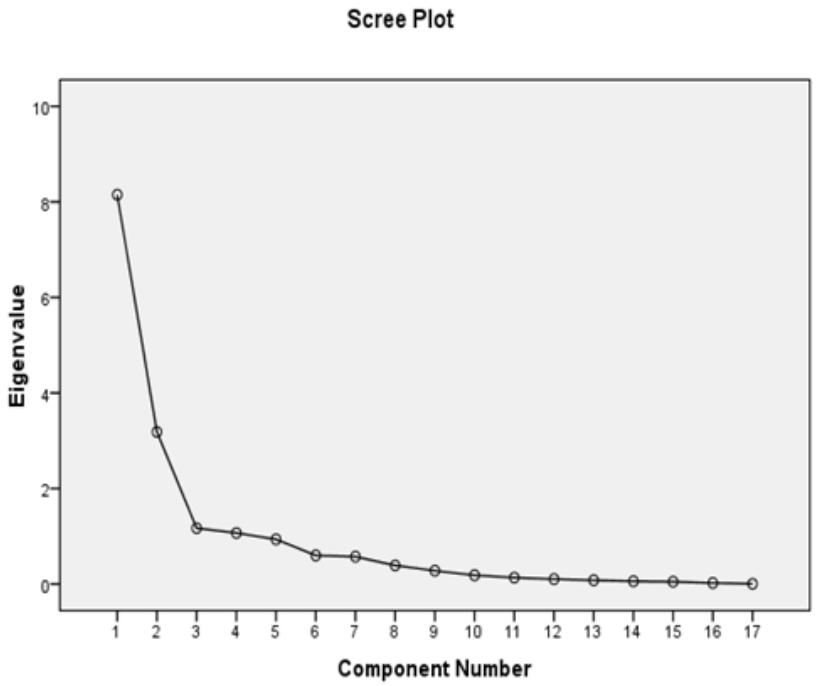

Figure 4: Scree Plot for examining the loadings of the items to factors (Approximate Quantities Method)

Table 18: Summary of Extracted Preliminary Cost Estimating Accuracy Factors

Extracted Factors	UM	SM	EM	AQM	Aggr.	%
Project team factors	√	√	√	√	4	100
Tendering-related factors	√	√	√	x	3	75
Contractor's organization factors	√	√	x	√	3	75
Competence-related factors	x	√	√	√	3	75
Economic-related factors	x	x	√	x	1	25
Project Information factors	√	√	x	x	2	50
Time-related factors	x	x	x	√	1	25

Key: UM= Unit Method; SM= Superficial Method; AQM= Approximate Quantities Method.

Conclusions and implications

The study concluded that the preliminary cost estimating methods in use in Nigeria is a mixture of both the single rate and multiple rates with the use of multiple rates options being slightly higher. The continuous use of the single rate methods could explain the high level of inaccuracy in the resulting preliminary cost estimates prepared in Nigeria. One of the major disadvantages of the single rate methods is their inability to be amenable to changes during the design development. They are not capable of capturing the differences in design details as we move from one stage to the other in the Royal Institute of British Architects (RIBA) Plan of Work. Moreover, consulting Quantity Surveyors in Nigeria prefer the use of approximate quantities, superficial (floor area), and elemental (cost analysis) methods, in that descending order, for the preparation of preliminary cost estimates.

It is also concluded that the preliminary cost estimates prepared in Nigeria are far less accurate than the range tolerated in the construction industry. This could explain the high incidence of cost over-runs presently being experienced in the Nigerian construction industry. Whereas high rise buildings were underestimated, low rise buildings show a high level of overestimation. The implication of this could be attributed to the fact that Quantity Surveyors may not have adequately come to terms with the expertise required for the estimation of complex building schemes.

On the variables influencing the accuracy of preliminary cost estimates, it is concluded that the seven most significant variables were lack of understanding of project requirements, time elapsed between estimates, lack of review of cost estimates by management, poor feedback on accuracy of previous estimates, and level of project scope definition. Others were number of bidders on competitive tenders and stability of market conditions.

The study also concluded that project team factors, tendering-related factors, contractor organizational factors, competence-related factors, and project information factors mostly influenced the accuracy of preliminary cost estimates in the study area.

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