DETERMINANTS OF BUILDING CONSTRUCTION PROJECT COST IN NIGERIA.

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Abstract
A review of literature on the factors that estimators in building industry consider when estimating for building projects indicated that nature of clients, professionals involved in a project and their decision regarding design, function, duration, technology and implementation have significant effects on the overall project cost. The objective of this is to examine the importance of these factors in determining the costs of building projects. Data for the study were obtained through random sampling of public building projects completed in Nigeria after the year 1995. The study identified six major significant factors in project cost among the design related variables as: Level of design complexity; level of construction complexity; level of technological advancement; percentage of repetitive element; presence of special issues and scope of work. Among time/cost related factors, three most significant factors are; Importance for project to be delivered; time allowed by the client and his representative for bid evaluation; need for the project to be completed. Client, consultant and contractor's experience on similar project; adequacy of contractor's plants and equipments are most significant among project parties experience related factors. It is suggested that previous information on these factors can assist an experienced professional rating of those factors in making realistic estimate of building project cost. To achieve this, Government as the largest initiator of public projects should formulate policies that will make client's report on previously executed projects by contractors and consultants available to the construction professional associations and the general public. This, to a very large extent will ensure most realistic rating of contractors and consultants alike when estimating the probable cost of project and will also ensure quality work is being delivered by contractors and improvement on service by the professionals.

Keywords: Building; Cost; Determinants; Estimating; Project.

INTRODUCTION
One of the major problems that have bedeviled the Nigerian construction industry is that building contracts are completed at sums much higher than the estimated cost (Giwa, 1988). A successful project means that the project has accomplished its technical performance, maintained its schedule and remained within budgetary costs. However, there has been a greater awareness of cost prediction by prospective building clients because of the prevailing economic condition which has placed severe restrictions on the availability of capital and thus made it essential to ensure that resources are judiciously utilised to secure the best economic advantage.

In these days of ever increasing costs, the majority of promoters of building projects are insisting on jobs being designed and executed to give maximum value for money. As building becomes more complex and clients become more exacting in their requirements due to rising in prices, restrictions on the use of capital and increases in interest rates.

A client is very much concerned with quality, cost and time and wants the building to be soundly constructed at a reasonable cost and within a specified period of time. For these reasons, it is imperative that the Architect, who may or may not be supported by Quantity

Surveyor, exercises the greatest care and skill in the design of the project with constant checks on cost (Achuenu, 1997). This research aims to (i) to identify the factors that contribute to project cost and (ii) to examine the importance of the identified factors based on the significance of their contribution. The subsequent sections review the previous work relating to the research title, present the data and discuss the results of the statistical analysis. Finally, conclusions were drawn from the results of the empirical study.

LITERATURE REVIEW

Cost is simply defined as what must be given or foregone to obtain something and can be classified into client's cost and contractors' cost and the difference between the two will be the profit or payment the contractor's will receive at the completion of the project (Achuenu 1999).

Lowe, Emsley and Harding (2006) asserted that the inappropriate nature of raw cost as a valid predictor of project cost can be demonstrated by comparing the results of a simple forward stepwise regression using raw cost with those obtained when using the other three variables.

Songer and Molenaar (1997) identified a list of metrics that measure and compare the performance of construction projects. Other studies (Akintoye 2000; Chan, Ho and Tam (2001) identified the determining factors and assessed their impacts on project cost.

A common finding of previous studies is that cost is affected by a large number of factors. This can be explained by the fact that construction is a multi-disciplinary industry and its work involves many parties such as the owner, professionals, contractors and suppliers. Therefore integrated efforts of the various parties and their decisions regarding the design, technology and implementation of the project can have significant effect on the overall project cost. Chan and Park (2005) asserted that project cost depends not only on a single factor but a cluster of variables related to the characteristics of the project and the construction team. Technological and project design requirements preset by the client's desired level of construction sophistication play an important role in determining the cost of the project.

METHODOLOGY

This study was designed to investigate into the factors that determine cost of construction project. Random sampling technique was used to effectively capture the target population. From the existing literature on determinants of project cost, a total of 38 determinants (Table 1) relating to the project, the construction team and the contractor were identified to have impact on project cost. These determinants are qualitative variables expressed in the Likert scale of between a minimum of 1 and a maximum of 5. Appropriate methods of data analysis were very necessary to be able to accurately process the data collected from field survey. However, Principal Component Regression (PCA) was used for purposes of selecting a small number of principal components that contributes satisfactorily to variation.

RESULTS AND DISCUSSION

Table 1 below shows that 5%, 2%, 71% and 22% of the respondents were Architects, Engineers, Quantity Surveyor and Builders respectively. It also reveals

that an appreciable number (37%) of the respondents have between 11 to 15 Years working experience, while 46% of the respondents have earned bachelor degrees and 49% and 34% are engaged in consultancy services and contracting work respectively. Thus the above revelation is a testimony that the responses were from a sample of qualified and experienced personnel.

Table 1: Characteristics of Respondents

RESPONDENTS		FREQUENCY	PERCENT
Profession	Architect	2	4.9
	Engineer	1	2.4
	Quantity Surveyor	29	70.7
	Builders	9	22
	TOTAL	**41**	**100**
Years of working experience	0 to 5yrs	6	14.6
	6 to 10yrs	14	34.1
	11 to 15yrs	15	36.6
	16 to 20yrs	6	14.6
	TOTAL	**41**	**100**
Educational Qualification	OND	-	0
	HND	8	19.5
	PGD	5	12.2
	BSc	19	46.3
	MSc	9	22
	TOTAL	**41**	**100**
Type of practice	Project Management	7	17.1
	Contracting	14	34.1
	Consultancy	20	48.8
	TOTAL	**41**	**100**

Source: Author survey (2009)

As the quest to gather relevant data for the research continues, the respondents were required to score the identified factors that are been considered as a determinates of cost of building project using a Likart scale of 5 – 1 that is 5 denoting very important and 1 denoting not important'. Table 2 shows the aggregation of the respondent's responses as percentage of the total number of responses received on each of the questions asked on the questionnaire.

Table 2: Factors that Determine Cost of Building Project

Factors	Percentage				
	N.I	S.I	M.I	V.I	E.I
DESIGN RELATED					
X1-Level of design complexity	-	-	17	51	32
X2-Level of construction complexity	-	-	22	44	34
X3-Level of technological advancement	-	12	20	46	22
X4-Level of specialization required of contractors	2	-	27	44	27
X5-Percentage of repetitive elements	17	32	34	15	2
X6-Presence of special issues	10	22	29	32	7
X7-Type of specification	-	2	17	49	32
X8-Extent to which bid documents allow additions to scope	2	17	32	34	15
X9-Flexibility of scope of works when contractor is hired	-	10	42	39	10
X10-Project scope definition completion when bids are invited	5	7	34	39	15
X11-Design completion(by owner) when bids are invited	5	15	34	32	15
X12-Design Decision made (by owner) when bids are invited	2	24	20	34	20
X13-Design completion when budget is fixed	-	8	22	46	24
TIME/COST RELATED					
X14-Importance for project to be completed within budget	-	2	17	32	49
X15-Importance for project to be delivered	-	2	22	42	34
X16-Time given to consultant to evaluate bids	24	17	34	27	20
X17-Extent to which contract period is allowed to vary	-	17	44	24	15
X18-Importance for project to be completed on time	-	2	10	46	42
X19-Bidding environment	5	39	17	24	15
X20-Consultant's level of construction sophistication	-	24	27	46	24
X21-Owner's level of construction sophistication	5	10	27	44	15

Source: Author survey (2009)

Key: N.I (Not Important), S.I (Slightly Important), M.I (Moderately Important), V.I (Very Important), E.I. (Extremely Important

Continuation of Table 2.

Factors	Percentage				
	N.I	S.I	M.I	V.I	E.I
PROJECT PARTIES EXPERIENCE RELATED					
X22-Consultant experience with similar project	-	2	22	42	34
X23-Owners experience with similar project.	7	15	29	24	24
X24-Consultant staffing level to attend to contractor	-	8	29	29	34
X25-Owners staffing level to attend to contractor	17	12	44	20	7
X26-Contractor's experience with similar type of projects	-	5	12	49	34
X27-Contractor's experience with similar size of project	2	7	17	49	24
X28-Contractors experience with project in Nigeria	2	5	29	44	20
X29-Subcontractor experience and capability	-	27	29	34	10
X30-Communication among project team	15	15	27	27	17
X31-Contractor's prior working relationship with the owners	12	17	37	32	2
X32-Contractor prior working relationship with consultant	7	15	39	24	17
X33-Contractor track record for completion on time	-	-	22	59	20
X34-Contractor track record for completion on budget	-	5	22	37	37
X35-Contractor track records for completion on quality	-	7	17	34	42
X36-Contractor staffing level	2	7	17	44	29
X37-Adequacy of contractor plant and equipment	-	-	36	32	32
X38-Magnitude of change orders in contractor past project	-	24	54	17	5

Source: Author survey (2009)

Key: N.I (Not Important), S.I (Slightly Important), M.I (Moderately Important), V.I (Very Important), E.I. (Extremely Important

PRINCIPAL COMPONENT ANALYSIS OF PROJECT COST DETERMINANT

Factor analysis was employed to condense large number of variables with a view to identify the underlying variables that explain the pattern of correlation with a set of observed variables. The main objective of factor analysis is to describe the covariance relationship among a large number of variables in terms of a few groups. Factor analysis specifies that variables are determined by common factor (the factor estimated by the model) and unique factor (which do not overlap between observable variables) with the assumption that all unique factors calculated correlate with each other and with common factor.

INITIAL EXAMINATION

Principal Component Analysis (PCA) was employed to confirm the factors that determine cost of building project and to explore the structure of the data as regards their individual significant contribution to project cost. To use PCA technique, the data presented on table 2 was first tested for suitability, involving Kaiser-Meyer-Olkin (KMO) measures and Bartlett's Test of Sphericity, the KMO measure of sampling adequacy was estimated to be 0.515, 0.601 and 0.586 for Design related, Time/Cost related and factors relating to experience of parties involved in project execution respectively, and these values are greater than 0.50. The Bartlett's test of sphericity, to confirm the identity of matrix was found to be significant at 0.000 level with chi-square values of 130.994, 59.728 and 287.734, for Design related, Time/Cost related and factors relating to experience of parties involved in project execution respectively. These measures confirmed the suitability of the data for proceeding with factor analysis.

EXTRACTING COMPONENTS

PCA was used in analysing the raw data for the purposes of extracting the factors that contributed significantly to cost of building projects. Kaming, Olomolaiye, Holt and Harris (1997) explained that the total number of factor estimated by the model (common factor) is equal to or less than the total number of variables involved which is shown in the result of analysis. Table 3, 4, and 5 below shows the extracted number of factor from PCA for design related, time/cost related and experience of project parties related factors based on their contribution to cost of building project. However, the most significant factors that contribute to project cost are those whose eigenvalues are greater than or equal to 1, because eigenvalues is a measure of the contribution of a variable to the principal components. However, the extraction sum of square loading of the factor analysis for design related factors indicates six (6) factors out of thirteen (13) factors with eigenvalues of 3.068 for factor 1 to 1.001 for factor 6, Time/Cost related factor indicates three (3) with eigenvalues of 2.394 for factor 1 to 1.074 for factor 3 and Experience of Parties to the Project factors indicates five (5) with eigenvalues of 4.357 for factor 1 to 1.301 for factor 5. Those factor with eigenvalues greater than or equal to 1 are considered in the extraction process.

Table 3: Total Variance extracted for Design related factors

Components	Initial Eigenvalues		
	Total	% of Variance	Cumulative %
1	3.068	23.603	23.603
2	1.64	12.614	36.217
3	1.442	11.089	47.306
4	1.429	10.996	58.302
5	1.14	8.765	67.067
6	1.001	7.702	74.77
7	0.877	6.749	81.519
8	0.777	5.976	87.495
9	0.476	3.659	91.154
10	0.381	2.934	94.088
11	0.305	2.343	96.431
12	0.272	2.092	98.523
13	0.192	1.477	100

Source: Author analysis of data (2009)

Table 4: Total Variance extracted for Time/Cost related factors

Components	Initial Eigenvalues		
	Total	% of Variance	Cumulative %
1	2.394	29.928	29.928
2	1.614	20.174	50.102
3	1.074	13.421	63.523
4	0.883	11.032	74.555
5	0.782	9.774	84.329
6	0.534	6.669	90.998
7	0.407	5.087	96.085
8	0.313	3.915	100

Source: Author analysis of data (2009)

Table 5: Total Variance extracted for factors related to experience of project parties

Components	Initial Eigenvalues		
	Total	% of Variance	Cumulative %
1	4.357	25.632	25.632
2	2.897	17.044	42.676
3	1.748	10.281	52.957
4	1.319	7.759	60.716
5	1.301	7.651	68.367
6	0.944	5.555	73.921
7	0.805	4.733	78.654
8	0.649	3.818	82.472
9	0.611	3.597	86.069
10	0.583	3.43	89.499
11	0.433	2.548	92.047
12	0.358	2.107	94.154
13	0.338	1.99	96.144
14	0.244	1.436	97.58
15	0.195	1.147	98.727
16	0.131	0.77	99.49
17	0.085	0.503	100

Source: Author analysis of data (2009)

The output in table 6, 7 and 8 shows the extraction factor loading greater than 0.500 and their respective communalities (h^2). The criterion for factor loading was that any variable with absolute value

in the component matrix belong to the component. Factor loading are simply the correlation coefficient between an original variable/determinant and an extracted factor. Also, the average communalities (h^2) which explain the variance in the variables accounted for by the extracted factor is 75%, 64% and 69% for Design related, Time/cost related and Experience of Project Parties related factors respectively.

Table 6: Factor loading of design factors to cost of project - extracted

	Variable	Factors						
		DF1	DF2	DF3	DF4	DF5	DF6	h^2
1	Level of design complexity	0.540						0.813
2	Level of construction complexity	0.520						0.788
3	Level of technological advancement	0.714						0.742
4	Level of specialization required of contractors	0.500						0.581
5	Percentage of repetitive elements		0.742					0.722
6	Presence of special issues		-0.603					0.906
7	Type of specification		0.659					0.620
8	Extent to which bid documents allow additions to scope			0.597				0.719
9	Flexibility of scope of works when contractor is hired			-0.507				0.847
10	Project scope definition completion when bids are invited				0.709			0.812
11	Design completion(by owner) when bids are invited				0.600			0.642
12	Design Decision made (by owner) when bids are invited					0.626		0.741
13	Design completion when budget is fixed						-0.569	0.736

Source: Author analysis of data (2009)

Table 7: Factor loading of Time/Cost factor - extracted

	Variable	Factors			
		TF1	TF2	TF3	h^2
1	Importance for project to be completed within budget	0.67			0.618
2	Importance for project to be delivered	0.757			0.752
3	Time given to consultant to evaluate bids	0.793			0.698
4	Extent to which contract period is allowed to vary	0.508			0.622
5	Importance for project to be completed on time	0.612			0.707
6	Bidding environment		0.719		0.53
7	Consultant's level of construction sophistication		0.719		0.459
8	Owner's level of construction sophistication			-0.659	0.697

Source: Author analysis of data (2009)

Table 8: Factor Loading for Project parties experience factor - extracted

	Variables	Factors					
		EP1	EP2	EP3	EP4	EP5	h^3
1	Consultant experience with similar project	0.537					0.577
2	Owners experience with similar project	0.703					0.780
3	Consultant staffing level to attend to contractor	0.589					0.783
4	Owners staffing level to attend to contractor	0.600					0.825
5	Contractor's experience with similar type of projects	0.536					0.774
6	Contractor's experience with similar size of projects	0.690					0.761
7	Contractors experience with project in Nigeria	0.694					0.611
8	Subcontractor experience and capability	0.520					0.677
9	Communication among project team		-0.650				0.781
10	Contractor's prior working relationship with the owners		-0.593				0.738
11	Contractor prior working relationship with the consultant		0.662				0.651
12	Contractor track record for completion on time		0.585				0.612
13	Contractor track record for completion on budget			0.510			0.591
14	Contractor track records for completion on quality			0.628			0.634
15	Contractor staffing level						0.502
16	Adequacy of contractor plant and equipment						0.693
17	Magnitude of change orders in contractor past project						0.633

Source: Author analysis of data (2009)

SELECTING PRINCIPAL COMPONENTS

Further to extraction of principal components, those components that contributed significantly to the factors must to be selected. However, the study adopts the criterion of selection used in (Kaming et al. 1997; Chan & Park 2005). This criterion include selecting the principal component whose eigenvalues and the percentage variance is more than the average eigenvalues and the percentage cumulative variance of the factor.

Based on the above criteria, from table 6, 7 and 8 above, six components are extracted from 13 variables pertaining to Project Design. The cumulative percentage variance explained by the six components is 75% and percentage variance explained by each of the components are displayed on table 3. Taking the significance of contribution of each variable into account (based on their respective percentage variance) and in comparison with the average eigenvalues (1.314), the first two components contributed significantly (accounted for 36% of the variance), thus those variables with eigenvalues higher than the average eigenvalues were selected. Hence, 6 out of 13 variables were selected.

Within the component of Time/Cost factors, three components was extracted,

having a cumulative percentage variance of 64% the average eigenvalues (3.34), table 7 present percentage variance explained by the three factors. Thus only one factor with relatively higher eigenvalues than the average eigenvalues was selected and 3 variables out of 8 were selected. Among the factors relating to experience of project parties, five components that amount to 69% of the variance are extracted and first two components whose eigenvalues are higher than average (1.748) account for 43% of the variance. Six out a total of seven variables are selected. The variables selected are presented on table 9.

Table 9: List of selected factors

Factor 1 (FAC1)	Level of design complexity
Factor 2 (FAC2)	Level of construction complexity
Factor 3 (FAC3)	Level of technological advancement
Factor 4 (FAC4)	Percentage of repetitive element
Factor 5 (FAC5)	Percentage of special issues
Factor 6 (FAC6)	Project scope
Factor 7 (FAC7)	Importance for project to be delivered
Factor 8 (FAC8)	Time allowed for bid evaluation
Factor 9 (FAC9)	Importance for project to be completed on time
Factor 10 (FAC10)	Client experience in construction project
Factor 11 (FAC11)	Contractor's experience on similar type of project
Factor 12 (FAC12)	Contractor's experience on similar size of project
Factor 13 (FAC13)	Communication among project team
Factor 14 (FAC14)	Contractor's prior working relationship with client
Factor 15 (FAC15)	Adequacy of contractor plant and equipment

Source: Author analysis of data (2009)

SUMMARY OF FINDINGS

Based on the information gathered from review of related literature and the analysis carried out the findings of the study are summarised as follows;

(i) Six most significant factors among the design related variables as major contributor to cost of public building projects, as Level of design complexity; level of construction complexity; level of technological advancement; percentage of repetitive element; presence of special issues and scope of work.

(ii) The results of the analysis on the time/cost related factors indicated Importance for project to be delivered; time allowed by the client and his representative for bid evaluation by prospective bidders and need for the project to be completed within stipulated period as very significant factors.

(iv) The study also revealed that estimator's do take cognisance of the client,

consultant and contractor's experience on similar project as contributing factors to project cost. And adequacy of contractor's plants and equipments feature prominently among the factors that are categorised as project parties experience related factors.

CONCLUSION AND RECOMMENDATION.

The study has identified 15 most important factors that contribute significantly to project cost from analysis performed on variables identified as project general requirements.

It is suggested that, since these factors are related to project design, time and nature of client, consultant and contractor's, previous information on them can assist an experienced professional (Quantity Surveyor, Builder and Architect) rating of those factors in making realistic estimate of building project cost. To achieve this, Government as the largest initiator of public projects should formulate policies that will make client's report on previously executed projects by contractors and consultants are available to the construction professional association and general public. This, to a very large extent will ensure most realistic rating of contractors and consultants alike when estimating the probable cost of project and will also ensure quality work is being delivered by contractors and improvement on service by the professionals

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