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Development of Tendering Duration Models for Federal Government Building Projects in Nigeria

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Abstract
The Study sought to fundamentally generate information on the relationship between tendering duration and project complexity/determinants of cost and duration in order to determine via a scientific model, realistic tendering durations of various types of federal building projects in Nigeria. To achieve this, historical data on project cost, project duration and tendering duration were obtained for 78 federal building projects. They were subjected to correlation and regression analysis to test for statistical significance and the relationship between tendering duration and cost variables. Results of the regression analysis revealed that there is a significant relationship between tendering duration and project cost, which can be seen from the strong statistical correlation; R square value = 0.53 and the P(significant) values of 0.00 < alpha value α (0.05)adopted in the study. Furthermore, a significant relationship between tendering duration and project duration was revealed. The statistical correlation was however observed to be higher; with R square value = 0.80 and P(sig) values < α (0.05). Hence, the following models were developed which proved significant for the sampled projects based on the quadratic regression equation: First, the tendering duration – project cost model which is in the form; TD = 2.574 + 1.137E-9C – 5.245E-20C^2, where TD is the tendering duration in weeks and C, project cost. Second, the tendering duration-project duration model expressed as TD = 1.299 + 0.073D + 0.000D^2, where D is the project duration in weeks. The study recommends that the Federal Government should formulate bidding deadlines for different categories of building projects based on complexity factors of cost and duration, via adoption of the models proposed by the study. This will promote standards, efficiency in project planning, achievement of fairness and transparency in the public tendering system.
Key Words: Building Projects, Development, Federal Government, Models, Nigeria, Tendering Duration.

1.0 Introduction

The building industry has developed a number of standard practices which enhance functional efficiency (Knowles, 1997). One of these practices is the tendering process, which is a preferred method used by the industry to enable clients engage contractors for their works, provide information to them in a fair and equitable way, give all those suitably qualified an opportunity to submit tenders, receive tenders from them in a confidential way, evaluate the tenders and select the best value for money option.

Selecting a contractual relationship is therefore very important as it establishes a good working relationship between contracting parties, which leads ultimately to a successful contract (Anonymous, 2001). Thus, the efficiency and effectiveness of the tendering process is crucial to the achievement of the desired goals and objectives of the construction project.

Tamimi (2009) posited that prior to the submission of completed tenders and subsequent selection of the most successful tenderer, a period of time is usually allowed for, or given to tenderers by the client or his consultants to prepare their estimates or proposals, and carry out all necessary activities that will enable them achieve it. This space of time is referred to as the tendering period or duration and is defined to begin with the tender advertisement and to end with the closing or submission date for tenders.

Clients and consultants are always known to be eager to obtain information on the contractor's proposal regarding the price and duration of the proposed projects. Lai (1979) observed that this anxiety to obtain bid proposals within the shortest possible time was responsible for the establishment of tender return dates by clients.

Clients would often desire a shorter tender period out of anxiety, but the contractor's reliable tender will need to follow from a series of actions such as measuring the scope of the services being sought, obtain prices from suppliers and sub-contractors, visiting the site, assessing the tender and contract conditions, assessing capacity to undertake the work, clarifying any inconsistencies or other queries, documenting the tender bid. These actions on the part of the contractor require considerable time to accomplish (Neighbour, 2006).

Clients often see time spent 'waiting for tenders' as wasted time. They often forget that compiling a tender is more than just filling in some paper work. Paynter (2009) also asserts that past recommendations in the industry have it that at least 6 weeks should be allowed for the process to be done properly. Common practices however usually allow fourteen days for minor works and a period of three weeks to three months for major or complex projects. However, these time frames are often subjective, and influenced greatly by the client, with no realistic or generally accepted basis for setting them.

Bina (2010) argues that tendering duration allowed for tenderers should depend on the type of tender, size/scale, complexity and value of the project. However, in the Nigerian scenario, the reverse is the case. The public procurement act (2007), section 25(ii) stipulates:
"in the case of goods and works valued under national competitive bidding, the invitation for bids shall be advertised on the notice board of the procuring entity, any official websites of the procuring entity, at least two national newspapers, and in the procurement journal not less than six weeks before the dead line for submission of the bids for the goods and works"

From the stipulations, the Act neither specifies the tendering time appropriate for various cost categories of projects, nor how such tendering time can be determined for such projects. Thus, the basis for the six weeks stipulated is unclear, not founded on any scientific basis which gives clients or procuring entities the liberty of stipulating whatever periods they deem appropriate without regards to project complexities as long as it falls within the maximum stipulated time.

2.0 Aim and Objective of the Study

The aim of this study is to determine the relationship between the tendering duration currently allowed for federal building projects and their project complexity in terms of cost and duration. In this regard, the specific objective of the study seeks to interpolate the project complexity factors in order to develop a predictive mathematical model for predicting tendering duration for various cost categories of federal building projects.

3.0 Scope of the Nigerian Building Construction Industry and Its Public Tendering System

The Nigerian building industry has recorded some major achievements among which are the construction of housing estates, public buildings, industrial complexes and institutional buildings (Jambol and Yusufu, 2004). The building industry in Nigeria is dominated by the public sector to the extent that over 55% of building projects are sponsored by Federal, State and Local governments (Izam, 2008).
In Nigeria, everything centers on the government. The government influences most activities of every sector of the economy. The government does this through its institutions, policies and economic/regulating tools. For instance, is the Bureau of Public Procurement an agency which strengthens the procurement process with respect to physical infrastructure, institutional and human capacities to lay foundations for national development (Bureau of Public Procurement, 2008).
The Federal Government of Nigeria thus established the Bureau of Public Procurement (BPP) to promote standards, transparency and accountability in the procurement process. A legal tool which it uses to realize this is the Public Procurement Act of 2007 which serves as a standard legal framework or guide to procuring entities for efficient, effective and successful tendering for public projects in Nigeria.
The present Government also favours a contract tendering process that is open, competitive, fair and equitable to all bidders and which seeks to strategically focus on minimizing waste and reduce incidence of failure of public sector projects (Ayeni,1990).
According to Omole (1999), tendering time allowed for Nigerian contractors should be adequate enough to allow firms tendering to obtain information from their domestic and specialist sub-contractors, visit site, which will lead to a very competitive tender. He further suggests the following durations for various types of projects.

Table 1 Recommended Tendering Duration for various types of projects in Nigeria.

Project type	Recommended Duration
Residential Buildings	3 -4 weeks
Complex Office Project	5 -8 weeks
Factory projects	4 -6 weeks
Heavy Engineering, Civil Engineering works	8 - 12 weeks

Source: (Omole, 1999)

3.1 Overview of the Concept of Statistical Model

A statistical model is a formalization of relationships between variables in the form of mathematical equations. A statistical model describes how one or more random variables are related to one or more other variables (Statistical Model, n.d).

A model can also be referred to as a simplified mathematical description of a system or process. Statistical models are used for future projections or to make forecasts by relying on objective historical or past data, which it uses to determine a summary value (Izam, 2007). Projection models are typically used when data on several years are available and the underlying relationships are measurable and relatively stable.
According to Markland, (1997), statistical projection models such as regression models, time series analysis are effective for an intermediate range of one to three years. Statistical projections by use of models have also been regarded as a critical necessity in every decision made by a manager and are crucial to the management process of an organization. As identified earlier in this study, realistic tendering duration is an essential requirement of a successful tender management and project success. Generally, the following models are available in curve estimation procedure using the regression approach: Linear, logarithmic, inverse, quadratic, cubic, power, compound, s-curve, logistic, growth and exponential. The study seeks to develop a realistic tendering duration model based on the regression analysis approach- considered to be one of the most powerful tools of prediction.

***3.2** The Regression Based Model*

Larsen (n.d) explains regression models as statistical models which describe the variation in one (or more) variable(s) when one or more other variable(s). Regression models provide the scientist with a powerful tool, allowing predictions about past, present, or future events to be made with information about past or present events. The scientist employs these models either because it is less expensive in terms of time and/or money to collect the information to make the predictions than to collect the information about the event itself, or, more likely, because the event to be predicted will occur in some future time

Regression analysis is thus widely used for prediction and forecasting. Regression analysis is also used to understand which among the independent variables are related to the dependent variable, and to explore the forms of these relationships. In restricted circumstances, regression analysis can be used to infer causal relationships between the independent and dependent variables. Typical Regression models involve the following variables: the unknown parameters, denoted as β,The independent variables, X. The dependent variable, *Y*. A regression model relates *Y* to a function of X and β (Statistical Model, n.d).

Once a regression model has been constructed, the goodness of fit of the model is confirmed and the statistical significance of the estimated parameters. Commonly used checks of goodness of fit include the R-squared, analyses of the pattern of residuals and hypothesis testing. Statistical significance can be checked by an F-test of the overall fit. Regression model Prediction *within* the range of values in the dataset used for model-fitting is known informally as interpolation.

Izam (2007) identified several virtues of the regression based models which are (i) Its simplicity of application. 48% of construction practitioners, from study findings are familiar with it (ii) minimal development cost associated with its data gathering and storage. The variables project cost and project duration can be accurately obtained for the projects (iii)a hypothesized relationship that exists between tendering duration and project parameters such as cost and duration and (iv) Most building construction projects are medium range in nature (less than three years duration)

4.0 Hypothesis

The following hypotheses were developed in order to promote the achievement of the purpose of the study.
H_0: There is no significant relationship between the tendering duration and project cost for federal building projects in Nigeria.
H_1: There is a significant relationship between the tendering duration and project cost for federal building projects in Nigeria.

H_0: There is no significant relationship between the tendering duration and project duration for federal building projects in Nigeria.
H_1: There is a significant relationship between the tendering duration and project duration for federal building projects in Nigeria.

5.0 Methodology of the Study

Data on tendering duration, project cost and project duration were sourced from historical project documents such as contract agreements and final accounts for 78 building projects executed from 2007 to 2010, obtained from the federal ministry of lands, housing and urban development and Federal Capital Development Authority (FCDA).The federal tenders journal adverts for related projects were also studied. These data obtained were analyzed afterwards using the relevant statistical methods of correlation and simple regression; thus testing the hypotheses and promoting the achievement of the research purpose. Results obtained were represented in the form of tables and graphs for pictorial elucidation.

6.0 Data Presentation

Table 2 shows the tendering durations, costs and project durations78 federal building projects executed between 2007 and 2010 that were sampled. These projects are of varying complexities ranging from housing, educational to health projects.

Table 2 Costs and Durations of Sampled Projects Executed Between 2007– 2010.

S/N	Project type	Project Cost (₦)	Project Duration (Weeks)	Tendering Duration (Weeks)
1	Federal	64,320,334.39	20	2
2	“	172,000,715.60	36	2
3	“	33,333,830.25	12	2
4	“	69,207,390.00	24	2
5	“	217,453,689.50	36	4
6	“	181,999,881.00	30	4
7	“	118,989,937.00	40	3
8	“	5,366,496.93	12	2
9	“	38,699,480.00	12	2
10	“	68,748,216.00	14	2
11	“	28,886,471.25	10	2
12	“	7,688,114.00	6	2
13	“	300,251,415.78	48	4
14	“	4,411,744,958.08	104	6
15	“	1,419,280,338.00	96	6
16	“	743,911,518.00	52	4
17	“	311,766,661.53	48	4
18	“	262,722,177.90	44	3
19	“	690,411,022.95	52	4
20	“	5,001,785,839.05	96	6
21	“	18,867,283,615.14	152	6
22	“	3,509,327,405.00	104	6
23	“	1,956,593,550.89	80	6
24	“	2,132,646,231.79	104	6
25	“	1,155,557,448.00	104	4
26	“	79,181,245.50	40	6
27	“	12,456,700.00	16	2
28	“	13,055,004.59	12	2
29	“	9,180,733,046.00	120	6
30	“	10,185,327.70	12	3

31	“	230,415,967.00	40	3
32	“	87,340,180.91	24	3
33	“	12,509,775.30	12	3
34	“	23,355,209.00	16	3
35	“	32,545,435.00	24	2
36	“	45,578,342.50	24	2
37	“	604,415,386.26	52	6
38	“	450,250,065.00	48	4
39	“	600,014,085.50	52	6
40	“	11,578,959.81	12	2
41	“	22,952,729.01	12	2
42	“	32,003,067.60	12	2
43	“	924,701,193.16	72	6
44	“	6,412,799.26	6	2
45	“	15,013,386.61	8	2
46	“	27,010,596.90	12	2
47	“	29,971,950.75	12	2
48	“	177,185,277.85	40	3
49	“	21,600,744.90	16	2
50	“	28,390,960.90	24	2
51	“	20,908,900.00	12	2
52	“	604,488,209.96	52	4
53	“	4,960,000.00	6	2
54	“	556,545,433.50	52	6
55	“	23,163,327.73	12	2
56	“	12,825,598.52	8	2
57	“	413,508,774.33	48	4
58	“	9,530,393.57	12	2
59	“	9,622,389.45	10	2
60	“	12,571,113.00	10	2
61	“	35,256,090.72	14	2
62	“	20,091,007.00	10	2
63	“	3,936,600.00	8	2
64	“	8,748,000.00	8	2
65	“	12,150,000.00	8	2
66	“	6,739,200.00	8	2
67	“	6,998,400.00	8	2
68	“	3,664,926.81	8	2
69	“	7,290,000.00	8	2
70	“	10,223,181.72	8	2
71	“	9,204,545.16	8	2
72	“	51,501,670.50	24	2
73	“	10,564,180.96	12	2
74	“	25,391,431.72	16	2
75	“	40,525,247.23	24	2
76	“	5,284,320.00	10	2
77	“	17,209,357.15	12	3
78	“	24,302,550.75	10	3

Source: Federal Ministry of Lands Housing and Urban Development, Federal Capital Development Authority.

7.0 Data Analysis

Data collected was analyzed using the statistical tools of correlation and regression.
When the value of one variable is related to another, they are said to be correlated. Thus correlation simply means an inter-relationship or association (Lucey, 1999).Correlation can therefore be regarded as a form of

statistical analysis or test used to measure the degree of relationship between two sets of data i.e. to find out the relationship between two variables, one independent(X) and the other dependent (Y).For instance, the value of 'X' determines the value of 'Y'. Although correlation is a less powerful technique than regression, the two are closely related because correlation is a useful aid in interpreting regression.
The degree of relationship or correlation between two sets of variables is called the correlation coefficient (R). It is an index designed to given an immediate picture of how closely two variables move together. The strength of the relationship is measured on a scale that varies from +1 through-1The value of the correlation coefficient does not however provide evidence of any underlying causal factors. The study adopted the Pearson Product Moment correlation coefficient method, calculated by the formula:

$$R = n\sum xy - \sum x\sum y/\sqrt{[n\sum x^2-(\sum x)^2 (n\sum y^2-(\sum y)^2]} \ldots\ldots(1)$$

For the scores of the 2 variables to be highly correlated, the calculated value of R has to be ≥ critical value of R given in the table.

Regression analysis adopted in the study is the procedure by which an algebraic equation/mathematical function or model is formulated to estimate the value of the dependent variable given the value of the independent variable (Naoum, 1998). A statistical tool attempts to discover the nature of the relationship by calculating an equation that enables the value of one variable to be estimated when the value of the other is known. It is defined as the science of estimating in functional form, the dependence of one variable upon another. It is thus used to estimate the relationship between the dependent/response variable and the independent/explanatory variable.
For the study, the model relationship of variables found suitable of use is the quadratic regression, expressed by the equation:

$$y = a + bx + bx^2 \ldots\ldots(2)$$

The regression analysis yields the Coefficient of determination which calculates what proportion of the variation in the actual values of 'y' may be predicted by changes in the values of 'x. It is the square of the correlation coefficient, and is denoted by $R^{2.}$ It is a measure or proportion of the total variation (deviation) in Y (dependent variable) explained by fitting the regression. Thus, to find out how good the line of best fit really is, $R^{2\ \text{is}}$ calculated. In other words, it calculates the accuracy of the regression line. Thus R^2 would seem to give a more meaningful interpretation the strength of the relation between y and x than would the correlation coefficient.

In testing for significance, the test tools for the regression experiment are the F and P (Probability) test. In the F test, where the F value obtained or calculated is greater than F-tabulated, there is statistical significance and the null hypothesis is rejected and vice versa. The study however adopted the P-test (probability test) which is also used to check the ANOVA (analysis of variance) statistical significance. The P –ratio or P-value derived from the analysis is compared with the alpha level (0.05). If the P-value is less than 0.05 level of significance, there is a strong statistical correlation.

8.0 Results and Discussions

8.1 *Tendering Duration vs. Project Cost interpolation*
Table 3 shows the regression summary which was adopted in testing the first hypothesis: if a significant relationship exists between tendering duration allowed and project cost for the sampled projects.

Table 3 Regression analysis of Tendering Duration and Project cost.

a) Quadratic Model Summary

R	R Square	Adjusted R Square	Std. Error of the Estimate
0.725	0.525	0.512	1.043

The independent variable is Project cost.

b) ANOVA

	Sum of Squares	df	Mean Square	F	Sig.
Regression	90.191	2	45.096	41.446	0.000
Residual	81.604	75	1.088		
Total	171.795	77			

c) Regression Coefficients

	Unstandardized Coefficients		Standardized Coefficients	t	Sig.
	B	Std. Error	Beta		
Project cost	1.137E-9	0.000	1.885		
Project cost ** 2	-5.245E-20	0.000	-1.452		
(Constant)	2.574	0.129		19.907	0.000

From the result of the tabulated data analysis in the summary, it is deduced that there is a significant relationship between tendering duration and project cost. This is because with reference to the R value (coefficient of correlation) there is a strong positive correlation between the variables i.e. R= 0.73 or 73%. The degree of determination R^2 = 0.525 shows that 53% variation of the values in tendering duration could be explained or accounted by variation or changes in the values of project cost.
Furthermore, the P values (Sig) = 0.00 as derived from the analysis is less than the alpha value of 0.05 ($P< 0.05$) and thus shows statistical significance. This leads us to reject the null hypothesis (H_0) and accept H_1 thus, a significant relationship between tendering duration and project cost. Table 4 below is the summary of the output of the quadratic goodness of fit statistics between tendering duration and project cost.

Table 4: Tendering Duration- Project Cost. Model Summary and Parameter Estimates

Equation	Model summary						Parameter Estimates		
	R	R square	F	df_1	df_2	Sig	Constant	b_1	b_2
Quadratic	0.725	0.525	41.446	2	75	.000	2.574	1.137E-9	-5.245E-20

The quadratic regression approach is considered worthy of use for this study. It is a process by which the equation of a parabola of "best fit" is found for a set of data. The simplest method of fitting is the least-squares regression. The Least Squares Regression model (function) for Quadratic Curve Fitting is very common and gives a good approximation. It seeks to minimize the sum of the squares of the difference between the observed values and the predicted values. It is expressed thus:

$y_i = a + b_1x_i + b_2x_i^2$……...(3)

Where: y_i and x_i are the dependent and independent variables respectively, a = value of constant, b_1 and b_2 are the coefficients..
By substituting TD for y and C for x in equation 3, the quadratic regression model for this relationship is thus given by:

$TD = 2.574 + b_1C + b_2C^2$……. (4)

Substituting for b_1 and b_2 from the table, which are coefficients describing how tendering duration performance is affected or measured by cost, we have:

$TD = 2.574 + 1.137E\text{-}9C – 5.245E\text{-}20C^2$……...(5)

Where: TD is tendering duration for the project measured in weeks and C =Project cost
The purpose of a scatter diagram is to illustrate mathematically any relationship that may exist between the dependent and independent variables. The graph in figure 1 is based on the plot of data on tendering duration and project cost from the sampled projects. The regression curve depicts a quadratic function which has been defined by equation 5.

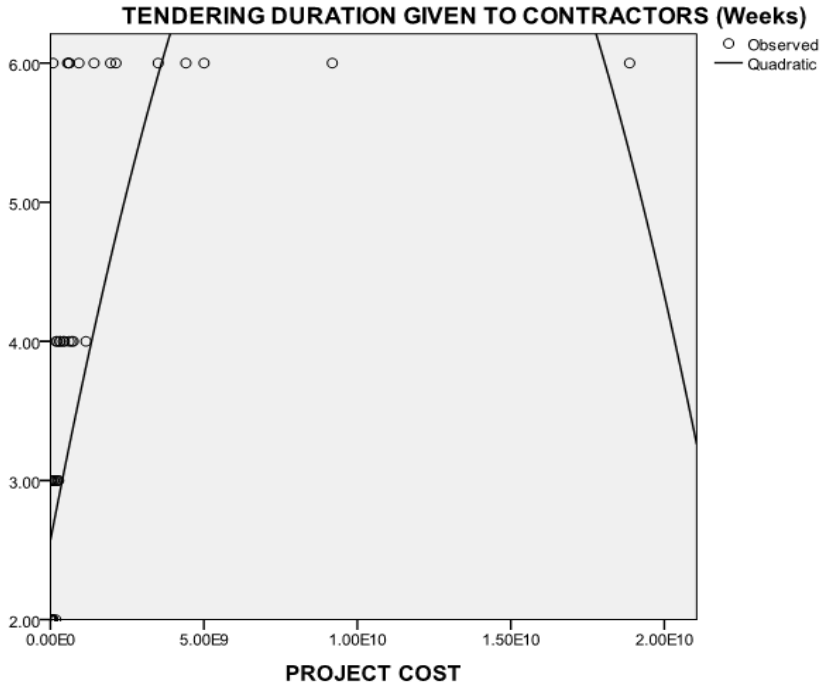

Figure 1 Plot of Tendering Duration Allowed versus Project Cost.

8.2 *Tendering Duration vs. Project Duration Interpolation*

Based on the hierarchy of hypothesized determinants, project duration is also a technical parameter used to determine tendering duration. Table 5 below is the summary output of the regression analysis showing the quadratic goodness of fit statistics between tendering duration and project duration.

Table 5 Regression analysis of Tendering Duration and Project Duration.

a) Quadratic Model Summary

R	R Square	Adjusted R Square	Std. Error of the Estimate
0.893	0.798	0.793	0.680

The independent variable is Project duration (weeks)

b) ANOVA

	Sum of Squares	df	Mean Square	F	Sig.
Regression	137.133	2	68.566	148.359	0.000
Residual	34.662	75	0.462		
Total	171.795	77			

c) Coefficients

	Unstandardized Coefficients		Standardized Coefficients	t	Sig.
	B	Std. Error	Beta		
Project duration	0.073	0.008	1.564	9.411	0.000
Project duration ** 2	0.000	0	-0.737	-4.437	0.000
(Constant)	1.299	0.153		8.506	0.000

The results of the analysis in table 5, shows an R value of 0.893 or 89%, which indicates a very strong positive relationship between tendering duration allowed and project duration . Also, the degree of determination R^2 = 0.798 indicates that 80% of variation in tendering duration is influenced by variation in project duration. The P-value (Sig) = 0.00 is less than the alpha value of 0.05, which shows a statistical significance that leads us to reject the null hypothesis and accept the alternative hypothesis. Thus, a significant relationship between tendering duration allowed for contractors and the project duration.

Comparing the R values of both statistical analysis, tendering duration -project cost = 0.73, while tendering duration-project duration= 0.89, it can be observed that though project cost factor is a significant, project duration is a more significant factor in determining tendering duration as its contribution is obviously higher. This observation may be due to the fact that construction costs in Nigeria which has been discovered to be among the highest in the world has several extraneous factors going into its computations and influencing final project costs.

Table 6: Tendering Duration- Project Duration Model Summary and Parameter Estimates

Equation	Model Summary						Parameter Estimates		
Quadratic	R	R square	F	df_1	df_2	Sig.	Constant	b_1	b_2
	0.893	0.798	148.359	2	75	.000	1.299	.073	.000

Table 6 reveals an admittedly large increase in R^2 from Model 1(Tendering duration-project cost) to Model 2(Tendering duration -project duration), which indicates that the latter model fits the data somewhat better than the former. Project duration is thus a stronger factor in determining tendering duration than project cost and thus more reliable.

By substituting TD for y and D for x in equation 3, the quadratic regression model for this relationship is thus given by:

$TD = 1.299 + b_1D + b_2D^2$…… (6)

Substituting for b_1 and b_2 from the table, which are coefficients describing how tendering duration performance is affected or measured by project duration, it gives:

$TD = 1.299 + 0.073D + 0.00D^2$……… (7)

Where: TD is tendering duration for the project measured in weeks and D, Project duration in weeks.

Figure 2 shows the plot of data on tendering duration and project duration from the sampled projects. The regression curve depicts a quadratic function which has been defined by equation 7.

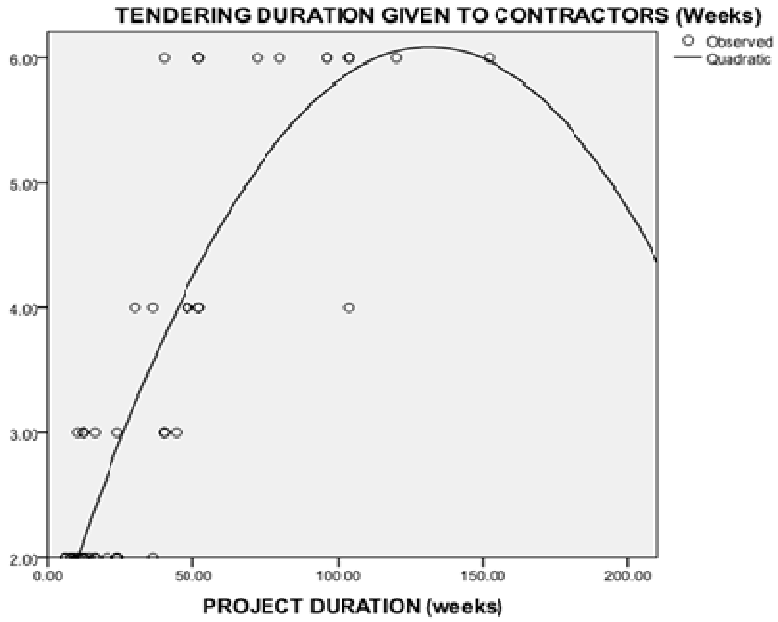

Figure 2 Plot of Tendering Duration versus Project Duration.

9.0 Conclusion and Recommendations

A critical study of the Nigerian Public Procurement Act revealed that there appears to be no common guideline for determining duration for preparation and submission of tenders for contractors executing federal government building projects in Nigeria. Section 25(ii) of the Act merely stipulated a minimum period of six weeks for this activity. The implication of this stipulation is that, provided the benchmark of six weeks is not violated, any length of time for tender submissions can be fixed irrespective of project complexity, scope or category. This ugly scenario can be obviated by the application of more scientific criteria for example the tendering duration-project duration model (which was found to be a stronger relationship than the tendering duration-project cost model) derived from the study. Several additional samples can be included in the experiment that could yield a national model. Other project complexity factors such as floor area, volume, height/number of floors can be used to derive complimentary models of tendering duration for public projects.

From the foregoing, it is recommended that public clients should formulate the various categories of building projects based on complexity factors of cost and duration, thus adopting the models proposed by the study in order to achieve standards, efficiency in project planning and transparency in the tendering system.

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