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Evaluation of Project Management on Successful Construction Project Delivery in the Nigerian Construction Industry

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ABSTRACT
The construction project encompasses many variables that interplay to deliver the project. The variables highlighted by the construction Management Association of America were grouped into seven categories, namely, project management, planning, cost, time, quality, contract administration, safety and professional practice. The project management was the independent variables and the others as dependent variables. A research survey through questionnaire was used to generate data from project construction professionals. The responses from the 44 respondents was used in the analysis using regression analysis, ANOVA, Students t test to assess the relationship among the variables on successful construction project delivery. The variables accounted for 72.57 percent of successful construction project delivery. Further work need to be done to establish the variables of the residual 27.43 percent.

KEYWORDS*: Construction, Project, Cost, Time, Quality, Performance, Successful*

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I. INTRODUCTION

There is need for creative conversion of resources into project asset through effect organization, planning, scheduling and controlling the fieldwork to achieve the constrain of project time, cost and quality. This is the responsibility of the project manager in the construction industry. However, the resources in achieving the success parameters in a construction project is always limited hence Jha and Iyar (2006) stated that in the realm of project management, the schedule, cost and quality achievement also referred to as the iron triangle are hardly achieved. Achieving the schedule and cost objectives, project quality is sometimes overlooked leading to project failure. It is only through a well planned project management that the three aspects of project objectives will be actualized. The success of any construction project is attributed to the proper management role of the project manager in putting together available resources. Considering the process of managing the competing demands and trade - offs between the desired result of the construction project (scope, performance, quality) and the natural constraints of the project (time & cost) and the nature of construction activities, the project manager often has to take action quickly on his own initiative. Sears, et al (2008) stated that the ineffectiveness of project managers in construction projects are due to:

(a) low background of practical construction experience.

(b) those persons with no expertise and experience in the application of specialized management techniques.

(c) no capacity to step back from the complex details of daily construction operation and look into the future problem areas; and

(d) not having the personality and insight that will enable him to work harmoniously with other people, often under very strained and trying circumstances.

The Nigeria Construction Sector is often criticized with delays, budget overruns, low productivity and quality problems. This reflects inefficiency in the use of project management tools. Nigeria construction industries have often been sidelined in large scale construction activities. This has been attributed to a number of factors such as mismanagement of funds and working capital which makes them prone to bankruptcy, with poor project execution and abandonment as the likely outcome. Apart from the mismanagement of funds by the firms, most construction projects in Nigeria are characterized by inadequate project objectives, inadequate details in the working drawings, the fact that designs are most of the time separated from the actual construction,

demands for the drawings and designs to be detailed enough. The common challenges facing project managers in Nigerian Construction Industry include:
- Inadequate project Objectives
- Design complexity
- Poor workmanship
- Non compliance of design with Government Regulation.
- Inflation
- Aesthetics

Construction project involve thousand of details and integrated inter-relation among owners, architects, engineers, builders, quantity Surveyors, project financiers, general contractors, special contractors, manufacturers, material dealers, equipment distributors, Government bodies and agencies, labour and others. The construction Management Association of America following this integrated inter-relation listed 120 common responsibilities of a construction manager and grouped them into seven categories namely:
(i) Project Management planning
(ii) Cost management
(iii) Time management
(iv) Quality management
(v) Contract administration
(vi) Safety management
(vii) Construction management professional practice.
Hence, each person's role and responsibilities on the project need to be defined by the project manager in any construction project.

Cooke-Davis (2002) Listed ten criteria necessary to measure the performance of a construction project namely time, cost, health and safety, profitability and quality, technical performance, functionality, productivity, satisfaction, environmental sustainability and were regarded as objective measures. It is only experienced and trained project managers that will surpass the objective of the construction project demands and the responsibilities associated with project management in the construction project delivery.

A construction project is termed unsuccessful even when completed within the critical success parameters namely cost, schedule and specification but with a record of site accident arising from unsafe site conditions. The same applies to conflict and lack of goodwill in construction projects arising from poor construction contract administrative planning. One of the areas of unsuccessful construction project delivery is the construction management professional practice, following the non-appointment of competent personnel to oversee the project from the inception to completion with adequate authority and maintaining international best practices.

The objective of this study is to evaluate the contributions of each category of the construction project management according to the construction management Association of America and to make recommendations for improving on the successful construction project delivery, in Nigeria.

Method of Study

A survey research was adopted in this work. Data for the study was generated through questionnaire and observations.

The questionnaire was structured in two sections. Section 'A' was the demography of the respondents. Section 'B' was the factors on successful construction project delivery. The respondents were asked to rank the significance and severity of factors on successful; construction project delivery using 5 point Likert type score 2 as strongly agree, 1 as agree, 0 as undecided, -1 as disagree and -2 as strongly disagree.

After completing data collection, responses were validated, uncompleted responses were considered invalid.

The consultants were mainly project managers, engineers, architects, quantity surveyors, builders. The contractors include representative in large, medium and small sized construction companies designated as site agents or site engineers. The client organization include private developers, state and federal government agencies and some Parastatals that were investing in construction projects.

Seven basic questions as shown in Appendix one were asked and the numerical summation of the ratings of a respondent formed the observed value for the variable for the particular respondent. This was repeated for all the variables and all the respondents. All these now formed the distribution for the independent variables. The same was done for the assessment of the state of project management on successful construction project delivery as applicable to construction industry in Nigeria which formed the dependent variable.

II. DATA ANALYSIS TECHNIQUE

Linear regression model was adopted for analysis. Its formations are as follows:

$Y = A_0 + B_1x_1 + B_2x_2 + \ldots\ldots B_nx_n + e_0$ ------------------------- (1)

Where

$A_0, B_1, B_2 \ldots\ldots\ldots B_n$ represents the coefficient to be estimated

Y: is the dependent variable which represents an assessment of the state of project management on successful construction project delivery

X_1 : Assessment of construction contract administrative planning
X_2 : Assessment of construction time management planning
X_3 : Assessment of construction management professional practice
X_4 : Assessment of construction cost management planning
X_5 : Assessment of construction quality management planning
X_6 : Assessment of construction safety management planning

The regression parameters were computed using the following formulae:

$$B_1 = \frac{N\Sigma X_1Y_1 - [\Sigma X_1][\Sigma Y_1]}{N\Sigma X_1^2 - [\Sigma X_1]^2} \quad \text{-----------------} (2)$$

And

$$a0 = \frac{\Sigma Y1 - B_1\Sigma X_1}{N} \quad \text{-----------------} (3)$$

The correlation coefficient [R] is determined using:

$$R = \frac{N\Sigma X_1Y_1 - [\Sigma X_1][\Sigma Y_1]}{\sqrt{[N\Sigma X_1^2] - [\Sigma X_1]^2][N\Sigma Y^2 - [\Sigma Y_1]^2]}} \quad \text{---------------} (4)$$

The coefficient of determination is determined using the formula:

$$R^2 = \frac{SSR}{SST} \quad \text{-----------------} (5)$$

qual to: SSR + SSE

Where

$$SSR = \frac{B_1[\Sigma X_1Y_1] - [\Sigma X_1 \Sigma Y_1]}{N} \quad \text{-----------------} (6)$$

----------------- (8)

And

$$SST = \Sigma Y^2 - \frac{[\Sigma Y_1]^2}{N} \quad \text{-----------------} (7)$$

----------------- (9)

Where "n" is the number of observations for each of the projects.

The R^2 [coefficient of determination] measures the proportion of the total variation in the assessment of project management on successful construction project delivery, that is, our dependent variable [Y], that is explained by the variations in the selected aggregates of project success, that is, the independent variables, put together.

The value of R^2 is expected to range from:

$O \leq R^2 \leq \pm 1$

The Correlation Coefficient [R]

The multiple correlation coefficient [R] measures the strength of contribution of the selected aggregates of construction project success on the level of application of project management.

This is calculated using the formula:

$R = \pm \sqrt{R}$

Where:- $1 \leq R \leq +$ --------------- (10)

The F-Ration Test

The F-ratio is used to test the significance of the contribution of all the selected variables of construction project cost control on the control of the cost of construction projects in Nigeria.

This is carried out using the analysis of variance table (ANOVA)
ANOVA TABLE

Source of variance	Sum of squares	Degree of Freedom	Mean Squares	F-Rato
Regression	SSR = $R^2\ \Sigma Y^2$	K	MSR = SSR	F* = MSR
Error	SSE = $\Sigma Y^2 - R^2\ \Sigma Y^2$	n – k – 1	MSE = SSE	
Total	SST = $\Sigma Y^2 - [\Sigma Y]^2$	n – 1		

Source: Onyeka (1990).
Having computed the F-value, the null hypothesis [H_O] is accepted at ∞ - 0.05 significance level if: F* < F_1 - ∞: k, n-k-1 degrees of freedom.

Otherwise, H_O is rejected in favour of the alternative hypotheses [H_A] for a one-tail test. Here, F_1-∞: k; n-k-a is the critical value obtainable from the F-distribution table.

The Student T – Test
If the F-ratio test reject the null hypothesis, that is, accepting that the selected aggregates of construction project management made a significant contribution to the variation in the control of the construction projects success, then the student's T-test is carried out to find out which of the selected aggregates of construction project management contributed to the significance established by the F-ratio test.

The T-test value is calculated using the formula:

$$T = R\sqrt{n-2} \over 1-R^2$$

for n – 2 degrees of freedom

The null hypothesis [H_0] that is b = 0 is accepted at ∞ = 0.05 significant level and
n – k – 1 degrees of freedom if:
t cal < $t_{1-\infty/2}$: n – k – 1

Where
T1 - ∞/2 n – k – 1 is the critical value obtainable from the t-distribution table. Otherwise, the alternative hypothesis [H_A], that is, B1≠ O is accepted if; t-calculated ≥ $t_{1-\infty/2}$ n – k – 1

Table 1: Summary of Weighted Scores for Analysis

S/N	Y	X1	X2	X3	X4	X5	X6	
1	7	2	24	24	26	21	19	
2	14	19	19	20	20	20	20	
3	25	23	24	24	23	23	23	
4	25	24	24	24	26	25	25	
5	11	15	20	20	21	22	20	
6	17	19	19	19	22	22	20	
7	9	16	8	8	14	13	12	
8	8	23	26	26	21	18	23	
9	12	21	22	22	21	22	22	
10	16	18	21	19	20	22	20	
11	25	26	24	22	26	21	24	
12	14	19	20	3	20	20	16	
13	25	23	24	24	23	23	23	
14	25	24	24	22	26	25	24	
15	11	15	20	22	21	22	20	
16	17	19	19	25	22	22	21	
17	11	16	8	12	14	13	13	
18	8	23	26	22	21	20	22	

19	12	21	22	22	21	22	22	
20	16	18	22	20	20	22	21	
21	14	19	20	3	20	21	17	
22	25	23	24	24	23	23	23	
23	25	23	24	22	26	25	24	
24	11	15	20	22	21	22	20	
25	17	19	19	25	22	22	21	
26	11	16	8	12	14	13	13	
27	8	24	26	22	21	18	22	
28	12	21	22	22	20	22	21	
29	16	18	22	20	20	22	20	
30	14	19	20	4	21	21	17	
31	25	24	24	24	23	23	24	
32	25	24	24	22	26	25	24	
33	11	15	20	22	21	22	20	
34	17	19	19	25	22	22	21	
35	11	16	8	12	14	13	13	
36	8	24	26	22	21	18	22	
37	9	21	22	22	21	22	22	
38	16	18	22	20	20	21	20	
39	11	15	20	21	21	22	20	
40	17	19	19	25	22	22	21	
41	11	16	8	12	14	13	13	
42	8	23	26	22	21	18	22	
43	12	21	22	22	21	22	22	
44	16	18	22	20	20	21	21	
Total	658	854	903	867	923	911	893	

III. DISCUSSION

The numerical summation of the ratings of the respondent that formed the observed value are as shown in Table 1. The mean of the observed value are:

Table 2: Descriptive Statistics

Variable	Mean	Standard Deviation	Sample Size
Y	14.95455	5.866	44
x_1	19.40909	4.156	44
x_2	20.52273	5.037	44
x_3	19.70455	5.963	44
x_4	20.97727	3.144	44
x_5	20.70455	3.246	44
x_6	20.29545	3.310	44

Source: Computer Analysis of Table 1

x_4 Assessment of construction cost management has the highest value with a mean value of 20.977. The dependent variable Y had the least value of 14.955. The implication is that attention on successful construction project delivery is more on cost management than any other variable.

Also the variable with the least standard deviation Y, the independent variable the assessment of the state of project management on successful construction project delivery. While the variable with the highest standard deviation is x_3 which is the assessment of construction management professional practice. As shown by the information in Table 1, the minimum and maximum standard deviation justified that the background of respondents matters in their opinion towards the factors of project management on successful construction project delivery.

A construction project encompasses many variables that interplay to deliver the project. Out of the common responsibilities of a construction manager highlighted by the construction Management Association of

America and grouped into seven categories and subjected to multiple regression analysis using equation 1. The rationale is to determine the contribution or role of each variable in the final output of a successful construction project delivery. The details of Y and x_n are fully explained in equation 1.

The computed multiple analysis coefficient r, is 0.8519, see Appendix 3. This indicates a very high positive relationship. This means that the state of project management on successful construction delivery is enhanced by co-ordinated cumulative performance of the six dependent variables. In other words, as these dependent variables symbiotically function optimally, the higher the success in construction project delivery.

Using the student's t-test model and substituting for r and 4 degrees of freedom, the t-statistic is 3.253. Testing at 95 percent confidence limit $(\alpha = 0.05)_4$ the critical value is 2.132. It is hypothesized in the null that the result of the analysis is not reliable. Since the t-statistic is greater than the critical value, the null hypothesis is rejected. It is then affirmed that the result of the multiple regression analyses is reliable.

To ascertain the contributory role of the six variables, the regression coefficient is square. The result is 0.7257. This 0.7257 is the coefficient of determination. This means that the six variables, X_1 to X_6 account for 72.6 percent of the variation in the assessment of the state of project management on successful construction project delivery. The residual of 27.4 percent of successful construction project delivery is yet to be accounted. The inference is that more variables from the possible 120 are yet to be included in the analysis. This calls for more research.

A mathematical model ensuring can be defined as:

$Y = b_1x_1 + b_2x_2 + b_3x_3 + b_4x_4 + b_5x_5 + b_6x_6 + C$

Where Y is the independent variable

x_1 to x_6 are the dependent variable

b_1 to b_6 are the coefficient of the x^s

C is the constant which is the point where the line of best fit cuts the Y axis on a Cartesian plane, and that is the residual and equal to 24.7.

To push the analysis further, the data were fed into the Analysis of Variance (ANOVA) model and computed. It is hypothesized that there is no significant difference in the variability of the independent variables and in the analysis. The computed F-statistic has a value of 16.32. Testing at 95 percent significance limit at $^6/_{37}$ is 3.12. This indicates that the f-statistics is greater than the critical value. The null hypothesis is therefore rejected. The alternative hypothesis of significant difference in the variability of the variables is accepted. Consequently, it is safe to conclude that the six independent variables are relevant contributors to the state of project management on successful construction project delivery.

IV. RECOMMENDATIONS

1. The six independent variables listed as x1 to x6 are relevant contributors to the state of project management on successful construction project delivery.
2. There is need to investigate on the residual of 24.7 percent that is not among the variables listed for successful construction project delivery.
3. Experienced construction project manager are needed from the inception of a construction project till the completion of the project.

V. CONCLUSION

The role of project mangers in successful construction project delivery can not be under estimated. All the variables associated with successful construction project delivery essential considering the outcome of the regression analysis. A drop in any of the variables will affect the successful project delivery. Construction projects are not only concerned with cost, time and quality but with other variables that will enhance successful construction project delivery.

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Appendix 1
Questionnaire

Please tick 2 for Strongly agree
1 for Agree
0 for Undecided
-1 for Disagree
-2 for Strongly disagree

	Variables	Options				
No.		**2**	**1**	**0**	**-1**	**-2**
1	There is lack of project management in construction project delivery					
2	Construction projects delivery has failed due to lack of project time planning					
3	Construction projects delivery has failed due to lack of construction project cost planning					
4	Construction projects delivery has failed due to lack of construction project quality					
5	Construction projects delivery has failed due to poor construction project contract administration					
6	Construction project delivery has failed due to lack or safety management in construction projects					
7	Construction projects delivery has failed due poor construction management professional practice					
	Contract Administration					
1	Contract procurement options					
2	Conflicting agenda's and objectives					
3	Fixed mindsets and recycling old solutions					
4	Issue of design information which is late and /or inadequate and /or incomplete					
5	Employer's rules for site operations					
6	Management of the construction project					
7	Contractor selection procedure and supply chain management					
	Time Management Planning					
1	Unrealistic contract durations					
2	Shortage of qualified workers/construction materials					
3	Unpredictability of weather					
4	Deficiencies in contractors organization					
5	Unforeseen contingencies and their effect on schedule					
6	Programme not prepared in different levels (master plan, weekly plan, daily plan)					
7	Variation and change orders and their effect on schedule.					
	Professional practice					
1	Lack of experience and reputation of the contractor					
2	Inadequacy of the contractors quality control system					
3	Inadequacy of contractors equipment for the size of the project					
4	Lack of pre-constitution planning using modern techniques					
5	Inadequate of managerial competence/skilled staff					
6	Inadequate or incompetent designs/documentation					
7	Unforeseen circumstances					
	Cost management					
1	Initial cost estimating errors					
2	Prime cost and provisional seams due to minimizing specialist works					
3	Inadequate established and systematic cost control procedure					
4	Not forecasting the cost effect of a decision before implementation					
5	Fluctuations in material, labour and plant cost (inflation)					
6	Computers rarely employed for cost control					
7	Attitude of project team and client towards cost control					
	Quantity management					
1	Use of sub-standard material					
2	Inadequate technical managers and supervisors					
3	Inadequate equipment to achieve specified quality					

4	Inadequate testing of materials					
5	Inadequate inspection					
6	Incomplete detailed design/specifications					
7	Inadequate quality control procedure in contractor's organizations					
	Safety Management					
1	Failure to control and tell others about exciting conditions					
2	Use of tools as a manner not intended					
3	Ignoring posted safety warning or notices					
4	Unavailable personal protection equipment					
5	Working at height without proper equipment					
6	Inadequate or poor proper house keeping					
7	Using tools that have not been maintained or serviced properly.					

Appendix 2

Descriptive Statistics

	Y	X1	X2	X3	X4	X5	X6
Mean	14.95455	19.40909	20.52273	19.70455	20.97727	20.70455	20.29545
Standard Erroi	0.8874	0.626509	0.759359	0.899013	0.473939	0.489401	0.499026
Median	14	19	22	22	21	22	21
Mode	25	19	24	22	21	22	20
Standard Devi	5.886344	4.155793	5.037019	5.963375	3.143755	3.246318	3.310164
Sample Varian	34.64905	17.27061	25.37156	35.56184	9.883192	10.53858	10.95719
Kurtosis	-0.71632	5.760598	2.137374	2.204929	1.09022	1.43914	0.868056
Skewness	0.704914	-1.59759	-1.63381	-1.73641	-0.71201	-1.39735	-1.20758
Range	18	24	18	23	12	12	13
Maximum	25	26	26	26	26	25	25
Minimum	7	2	8	3	14	13	12
Sum	658	854	903	867	923	911	893
Count	44	44	44	44	44	44	44
Geometric Me	13.90324	18.56897	19.61842	17.99698	20.72099	20.40616	19.98382
Harmonic Mea	12.96434	16.12785	18.28401	14.64901	20.43296	20.04878	19.61641
AAD	4.811983	3.055785	3.451446	4.229339	1.985537	2.338843	2.391529
MAD	3	3	2	2	1	1	1
IQR	6	5.5	4.25	2.5	2	2	2

Regression Analysis

OVERALL FIT	
Multiple R	0.851891
R Square	0.725718
Adjusted R Squ	0.68124
Standard Erroi	3.323361
Observations	44

AIC	112.062
AICc	116.1763
SBC	124.5513

ANOVA — Alpha 0.05

	df	SS	MS	F	p-value	sig
Regression	6	1081.254	180.209	16.31629	4.42E-09	yes
Residual	37	408.655	11.04473			
Total	43	1489.909				

	coeff	std err	t stat	p-value	lower	upper	vif
Intercept	-24.4016	4.326044	-5.64064	1.93E-06	-33.167	-15.6363	
X1	0.914243	0.352034	2.597033	0.013414	0.200955	1.627531	8.332771
X2	-0.96316	0.358117	-2.68952	0.010669	-1.68878	-0.23755	12.66805
X3	0.096045	0.324055	0.296385	0.768594	-0.56055	0.752642	14.53899
X4	1.535823	0.45442	3.379746	0.001722	0.615082	2.456565	7.945566
X5	1.023335	0.456247	2.242943	0.030976	0.098892	1.947779	8.540728
X6	-0.68583	1.559756	-0.43971	0.662708	-3.8462	2.474531	103.7829

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