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ANALYSIS OF FACTORS OF DELAY IN ROAD CONSTRUCTION AND OTHER PROJECTS IN IMO STATE

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ABSTRACT

This paper is aimed at identifying various factors responsible for road construction delays. From literature 165 common factors causing delays were identified. A survey were carried out amongst selected experienced personnel for expert opinion to identify the significant factors causing road construction and other projects delays in Imo State, Nigeria. 436 responses were collected from each of the respondents groups including client, consultant and contractor covering the Senatorial zones of Imo State. The questionnaire responses were analyzed by exploratory factor analysis method, which resulted in identification of 58 common factors causing road construction delays. Results show that that Poor site practices exhibits the highest rotated loading factor 0.950, followed by Contractor selection method of 0.964, Delays in contractor's progress payment by owner of 0.878, Excessive overtime of 0.959, Design changes by owner or his agent during road construction of 0.867, Uncooperative owners of 0.913, Weather effect of 0.869, Equipment failure of 0.861, Building permits approval process of 0.871, Materials changes in types and specifications during road construction of 0.803 and Transportation delays of 0.892 factor loading in technical, quality management, financing, human resources, changes, contractual relationships, environment, equipment, rules and regulations, materials and scheduling and control factors respectively.

KEYWORDS: Delay, Construction, Road, Factor Analysis and Projects.

I. INTRODUCTION

Background to the Study

However, various research efforts as it relates to factors of delay in road construction and other projects were extensively surveyed, noting key factors contributing to construction delays in different parts of the world. In addition, perceptions of construction practitioners on how important are the causes of delays globally was fully explored. An extensive survey of global categorization of construction delays was carried out with particular reference to their respective causes. In all these, no particular reference was made to the wide range of variables considered in this work. This paper is empirical in all respects and the template for overcoming major factors of delay in road construction project was suggested.

[12] examined the causes of delay and cost overruns by examining data relating to construction projects in Nigeria. [2] studied the main causes of delay in large building projects in Saudi Arabia and their relative importance. According to [2], the largest number of causes of delay (56 causes) was listed and the respondents were asked to point out their degree of importance. The authors grouped the delay factors into nine major groups: financing, materials, contractual relationships, project changes, government relations, manpower, scheduling and control, equipment, and environmental factors. The financing group of delay factors was selected as the most significant delay factor by all parties and that environment group was selected as least significant. In a study by [14] to determine the most significant causes of construction delays with traditional type of contracts with regard to contractors and consultants, it showed that owner interference, inadequate contractor experience, financing and payments, labor productivity, slow decision making, improper planning, and subcontractors are among the top ten most significant causes of delays.

The importance of the construction industry is not limited to the different measures of economic development alone, slumps or upsurges in its activities, have a high multiplier effects on almost every phase in the social and economic structure of the nation. It has been concluded that the high cost of house ownership in Nigeria and other housing problems of the lower income groups are results of the defect in the construction industry [7]. "There is no gainsaying doubt that the problems of cost and time overruns may not yet be over as they still characterize construction projects in most parts of the world especially in developing countries like Nigeria"[16]. In Nigeria, cost and time overruns are common occurrences in the construction industry and these have continued unabated [15]. This is no exception to the case of schedule delay, as schedule delay contributes to time and cost overruns [11]. Earlier studies have shown that schedule delay costs vary between 3 and 15 per cent of project's contract value [5], [8]. Also [1] stated that: up to 30% of construction is schedule delay, labour is used at only 40-60% of potential efficiency and at least 10% of materials are wasted. It was posited that schedule delay costs could be significantly higher than figures reported in the previous literature [10]. Indeed [3] suggested that schedule delay costs could be as high as 23 per cent of the contract value.

In some studies, [6],[9],[13] asserted that an excusable delay can be classified as "excusable compensable" and "excusable non-compensable". As [13] reports that compensable delays are caused by the owner or the designer (engineer or architect). The contractor is typically entitled to a time extension or recovery of the costs related with the delay, or both. Factors which are specified in the contract resulting in delays such as differing site conditions, changes in the work, access to the site are some examples of compensable delays. According to [17] only excusable delays may be compensable. The authors further explain non-compensable delays as those which despite being excusable do not entitle the contractor to any compensation. Many authors such as [4],[13], point out that excusable non-compensable delays are normally beyond the control of either owner or contractor such as unusual weather conditions, natural disasters, wars, national crises, floods, fires or labor strikes. They add that usually the contractor is entitled to a time extension, but not additional compensation.

The main objective of this paper was to analyze the factors of road construction delays on project completion duration. The specific objectives of the study are: to identify and evaluate the variables of the factors responsible for schedule delay on road construction and other projects, to compare the impacts with those of other factors; and to assess the relationship of the identified factors.

II. METHODOLOGY

The questionnaire was structured in way that variables regarded as contributor to each of the factor were separated and well captioned under the appropriate heading. 165 variables were identified in all. The 500 copies of questionnaire were prepared to take care of the data to be sourced and to provide the respondents the opportunity to score the factors or variables which is capable of contributing to the scheduled delay in the some road construction projects in the senatorial zones of Imo State and 436 copies of questionnaires were returned and analysed. The following road construction projects are surveyed in this study: Bridge connecting Old Nekede and New Nekede, Egbeada Overhead Bridge. Naze Industrial Clusters, Oguta Lake Resort projects, Okigwe regional water scheme, Afor Umunna/Umuduru/Arondizuogu Ideato road, Ahiara Junction – Okpala Junction road, Iho-Ogwa-Amauzari-Amaigbo road with bridge, Imo State street gate project and Oguta Oku Refinery. The following five levels of scoring was adopted using Likert scale 'Extremely Significant' (5 points), 'Very Significant' (4 points), 'Moderately Significant' (3 points), 'Slightly Significant' (2 points) and 'Not Significant' (1 point).Respondents were required to score only the factors that influence the delay as it affects such projects.

Factor analysis is employed to condense large number of variables with a view to identifying the underlying variables that really explains the pattern of correlation with a set of observed variables. The main essence of factor analysis is to describe the covariance relationship among large number of variables in terms of a few groups. Factor analysis model specifies that variables are determined by common factors (the factors estimated by the model) and unique factor which (do not overlap between observed variables); with the assumption that all the unique factors calculated correlate with each other and with the common factor. In addition, one sample t-Test and correlation model was employed to test the hypotheses in the paper.

III. RESULTS AND DISCUSSIONS

Rotated Factors for Delays in Road Construction and Other Projects

To simplify the interpretation of factors, varimax method of rotation with Kaiser Normalization was used to reproduce calculations generating the final solution to the problem, with an orthogonal rotation method that minimizes the number of variables that has high loading on each factor. The criterion for grouping of the factors was also based on the principle that a variable that exhibits highest loading with value greater than 0.50 in one component belongs to that component. The underlying structure of the factors studied has been revealed by a careful inspection of the clustering of factor scores during the rotation process. The revealed structure consists of ten key factors identifying causes of delay in construction.

Considering the component in each factor/group that have the highest loading with value greater than 0.50 in any component of the factors, it is obvious that Poor site practices exhibits the highest rotated loading factor 0.950, followed by Contractor selection method of 0.964, Delays in contractor's progress payment by owner of 0.878, Excessive overtime of 0.959, Design changes by owner or his agent during road construction of 0.867, Uncooperative owners of 0.913, Weather effect of 0.869, Equipment failure of 0.861, Building permits approval process of 0.871, Materials changes in types and specifications during road construction of 0.803 and Transportation delays of 0.892 factor loading in technical, quality management, financing, human resources, changes, contractual relationships, environment, equipment, rules and regulations, materials and scheduling and control factors respectively

From the condensed variables, the analysis only precipitated 45 variables that really explain the pattern of correlation with a set of observed variables. Meaning only 58 of the 165 observed variable contributed to road construction delays of the studied projects. Following from the above analysis, it seems reasonable to infer that the data set for the present study is strong. The observation would seem to be supported by the uniformly high communalities recorded which have exceeded the more common magnitudes in social sciences of low to moderate communalities of 0.40 to 0.70. Though, the findings relates Nigerian experience but corroborated the results of the previous studies in the UK, Australia and Indonesia. Further research should be carried out in the other states of federation both on public and private projects to have a better understanding of the menace of delays in road construction and other projects and probably reduce if not total elimination.

Test of Research Hypotheses

The following hypotheses were formulated for the study: H_{01}: Delays in constructions are not man-made or environmentally induced.H_{02}: There is no interrelationship among key factors contributing to delay of road construction projects.Ho_3: Each of the salient variation (changes) factors of project plan does not contribute significantly to delay in road construction projects. These three null hypotheses were tested at 5% level of significance. T-test was used for H_{01} and H_{02} and Spearman's rank correlation model was used for H_{03}.

Based on the decision rule, if their respective observed t-value is greater than table t-value (sig) at 5% (1.645) (See tables 1 and 2), the null hypotheses will be rejected in favour of the alternative hypotheses and vice versa. Hence for H_{01} the null hypothesis is rejected, implying that delays to road construction projects are man-made as well as environmentally designed. In H_{02} most of the key factors contributing to delay in road construction projects are interrelated (significant ones are flagged *or **). Though their correlation coefficients are positively or negatively weak. (See table 4). In the case of H_{03}, two salient variation (changes) factors contribute significantly to delay in road construction projects (i.e. Foundation conditions encountered in the field and Design changes by owner or his agent during construction). However, a geographical problem at site does not contribute significantly to delay of road construction projects. (See table 3)

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Table 1: One-Sample T- Test for Human Resource Factors

	Test Value = 3					
	t	df	Sig. (2-tailed)	Mean Difference	95% Confidence Interval of the Difference Lower	Upper
Excessive over time	-13.829	435	.000	-.548	-.63	-.47
Staff turnover	-91.446	435	.000	-1.789	-1.83	-1.75
Unpredictable factors from different sources	-11.806	435	.000	-.369	-.43	-.31
Labor injuries	-49.665	435	.000	-.885	-.92	-.85
Alteration	-22.643	435	.000	-.979	-.89	-1.06
Disturbance in personnel planning	-64.353	435	.000	-1.177	-1.21	-1.14
Labor and management relations	-9.583	435	.000	-.174	-.14	-.21

Table 2: One-Sample T-Test for Environmental Factors

	Test Value = 3					
	t	df	Sig. (2-tailed)	Mean Difference	95% Confidence Interval of the Difference Lower	Upper
Social and cultural factors	-37.824	435	.000	1.128	-1.07	-1.19
Weather effect	-8.050	435	.000	-.213	-.27	-.16
Flood	-46.798	435	.000	-1.667	-1.74	-1.60
Hurricane	-44.061	435	.000	-1.596	-1.67	-1.53

Table 3: One-Sample T-Test for Salient Variation (Changes) Factors

	Test Value = 3					
	t	df	Sig. (2-tailed)	Mean Difference	95% Confidence Interval of the Difference Lower	Upper
Foundation conditions encountered in the field	-6.630	337	.000	-.231	-.30	-.16
Design changes by owner or his agent during construction	76.551	337	.000	1.071	1.04	1.10
Geological problems on site	.585	337	.559	.015	-.03	.06

Friedman Analysis of Extracted Key Factors of Delay in Road Construction and Other Projects in Imo State

The Friedman chi-square tests the null hypothesis that the ranks of the variables do not differ from their expected value. For constant sample size, the higher the value of this chi-square statistics the larger the differences between each variable rank sum and its expected value. Because the chi-square of 14386.571 for constructions projects with 58 degree of freedom are unlikely to have arisen by chance, the 436 respondent interviewed do not have equal opinion on delay factors in constructions. The asymptotic significance is the approximate probability of obtaining a chi-square statistics as extreme as 14386.571 road construction projects with 58 degree of freedom in repeated samples if the rankings of factors of road construction delays are not truly different. Hence, this is satisfied in the study.

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Table 5 Extracted Key Factors of Delay in Road Construction and Other Projects in Imo State

Order of Importance	**Factors of Delay In Road construction and Other Projects in Imo State**	Mean Rank
1	Poor instructions	50.12
2	Equipment failure	49.93
3	Inadequate funding	49.07
4	Transportation delays	48.78
5	Delays in contractor's progress payment by owner	47.51
6	Inadequate resources	44.52
7	Incomplete information	44.31
8	Poor planning and scheduling of work load	43.50
9	Judgment and experience of the involved people in estimating time and resources	43.36
10	Defective materials	43.11
11	Slowness of the owner decision making process	42.81
12	Social and cultural factors	42.19
13	Insufficient communication between the owner and designer in design phase	41.65
14	Obtaining permits from municipality	41.58
15	Project delivery systems used (design-build, general contracting…etc.)	41.57
16	Uncooperative owners	41.12
17	Materials changes in types and specifications during construction	41.11
18	Equipment productivity	40.72
19	Shortage in equipment	40.57
20	Design changes by owner or his agent during construction	40.07
21	Alteration	40.00
22	Contractor selection method	39.19
23	Building permits approval process	39.08
24	Checking procedures	38.50
25	Non-utilization of professional construction/contractual management	38.28
26	Non-adherence to contract conditions	37.29
27	Traffic control regulation practiced in the site of the project	28.94
28	Preparation of scheduling networks and revisions by consultant while road construction is in progress	28.68
29	Labor and management relations	28.28
30	Geological problems on site	25.73
31	Insurance requirement	25.66
32	Safety rules	25.46
33	Change in specification by client	24.98
34	Conflicting information	24.73
35	Foundation conditions encountered in the field	23.97
36	Waiting for sample material approval	23.57
37	Imported materials and plant items	23.14
38	Timeliness of project information	23.07
39	Weather effect	22.90
40	Unanticipated consequences of change	22.84
41	Poor contractual relationship	22.78
42	Inadequate early planning of the project	22.56
43	Ineffective coordination and integration of project participants	22.54
44	Unpredictable factors from different sources	22.54
45	Lack of proper monitoring and evaluation	21.35
46	The conflict between contractor and consultant	21.31
47	Non-compliance to standards/ specification	21.22

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48	Excessive over time	20.24
49	Lack of Quality management system	20.19
50	City administrative code	14.91
51	Poor quality contract documentation	13.71
52	Labor injuries	13.50
53	Disturbance in personnel planning	12.90
53	Poor site practices	11.84
54	Errors during road construction	10.69
55	Staff turnover	9.21
56	Building codes used in the design of the projects	9.15
57	Flood	8.85
58	Hurricane	8.63

From the table above, the critical variable that causes delays in the execution of road construction projects is poor instruction followed by Equipment failure. This is closely followed and inadequate funding. The least delay factor in order of importance is hurricane which is not a severe factor in this part of the world.

IV. CONCLUSION

Based on this paper, some general recommendations are presented here, which could also have been useful in minimizing or avoiding the impacts of the road construction delays in the projects analyzed. The design of the project should be finalized with all details before tendering the work so as to avoid change orders by the owners. Owner should allocate sufficient time and adequate finances for the design stage of the project. The selection of the contractor should be done through a pre-qualification of the firms. The owners should mobilize all resources and get the necessary permissions before signing the contract. The contract should include clauses of incentive for early completion. The schedule should be prepared and agreed over by both the contractors and the consulting companies. The contractor should employ qualified work teams and provide in-house worker training in order to improve managerial and technical skills. The contractor should also have a project manager in his team to check the progress of work and ensure timely delivery of materials. The last but most important issue is to establish a healthy communication between all parties in order to solve problems in a timely manner

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Table 4: Correlations Of Key Factors Contributing To Delay In Road Construction and other Projects

		Poor site practices	Contractor selection method	Delays in contractor's progress payment by owner	Excessive over time	Design changes by owner or his agent during construction	Uncooperative owners	Weather effect	Equipment failure	Building permits approval process	Materials changes in types and specifications during construction	Transportation delays
Poor site practices	Correlation Coefficient	1.000	.000	.144**	.105*	-.326**	.307**	-.303**	-.119*	.018	.277**	.442**
	Sig. (2-tailed)	.	1.000	.003	.029	.000	.000	.000	.013	.701	.000	.000
	N	436	436	436	436	436	436	436	436	436	436	436
Contractor selection method	Correlation Coefficient	.000	1.000	-.567**	-.164**	.079	-.401**	-.432**	.000	.116*	.004	-.005
	Sig. (2-tailed)	1.000	.	.000	.001	.098	.000	.000	1.000	.015	.926	.923
	N	436	436	436	436	436	436	436	436	436	436	436
Delays in contractor's progress payment by owner	Correlation Coefficient	.144**	-.567**	1.000	.210**	.126**	.230**	.309**	-.131**	.005	.188**	.021
	Sig. (2-tailed)	.003	.000	.	.000	.008	.000	.000	.006	.917	.000	.655
	N	436	436	436	436	436	436	436	436	436	436	436
Excessive over time	Correlation Coefficient	.105*	-.164**	.210**	1.000	.090	-.104*	.292**	-.323**	-.022	.339**	.088
	Sig. (2-tailed)	.029	.001	.000	.	.060	.030	.000	.000	.640	.000	.068
	N	436	436	436	436	436	436	436	436	436	436	436
Design changes by owner or his agent during construction	Correlation Coefficient	-.326**	.079	.126**	.090	1.000	-.169**	.207**	.133**	.007	-.099*	-.280**
	Sig. (2-tailed)	.000	.098	.008	.060	.	.000	.000	.005	.888	.039	.000
	N	436	436	436	436	436	436	436	436	436	436	436
Uncooperative owners	Correlation Coefficient	.307**	-.401**	.230**	-.104*	-.169**	1.000	.062	-.179**	-.081	.226**	.098*
	Sig. (2-tailed)	.000	.000	.000	.030	.000	.	.199	.000	.093	.000	.040
	N	436	436	436	436	436	436	436	436	436	436	436
Weather effect	Correlation Coefficient	-.303**	-.432**	.309**	.292**	.207**	.062	1.000	-.210**	-.078	-.279**	.012
	Sig. (2-tailed)	.000	.000	.000	.000	.000	.199	.	.000	.104	.000	.798
	N	436	436	436	436	436	436	436	436	436	436	436
Equipment failure	Correlation Coefficient	-.119*	.000	-.131**	-.323**	.133**	-.179**	-.210**	1.000	.209**	-.352**	-.051
	Sig. (2-tailed)	.013	1.000	.006	.000	.005	.000	.000	.	.000	.000	.284
	N	436	436	436	436	436	436	436	436	436	436	436
Building permits approval process	Correlation Coefficient	.018	.116*	.005	-.022	.007	-.081	-.078	.209**	1.000	-.054	-.057
	Sig. (2-tailed)	.701	.015	.917	.640	.888	.093	.104	.000	.	.260	.237
	N	436	436	436	436	436	436	436	436	436	436	436
Materials changes in types and specifications during construction	Correlation Coefficient	.277**	.004	.188**	.339**	-.099*	.226**	-.279**	-.352**	-.054	1.000	.280**
	Sig. (2-tailed)	.000	.926	.000	.000	.039	.000	.000	.000	.260	.	.000
	N	436	436	436	436	436	436	436	436	436	436	436
Transportation delays	Correlation Coefficient	.442**	-.005	.021	.088	-.280**	.098*	.012	-.051	-.057	.280**	1.000
	Sig. (2-tailed)	.000	.923	.655	.068	.000	.040	.798	.284	.237	.000	.
	N	436	436	436	436	436	436	436	436	436	436	436

**. Correlation is significant at the 0.01 level (2-tailed). *. Correlation is significant at the 0.05 level (2-tailed).