INFRASTRUCTURE DELAYS AND COST ESCALATION: CAUSES AND EFFECTS IN NIGERIA.

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ABSTRACT: One of the major outcomes of the present ailing social and economic conditions in sub-Saharan Africa is the enormous waste of resources due to project delay and cost escalation in the region. This paper critically analyses the causes and effects of project delay and cost escalation in sub-Saharan Africa taking Nigeria as a case study. The major causes of project delay and cost escalation in Nigeria from experimental survey were acknowledged and ranked. The ranking was carried out using the relative net difference between the mean severity index percentage and the standard error of mean percentage in order to achieve unambiguously the ranking for each variable factor. Empirical analysis revealed the consequences of project delays and cost escalation for some completed projects in Nigeria with these subsequent findings: the minimum average percentage escalation cost of projects in Nigeria was 14%; the minimum average percentage escalation period of projects in Nigeria was found to be 188% with an average percentage completion work of just 96%. To enhance the ability to study this disturbing trend in the future, some mathematical relationships to forecast future project delays and cost escalation effects in Nigeria was developed. It was recommended that efficient man-power and material systems, alternative financial strategies and increased contingency allowance pattern in pre-contract estimates be developed.

Keywords: Infrastructure-delays, Causes, Effects, Cost-Escalation, Nigeria, sub-Saharan Africa.

1. INTRODUCTION

This paper addresses the problems resulting from infrastructure delays and cost escalation in Nigeria through a detailed empirical analysis of its causes and effects. Secondary data was collected from the Nigerian Federal Ministry of Works and Housing and questionnaire survey results from Mansfield *et al*. (1994). This literature and data addresses the causes of delays and cost overruns in Nigerian construction projects. Firstly, however, it would be appropriate to develop an overview of infrastructure projects in sub-Saharan Africa, and Nigeria in particular.

Developing countries invest about US$200 billion a year on new infrastructure, and this constitutes 4% of their national output and a fifth of their total investment (World Bank 1994). The result has been a striking increase in infrastructure services for transport, power, water, sanitation, telecommunications and irrigation. However, one billion people in the developing world still lack access to clean water and nearly two billion lack sufficient sanitation (World Bank 1994). Meanwhile, in rural areas, women and children frequently spend long hours fetching water just to meet daily needs. At the same time, transport systems are deteriorating rapidly, while electric power is yet to reach two billion people in many developing countries, all of which has implications for employment and education (World Bank 1994). This demand for infrastructure to modernize production and enhance both domestic and international competitiveness is overwhelming and exceeds existing capacity. Despite these inadequacies, population growth and urbanization are exacting more pressure on the few available infrastructures in these countries (World Bank, 1994).

In bridging the huge infrastructure gaps, there is an urgent need for a thorough appraisal of the process of infrastructure delivery in the developing countries. One of most pressing concerns is the alarming rate of project delay and cost escalations in the construction industry for most developing countries. Such trends have adversely affected infrastructure provision in sub-Saharan African countries with specific reference to Nigeria.

The relevance of the construction industry to the task of bridging this huge infrastructural gap is obvious because the social and economic stability and relevance to the world economy of any developing country hinges to a considerable extent on the effectiveness of that industry (Ofori *et al*. 1996). The relatively large investments committed to construction, makes the industry an important source of demand generation (Ofori *et al*. 1996). The multiplier effect of this demand (i.e. the great capacity to generate employment, income and expenditure in other sectors of the economy) contributes distinctively to the general economy (Mansfield *et al*. 1994; Ofori *et al*. 1996).

However, various projects of high economic and social relevance in Nigeria, worth billions of naira, are in complete state of disrepair. Amongst them are abandoned hospitals, clinics, markets, dams, airports, office blocks, housing projects, school buildings, factories, industries, libraries, theatre complexes, hotels, hi tech installation-to mention just a few. Nonetheless, the pivotal role of the Nigerian construction industry in the mainstream economy gives weight to the need for effective planning and management of this sub sector. Construction investment accounts for over 60% of the gross fixed capital formation (GFCF) (i.e. the total national investments in Nigeria) and only 20% of the GFCF in most other sub-Saharan countries (Dlakwa and Culpin 1990). By implication, the construction industry in Nigeria has a far reaching effect in comparison to other countries as it could impede national growth and planned economic developments if it becomes ineffective, as observed by Dlakwa and Culpin (1990). The enormous debt burden of over US$31 billion as at 2005 ending makes this problem of project delay and cost escalation in practically all infrastructural projects much worse. Worse still, the limited and scarce resources divested as a result of these problems further compounds the poverty level of the nation.

3. OBSERVATION

Mansfield *et al*. (1994) survey results (the secondary data employed for this investigation) have been summarised in Tables 1, 2 and 3. In addition to Mansfield *et al*.'s investigation, the authors are of the view that price fluctuations, inaccurate estimates, delays and additional work are not necessarily cost overrun variables only as indicated in Table 2 but also of delays. Hence, it is wise to classify all the variable factors as factors responsible for project delays and cost overruns in Nigeria.

Table 1. Questionnaire distribution and response

Description	Number distributed	Number of respondents	% of number distributed	% of number of responses
Contractors	35	15	43	41
Consultants	25	13	52	35
Public clients	20	09	45	24
Total	80	37		47

Source: [Data from Mansfield *et al.* (1994)]

Table 2. Factors responsible for project delays and cost overruns from Mansfield et al. (1994)

Variables	Severity index, %		
	Contractors	Consultants	Public clients
Poor contract management	80	100	100
Financing and payment of completed works	100	92	88
Changes in site conditions	74	84	77
Shortages of materials	74	76	77
Imported materials and plant items	54	84	88
Design changes	66	68	66
Subcontractors and nominated suppliers	80	62	55
Cost overrun variables (only):			
Price fluctuations	100	100	100
Inaccurate estimates	86	76	66
Delays	73	91	88
Additional work	60	77	77

Table 3. Summary of survey results from Mansfield et al. (1994)

Variable code	Variables	Severity Index %		
		contractors	consultants	Public clients
1	Financing and payment of completed works	100	92	88
2	Poor contract management	80	100	100
3	Subcontractors and nominated suppliers	80	62	55
4	Shortages of materials	74	76	77
5	Changes in site conditions	74	84	77
6	Weather	67	62	55
7	Design changes	66	68	66
8	Mistakes and Discrepancies in contract document	60	46	55
9	Imported materials and plant items	54	84	88
10	Preparation and approval of drawings	54	46	55
11	Nonadherance to contract conditions	47	62	66
12	Mistakes during construction	40	53	22
13	Negotiations and obtaining of contracts	33	38	44
14	Labour and management relations	27	31	55
15	Inspection and testing of completed portion of work	13	15	33
16	Construction methods	13	23	11
17	Price fluctuations	100	100	100
18	Inaccurate estimate	86	76	66
19	Delays	73	91	88
20	Additional work	60	77	77
21	Fraudulent practices and kickbacks	54	60	44
22	Shortening of contract periods	40	60	55
23	Insurance	13	15	22

4. METHODOLOGY OF EMPIRICAL ANALYSIS CARRIED OUT

Firstly, the authors had sought to determine if there was an acceptable general agreement amongst respondents in terms of the relative severity index accorded all the variable factors in Table 3. The one-way analysis of variance (One-way ANOVA) test was applied to the data in Table 3. One–way ANOVA was employed because of its robustness – i.e. its property of broad applicability to procedures that depart somewhat from basic assumptions, a state of affairs common in relatively large samples of twenty or more observations (Kleinbaum *et al*., 1988). This test was carried out using ORIGINS software. Furthermore, a graph was plotted for the severity index against the overall ranking of variables based on the severity index magnitudes for contractors, consultants and public clients. This was intended to facilitate a visualisation of the level of agreement amongst respondents (See Figure 1).

Secondly, the data in Table 3 were subjected to a further descriptive statistical analysis to obtain the standard deviation of severity index, standard error of mean and the mean severity index (See Table 4). Using the mean severity index magnitude some notable variable factors were selected and ranked accordingly. At the same time, a ranking comparison of variable factors was carried out between the mean severity index on one hand and the net difference of the mean severity index and the standard error of mean on the other (See Tables 5 and 6).

The methods of regression analysis and descriptive analysis were adopted for analyzing the effects of project delay and cost escalation using some completed highway projects in Nigeria from 1988-1991. The data was collected from the Federal Ministry of Works and Housing (See Table 7 and Table 8). The regression and descriptive analysis was achieved by summarising the data collected into a more presentable format that would reflect the effects of project delay and cost escalation (see Table 9) in terms of percentage cost escalation of Project ($\boldsymbol{E_C}$), percentage project cost escalation period ($\boldsymbol{E_P}$) and percentage completion of project work ($\boldsymbol{C_P}$). The average mean percentage, standard deviation and standard error of mean of $\boldsymbol{E_C}$, $\boldsymbol{E_P}$ and $\boldsymbol{C_P}$ were estimated (See Table 10). The standardized mean of these three major effects were also estimated (see Table 11).

Furthermore, the following regression plots of the data in Table 9 were carried out in order to quantitatively capture some models that would assist future forecast of the effects of project delay and cost escalation in Nigeria:

- percentage (%) escalation cost (E_C) against percentage (%) escalation period (E_P)
- percentage (%) escalation cost(E_C) against Project duration (P_d)
- percentage (%) escalation period (E_P) against sub total expenditure (S_e)
- percentage (%) completion of project work to date (C_P) against percentage(%) escalation period (E_P)

In all, testing for the best-fitted regression plot to get the best fitted model for the data was carried out through the means of empirical parameters like standard deviation of fit, correlation coefficient, and the probability that the correlation coefficient would be zero. The test was limited to polynomial regression plot of first, second and third degree because these types of polynomial are much easier approximations that could better represent the given data.

5. DISCUSSION OF SURVEY RESULTS

The results obtained from one-way analysis of variance test revealed that the means of the three groups of respondents are not significantly different. In addition, the plot in Figure 1 reveals a similar order of progression in the mean severity index accorded variable factors by the contractors, consultants and public clients. Hence, there was a significant degree of agreement amongst respondents with respect to how they ranked the variable factors. The following 15 variable factors were selected out of the total 23 to be the major causes of project delay and cost escalation in Nigeria.

The survey results revealed ***price fluctuations*** as the most severe cause of project cost escalation in Nigeria. This is true because the mean severity index response from contractors, consultants and public clients was 100% and the mean standard error of Severity Index was 0%; (See Tables 3 and 4 and Figures 2 and 3). This could be attributed to the limitation in exchange rate which in turn affects construction materials prices and the general price level. Another factor is the unstable inflationary trend in Nigeria and sub-Saharan Africa in general. This inflationary trend is a result of demand exceeding supply, creating a scarcity of goods which in turn leads to the escalation of the cost of goods. Given such a scenario, construction cost projection is extremely difficult (Arditi *et al.*, 1985).

Financing and payment of completed works was second in the order of ranking of factors responsible for project delay and cost escalation in Nigeria. The mean severity index from respondents was 97.33%. The variation in ranking between respondents amounted to a standard mean error severity index of 2.67%. The net difference between these two values was 94.66%, a difference value which indicated the marginal nature of disagreement amongst respondents with respect to the ranking of this factor (See Tables 3 and 4 and Figure 2 and 3). The irregular financing of public projects is a major cause of liquidity problem for

contractors; however, contractors can be paid in accordance with the contract agreement if clients can guarantee the availability of adequate funds before the project commences (Mansfield *et al*., 1994; Ogunlana *et al*., 1996). Regular ***financing and payment of completed works*** could remove constraints that could otherwise impedes project objectives, as observed by Oglesby *et al*. (1989) and reported by Frimpong *et al*. (2003).

Third in ranking of factors from the survey on project delay and cost escalation is ***poor contract management***. The results showed that this factor had a mean severity index of 89.3% with a standard mean error of the severity index of 5.8% due to the level of disagreement amongst respondents (see Tables 3 and 4 and Figures 2 and 3). The difference between these two values was 83.5%. ***Poor contract management*** could well be attributed to the manner in which contracts are awarded. In most cases projects are awarded to the lowest bidder (Mansfield *et al*., 1994). Some of these low bidders may lack management skills and have less regard for contract plans, cost control, overall site management and resource allocation. As we know in the case of Nigeria, contracts are usually awarded to politicians and well connected individuals irrespective of the apparent deficiencies in their relevant delivery potentials. Accordingly, Frimpong *et al*. (2003) and Ogunlana *et al*. (1996) have observed that most contractors in sub-Saharan Africa are entrepreneurs who are in the business of making money at the expense of good management. Consequently, they pay low wages, submit very low bids and have very little, if any ability to plan and co-ordinate contracts (Ogunlana *et al*., 1996).

Delay constitutes another factor that was ranked fourth with a mean severity index of 84% and standard mean error of 5.5% by respondents (See Tables 3 and 4 and Figures 2 and 3). The variation in agreement of ranking by respondents was slightly less than that of ***poor contract management***. The net difference in both values for ***delay*** was 78.5%. ***Delay*** in construction sites could be due to the absence of adequate statistics on available materials, fluctuations in the availability of construction materials, very long average waiting times and uncertainties about deliveries of ordered materials, shortages of funds to procure materials and inadequacy in terms of transportation (Mansfield *et al*., 1994).

Changes in site conditions is another factor ranking fifth from the survey with a mean severity index of 78.3%; standard mean error due to variation in ranking by respondents was 2.96% (See Tables 3 and 4 and Figures 2 and 3). The difference in values was 75.34%, an indication that the variations in ranking by respondents have not affected the position accorded this factor. This problem of ***changes in site conditions*** is attributed to inadequate feasibility studies before project authorisation (Mansfield *et al*., 1994). Moreover, political insensitivity and the exploitation of resident communities contribute immensely to ***changes in site conditions*** in Nigeria with an enormous potential to stall project developments. A practical example of this in Nigeria is the effects resulting from protests and repression of affected communities or regions plagued by neglect and environmental disasters, as in the Niger delta region. Such neglect and environmental disaster ranges from drinking water containing levels of petroleum hydrocarbons that are 350 times that allowed in European Union and an average of four oil spills per week to an estimated 1.1 billion cubic feet of natural gas flaring each day between 1976 and 1991 causing acid rain that destroys crops and causes illness in residents (Dixon, 2000).

Inaccurate estimates ranked sixth. The severity index was 76% with a standard mean error of about 5.77% (See Tables 3 and 4 and Figures 2 and 3). The net difference in values between the mean severity index and the standard mean error of severity index was 70.23%. The ranking position accorded this factor by virtue of its mean severity index percentage is questionable, as shown in the next paragraph. Nonetheless, this factor could be attributed to the unpredictable inflationary trend, specialisation, lack of adequate training and experience at the senior management level, and fraudulent practices (Mansfield *et al*., 1994).

Shortage of materials was ranked seventh. The mean severity index for it was 75% with a very small variation to the degree of disagreement by the respondents; standard mean error was 0.88% (See Tables 3 and 4 and Figures 2 and 3). The net difference between both values was 74.12% which was greater than the 70.23% calculated for ***inaccurate estimate*** in the preceding paragraph. The implication of this finding is that ***shortages of materials*** ranked seventh because of its mean severity index magnitude ought to have been ranked sixth and ***inaccurate estimate*** ranked seventh. However, the reason that could be attributed for ***shortage of materials*** is defective supply of materials occasioned by general shortages in the industry, poor communications amid sites and head office, purchasing planning and materials co ordination (Ogunlana *et al*., 1996).

Though ***imported materials and plant items*** was ranked eighth from the response made by the respondents in the survey, with a mean severity index of 75.3%, it accounted for the highest degree of disagreement amongst respondents. The standard mean error was 10.72% (See Tables 3 and 4 and Figures 2 and 3). The net difference between mean severity index and the standard mean error was 64.58%. One of the chief reasons for this drawback is the low level of manufacturing and exploitation of abundant local construction materials in Nigeria. Eyo-Ita-Eyo (2001) observed that Nigeria still imports cement when Nigeria's cement production potentials surpass any other African country except Egypt and that the 100 per cent raw materials required for cement production is readily available in Nigeria. Although energy contributes as much as 70% of the cost of cement production, Nigeria's energy needs for this sector are adequately catered for by its enormous energy resource. In another development, Makoju (2000) observed that 90% of the aggregate components for production and delivery of electricity in the country still depends on other developed countries. In other words, the inadequacies of indigenous technical capabilities have contributed to the overdependence on foreign construction firms.

The next in the order of ranking from the survey was the problem arising from ***additional work***. The mean severity index was 71.33% with a standard mean error of 5.66% resulting from the variations in levels of ranking amongst respondents (See Tables 3 and 4 and Figures 2 and 3). The net difference between mean severity index and the standard mean error was 65.67% which was slightly greater than the 64.58% for ***imported materials*** and plant items. This implied that its actual ranking position should have come first before that of ***imported materials and plant items***. Mansfield *et al*. (1994) had observed that ***additional work*** is related to design changes, which is due to lack of detailed briefing on the functional and technical requirements of the project by the clients.

Design change was ranked tenth, with a mean severity index of 66.67% and a standard mean error of about 0.67 % (See Tables 3 and 4 and Figures 2 and 3). The net difference between the two values was 66%, which was higher than the two presiding variable factors and should have been ranked eighth instead of tenth position. This problem arose from inadequate project planning and management of the design process. A quite distinctive example is the Progress of West African gas pipeline (WAGP). Asamoah (2002) reported that WAGP Project has suffered a number of setbacks, culminating in the escalation of its cost from an initial US$430 million to US$500 million. One of the problems includes the changing of the initial plans to lay the pipeline offshore to an onshore configuration (Asamoah, 2002).

Subcontractors and nominated supplier were ranked eleventh, with a mean severity index of 65.7% and a standard mean error indicating the variation in agreement of 7.45% (See Tables 3 and 4 and Figures 2 and 3). The difference or net value was 58.25%. The major reasons responsible for this factor as observed by Manavazhi and Adhikari (2002) were monopoly control of the market by some suppliers, work stoppages in factories, lack of industrialized materials, fluctuating demands forcing suppliers to wait for accumulation of orders and difficulty in importing raw materials from other countries. Other factors included

governmental delays resulting in procurement delays. During procurement, delays come from foreign exchange unavailability which would have been required for importing materials and equipment.

The twelfth factor the ***Weather*** with a mean severity index of 61.33% and standard mean error of about 6.03% (See Tables 3 and 4 and Figure 2 and 3). The net difference value was 55.3%. ***Weather*** was the most uncontrollable factor amongst the other variables considered. Temperature and humidity affects productivity of workers. If the temperature and humidity are high, workers feel lethargic and lose physical coordination, as reported by Frimpong *et al*. (2003).

Non-adherence to contract conditions, ***mistakes and discrepancies in contract document*** all amount to ***fraudulent practices*** in Nigeria. ***Fraudulent practices and kickbacks*** were ranked with a mean severity index of about 52.67% and a standard mean error of 4.67% (See Tables 3 and 4 and Figure 2 and 3). The net difference value was only 48%. It is rather unfortunate that as prevalent as this factor in the sub Saharan Africa, it was ranked low by the respondents amongst the major factors responsible for project cost escalation. ***Fraudulent practices and kickbacks*** occasioned by greed are perpetuated by some major players in the Nigerian construction industry (Hussain, 1999). The severity index percentage of this factor in the survey was small because the perpetrators of this act in the industry are predominantly found within the rank and file of contractors, consultants and public clients as evident from the report published by TELL (2002). Regrettably, it was the judgement of these three stakeholders only that was used in defining the severity index percentages. Tell (2002) reported that there were verifiable cases of corruption in the execution of some of the contracts awarded by Petroleum (special) trust fund (PTF). The Interim management committee (IMC) set up by President Obasanjo found that of the total 181.8 billion naira that accrued to PTF for the three years it operated, as much as 25.6 billion naira was wrongly paid to contractors. These include inflated contracts, fraudulent overpayment of contractors by some of the agency officials and undue receipt of interest on funds placed in banks by the agency.

In all, the presentation of the causes of project delay and cost escalation in Nigeria revealed five fundamental shifts in ranking positions of notable factors when ranked by the net difference between the mean severity index and the standard error of mean as compared to the mean severity index alone (see Tables 5 and 6).

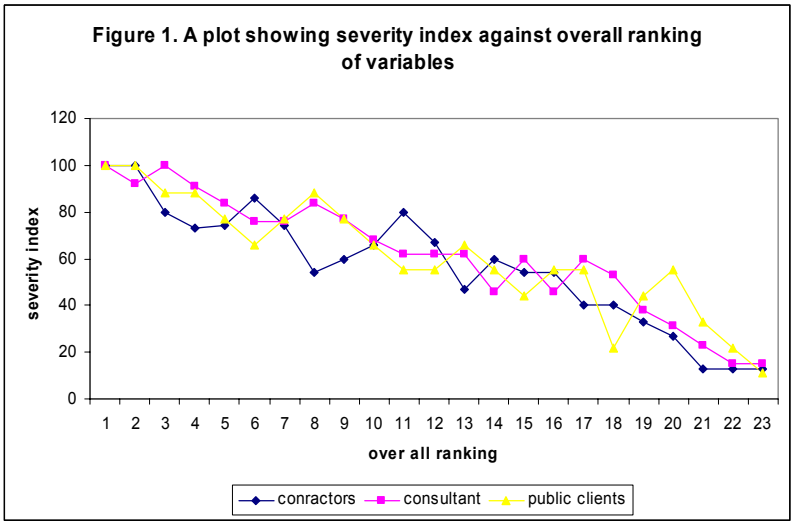

Table 4. Descriptive statistics of survey results:

Variable code	Severity Index %			Ranking			Descriptive statistics			Overall ranking
	Contractors	Consultants	Public clients	Contractors	Consultants	Public clients	mean	Standard deviation	Standard Error of mean	
1	100	92	88	1.5	3	1.5	97.3	4.6	2.66	2
2	80	100	100	4.5	1.5	3.3	89.3	10.1	5.81	3
3	80	62	55	4.5	11.3	9.2	65.7	12.9	7.44	11
4	74	76	77	6.5	8.5	5.3	75.7	1.5	0.88	7
5	74	84	77	6.5	5.5	5.3	78.3	5.1	2.96	5
6	67	62	55	9	11.3	9.2	61.3	6.0	3.48	12
7	66	68	66	10	10	7.3	66.7	1.2	0.67	10
8	60	46	55	11.5	16.5	9.2	53.7	7.1	4.10	14
9	54	84	88	13.3	5.5	3.3	75.3	18.6	10.73	8
10	54	46	55	13.3	16.5	9.2	51.7	4.9	2.85	17
11	47	62	66	15	11.3	7.2	58.3	10.0	5.78	13
12	40	53	22	16.5	15	14.5	38.3	15.6	8.99	18
13	33	38	44	18	18	11.5	38.3	5.5	3.18	19
14	27	31	55	19	19	9.2	37.7	15.1	8.74	20
15	13	15	33	20.3	20	13	23	10	5.77	21
16	13	23	11	20.3	21.5	15	13	2	1.15	23
17	100	100	100	1.5	1.5	1.5	100	0.0	0.00	1
18	86	76	66	3	8.5	7.3	76	10	5.77	6
19	73	91	88	8	4	3.3	84	9.6	5.57	4
20	60	77	77	11.5	7	5.3	71.3	9.8	5.67	9
21	54	60	44	13.3	13.5	11.5	52.7	8.1	4.67	15
22	40	60	55	16.5	13.5	9.2	51.7	10.4	6.01	16
23	13	15	22	20.3	21.5	14.5	16.7	4.7	2.73	22

Figure.2 Order of ranking of Variable factors and Mean severity index bar chart plot

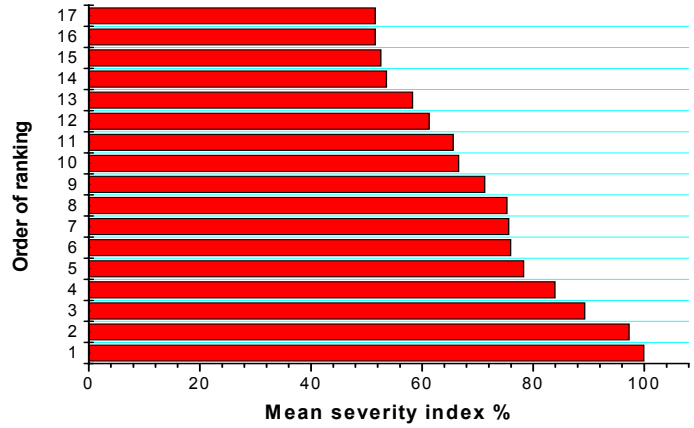

Figure.3 Order of ranking of Variable factors and standard mean error bar chart plot (respondents degree of disagreement)

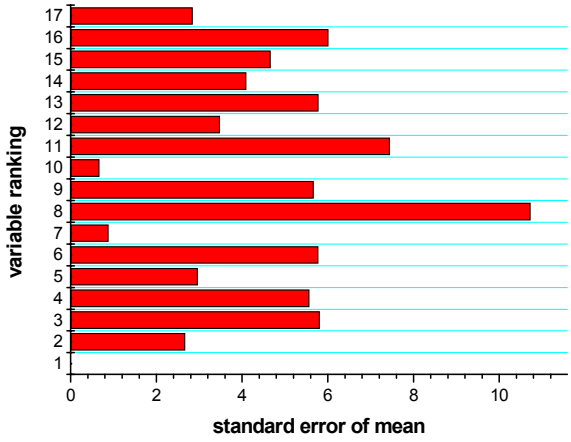

Table 5. Variable factors ranking and codes using their Mean severity index magnitudes

Ranking positions	Variable factors	Variable codes
1	Price fluctuations	17
2	Financing and payment of completed works	1
3	Poor contract management	2
4	Delays	19
5	Changes in site conditions	5
6	Inaccurate estimates	18
7	Shortages of materials	4
8	Imported materials and plant items	9
9	Additional work	20
10	Design changes	7
11	Subcontractors and nominated suppliers	3
12	Weather	6
13	Non adherence to contract conditions	11
14	Mistakes and discrepancies in contract document	8
15	Fraudulent practices and kick backs	21

Table 6. Actual Ranking of the major variable factors from estimated Net difference between Mean, Severity Index and Standard error of mean.

Actual ranking	Variable Factors	Variable code
1	Price fluctuations	17
2	Financing and payment of completed works	1
3	Poor contract management	2
4	Delays	19
5	Changes in site conditions	5
6	Shortages of materials	4
7	Inaccurate estimates	18
8	Design changes	7
9	Additional work	20
10	Imported materials and plant items	9
11	Subcontractors and nominated sub suppliers	3
12	Weather	6
13	Fraudulent practices and kick backs	21

6. HIGHWAY DATA ANALYSIS AND REGRESSION PLOT

Having analysed the actual causes of project cost escalation in Nigeria, the next stage in this investigation is to analyze its possible effects. Data in Tables 7 and 8 of some completed highway projects in Nigeria from the Federal Ministry of Works as mentioned previously in the methodology is presented in summary in Table 9. From Table 9 above, the descriptive statistics of the effects of project cost escalation is summarised in Table 10.

To increase the probability of the calculated mean because of the variations in items of the given data in Table 9 to a standardised mean value or sample mean that could effectively approximate the given set of data, the following equation was applied.

Practical (sample) mean = *Mean + Z (SEM)*…….. (4)

where: the standardized critical value $Z = 1.645$, ***SEM*** is the standard error of mean and the results obtained are shown in Table.11:

All the relevant plots stated in the methodology were initially plotted linearly. In checking for the curve that could give a suitable model that best represents the set of data, two basic conditions were employed, namely:

- Comparing the parameters of each linear plot to their corresponding second and third degree polynomial parameters.
- Check if the plot meets practical trend or expectation.

Having satisfied the two basic conditions above, the following relationships were developed:

$$E_C = 4.866 + 0.027\,E_P \quad \text{.....(8)}$$
$$E_C = 30.7 - 3.65P_d + 0.11P_d^2 \quad \text{.....(9)}$$
$$E_P = 157.420 - 5.15\times10^{-4}\,S_e \quad \text{.....(10)}$$
$$C_P = 2.56 + 1.38E_P - 6.58 \times 10^{-3}\,E_P^2 + 9.86X\,10^{-6}\,E_P^3 \quad \text{.....(11)}$$

Table 7. The Highway Project status report showing financial progress

Contract code	Estimated contract sum (N X 10^3)	Value of permanent work to date (N X 10^3)	Variation of cost of Materials and freight (N X 10^3)	Subtotal expenditure to date (N X 10^3)
1	12050	9386	1633. 0	9550
2	17632	10098	-	11628
3	16336	13835	268. 0	14067
4	8843	7952	119. 0	8015
5	54660	49097	3338.6	54509
6	69070	48691	9191. 4	62888
7	52555	47217	1841. 0	48809
8	11067	7700	531. 4	8193
9	6357	4406	130. 0	4874

Source: [Data from Mansfield *et al.* (1994)]

Table 8. Highway Project status report showing durations, expenditures and work progress at time of reporting

Contract code	Duration months	Completion of Project work to date %	Lapse of contract Period and freight %	Expenditure to date %
1	12	76. 87	141. 67	79. 25
2	23	65. 08	97. 83	65. 92
3	12	80. 56	91. 67	86. 11
4	24	97. 36	126. 92	90. 64
5	27	100. 00	106. 20	100. 26
6	30	100. 00	175. 00	91. 05
7	15	94. 00	120. 00	92. 87
8	28	93. 79	100. 00	74. 03
9	7	99. 00	342. 90	76. 68

Source: [Data from Mansfield *et al.* (1994)]

Table 9: A brief summary of Highway Project status report

Contract code	Estimated contract sum ($Nx10^3$)	Cost of permanent work to date ($Nx10^3$)	Subtotal of expenditures to date ($Nx10^3$)	% Escalation cost to date	% Escalation period to date	% completion of Project work to date	Duration of contract (months)
1	12050	9386	9550	1.75	141.67	76.84	12
2	17632	10098	11628	15.15	97.83	65.08	23
3	16336	13835	14067	1.68	91.67	80.56	12
4	8843	7952	8015	0.79	126.92	97.36	24
5	54660	49097	54509	11.02	106.2	100.00	27
6	69070	48691	62888	29.15	175	100.00	30
7	52555	47217	48809	03.37	120	94.00	15
8	11067	7700	8193	06.4	100	93.79	28
9	6357	4406	4874	10.62	342.9	99.00	7

Table. 10. Descriptive Statistics of the Effects of Project cost escalation

Effects of Project cost escalation	Descriptive statistics		
	Mean (%)	Standard deviation (SD)	Standard error of mean (SEM)
% Escalation cost (E_C)	8.88	9.10	3.03
% Escalation period (E_P)	144.69	78.76	26.25
% completion of project work (C_P)	89.54	12.6	4.15

Table. 11. Standardized or Sample mean values

Effects of Project cost escalation	Standardized mean (%)
% Escalation cost (E_C)	14
% Escalation period (E_P)	188
% completion of project work (C_P)	96

7. CONCLUSION AND RECOMMENDATIONS

Contrary to the Mansfield et al investigation, the ranking of any factor in a survey of this magnitude can only be explicit if done on the basis of the net value between the mean severity index and the standard error of mean, instead of either of these in isolation. The ranking carried out with the net difference in this study revealed shifts in ranking positions of notable causes responsible for project delay and cost escalation (see Table 5 and 6).

The ranking accorded to fraudulent practices and kickbacks, in spite of its notable prevalence in the construction industry in Nigeria, was questionable. It was argued from available evidence that fraudulence is predominant within the rank and file of contractors, consultants and the public clients in the construction industry. Most regrettably, it was only these classes of respondents that were used in the investigation to define the extent of severity of each of these factors. In quantifying further the significance of fraudulent practices and kickbacks using the severity

index accorded it by respondents amongst the other variable factors responsible for project cost escalations i.e. its percentage of the selected 17 variable factors:

{[Mean severity index for variable factor 21] x [total Mean severity index of the 17 selected causes]$^{-1}$}100%

It was alarming from the above expression that fraudulent practices and kickbacks amounted in effect to just 4.36% of the total selected causes. If we decide to eliminate fraudulent practices and kickbacks and check what effect it has on percentage project escalation cost E_C and percentage project escalation period E_P , 4.36% value was of no significant impact. This discovery is no doubt completely at variance with the obvious in the Nigeria construction industry which calls in question the relative ranking accorded fraudulent practices and kickbacks by respondents.

Nevertheless, this study has definitively established the minimum percentage escalation cost of projects in Nigeria at about 14%. The approximate minimum mean percentage escalation period of project in Nigeria from this study was 188%. In spite of these severe loses, the mean average percentage completion of work was just 96%. This damaging trend has prompted the development of enabling equations for future forecast of these effects in Nigeria.

Moreover, procurement guidelines should be effectively followed as it will definitely improve standards in many ways while excluding unqualified competitors from the bidding process. This process would encourage the active involvement of qualified contractors and suppliers in the bidding process. It would also limit the recurring incidence of fraud.

As a means of improving the present project financing strategy, private sector participation is to be encouraged in financing public projects as a way of checking insufficient funding. This strategy would enhance greater involvement and commitment to project delivery. Contract methods in public private partnership (PPP) such as build-own-operate-transfer (BOOT) schemes could be introduced to encourage contactors to participate in financing new projects (Hallmans, 1999)

The minimum 14% escalation cost of projects in Nigeria established from this study had reinforced the call for a more reasonable percentage increase in contingency allowance from the current 5-10% in Nigeria to about 15-20%, as recommended by the United States Department of Energy (DOE) for budget estimates (Abinu and Jagboro, 2002). There is the need to remove all forms of bureaucracy militating against project development in order to create an enabling environment for potential investors (Abinu and Jagboro, 2002; Frimpong *et al*., 2003; Oglesby *et al.,* 1989). Stakeholders in the construction industry should as a matter of urgency establish an efficient and sustainable material management or expansion of local resource base and manpower development systems.

For future investigation, the number of respondents should be increased to enhance a wider aggregate representation of views.

8. REFERENCES

Abinu, A. A. and Jagboro, G. O. (2002) The Effects of Construction Delays on Project delivery in the Nigerian Construction Industry. *International Journal of Project Management* 20, 593-599.

African Development Bank and African Development Fund (1997a) *Rules of procedure for procurement of goods and works Procurement.* Monitoring consultancy services unit, Abidjan.

African development Bank and African development Fund (1997b) *Standard Procurement prequalification document, Procurement of works Procurement.* Monitoring consultancy services unit, Abidjan.

Arditi, D., Akan, G.T. and Gurdarmar, S. (1985) Cost Overruns in Public Projects. *Project Management* 3 (4) 218-224.

Ajanlekoko, S. (2002) The state of Roads / Infrastructure in Nigeria. Reported in *Monday Vanguard Newspaper Conference Hall*. Nigeria.

Asamoah, J. (2002) Satisfying the Energy Hunger in West Africa: A Progress on West African Gas Pipeline. *African energy*, Brooke Patrick Publications, Johannesburg, http//www.africanenergy.co.za

Clough, R. H. (1986) Contract Systems. In *Construction Contracting*. Page (9-10), John Wiley and sons, New Mexico.

Dixon, N. (2000) Repression escalates as Shell returns to Ogoni Land. *Asheville Global Report*,. www.agrnews.org

Dlakwa, M. M. and Culpin, M. F. (1990) Reasons for Overrun in Public Sector Construction Projects in Nigeria. *Project Management* 8 (4) 237-241.

Eyo-Ita-Eyo, N (2001) Nigerian Cement Industry is Pathetic. *THISDAY People*, Leaders and company limited. http://www.thisdayonline.com

Frimpong, Y.,Oluwoye, J. and Crawford, L. (2003) Causes of Delays and Cost Overruns in Construction of Groundwater Projects in Developing Countries; Ghana as a case study. *International Journal of Project Management* 21, 321-326

Hallmans, B. and Stenberg, C. (1999) Introduction to Boot. *Desalination* 123 , 109-114.

Hussain, H. (1999). The detrimental effects of corruption in developing countries. *Social science* 410, Nov.1999.

Kleinbaum, D.G., Kupper, L.L., Muller, K.E. (1988) *Applied Regression Analysis and Other Multivariable Methods*. PWS-Kent Publishing Company, Boston.

Makoju, J. (2000) Chanllenges of Investing in Nigeria's Power Sector. *THISDAYOnline.com, THISDAY People*, Leaders and company Limited. http://www.thisdayonline.com

Manavazhi, M.R. and Adhikari, D.K. (2002) Material and equipment procurement delays in Highway projects in Nepal. *International Journal of Project Management* 20 , 627-632.

Mansfield, N. R., Ugwu, O. O. and Doran, T. (1994) Causes of delay and cost overruns in Nigerian construction Projects. *International Journal of Project management* 12 (4) 254 - 260.

Ofori, G., Hindle, R. and Hugo, F. (1996) Improving the Construction Industry in South Africa. *Habitat International*, 20 (2) 203-220.

Ogunlana, S., Krit, P. and Vithool, J. (1996) Construction delays in a fast growing economy: comparing Thailand with other economies. *International Journal of Project Management* 14 (1) 37- 45.

Oglesby, C., Parker, H. and Howell, G. (1989) *Productivity improvement in construction*. McGraw-Hill, New York.

Sola, A. and Kemi, S. (1996) The liquefied Natural Gas project. *Enegy policy* ,24 (6) 593-596

TELL (2002) The Rot that was PTF. *Nigeria's Independent weekly magazine* number 43, Special Report. TELL communications limited.

The World Fact Book (2002) Nigeria. Directorate *of Central Intelligence*, Washington D. C. http//www.cia.gov/cia/publications.

Webster Reference Library, (2003) *Concise edition Dictionary and Thesaurus*. Geddes Grosset, Scotland.

World Bank, (1994) Infrastructure for Development and World development Indicators. *World Development Report*. Oxford University press. New York.

World Bank Group, (2003) Guide to International business opportunities-Procurement. *World from poverty:* http://www.worldbank.org.