

**PREDICTORS OF CHANGE ORDER RATES IN BUILDING PROJECTS UNDER
"DUE PROCESS" IN NORTHERN NIGERIA**

KOLAWOLE, A. RICHARD¹
KAMAU.K. PETER²
MUNALA GERRYSHOM³

¹Department of Environmental Planning & Mgt, Kenyatta University, Nairobi, Kenya

²School of Architecture & Built Environment, Kenyatta University, Nairobi, Kenya

³Centre for Urban Studies, Jomo Kenyatta University of Agriculture and Technology, Nairobi, Kenya

ABSTRACT

An investigation was conducted to examine the influence of project size and the difference between base estimate and initial contract sum in predicting change order rates. The study was conducted on historical data of 45 projects in Northern Nigeria that were in progress from 2004 to 2014. Base on the study analysis, it was found that project size and the difference between base estimate and initial contract sum can be predictors of change order rates. The study concluded that despite the fact that cost overrun rate and change order rate are not identical, they can be predicted by the same factors.

KEYWORDS: Due Process, Change Order, Change Order Rate Cost Overrun, Predictors

1.0 INTRODUCTION

Change orders are instruction which allows amendments or modification to be made on an initial agreement. This amendments or modification could be in terms of volume or nature of tasks to be executed and may be due to diverse reasons such as scope change, change in schedule and construction methods. Change orders and claims are a large part of most time and cost overrun in construction contracts (Aibunu & Odeyinka, 2006). Although the change order rate is not identical to cost overrun rate, it is likely that they are both influenced by similar factors since change orders is a large part of cost overrun. Change order rate is defined as the total value of change orders in term of Naira divided by the contract sum. Researcher have found amongst other factors that project size and difference between consultants base estimate and award amount to influence cost overrun rates (Mahamid,2013; Ogunsanmi,2013). However, no quantitative studies were found in literature that analysed these factors as predictors of change orders rate, this is the focus of this paper.

2.0 Literature Review

2.1 Due process and procurement in Nigeria

The procurement challenges in the Nigerian Construction Industry (NCI) have not been different from that of many other less developed countries (LCD). These difficulties amongst others relate to lack of fiscal transparency and public accountability resulting from unguarded and uncoordinated way in which public projects were awarded. This state of affairs led the Federal Government of Nigeria (FGN) in 1999 to adopt the use of competitive bidding as a means of providing public goods and services. The implementation, monitoring and compliance with this provision is known as 'Due process'(Wahab,2006). According to Ezekwesili (2004) due process implies that government activities and business should be carried out openly, economically and transparently. The heart of the Due process reform is to get the lowest responsive and responsible bidder, one who takes into proper thought the pros and cons of the project if the contract is won (Ade-ojo & Babalola, 2013).

2.2 Consultants' Base Estimate and Contract Award Amount

The consultants' base estimate is the fairly accurate judgment or view regarding the worth of a project and it is against this that contractors' bids are compared. The Public Procurement Act (PPA)(2007 p.17) states "the winning bid shall be that which is the lowest evaluated responsive bid which has been responsive to the bid with regards to work specification and standards." The PPA (2007) further recommends public opening of bids. Studies have shown that being the lowest bidder is the concern of most contractors in order to win a bid rather than their bid to be responsible and responsive in the hope of getting change order claim to compensate for the low price (Chan & Yeong, 1995; Ade-ojo & Babalola, 2013). The consequence of this is that reasonable performance of construction projects in term of time and cost cannot be guaranteed.

2.3 Project size

Many studies have shown that project size influence cost overrun. Flyvbjerg, Holm and Buhl (2006) investigated causes of cost rise in 258 projects in the United States. The focus of the study was the dependence of cost escalation on project size and the length of project implementation phase. The study found that larger projects have larger percentage of cost overrun than do smaller projects.

Similarly, Jahren and Ashe (1990) conducted a study on cost overrun rates predictors by investigating the influence of these factors: project size, construction type, number of bidders and the percent difference between government estimate and award amount in 1576 projects

in the United States of America, The study found the frequency distribution for cost overrun rate increased with the size of project.

Randolph, Rajandra and Campfield (1987) on their part found in their study of municipal contracts in Lansing that cost overrun rates decrease as contract sum increased.

3.0 Research Methodology

This present research form part of a larger study probing management of change orders in building project delivery northern Nigeria. The study used explanatory survey method (case study) and targeted medium and large projects. Stratified random sampling technique was applied in selecting the projects. Historical data of 45 completed projects from Northern Nigeria were obtained. From each project file the following were extracted: consultants' based estimate, initial cost, change order cost and final cost. The projects were categorized by project size based on the following award amount N 5 - N 50 m (medium) and over N 50 m (large). The limit was chosen based on the Federal government of Nigeria registration category (Inuwa,Githae & Dianga 2014). Northern Nigeria consist of 3 geo-political zones namely north-central, north-east and north- west and occupies 81% of Nigeria land size. Tables were used for data presentations and data analysis was done using SPSS 22 to perform t-test and chi-square analysis. To calculate the effect size the equation provided by Rosnow and Rosenthal (2005) cited in Fields (2009 p.332) was used.

$$r = \sqrt{\frac{t^2}{t^2 + df}} \dots\dots\dots \text{Equation 1}$$

Where:

t =t-value

df= degree of freedom

4.0 Finding and Discussion

4.1 Influence of Project Size on Change Order Rate

A look at the combined data set as shown in Appendix A, it indicate the mean rate for change order to be 13.10 percent for the medium projects and 49.43 percent for the large projects. To test the hypothesis that project size has no effect on change order rate, independent t-test was employed. Tables 1 give the group statistic and Table 2 presents the results of the t-test. It can be seen that Levene's test p-value -0.000 is significant at α of 0.05. This is an indication that the samples are of unequal variance and so the test statistics must be taken from the row labelled “Equal variances not assumed”. The two-tailed values of p is 0.106 is greater than 0.05, and so it can be concluded that there is no significant difference

between the means of these project groups. Computed r value ($r=.47$) for effect size indicates a medium size effect.

Table 1: Group Statistics

	N	Mean	Std. Deviation	Std. Error Mean
Medium Projects	33	3.5376	6.39384	1.11302
Large Project	12	390.1192	760.30998	219.48258

Table 2: Independent Samples Test

	Levene's Test for Equality of Variances		t-test for equality of Means							
	F	Sig.	t	df	Sig (2-tailed)	Mean Difference	Std Error Difference	95% confidence interval of the Difference		
Cost	35.912	.000								
Equal variance assumed			-2.98	43	.106	-386.58	129.65	-648.04	-125.13	
Equal variance not assumed			-1.76	11.0	.106	-386.58	129.49	-869.66	96.50	

The finding indicates on the average that construction projects experience greater change order rate in larger projects ($M=390.11$; $SE= 219.48$) than medium projects ($M=3.53$; $SE=1.11$). The difference was not significant $t(11) = -1.76$, $p > 0.5$; however it did represent a medium size effect $r = .47$. In terms of the study, it can be inferred that project size has an effect on change orders rate of medium and large projects in northern Nigeria. One possible explanation for this result is that larger projects are generally more complex, and the complexity often increase change order rates. However, on large projects project managers can reduce change order rates by due diligence in the bidding and planning process of projects.

4.2 Effect of Base Estimate and Contract Award Difference

4.2.1 Test for linear relationship

Simple linear regression analysis was conducted to determine if a linear relationship existed between the base estimate-award difference and change order rate. Represented literally as:

$$\text{Change Oder rate} = b_0 + b_1(\text{base estimate-award difference}) + e_i \dots\dots\dots \text{Equation 2}$$

Table 3 provides the value of R and R² for the model. R value of .542 represents the simple correlation between base estimate - contract award difference and change order rate. The R² is .294, which tells us that base estimate- award difference accounts for 29.4% of the variation in change order rate.

Table 3: Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.542 ^a	.294	.278	354.2054

a. Predictors: (Constant), Award Difference

b. Dependent Variable: Change Order Rate

Table 4 reports the analysis of variance. From this table F is 17.93 which is significant at P<.001. This finding tells us there is less than 0.1% probability the F-ratio would happen if the null hypothesis were true.

Table 4: ANOVA

Model	Sum of Squares	df	Mean Square	F	Sig.
Regression	2249796.014	1	2249796.014	17.932	.000
Residual	5394843.734	43	125461.482		
Total	7644639.748	44			

Dependent Variable: Change Order Rate

Predictors: (Constant), Award Difference

Table 5: Model Coefficients

Model	Unstandardized Coefficients		Standardized Coefficients	t	Sig.	Collinearity Statistics	
	B	Std. Error	Beta			Tolerance	VIF
1 (Constant)	94.345	52.927		1.783	.082		
Award Difference	12.458	2.942	.542	4.235	.000	1.000	1.000

Dependent Variable: Change Order Rate

Reading - off the values of b₀ and b₁ from Table 6 and replacing the in equation 2 the model becomes:

Change order rate = 94.35 + 12.46 (base estimate - contract award difference) ... Equation 3

The analysis indicates the subsistence of a relationship, as a result additional testing was performed.

4.2. 2 Test for change order rate among groups

In order to investigate how change order rate varied among two groups of contract award-estimate difference. Chi -square (χ^2) was employed to test within this group by classifying them as shown in Table 6(details in Appendix B).

Table 6: Influence of Award-Estimate difference on change order rate

Grouping	Number of Projects with Change order rate exceeding 5%		
	Number Of Projects	Amount	Percentage
Group 1			
Award -Estimate Difference between 0 - 10%	22	5	23
Award -Estimate Difference below 0 %	17	11	65
Group 2			
Award -Estimate Difference between 10 - 15%	3	0	0
Award -Estimate Difference above 15 %	3	0	0

Table 7 indicates a significant value of .432, which is larger than the alpha value of 0.05, making it not significant, therefore we can conclude that the result suggest that the groups are statistically different

Table 7: Test Statistics

	position
Chi-Square	.641 ^a
df	1
Asymp. Sig.	.423

a. 0 cells (0.0%) have expected frequencies less than 5.
 The minimum expected cell frequency is 19.5.

The analysis could not be repeated for the second group of the data set because assumptions of chi-square (χ^2) concerning the minimum expected cell frequency was violated. The result of this Chi-square (χ^2) test support the finding that the higher the different between the base estimate and contract amount the higher the regularity of change order under due process. An explanation for this result is that most projects executed under due process have lump sum contracts. Therefore any additional works outside the stipulated

contingency sum will be contributed by the procuring entity. In order to avoid this and also not to completely erode the contractors' profit, what most procuring entity does is to issue change order instructions to approve cheaper alternatives. However, where this is not possible the Bureau for Public Procurement (BPP) must be made aware for further necessary action.

5.0 Conclusion

The aim of the study was to do quantitative analysis to see if project size and the difference between base estimate and initial contract sum could serve as predictor of change order rate. Based on the outcome of the analysis, it can be concluded that project size and the difference between base estimate and initial contract sum are predictors of change order rates. It can also be said that cost overrun rate and change order rate can be predicted by the same factors despite the fact that they are not identical. The research did not just go without some limitations amongst which is that only a small sample of projects were analysis with specific period of time. An important approach in a future research would be to examine a larger project sample.

6.0 Acknowledgement

The completion of this PHD research would not have been possible without the help, guidance and supervision of my supervisors, a very special thank you, Dr Peter K. Kamau and Dr Gerryshom Munala who were not tired of correcting my mistakes and giving sound advice. I owe you my deepest gratitude.

References

1. Adejo, C., & Babalola, A. (2013). Cost and Time Performance of Construction Projects under Due Process Reform in Nigeria. *International Journal of Engineering and Science* 3(6) , pp 1 -6. <http://www.researchinventy.com/papers/v3i6/A0360106.pdf>
2. Aibinu, A. A., & Odeyinka, O. (2006). Construction Delay and their Caustive Factors in Nigeria. *Journal of Construction Engineering and Management* 132 (7) , pp 667 - 677. DOI: HYPERLINK "http://dx.doi.org/10.1061/%28ASCE%290733-9364%282006%29132:7%28667%29" \t "_blank" 10.1061/(ASCE)0733-9364(2006)132:7(667)
3. Bureau for Public Procurement. (2007). *Public Procurement Act*. Abuja: Bureau for Public Procurement 43p.
4. Chan, A., & Yeong, C. (1995). A Comparism of Strategies for Reducing Variation. *Journal of Construction Management and Economics* 13 , pp 467 -473. DOI:10.1080/01446199500000054
5. Ezekwesili, O. (2005). Due Process and Digital Opportunities. *Paper Presentation to the University Community at Princess Alexandria Auditorium* . Nsukka, Nigeria: University of Nsukka.

6. Field, A. (2009). *Discovering Statistics Using SPSS 3rd Edition*. London: SAGE Publications Limited.
7. Flyvbjerg, B., Holm, M., & Buhl, S. (2004). What causes cost overrun in transport infrastructure projects? *Transport Reviews* 24 (1) , pp 3 - 18. DOI: 10.1080/0144164032000080494a
8. Inuwa, I., Githae, W., & Diang'a, S. (2014). Indigenous Contractors Involvement and Performance in Construction Procurement Systems in Nigeria. *Global Journal of Research in Engineering* 14 (1) , pp 4 -15. www.academia.edu/.../Indigenous_Contractors_Involveme.
9. Jahren, C. T., & Ashe, A. M. (1990). Predictor of Cost-Overrun Rates. *Journal of Construction Engineering and Management* 116(3) , pp 548 - 552. [http://dx.doi.org/10.1061/\(ASCE\)0733-9364\(1990\)116:3\(548\)](http://dx.doi.org/10.1061/(ASCE)0733-9364(1990)116:3(548))
10. Mahamid, I. (2013). Effects of Project's physical characteristics on cost deviation in road construction. *Journal of King Saud University-Engineering Sciences* 25 , pp 81- 88. <http://dx.doi.org/10.1016/j.jksues.2012.04.001>
11. Ogunsanmi, O. E. (2013). Effects of Procurement related factors on Construction Projects Performance in Nigeria. *Ethopian Journal of Environmental Studies and Management* 6(2) , pp 215 - 222. <http://dx.doi.org/10.4314/ejesm.v6i2.12>
12. Randolph, D. A., Rajandra, K., & Campfield, J. J. (1987). Using risk management techniques to control construction contract cost. *Journal of Construction Engineering and Management ASCE* 3(4) , pp 314 - 324. [http://dx.doi.org/10.1061/\(ASCE\)9742-597X\(1987\)3:4\(314\)](http://dx.doi.org/10.1061/(ASCE)9742-597X(1987)3:4(314))
13. Wahab, K. A. (2006). Federal Government Economic Reforms, Human Development and Due Process. *1st Annual Lecture of School of Environmental Technology*. Akure, Nigeria: Federal University of Technology Akure.

APPENDIX A: Project Classification by Size

Cases (1)	Location (2)	Project Type (3)	Cost (N 000,000.00)			Cost Overrun (%) (7)	Time (in Months)		Time Overrun (%) (10)
			Initial cost (4)	Final Cost (5)	Change Order Cost (6)		Initial (8)	Final (9)	
Category B & C (N 5 m -N 50 m)									
1	Kano	Private	10	14.63	+ 4.63	46	8	16.5	106
2	Abuja	Public	15.00	15.00	0.00	0	3.00	6.00	100
3	Kano	Private	15.30	21.50	+ 6.20	41	24	42	75
4	Abuja	Public	17.00	17.00	0.00	0	6.0	6.25	4
5	Bauchi	Private	18.00	21.00	+ 3.00	17	5	3	- 40
6	Bauchi	Public	19.00	19.00	0.00	0	3	7.30	143
7	Kano	Private	20.00	27.36	+ 7.36	37	9.50	16.5	74
8	Abuja	Public	20.00	30.00	+10.00	50	3	7.5	150
9	Bauchi	Private	20.00	27.00	+ 7.00	35	9.5	16.5	74
10	Kano	Public	21.20	21.20	0.00	0	3	14	367
11	Bauchi	Private	23.00	22.10	- 0.90	- 4	12	8	- 33
12	Abuja	Private	23.00	26.00	+ 3.00	13	3	5	67
13	Bauchi	Public	24.90	42.10	+ 17.20	69	6.5	9	38
14	Abuja	Public	25.00	25.00	0.00	0	3	7	133
15	Abuja	Public	29.00	31.00	+ 2.00	7	6	9	50
16	Kano	Private	30.20	30.20	0.00	0	4	6	50
17	Abuja	Private	30.2	30.2	0	0	1	1.5	50
18	Kano	Public	33.00	33.00	0.00	0	3	8	167
19	Bauchi	Public	35.00	37.00	+ 2.00	6	8	16	100
20	Bauchi	Public	35.40	34.60	- 0.80	- 2	6	9	50
21	Abuja	Public	41.00	41.00	0.00	0	3	5	67
22	Kano	Private	41.30	41.40	+ 0.10	0.2	3	11	267
23	Kano	Private	42.7	44.9	+ 2.20	5	24	34	42
24	Kano	Public	42.80	42.80	0.00	0	3	4	33
25	Abuja	Private	46.00	62.00	+ 16.00	35	3	12	300
26	Bauchi	Public	46.00	47.00	+ 1.00	2	24	30	25
27	Bauchi	Public	47.00	44.00	- 3.00	- 6	7.5	9	20
28	Bauchi	Public	47.00	57.00	+ 10.00	47	7.5	16	113
29	Bauchi	Public	57.00	57.00	0.00	0	9	9	0
30	Abuja	Public	59.00	64.00	+ 5.00	8	6	14	133
31	Bauchi	Public	179.00	176.00	- 3.00	- 4	8.8	27	207
32	Kano	Private	90.77	117.80	+ 27.03	30	15	21	40
33	Kano	Public	97.15	97.15	0.00	0	9	14	56
						13.10			91.75
Category D (> N 50 m)									
1	Kano	Public	107.77	140.10	+ 32.33	30	7.5	9	20
2	Abuja	Private	131.80	151.40	+ 19.60	15	27.5	31	13
3	Abuja	Public	141.00	195.00	+ 54.00	38	21	36	71
4	Bauchi	Public	162.00	161.00	+ 1.00	0.6	6.50	9.00	38
5	Kano	Public	165.02	175.44	+ 10.42	6	9.5	11.5	21
6	Bauchi	Public	186.00	185.00	- 1.00	- 0.5	13	15	15
7	Abuja	Public	282.56	712.87	+ 430.31	152	54	117	117
8	Kano	Private	575.35	680.12	+ 104.77	18	14	21	50
9	Kano	Public	630.00	790.00	+ 160.00	25	24	32	33
10	Abuja	Public	630.00	2990.00	+ 1660.00	263	32.5	48	48
11	Bauchi	Public	680.00	610.00	- 70.00	- 10	28	43	54
12	Abuja	Public	4060	6340	+ 2280.00	56	32	106	231
						49.43			59.25

Notes: 197 naira = 1 US\$, where the naira is the Nigeria currency

APPENDIX B: Case Study Projects

Case Study (1)	Location (2)	Client Type (3)	Cost (N 000,000.00)						
			Based Estimate (4)	Initial cost (5)	Difference (Col 5- Col 4) (6)	Difference Factor (%) (7)	Final Cost (8)	Change Order Cost (9)	% Overrun (10)
1	Abuja	Public	14.65	15.00	0.35	+2.38	15.00	0.00	0
2	Abuja	Public	16.80	17.00	0.20	+1.19	17.00	0.00	0
3	Abuja	Public	21.50	20.00	-1.50	-6.98	30.00	+10.00	50
4	Abuja	Private	23.00	23.00	0.00	0.00	26.00	+ 3.00	13
5	Abuja	Public	28.00	25.00	-3.00	-10.71	25.00	0.00	0
6	Abuja	Public	34.00	29.00	-5.00	-14.71	31.00	+ 2.00	7
7	Abuja	Public	3950	4060	110.00	+2.78	6340	+ 2280.00	56
8	Abuja	Public	39.00	41.00	2.00	+5.12	41.00	0.00	0
9	Abuja	Private	46.00	46.00	0.00	0.00	62.00	+ 16.00	35
10	Abuja	Public	63.00	59.00	-4.00	-6.35	64.00	+ 5.00	8
11	Abuja	Public	670.00	630.00	-40.00	-5.97	2990.00	+ 1660.00	263
12	Abuja	Private	142.00	131.80	-10.2	-7.18	151.40	+ 19.60	15
13	Abuja	Public	149.00	141.00	-8.00	-5.37	195.00	+ 54.00	38
14	Abuja	Private	30.2	30.2	0.00	0	30.2	0	0
15	Abuja	Public	279.5	282.56	+3.06	+1.09	712.87	+ 430.31	152
16	Kano	Private	13.20	15.30	2.10	+15.91	21.50	+ 6.20	41
17	Kano	Private	39.80	42.7	2.90	+7.29	44.9	+ 2.20	5
18	Kano	Private	19.40	20.00	0.60	+3.09	27.36	+ 7.36	37
19	Kano	Public	18.20	21.20	3.00	+16.48	21.20	0.00	0
20	Kano	Private	30.00	30.20	0.20	+0.67	30.20	0.00	0
21	Kano	Public	35.00	33.00	-2.00	-5.71	33.00	0.00	0
22	Kano	Private	9.00	10	1.00	+11.11	14.63	+ 4.63	46
23	Kano	Public	105.00	107.77	2.77	+2.63	140.10	+ 32.33	30
24	Kano	Private	44.90	41.30	-3.60	-8.02	41.40	+ 0.10	0.2
25	Kano	Public	41.00	42.80	1.80	+4.39	42.80	0.00	0
26	Kano	Private	92.00	90.77	-1.23	-1.34	117.80	+ 27.03	30
27	Kano	Public	95.00	97.15	2.15	+2.26	97.15	0.00	0
28	Kano	Private	580.00	575.35	-4.65	-0.80	680.12	+ 104.77	18
29	Kano	Public	635.00	630.00	-5.00	-0.79	790.00	+ 160.00	25
30	Kano	Public	171.00	165.02	-5.98	-3.50	175.44	+ 10.42	6
31	Bauchi	Private	17.20	18.00	0.80	+4.65	21.00	+ 3.00	17
32	Bauchi	Public	20.00	19.00	-1.00	-5.00	19.00	0.00	0
33	Bauchi	Private	19.35	20.00	0.65	+3.36	27.00	+ 7.00	35
34	Bauchi	Public	167.00	162.00	-5.00	-2.99	161.00	+ 1.00	0.6
35	Bauchi	Private	22.80	23.00	0.20	+0.88	22.10	- 0.90	- 4
36	Bauchi	Public	26.00	24.90	-1.10	-4.23	42.10	+ 17.20	69
37	Bauchi	Public	36.20	35.40	-0.80	-2.21	34.60	- 0.80	- 2
38	Bauchi	Public	36.00	35.00	-1.00	-2.78	37.00	+ 2.00	6
39	Bauchi	Public	51.00	46.00	-5.00	-9.80	47.00	+ 1.00	2
40	Bauchi	Public	43.00	47.00	4.00	+9.30	44.00	- 3.00	- 6
41	Bauchi	Public	51.00	47.00	-4.00	-7.84	57.00	+ 10.00	47
42	Bauchi	Public	56.60	57.00	0.40	+0.71	57.00	0.00	0
43	Bauchi	Public	81.90	79.00	-2.90	-3.54	76.00	- 3.00	- 4
44	Bauchi	Public	186.00	186.00	0.00	0	185.00	- 1.00	- 0.5
45	Bauchi	Public	660.00	680.00	20.00	+3.03	610.00	- 70.00	- 10