

## Assessment of Causes of Variation Order in Road Construction Projects in Niger State

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### Abstract

Road construction projects in Nigeria are hardly completed without cases of variation orders (alteration or changes in the original scope of work); as identification of the causes of variation orders assist in proper management of road construction projects. Thus, this study aimed at assessing the main factors responsible for variation orders in road construction projects in Niger State. A survey questionnaire was administered to the key players who participated in road construction projects in Niger State. These included project managers, civil engineers, contractors and quantity surveyors. A total of 80 completed questionnaires were retrieved out of the 100 questionnaires distributed using the stratified sampling technique. The collected data were analysed using descriptive method (Mean Item Score and ranking methods). It was found that increase in prices of materials, delay in progress payment by client, differing climatic or site condition were ranked high and deemed to be the major causes of variation orders in roads projects. However, postponement of projects by owners, conflict among project participants and road length/width were the least ranked causes of variation in road projects. Based on these findings, it can be concluded that proper management of these key factors would translate into cost effective road construction project. The research recommended efficient management of cost and time during course of road construction projects.

**Keywords:** *Construction projects, Niger state road construction, Variation order*

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## **Background to the Study**

The construction industry remained one of the driving forces behind the socio-economic development of any nation. This is evident in the provision of employment and physical infrastructural facilities, including bridges, dams and roads (Ashebir, Wubishet & Murad., 2016). Roads represent the wealth and asset, which support social development and economic growth of any nation (Pinard, Newport & Vanrijnl., 2016). Ashebiretal. (2016) highlighted that roads contribute immensely to the rating standards of a nation, by bringing about growth in industries, commerce, trade and improving the standard of living of people (Markow, 2012). Cities can only grow bigger when there are good road networks that can enable people to go about their normal businesses; and goods and services can be moved and distributed without much hindrance (Asiyanbola, Osoba & Adewale., 2012).

In Nigeria, roads play important roles in every aspect of development. For instance, people travel to villages with their goods for social purposes. Before the advent of the British rule in Nigeria, most roads were in the form of communal foot paths, but later developed into standard roads for trading and commercial activities. This is to say that footpaths are the genesis of road development in Nigeria (Oribuyaku, 2010).

It is hardly possible to complete the construction of complex project without changes to the plan or to construction process itself (Jaspal, Abdul-Aziz & Abdelnaser, 2010). A total of 279.94 billion Naira was budgeted for road construction projects across Nigeria in the year 2017, representing approximately 3.76 percent of the Federal Government annual approved total budget; but most of these projects experienced cost overrun at completion (Budget, 2017). There is always a wider discrepancy between the estimated cost and final cost of projects, and hardly ever a road construction is completed without cost overrun (Ashebir, etal., 2016). Moreover, similar road projects with common characteristic do experience a very wide range of discrepancy in terms of cost, due to the complicated and uncertain nature of construction projects (Aljohani, Dagbui & Moore 2017). Variation order is amendment of the original scope of work as in the contract and it lead to dissatisfaction and dispute among the parties involved in construction projects. (Aftab, Ismail & Mohammed., 2014). Therefore, these changes in construction projects have adverse effect on initial contract sum and completion period, this sometime resulted in time and cost overrun and additional works which affect development plan and some time lead to project abandonment (Kasimu, 2017) it has been observed globally that, variation are the major causes of cost and time overrun in construction projects. Various researchers attribute 10-17% of cost overrun in construction projects to variations (Hsieh, Lu, & Wu 2004; Mohammed, 2001). 65% of site instruction issued during project execution are variation of additional works (Ndiokubwayo & Haupt, 2001) however, in Nigeria project of complex nature are faced with challenges of variation during the course of construction most especially bridges, flyover, railway and high rise constructions.

## **Statement of the Research Problem**

The main problem of this research is that road construction projects in Niger State are hardly completed without cases of variation orders (alteration or changes in the original scope of

work)(Kasimu, 2017); and identification of the causes of variation orders would assist in proper management of road construction projects (Aftab, Ismail & Mohammed., 2014). Previous research on variation orders included those for building projects and rail projects, however, very few researches focused specifically on assessment of the causes of variation orders in road construction projects in Niger State.

### **Aim of the Research**

This research aimed at assessing the major causes of variation orders in road construction projects in Niger State.

### **Causes of Variation Orders in Construction Projects**

Variation in construction projects is the alteration or modification of the design, quality and quantity of works shown upon the contract drawings, Bill of Quantities and / or the specification (Fong, 2004). It also includes the addition, omission or substitution of any work, alteration of the kind or standard or any of the material or goods to be used for the works and the removal off the site of any work, material or goods executed or brought to the site except if the work, material or goods are not in accordance with the contracts (Fong, 2004; Kasimu, 2016; Mohammad, *et al.*, 2010)

Amiruddin, Towhid, Amir & Majid (2012) identified 26 causes of variation order in road construction project and isolated 10 as the most critical factors among them are change of plan or scope by the client, errors and omission in design, differing site condition and contractors financial difficulties in addition the researcher concluded that time and cost overrun are the most significant factors that has great effect on project performance. Al-Momani (2000) carried out research on causes of delay in project of 130 public buildings.

Executed in Jordan for a period of 7 years from 1990-1997. He presented regression models of the relationship between planned project duration and actual for various types of public building facilities. He concluded that the major significant causes of variation orders are related; user changes, weather, site conditions, late deliveries, economic condition sand increase in quantity. Sadi & Sadiq (2006) identified seventy three factors that causes time overrun in large construction projects in Saudi Arabia. But they concluded that "change order" is the most common factor identified by the contractors, the consultants and the clients. Nicholas & Paul (2010) carried out research to identified major causes of cost overrun within the Ghanaian road construction and found that the most significant of all the factors are the following delayed in honoring the certificate for payment, variation, inflation and slippage in schedule.

### **Effect of Variation Order**

Change order is unavoidable and may cause disturbances to the work which may lead to loss of productivity (Hanna, Camlic, Peterson & Nordheim 2002). Halwatura & Ranasinghe (2013) stated that changes that occur due to variation order bring about change on the cost of projects and it must be addressed carefully as it would disrupt the progress of work and cause time and cost overrun. Variation increases the possibility of contractual disputes (Kasinu,

2017). Project progress quality and completion time of the project may be affected by variation and most time new professional need to be hired or the entire project team is replaced to effectively execute and carried out variation due to the complexity of the project. (Arain& Low 2005).

**Research Methodology**

A survey design approach was employed in this study with quantitative data gathered from the respondents. The research population constituted the major road construction key players (projects managers, contractors, engineers and Quantity Surveyors) who actively participated in road construction projects in Niger State. Niger State was selected because most of its road construction projects experienced the problems of variation orders (Kasimu, 2017).

In order to guarantee equal representation for each of the identified groups/strata in the population, stratified random sampling method was adopted. The respondents were first categorized into different strata(project managers, contractors, engineers and quantity surveyors) before they were selected and randomly sampled accordingly. The sample frame included: 15project managers, 35civil engineers, 25quantity surveyors and 25 contractors, making up a total of 100 respondents. Therefore, a total of 100 structured questionnaires were distributed to the respondents from which 80 were retrieved and found valid for analysis. This represents 80% response rate.

Table 1 shows the distribution of the respondents and the number of questions retrieved.

**Table 1:** Sample Frame of the Study

Respondents	Population Size	Questionnaires administered	Questionnaires retrieved and valid for analysis	Percentage rate
Project managers	15	15	13	13%
Quantity Surveyors	25	25	21	21%
Contractors	25	25	18	18%
Civil Engineers	35	35	28	28%
Total	100	100	80	80%

**Source:** Researchers' survey, 2018

A comprehensive list of factors responsible for variation orders in road construction projects was compiled from literature review. The questionnaires were structured on a Five point Likert scale ranging from strongly disagree =1, disagree 2, neutral = 3, agree = 4, strongly agree = 5. The collected data in this research were analyzed using the descriptive statistics method including the use of Mean Item Score (MIS) and ranking method. The MIS was used to determine the weighted mean average of the identified measures and the premise of decision for the ranking is that the factor with the highest MIS is ranked 1<sup>st</sup> and others in such subsequent descending order. The result obtained from the descriptive analysis were summarized in tabular form for clear understanding and interpretation. The decision on the result of descriptive analysis was based on the class range as it contained in table

**Table 2:** Class range of mean value

Mean range	Likert scale
$0.00 \leq \text{mean value} < 1.49$	Strongly disagree
$1.5 \leq \text{mean value} < 2.49$	Disagree
$2.5 \leq \text{mean value} < 3.49$	Neutral
$3.5 \leq \text{mean value} < 4.49$	Agree
$4.5 \leq \text{mean value} < 5.00$	Strongly agree

Source: Kasimu, (2016)

### Results and Discussion

The results of the factors responsible for variation in road construction projects are summarized in Table 3.

**Table 3:** Factors responsible for variation in road construction projects

SN	Factors	MIS	Standard Deviation	Ranking
1	Increase in price of materials	3.70	1.23	1
2	Client financial problems	3.63	1.23	2
3	Differing climatic or site condition	3.56	1.09	3
4	Lack of design experience	3.55	1.08	4
5	Fraudulent practices, kickbacks and corruption	3.54	1.43	5
6	Change in design by consultant	3.53	1.06	6
7	Shortage of equipment	3.50	1.13	7
8	Lack of productivity and efficient of equipment	3.49	0.99	8
9	Delay in procurement	3.48	1.20	9
10	Shortage of construction materials	3.46	1.30	10
11	New government regulation and political interference	3.45	1.32	11
12	Poor management of site	3.44	1.16	12
13	Delay in taking decision by the client	3.43	1.09	13
14	Re-work as a result of poor quality of materials	3.41	1.17	14
15	Change in specification by owner	3.40	1.13	15
16	Type of contracting method	3.39	0.79	16
17	Insufficient or unavailability of labour	3.38	1.33	17
18	Additional work at owner's request	3.36	1.07	18
19	Poor terrain condition	3.35	1.09	19
20	Soil and rock suitability/drill ability	3.33	1.13	20
21	Poor communication	3.31	1.12	21
22	Force majeure	3.30	1.01	22
23	High cost of labour	3.29	1.16	23
24	Legal dispute between various parties	3.25	1.16	24
25	Poor financial control on site	3.24	1.39	25
26	Improper construction methods	3.23	1.01	26
27	Inadequate geotechnical investigation	3.21	1.25	27
28	Number of drainage work that crosses the road	3.20	1.10	28
29	Road length and width	3.19	0.98	29
30	Conflict among project participants	3.18	1.24	30
31	Postponement of project by owner	3.15	1.27	31

Source: Researchers' Field work (2018)

### **Factors responsible for Variations orders in road Construction Projects**

Table 2 shows that increase in prices of materials and client financial problems were ranked high with the mean score of 3.70 and 3.63 respectively. The result reflects the view of the key players in the construction industry based on their level of agreement, the two factors mentioned are the major factor that causes variation in road construction project These are followed by differing climatic or site conditions; lack of design experience; and fraudulent practice or kick back /corruption with MIS values of 3.56, 3.55 and 3.54 respectively .They were deemed high by the respondents because they fall between mean ranges of 3.50 – 4.49. However, postponement of project by owner; conflict amongst project participants; and road length/width were deemed to be the least ranked factors by the respondents, with the mean item score values of 3.15, 3.18 and 3.19 respectively. This is because they fall between mean ranges of 2.5 to 3.49 which show that respondents were moderate in term of causes of variation of these factors. These results corroborate the findings of Amiruddin, *et al.* (2012); Kasimu. (2016); Msalam, *et- al.*(2015); Mhando, Mlinga & Alinaitwe (2017); Halwatura & Ranasinghe,(2013) on the major factors responsible for variation order for road construction projects. They all agreed that changes in design, client financial problems and site condition were ranked among the major factors responsible for variation orders in construction projects. On the other hand, Aftab & Ismail (2014); Nicholas & Paul (2010) concluded that unavailability of equipment; poor workmanship; design complexity; and impediment to prompt decision making process were the major causes of variation orders in construction projects.

### **Conclusion and Recommendations**

Road construction projects in Nigeria are hardly completed without cases of variation orders and identification of the causes of variation orders would assist in proper management of road construction projects. This study aimed at assessing the main factors responsible for variation orders in road construction projects in Niger State.

It is concluded that the major factors responsible for variation orders in road construction projects in Niger State are: increase in prices of materials; client financial problems; differing climatic or site conditions; lack of design experience; and fraudulent practice or kick back /corruption. However, postponement of project by owner; conflict amongst project participants; and road length/width were least factors responsible for variation orders in road construction projects in Niger State. Based on these findings, it can be concluded that proper management of these key factors would translate into cost effective road construction project

The following recommendation from this study are proposed in order to minimize cases of variation order in construction projects

1. There should be effective management of cost and time during course of road construction projects.
2. Professionals and experts must actively involved in the design and planning at all stages of construction in order to address the technical problem appropriately and proffered a better solution to technical issues to minimize the effect of variation.

3. The professionals and experts must also visit the site to ascertain the nature or terrain of the site before coming up with the comprehensive total cost of the project that will eliminate frequent variation to the original plan of the projects.
4. Client must also ensure that the advance payment to the contractor are fully utilized for the purpose of which they are made in order to solve the problem of fluctuation in the prices of materials which may later bring changes to the total contract sum.
5. Client must also ensure that the progress payment due for contractor should not be delayed because delays in payment lead to project abandonment and at long run lead to variation order.
6. Attitudinal or character change toward corrupt practices should be thought in our higher institutional of learning that produces professionals and specialist to avoid corruption which is the most deadly cancer that has been eating all cells of our entire system.

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