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Evaluating the Causes and Control of Variation in Public Institutions' Buildings in Kwara State, Nigeria

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Abstract

Variation order is observed as one of the most frequently occurring issues in construction projects in Nigeria. These variations are known to impact various aspects of the projects. This study assessed the effect of variation orders on public building projects in Kwara State with a view to reducing them. The objectives of the study include: determining the causes of variation orders; identifying the effects of variation orders; and then recommending strategies to minimize variation orders. A comprehensive review of relevant literature resulted in the identification of 8 common causes of variation orders, 7 effects of variation orders, and 10 recommended strategies to minimize the variation orders. A desk study and questionnaire survey were carried out to identify the causes of variation orders, and their impacts on public building projects and to seek recommendations to reduce them. The desk study was conducted on fifty-five sample sizes and the causes of variation orders and their impacts on the projects were identified. The questionnaire responses were analyzed using SPSS descriptive statistics and the results were ranked using the average mean. The results indicated Risk factors, the complexity of design, Governmental financial problems, poor procurement process, and varying specifications by the consultant were the most common causes of variation orders. The results also showed that Productivity degradation, quality degradation, cost overrun, time overrun and delay in completion have the

most effect on variation. The findings also suggested the most recommended strategies to minimize variation orders. These strategies include Value engineering, comprehensive design details, reduction of contingency, completeness of order documentation, and adequate payment from the client to lessen variation on public building projects.

Keywords: Variation, Variation Orders, Building Projects, Public Institutions, Kwara State.

Introduction

Variation is a change that occurs in the master plan of the project different from the agreed or signed contract. It is common in all types of construction projects and plays an important role in determining the closing cost and time of projects (Akomah, Justice, Zakari, and Kottey, 2018). Adnan *et al*., (2012) stated that variation orders involved alteration, addition, omission, and substitution in terms of quality, quantity, and schedule of work. Bin-Ali (2012) defined variation as any deviation i.e., alteration, addition, or omission from the contract concerning contract drawings specifications, and/or bills of quantities. Variation order is also defined as the alteration or modification of the design, and quality of works, as agreed upon in the contract drawings, bill of quantities, and/or specifications.

Memon, Rahman, and Hasan (2014) explain that variations are caused by various factors, which often result in disputes and dissatisfactions among the parties involved in construction projects. Babatunde (2013) stated that the construction process is subject to many variables and unpredictable factors resulting from many sources. Furthermore, he stressed that one of these variables and unpredictable factors are changes in the scope of work by project participants, as these changes can lead to deviations from the sum stipulated in the contract.

Great concern has been expressed in recent years regarding the adverse impacts of variations in construction projects (Memon, Rahman, and Hasan, 2014). Most building projects are liable to variations that might be caused by the change of mind of the clients, consultants, or any unforeseen scope of the project raised by one of the project participants, but Keane, Sertyesilisik, and Ross (2010) argue that the causes of variations could originate from the client, consultant, contractor, and non-party-related causes.

Murdoch and Hughes (2008) insist that variations may originate from any of the following three ways:

(i) clients may change their minds about what they asked

for before the work is complete;

(ii) designers may not have finished all of the design and specification work before awarding the contract; and

(iii) changes in legislation and other external factors may force changes upon the project team.

Over a period of time, studies have observed that most public projects ranging from bridges, road construction, and tertiary institution buildings in Nigeria and internationally usually rise above their estimated project cost. This is of great concern to clients, government, and building professionals as such. Subramani, Sruthi, and Kavitha (2014), surveyed the causes of this problem, and the results indicated that the major causes are slow decision-making at the planning stage of a project; poor project schedules and management; increases in the prices of materials and machines; poor contract management; poor design/delay in producing design; rework due to mistakes or wrong work; land-acquisition problems; poor estimation or estimation techniques, and the long time taken between the design and the time of bidding/tendering. In the context of Nigeria's construction sector, it was observed by Babatunde (2013), that instead of a project taking two years, it may take more than three years with its cost possibly doubling. However, this unfavourable circumstance is a result of variations, which tends to raise a concern about public building and infrastructure facilities developed through meagre public resources that fail to provide value for money. Memon, Rahman, and Hasan (2014) pointed out that the occurrence of variation stands as the basis for why most construction works do not achieve quality, cost, and timely delivery.

Nowadays, variation orders have become a common problem in public building projects in Nigeria. The major causes of delay, disputes, and sometimes generate significant cost and environmental impacts are variation orders issued during the construction of projects. Yet, no unique method is available for minimizing variation effectively. However, their impact can be curtailed with an appropriate study of the causes. Variation orders on public building projects have the potential to impact public building projects, and the identification of their causes might lead to their reduction, possible elimination, and subsequent improvement in the overall performance of public building projects in Kwara State.

The research aimed to evaluate the causes and control of variation in public institution buildings in Kwara State, Nigeria. The aim was achieved using the following research objectives:

- To identify root causes of variation in building projects in Kwara State
- To examine the effects of variations on public building projects in Kwara State
- To proffer strategy and control measures for reducing the detrimental effects of variations in public building projects in Kwara State.

THE CONCEPT OF VARIATION IN THE CONSTRUCTION INDUSTRY

Hayati (2006) in Yadeta, (2014) affirm that variation could be taken to be any or a combination of any or all of the following:

a. Variation in building projects may mean 'the alteration or modification of the design, quality or quantity of the works, as shown upon the contract drawings and described by or referred to in the contract bills, and includes the addition, omission or substitution of any work, the alteration of the kind or standard of any of the materials or goods to be used in the works, and the removal from the site of any work materials or goods executed or brought thereon by the contractor for the works other than work or material or goods which are not in accordance with the contract.
b. Variations in building projects with instructions concerning the nature of the works are not specifically termed variations in the contract documents.
c. Variation of contract in law, i.e. if both parties alter a contract document by agreement after execution of the original contract this is a variation of the contract terms or conditions.
d. Variation of price clause which enables the contract sum to be adjusted for rises and falls in the cost of labour or materials.

Sunday (2010) identified 53 causes of variation orders for the formulation of the questionnaire. 58 questionnaires were distributed to the in-house construction professionals, consultants, and contractors involved in handling government projects. 30 in-house staff responded to the questionnaire and 18 responded by both the consultants and contractors who were involved in government construction projects. Through the analysis of the data, it was discovered that the projects handled by the consultants are more prone to variation orders than projects handled by the in-house professionals. Aside, the study also discovered that the percentage difference in the initial contract sums and final sums was significant both once the contract has been concluded, its terms cannot be changed unless the contract itself contains some provisions for variation, and then the only permitted variations are those that fall clearly within the contractual terms.

Ijaola and Iyagba (2012) indicated in their study that the "clients' additional works and modification to design" were the most important causes of a change order in both Nigeria and Oman, and the most important effects of change orders are "variations result in claims and disputes" in Nigeria while "delay in the completion date of the project and cost overruns" were the most important effects in Oman. He also identified the contractor as the most beneficial party in the variation. He determined certain points that are: Implementation of the National Building code, Review of contractor's/consultant's registration should be carried out periodically to ascertain

their professional competency, and the Client should carry out a proper feasibility study and survey before the design stage.

Variations of project scope, political factors, wrong estimates, and faulty design may cause the abandonment of construction projects, resulting in a waste of government resources (Olusegun and Michael (2011). Likewise, variation strains the relationships of the owners, engineers, contractors, subcontractors, and others involved in the construction process as well as additional cost and schedule delay. Changes in one project can also affect other unrelated projects by tying up resources that are committed elsewhere. Negative relationships between the parties are another by-product of changes in a project. Not only is workflow disrupted, but also trying to get quick responses to quotes, shop drawings, and many other things required to get back to schedule causes a strain on working relationships (Rashid, Elmikawi, and Saleh, 2012). It is therefore clear that construction work processes might have many unpredictable variations such that their minimization is necessary. Thus, the project management team must have the knowledge, skills, and abilities to deal with the day-to-day management challenges of change (Zadeh *et al*., 2016).

Classification of Variation

The nature of a variation can be determined by referring to both the reasons for its occurrence and subsequent effects. Arain and Pheng (2005), distinguished three types of variation namely: beneficial, detrimental, and unpredictable variation.

Beneficial Variation

Ruben (2008) explains beneficial variation as the one issued to improve the quality standard and reduce cost, schedule, or degree of difficulty in a project. It is a variation order initiated for value analysis purposes to realise a balance between the cost, functionality, and durability aspects of a project to the satisfaction of clients. Beneficial variations are those that help to reduce cost, schedule, or degree of difficulty in the project (Arain and Pheng, 2005).

Beneficial variation orders are initiated for value analysis purposes to achieve a balance between the cost, functionality, and durability aspects of the project to the satisfaction of the client by eliminating unnecessary costs from the project (Ndihokubwayo and Haupt, 2008).

Detrimental Variation

According to Ndihokubwayo and Haupt (2008), Detrimental variations are those that reduce owner value or have a negative impact on a project, a detrimental variation order compromises the client's value system (Ndihokubwayo, 2008). However, detrimental variations were identified to be the major causes of conflict and dispute in the construction industry (Yates and Hardcastle, 2003). The client who is experiencing

financial problems may require the substitution of quality standard expensive materials for substandard cheap materials. For example, on a construction project situated in a salty environment, steel window frames result in steel oxidation if selected instead of timber or aluminium frames.

Unpredictable Variation

According to Mbatha (2006), Variations leading to cost overruns are caused by additions, fluctuations, adjustment of prime cost sums, provisional quantities, uncertain ground conditions, wrong design, claims due to delays from designers, etc. When weather conditions vary, the contractor will need to adjust his construction schedule accordingly and this may lead to adverse effects on the progress leading to overall project delay.

The Predominance of Variation in Public Construction Projects in Nigeria

Olowo-Okere, (1985). asserted that most countries put over 55% of their gross domestic investment into the creation of physical facilities, including infrastructure that is necessary for development. Wuyts and Kilama (2014), found that in 2010 the construction sector contributed 8 percent of the country's GDP. The Contractors' Registration Board (CRB) of Nigeria (2011), affirms that the construction value of capital formation was 50 percent in the year 2010.

A significant portion of the government's development budget (about 60 percent) is spent on construction projects. National Bureau of Statistics (NBS) (2017), affirms that construction activities grew faster than other activities in the year 2015 at 16.8 percent. This growth is mainly attributed to continued Government investment in infrastructure development. The economic reforms carried out during the past decade have attracted a significant increase in the donor, private sector, and foreign direct investments in infrastructure developments. The amount of manpower employed by the construction sector is about 9 percent of the workforce in Nigeria.

Variation orders in construction projects for instance in Kenya have been associated with cost and time overruns in the magnitude of 70 - 151% and 32 - 179% respectively. It was reported that the rampant occurrence of variations was considered an avenue through which unscrupulous contractors, engineers, and government officials conspire to escalate project costs resulting in the wastage of public funds (Dickson, Gerryshom, and Wanyona, 2015).

In Nigeria, variation to works in public projects is administered by the Public Procurement and Disposal Act of 2005. Under this legal dispensation, the Public Procurement Oversight Authority (PPOA) was created to oversee the public procurement system with its principal function of ensuring that the public procurement law is complied with.

According to PPOA (2006), Variations to work shall be effectively provided; the quantity variation for works does not collectively exceed 15% of the original contract quantity, and quantity variation is to be executed within the period of the contract. Further, PPOA (2009), instructs that all variations must be approved by the tender committee within the procuring entity and instruction issued in variation instruction or variation order.

Attempts have been made to solve the problem of variations by restricting their magnitude. FIDIC (1999) allows for up to 10% while FIDIC (2006), stipulates 25% of the contract sum.

Despite these attempts, building and civil engineering construction projects in Nigeria are still overwhelmed by variation orders which are not only incessant but also excessive in magnitude, thus negatively impacting the performance of these projects. Moreover, Nigeria Anti-Corruption Commission (2007), cautioned that unwarranted variations present loopholes that could be exploited by unscrupulous personnel to embezzle public funds.

Nature of Variation in the Construction Project

There are variations in all types of construction projects, but Ibbs, Wong, and Kwak (2001) affirm that various factors determine how the frequency and nature of variations vary from one project to the other. According to Kaming, Olomolaiye, Holt, and Harris (2007) in the event of variations in the construction project either total direct and indirect cost, adjustment to the contract duration, or both are experienced, in order to minimize adverse effects of variations on projects teams must possess the capability to efficiently react to variations. Variations are common in construction projects because of considerable changes to the cost, quality and project time. The task of variation management is hard for most clients because of how diverse the causes of variation orders tend to be. However, if a mechanism for handling variation orders and making better-informed decisions with the help of past projects can be built into project management then this unfavourable situation can be alleviated. Whether there are variation orders should not be the litmus test for successful management, but rather, if variation orders were resolved on time for the benefit of all the parties in the project.

Causes of Variation in Public Building Projects.

Variation arises for a variety of causes, of which some causes are foreseen and others are not. Literature reviews that variation Orders require a comprehensive understanding of the root causes of Variations (Hester, Chang, and Kuprenas, 1991). Some of these are financial, design aesthetics, changes in drawings, weather, geological and geotechnical reasons. From the literature review, there are various

causes of Variations identified and these Variations are mainly caused by the Employer, Consultants, and Contractors. These causes of Variations were grouped under four categories: Employer-related Variations, Consultant-related Variations, Contractor-related Variations, and other Variations (Hester Chang, and Kuprenas 1991). These Causes of Variations have been identified by many researchers (CII, 2005; Thomas and Napolitan, 1995; Mokhtar Bédard, and Fazio, 2000; Gray and Hughes, 2007; Arain and Pheng, 2004). Below are the perceived causes of variation in public building projects in Nigeria.

Change in Project Schedule

According to Aftab (2014), almost every construction project in the world faces the problem of a change of schedule during the executions In the case of a change in schedule, the contractors have either to endow themselves with extra resources or also may keep some of the resources inactive. In both cases, the additional cost is incurred. Thus, it affects severely the performance of the project. A change in schedule means that the Contractor will either provide additional resources or keep some resources idle at the construction site. In both cases, the additional cost is incurred (Fisk, 2007).

Client Financial Problems

According to Mohammad, Ani, Rakmat, and Yusof (2010), financial problems of government bodies and stakeholders frequently affect the quality and progress of the project. This problem can lead to changes in work schedules and specifications, which then affect the quality of the construction. The Employer of the project may run into difficult financial situations that force him to make changes in an attempt to reduce the cost of the project. Employers' financial problems affect project progress and quality (Clough and Sears, 2002).

Varying Specification by the Client

Variation to contract specification by the client is a rampant occurrence due to inefficient project goals (O'Brien, 2008). In the event of the execution of such changes, there is the possibility of the occurrence of variation during the construction phase of the project. In a multi-player environment like any construction project, a change in specifications by the Employer during the construction phase may require major Variations and adjustments in project planning and procurement activities.

Complexity of Design

The complex nature of designs demands exclusive proficiency, attention, and technological advancement in construction (Arain, 2004). The flow of the construction sequence is affected by the complex nature of the designs while uncomplicated

construction activities are comparatively tractable (Fisk, 2007). Hence, complexity may cause major Variations in construction projects.

Poor procurement process

Procurement delays have various negative effects on other processes in the construction cycle (Fisk, 2007). Occasionally, the procurement delay may cause an entire change or replacement for originally specified materials or equipment for the project (Arain *et al*., 2004). This may therefore cause a need for project activities to be reworked.

Change in specifications by consultant

Changes in specifications are frequent in construction projects with inadequate project objectives (O'Brien, 2008). As mentioned earlier concerning changes in specifications by the Employer, this is also a potential cause of Variations in a project, leading to reworks and delays in the project completion.

Sketchy working drawing details

Oluwaseun and Clinton (2018), in their research, pointed out that the use of inexperienced designers will result in wrong/inadequate descriptions in specifications, and omissions of details were the most implicated. Arain (2004), affirmed that scrappy detailing of construction working drawings can lead to a misconstruction of the prerequisite hence causing variations in the project.

Risk Factors:

According to Odeyinka, Lowe, and Kaka (2012), risks are the factors that can cause a project to fail to meet its goals. For example, as they pointed out, positive variations between actual and forecasted cash flows are the impacts of risk factors that occur during construction. It should also be noted that wherever the word risk factor used in this study implies the factor that can cause variations in forecasted construction cash flows for a certain work part of the building project. Normally, the variations are caused by risk factors inherent in the construction cash flow forecast.

RESEARCH METHODOLOGY

This section presents the methodology adopted and identifies the tools and techniques employed in conducting this study. The methodology describes the practical way in which the whole research project has been organized (Oliver et al., 2004). The methodology is a plan of action that shows how the problems will be investigated, what information will be collected using which methods, and how this information will be analysed to arrive at conclusions and develop recommendations. The research follows some steps and procedures when conducted. Once the problem statement has

been formulated, it should become evident what kind of data will be required to study the problem, and also what kind of analysis would be most appropriate to analyse the data (Walliman, 2005). The problem investigated in this study is evaluating the causes and control of variation in public institution building in Nigeria. It is anticipated that the identification of the causes of variation orders may lead to their reduction, possible elimination, and improvement in the overall performance of public building projects.

Research Design

Research design is an action plan for getting here to there. Here' refers to the initial set of questions to be answered and 'there' is some set of conclusions about the questions. This study is designed to obtain views from architects, engineers, quantity surveyors, and procurement officers about the causes of variations in public building projects using a questionnaire survey.

Study Population

Population refers to the total set of observations that can be made. The population of the study comprises engineers, architects, quantity surveyors, procurement, and supply officers within Ilorin, Kwara State, Nigeria. The population for this study was drawn from the sample size.

Sample Size and Sampling Techniques

Due to the nature of data to be collected from the desk study and the expected participants for the survey study, a non-probability sampling technique was preferred to be used. A purposive sampling method was adopted to select the population for the study therefore not every member of the population has a chance to participate in the study.

The study adopted a sample size of fifty-five (55) respondents derived from the sample size formula, the population was the stakeholders in the Ilorin city government public building projects namely clients (project owners), contractors, and consultants to which the questionnaires were sent. These populations were selected depending on their direct exposure to the public building project activities in Ilorin from a total population of 65.

Method of Data Collection

It has been found that the data at hand is often not sufficient for dealing with any real-life problem, thus, the need to collect appropriate data for a research study. Primary sources of data have been employed in this study. Primary data sources are those collected directly from the subjects of study either through experiments or surveys, whilst commonly used secondary data sources include journals, organisational reports, periodicals, books, etc. Primary data for this study were collected using questionnaires.

Research Instruments

Questionnaires were designed to primarily collect information that can be used as data for analysis. It consists of a series of questions asking respondents to directly provide the information requested in line with the objectives of the study. The questionnaire form was divided into two main sections. In section 1 of the questionnaire, the respondents were asked to fill in the space provided with the appropriate respondent's general information. However, in section 2 of the questionnaire, the respondents were required to rate causes, effects, and strategies to reduce the effect of variations in public construction projects using a five-point Likert scale viz-a-viz: strongly disagree = 1; disagree = 2; neutral = 3; agree = 4 and strongly agree = 5. The Likert scale rating system has been used successfully by many researchers such their studies.

Validity of Research Instrument

To ensure that, the data collected through the research instrument would enable the researcher to address the aim and objectives of which the research was undertaken, the validity of the research instrument was conducted. In general, validity is an indication of how sound is research. More specifically, validity applies to both the design and the methods of the research. Validity in data collection means that the findings truly represent the phenomenon that is expected to be measured. The goal of conducting this test was to identify any mistakes in the questionnaire and also to make sure that the questionnaire was easily comprehensible to the respondents, to get a valid response.

Method of Data Analysis

This involves the breaking down, extracting, implementing, and regrouping of data to interpret them, as they apply to the causes and control of variation in a public building project in Ilorin, Nigeria. The results were analyzed in percentages and figures using descriptive statistics and presented in the form of charts and tables. In order to generate the result, mean, standard deviation, and ranking of the results, the researcher adopted the Statistical Package for Social Sciences (SPSS) version 21.0 for the analysis.

PRESENTATION OF RESULT AND DISCUSSION

This section presents the findings of the research titled Evaluating the causes and control of variation in public building projects with a focus on public institutional projects in Kwara state. This research has been conducted on a sample size of 55 respondents spread among Clients, Builders, Quantity Surveyors, Design Consultants, Project Managers, and Contractors in construction projects out of which 42 respondents completed and returned the questionnaires duly filled in making a response rate of 76%. For analysis, frequencies (absolute and relative) on single-response questions have been used and on multiple-response questions, the Likert

scale in collecting and analyzing the data whereby a scale of 5 points was used in computing the means and standard deviations. These were then presented in tables with appropriate explanations.

Analysis of Findings

The results from the data in the displayed tables are analyzed and interpreted to find answers to the research problems. The numbers are summarized and interpreted by using statistics. Statistics provide a means through which numerical data can be made more meaningful.

An analysis of the summarized research results was done to make meaningful conclusions and recommendations. Tables and descriptive explanations have been employed to illustrate data gathered from the field to make the research findings more meaningful. The following analysis shows the responses received from forty-two (42) professionals within Kwara State, Nigeria.

Demographic Characteristics of the Respondents

This section is mainly designed to provide general information about the respondents in terms of their Profession, Educational Qualification, Experience of the respondents, and major organization type.

Table 1 Respondent's Organization Type

S/N	Organization	Frequency (No)	Percentage (%)
1	Contractors	22	52.4%
2	Consulting	15	35.7%
3	Government	5	11.9%
	Total	**42**	**100**

Field Survey, 2019

From Table 1, out of the 42 respondents, 52.4% of the respondents were contractors across different parts of Ilorin, while 35.7% of the respondents were consultants, and the rest respondents 11.1% were respondents under a government institution.

Table 2 Professional Distribution of Respondents

Organization	Frequency (No)	Percentage (%)
Quantity Surveyor	12	28.6%
Engineer	10	23.8%
Architect	9	21.4%
Builder	11	26.2%
Total	**42**	**100%**

Field Survey, 2019

From Table 2, it can be deduced that this research covers quantity surveyors (28.6%), Engineer 10 (23.8%), Architect 9 (21.4%), and the rest respondents were Builder 11 (26.2%).

Table 3 Years of Experience in Practice

Years of Experience	No frequency	Percentage (%)
0 - 5 years	8	19.05%
6 -10 years	11	26.2%
10 – 15 years	13	31%
16 – 20 years	10	23.8%
21 years	-	
Total	42	100%

Field Survey, 2019

The result illustrates that more than half of the professionals (Quantity Surveyors, Builders, Architects, and Engineers) have an experience of more than five years. These results also provide a level of satisfaction that the obtained data will reflect what it was designed for. Those respondents have good positions in their organizations to provide accurate and precise information.

Table 4 Educational Qualification of Respondent

Organization	Frequency (No)	Percentage (%)
HND	7	16.7%
B –Tech/B.sc	11	26.2%
PGD	9	21.4%
Msc/M-Tech	9	21.4%
PHD	6	14.3
Total	**42**	**100%**

Field Survey, 2019

In Table 4, it can be deduced that most of the professionals are B.Tech/ BSc holders with (26.2%) while 7 of the respondents (16.7%) were HND holders, others are as follows, PGD with (21.4%) and MSc/M.Tech with 21.4%

Table 5 Profession Qualification Respondents

Variables	Frequency	Percentage (%)
Nigeria Institute of Building (NIOB)	10	23.8%
Nigeria Institute of Quantity Surveyor (NIQS)	12	28.6%
Nigeria Society of Engineers (NSE)	5	11.9%
Nigeria Institute of Architects (NIA)	8	19.0%
Not registered	7	16.7%
Total	**42**	**100%**

Field Survey, 2019

Table 5 shows the professional qualifications of the respondents. It indicates that (23.8%) of the respondents were registered under the Nigeria Institute of Building, while the majority of the respondents were registered under the Nigeria Institute of Quantity surveyors (28.6%). 12% of the respondents were registered under the Nigeria Society of Engineers, 19.0% were registered under the Nigeria Institute of Architects, and the rest of the respondents were unregistered under any of the professional bodies.

Analysis of Research Objectives

Table 6 Root causes of variation in a public building in Kwara state

Root causes of variation in a public building									
Rating	**5**	**4**	**3**	**2**	**1**	**Total**	**Mean**	**STD**	**Rank**
Risk factors	26	10	4	1	1	**42**	4.40	0.94	**1st**
Complexity of design	22	15	3	2	0	**42**	4.36	0.82	**2nd**
Governmental financial problems	21	14	5	2	0	**42**	4.29	0.86	**3rd**
Poor procurement process	21	15	3	1	2	**42**	4.24	1.03	**4th**
Varying specifications by the consultant	20	14	6	1	1	**42**	4.21	0.95	**5th**
Sketchy working drawing	17	5	6	2	2	**42**	4.02	1.09	**6th**
Varying specifications by client	11	16	12	2	1	**42**	3.81	0.97	**7th**
Change in a project schedule	10	7	13	8	4	**42**	3.26	1.29	**8th**

Field Survey, 2019

In this section, the root causes of variation in public building projects in Kwara State were addressed. As it relates to the first objective of the research discussed. On a Likert score of 1 to 5, descriptive statistics were used to determine the standard deviations and the mean score of the variables, where, a scale "5" very high, "4" high, "3" neutral, "2" low and "1" very low

In order of agreement, "Risk factor" was ranked first based on the average mean of 4.40 while "complexity of design" with an average mean value of 4.35 was ranked second, "Governmental financial problem" was ranked 3rd with an average mean of 4.29 "poor procurement process" was ranked 4th with a mean 4.23, lastly "varying specification by the consultant" was ranked 5th with a mean of 4.21

Table 7 Detrimental effects of variations in public building projects in Kwara state

Detrimental effects of variation in public building projects in Nigeria									
Rating	**5**	**4**	**3**	**2**	**1**	**Total**	**Mean**	**STD**	**Rank**
Quality Degradation	30	11	1	0	0	**42**	4.69	0.51	**2nd**
Cost overrun	28	9	2	1	2	**42**	4.52	0.89	**3rd**
Delay in completion	26	12	2	1	1	**42**	4.36	1.03	**5th**
Conflict and disputes among construction parties	20	8	6	6	2	**42**	3.90	1.28	**9th**
Logistics delay	15	15	10	1	1	**42**	4.00	0.96	**6th**

Delay in payment	16	14	8	2	2	**42**	3.95	3.95	**8th**
Productivity degradation	10	20	5	5	2	**42**	4.69		**1st**
Re-execution of work	20	10	5	5	2	**42**	3.97	1.24	**7th**
Time overrun	26	12	2	1	1	**42**	4.45	0.88	**4th**

Field Survey, 2019

The results in Table 7 show the detrimental effect of variation of public building projects in Kwara State. In order of agreement, "Productivity degradation" was ranked first based on the average mean of 4.70, while "Quality degradation" with an average mean value of 4.69 was ranked second, "Cost overrun" was ranked 3rd with an average mean of 4.52, "Time overrun" was ranked 4th with a mean 4.45 and lastly "Delay in completion" was ranked 5th with a mean of 4.36.

Table 8: Recommend strategy and control for reducing the detrimental effects of variation in public building projects in Kwara state

Recommend strategy and control for reducing the detrimental effects of variation in public building projects in Kwara state

	Rating								
	5	**4**	**3**	**2**	**1**	**Total**	**Mean**	**STD**	**Rank**
Value engineering	34	6	2	0	0	**42**	4.74	0063	**1st**
Comprehensive design details	30	10	2	0	0	**42**	4.67	0.57	**2nd**
Reduction of contingency	29	11	2	0	0	**42**	4.55	0.8	**3rd**
Completeness of order documentation	28	10	4	0	0	**42**	4.57	0.67	**4th**
Clarity of project requirement	24	16	2	0	0	**42**	4.52	0.59	**5th**
A thorough investigation of the site	22	18	2	0	0	**42**	4.48	0.59	**6th**
Use of project scheduling/management techniques	21	18	3	0	0	**42**	4.43	0.63	**7th**
Freezing design	20	19	3	0	0	**42**	4.4	0.62	**8th**

Field Survey, 2019

The results in Table 8 recommend a strategy that will control and reduce the detrimental effects of variation in public building projects in Kwara State. In order of agreement, "Value engineering" was ranked first based on the average mean of 4.73 while "Comprehensive design details" with an average mean value of 4.66 was ranked second, "Reduction of contingency" was ranked 3rd with an average mean of 4.54 "completeness of order documentation" was ranked 4th with a mean 4.57and lastly "adequate payment from client" was ranked 5th with a mean of 4.31.

Discussion of findings

This section presents the discussion of the study findings from the questionnaires and the desk study. The cause of variation orders, the effect of variation orders, and recommendations to minimize variation orders are discussed.

Causes of variation

From the questionnaires, the common causes of variation orders on public building projects were risk factors, the complexity of design, Governmental financial problems, poor procurement process, and varying specifications by the consultant were the most causes of variation orders. The causes of variation orders were ranked in descending order of mean and the most frequent were identified.

The first major cause of variation orders was the risk factors. This could also be caused due to risk factors inherent in construction cash flow. This similarly confirms the literature by Odeyinka, Lowe, and Kaka (2012), that risks are the major factors that can cause variation and a project to fail in meeting its goals. For example, as they pointed out, positive variations between actual and forecasted cash flows are the impacts of risk factors that occur during construction.

The complexity of design was the second major cause of variation orders. This occurs due to the inadequate skill of the designer. Pheng and Teo (2004) explained that designs require unique skills and construction methods. Complexity affects the flow of construction activities, whereas simple and linear construction works are relatively easy to handle (Fisk, 2007). Hence, complexity may cause major variations in construction.

Governmental financial problems are the third according to the ranking of this finding. The government may run into a difficult financial situation that may prompt changes. This similarly confirms the literature by Mohammad *et al.,* (2010), Financial problems of the government bodies and stakeholders frequently affect the quality and progress of the project. This problem can lead to changes in work schedules and specifications, which then affect the quality of the construction. The poor procurement process was ranked 4th indicating a major cause of variation in public building projects. A literature review by Arain *et al.,* (2004) also pointed out that occasionally, the procurement delay may cause an entire change or replacement for originally specified materials or equipment for the project.

Varying specification by the consultant was ranked 5th in the result which explained how the consultant contributed to variation and this could lead to rework. Changes in specifications are frequent in construction projects with inadequate project objectives (O'Brien, 2008). In the design stage, it could be a failure to change the specification due to a change of mind of the client or the consultant which results in variation orders. Consequently, a change in specifications can be the major cause. Ndihokubwayo (2008), listed changes in specifications as among the major causes.

The detrimental effect of variation

The results of this research also showed that Productivity degradation, quality degradation, cost overrun, time overrun, and delay in completion were the most

effective variations as ranked in Table 7. Productivity degradation was ranked first in this research based on responses from the questionnaire. However, construction works that are associated with variations have a negative impact on both plant and labour productivity. Alinaitwe, Mwakali, and Hansson (2007), also stressed that a loss in productivity implies a loss of time and subsequent delays, indicating that it has a major impact on a construction project

The second major detrimental effect of variation according to this study is Quality degradation. Quality degradation is also the major impact as reviewed in the literature part.

Cost overrun was the third major impact of variation orders as identified in this study. An increase in project cost is also the major impact as reviewed in the literature part. For example, Koushki, Al-Rashid, and Kartam (2005) found that variation orders impacted both the completion time and costs of projects. These impacts were due to detrimental variation orders since they negatively impacted the client's value. Any major additions or alterations in the design may eventually increase the project cost. It was not unexpected for the project cost to increase due to frequent variations in the project. This was because the variation orders may impact the project's total direct and indirect costs. Therefore, any major addition or alteration in the design may eventually increase the project cost.

Time overrun and delay in completion were ranked 4th and 5th respectively According to the findings from the questionnaire investigation, the delay is the common impact on public building projects that increases the consistency of the response to a conclusion. Previously (Ibbs, 1997) pointed out that completion schedule delay was a frequent result of variations in construction projects. This confirmed that variations impact the project adversely, leading to delays in the project's completion. Likewise, many construction projects worldwide have suffered delays due to variations such that their value for money has been jeopardized. Thus, it can be concluded that variations result in the requirement of additional time to complete the job (Priyantha, Karunasena, and Rodrigo, 2011).

Recommend strategy and control for reducing the detrimental effects of variation in public building projects

The findings also suggested the most recommended strategies to minimize variation orders. These strategies were Value engineering, comprehensive design details, reduction of contingency, completeness of order documentation, and adequate payment from the client to minimize variation on public building projects.

According to the findings from the questionnaires ranked previously in **Table 8**, the first most recommended strategy was Value engineering this would provide an opportunity for the consultant to review and finalize project goals in the preliminary

phase. Literature also reviewed that, this is a cost minimization procedure in the design phase of a construction project. There will be no need for rework or demolition at the construction site when a change in design element at this stage occurs. Project goals are clearly defined when value engineering is exercised at the preliminary phase of a project to assist in minimizing variation or disparities in project designs (Dell'Isola, 2002).

Comprehensive design detail was the second most recommended strategy to minimize variation orders. Any change or modification made later will result in additional work which leads to variations. The design team should submit a complete design for tendering. This would assist in reducing the occurrence of variations during the construction phase where the impact of variations can be severe on the project. This confirms the contribution of Hao, Shen, Neelamkavil, and Thomas (2008), who proposed clear design specifications before bidding and curbing corruption in the Procurement process as the potential mitigation measures of detrimental variations in construction projects. An exhaustive design is very easy to understand and manageable to work with (O'Brien, 2008).

There were higher frequencies for claims for payment of work and extensions of time occasioned by the execution of the alleged varied work. In certain circumstances, loss of profit, loss, expense, and damages are also included within the claims. The major events that triggered the disputes were the terms of the contract (express or implied), the effects of instructions, and disputes over the rates. Although there were various points that counsel took when arguing for or against the claim, two bases and/or defence of claims are different from the rest: 1. The claim or relief sought is expressly provided for in the contract, and 2. The claim or relief sought is not within the meaning of the clause in question or outside the original agreement.

These findings suggest that there are areas of variation clauses that need to be clarified. Presumably, some of the disputes could have been avoided if both parties had similar conclusive notions of the scope and limitations of the contract. The obvious differences in their interpretations suggest that it may be fruitful to improve the terms, especially on time and money-related issues.

CONCLUSIONS AND RECOMMENDATIONS

This section draws conclusions and recommendations. The conclusion constitutes the recapitulation of major findings from the exploratory study, interviews, and research instrument. The recommendation section highlights the practical implication of the study and suggests further research studies

Conclusion

The project has revealed that variation is inevitable in building projects, thus having a great impact on the duration and completion of public residential building projects. It

was revealed that not all variations are caused by architects and the project team alone but corruption has an impact on it to an extent. An exploratory study was done on some selected public residential building projects and data was collected, variations have impacts like an increase in contract sum and extension of time in the contract duration in some of the selected building projects. However, not all variations increased the final contract sum, some have value, while some have little or no impact on the final cost of the project.

In the same vein, not all variations resulted in the extension of contract periods as some had little or no impact on the duration and completion of building projects. Research also revealed that unfavourable site conditions, incomplete architectural design, insufficient time frame for planning, and changes in specification by the architect are the major factors that expose buildings to variation. Since variation is encountered on most public building projects, there are unforeseen threats that must be accommodated by making provisions and procedures in the contract and administration of the project, for which both the client and the contractor must be prepared to, negotiate.

Recommendations

Based on the findings of this study the following recommendations are proposed to minimize the occurrence of variation in public building projects:

i. As part of preconstruction planning, the Government, client, and the Institution's management should acquire the right way for the entire corridor before the contractor moves in to commence work.
ii. Contract Variation issued should always be accompanied by time for carrying out the specific variations.
iii. Project Managers must agree that delays or impacts which cause extension of time and/or increase in cost are a frequent occurrence in project construction and plan for their time
iv. Contractors should regularly try to identify and bring to the attention of the client project risks such as an ill-defined scope in the early stages like at tender clarification meetings of a project.
v. A conclusive feasibility study that entails a thorough geotechnical investigation that brings to the fore all subsurface conditions necessary for the design.
vi. The consultant should produce a concluding design and working drawings and contract drawings should be competing at the tender stage
vii. Proper coordination between overseas and local designers so that the local design standards and requirements are adhered to and the actual site conditions are taken into consideration during design.
viii. Enhance communication and all parties should be proactive at all times.

ix. The design team must patiently and carefully examine and interpret the client's brief and quality time should be spent providing several sketches, detailed cost control should be done at this stage to represent the client's intended project and financial capacity before preparing a detailed drawing.

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