IMPACT OF FACTORS CAUSING VARIATION ORDERS ON ROAD CONSTRUCTION PROJECT IN KWARA STATE

BY

ABDULLAHI QUDIRAT OLUWATOYIN

HND/23/QTS/FT/0002

BEING A RESEARCH PROJECT SUBMITTED TO

DEPARTMENT OF QUANTITY SURVEYING,

INSTITUTE OF ENVIRONMENTAL STUDIES,

KWARA STATE POLYTECHNIC, ILORIN

IN PARTIAL FULFILMENT OF THE REQUIREMENT

FOR THE AWARD OF HIGHER NATIONAL DIPLOMA (HND)

IN QUANTITY SURVEYING

KWARA STATE POLYTECHNIC, ILORIN

JULY, 2025

CERTIFICATION

This is to certify that the research titles Impact of Factors causing Variation Orders on Road Construction Project in Kwara State was carried out by Abdullahi Qudirat Oluwatoyin with matriculation number HND/23/QTS/FT/0002 has been read and approved as meeting for the award of Higher National Diploma (HND) in the Department of Quantity Surveying, Kwara State Polytechnic, Ilorin, Kwara State.

_____ _____

QS. SIDIQ LATEEF (MNIQS, RQS) DATE
(*Project Supervisor*)

_____ _____

QS. SIDIQ LATEEF (MNIQS, RQS) DATE
(*Head of Department*)

_____ _____

QS. AISHAT OMAR MUAZU DATE
(*Project Supervisor*)

_____ _____

QS. (DR.) ADAMU MUDI-ADAMU (FNIQS, RQS) DATE
(*External Examiner*)

DEDICATION

This project is dedicated to the Almighty God, the giver of life and peace, for guiding us through and granting us the strength to successfully complete our academic program at Kwara State Polytechnic, Ilorin. I also dedicate this project to my beloved parents, whose unwavering support and love have been our pillars of strength throughout this journey.

ACKNOWLEDGMENT

All praise and gratitude are due to Almighty Allah for granting me life and the opportunity to study at Kwara State Polytechnic, Ilorin, Kwara State. I extend my heartfelt appreciation to our project coordinator, QS AISHA OMAR MUAZU, for her invaluable cooperation and motherly support despite her busy schedule. May Allah reward her with abundant blessings. I am also deeply grateful to our project supervisor, QS SIDIQ LATEEF, for his unwavering support and dedication. Despite his tight schedule, he took the time to review our work and provide necessary feedback. May Allah abundantly reward him for his efforts.

Special thanks to my parents for their unwavering support and assistance throughout my journey. I pray that they reap the fruits of their labor and enjoy peace and prosperity.

Lastly, I appreciate my mentor, friend, and brother, QS Olalekan Hadiru, LAWAL (*the man of his word*), for taking the time to review my work and offer constructive feedback. May Allah reward him abundantly (Ameen).

ABSTRACT

One of the most important problems in the construction industry is variations. They occur in every construction project and the magnitude of these variations varies considerably from project to project. Hence, the variations orders bear great importance right from the inception to completion in the construction industry. Most of the road construction projects in Nigeria have experienced a large number of variation orders. The client had to spend more than what was initially estimated in most cases. Sometimes, disputes and unnecessary delays occur due to variations. This study attempted to reveal the possible causes of variation orders in the road construction projects in Nigeria. The data were collected through a literature review, a case study analysis focused on road construction projects, and a questionnaire administered to professionals in the road construction industry in Nigeria. The study found out that the causes in the local context differ from those in the international context. According to the questionnaire survey, poor estimation was the most significant cause of variation orders. Unforeseen site conditions, political pressure during construction stage, poor investigation, and client-initiated variations occupy the 2nd to 5th places, respectively, in the ranking. This ranking was further proven through the case study analysis.

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CHAPTER ONE

INTRODUCTION

1.1 Background of the study

Construction industry makes significant contributions to the socio-economic development process of a country. Its importance emanates largely from the direct and indirect impact it has on all economic activities. It contributes to the national output and stimulates the growth of other sectors through a complex system of linkages (UNEP, 1996). UNEP further observes that the industry consumes one-sixth to one half of the world's wood, minerals, water and energy. It contributes to employment and creates income for the population and has multiplier effects on the economy.

Road construction, in particular, plays a significant role in realizing economic development and for the expansion of investment. The role of construction of roads is crucial for sustainable development. Road development is also essential with the perspective of saving of time, minimizing traveling expenses and improving services in trade, education and health sectors. For the realization of sustainable social and economic development, building new roads, maintaining and upgrading of the existing ones is vital (BOFED, 2002).

The cost of a construction project is one of the most important factors in the construction industry. Due to many reasons, the total cost of a project can significantly vary from the initial estimated cost. The reasons could be changes in scope of work, specifications, or any other contract documents. In the construction industry, variation orders are created when changes occur. It is an official document that states the changes made into the original agreement between the client and the contractor. When a variation order is created, it brings several negative effects to both the client and the contractor.

The success of a project depends on the achievement of desired performance as regards the schedule, cost, and quality which are usually measured through project schedule, budget certainty, and satisfactory conformance to functional and technical specifications (Baccarini 1999; McKim *et al.* 2000). Meanwhile, Hao et al. (2015) defined change order as the major cause of project delays, cost overruns, defects, and project failures which is normally due to several factors such as design errors, design changes, scope modifications, or unknown conditions in the field (Hanna *et al.* 2002; Hanna and Swanson 2007).

Change orders are also generally explained as the corrections, additions, or deletions to contracts and design drawings due to the complex nature of relationships and processes in construction work (Alnuaimi *et al.* 2010; Hwang and Low 2012). The six types are described by O'Brien (1998) to include unforeseen circumstances, plans and/or specifications, changes in scope through the additions or enhancements by the owner, value engineering, force majeure, and acceleration.

These change orders have a significant negative impact on project performance which is difficult to evaluate due to the highly integrated nature of construction operations (Finke 1998) as indicated by several factors associated with the process which have certain effects required to be considered (Karim and Adeli, 1999; Motawa *et al.,* 2007) in the research of Hwang and Low (2012).

1.2 Statement of research problems

Most of the road projects in Nigeria are not completed within the original contract price and original contract time due to issuance of variation orders during construction period which is becoming a common practice that reflects the improper management of variation orders in the road projects of the Country. The Employer and the Contractors are not beneficial from this scenario and at large the end users of the road project. Variation orders are issued

frequently and projects are subject to delay, additional cost and disputes. The Employer is forced to accept those changes with their consequential additional costs during construction though it could have been managed or minimized during the design and construction stages. Most importantly, Consultants make frequent review of the design during construction time and Contractors do suffer from the resulted delay of the review and employer's approval.

Therefore, it is clear that stakeholders are not beneficial from the negative effects of such variation orders. Thus, it is important to explore the extent of variation order in the national contracts of road projects in Nigeria and better understand their influences.

1.3 Research questions

In order to achieve at credible conclusion, the research study was guided by the following questions;

1. What are the predominant causes of variation orders in the national contract road projects in Kwara State?
2. Which contacting party is mostly initiating the predominant causes of variation orders?
3. What are the most consequential effects of variation orders in the national contract road projects in Kwara State?
4. How can variation orders be controlled or minimized in the national contract road projects Kwara State?

1.4 Objectives of the study

The main objectives of this research study are;

1. To identify the predominant causes of variation orders in road projects in Kwara State.
2. To identify the main origin agents for the predominant causes of variation orders in road project in Kwara State,

3. Investigate the potential effects of variation orders in national works contract of Kwara State Road projects and
4. To recommend how to control or minimize variation orders in national works contract of Kwara State projects.

1.5 Significance of the study

Generally, the study is envisaged to provide valuable relevant information for all contracting parties (*Client, Contractor, Consultants, Sub-Contractor and Supplier*) based on the findings of the study on Variation orders in the road construction projects of Nigeria. Particularly, this study will assist both employer and road contractors to identify the potential causes and effects at design and construction stages to minimize and control variation orders and its consequential impacts. The study will also lay the foundation for further research on the subject matter.

1.6 Scope and Limitation of the Study

The project will identify the causes and effect of variation on road projects (Kwara state) due to a lot of ongoing road projects in Kwara state and also because of my closeness in obtaining data. The professionals that launched on road projects will be involved. The project will be used for road project and excluding other engineering projects due to time and cost constraints.

1.7 Limitation of the study

Tadesse Ayalew (2009) has indicated that variation is one of the major problems in Nigerian Federal Road construction projects. He has identified the major causes of variations as Right of way problem, change in defined scope, lack of proper planning, lack of contractor's proper evaluations of tender documents at tendering phase and contractor's financial problems. The

major effects identified are delay in completion time, increase in project cost, suspension (hold on) of work, decrease in productivity and dispute between parties.

CHAPTER TWO

LITERATURE REVIEW

2.1 Introduction

In this chapter a comprehensive literature review has been made focusing on the possible causes of variation orders, their effects, origin agents and methods that should be adopted in controlling potential variation orders on road construction projects.

The need to make changes in a construction project is a matter of practical reality. Even the most thoughtfully planned projects may necessitate changes due to various factors (O'Brien, 1998). Likewise, Ssegawa *et al.,* (2002) elaborated due to its compartmentalization the construction industry has made variation almost an inevitable element and has become so prevalent that it is hardly possible to complete a project without changes to the plans or the construction process itself. This complexity gives rise mostly to unwanted situation like variations with their attached effects, and the more variation orders on a project, the greater the likelihood that they become time consuming and costly in construction projects (Mohamed, 2001).

Thus, construction projects are bound to encounter variation orders; the goal of the owner, design or construction manager is to limit the number of such changes (CII, 1994b). Variations in drawings and contract documents usually lead to a change in contract price or contract schedule. Conventionally, variations present problems to all parties involved in the construction process. Proper management of variation orders is therefore very significant for all types of construction projects.

Chan and Yeong (1995) also indicated that a variation order often involves additional cost and disruption to work already underway, leading to cost and time overruns, quality degradation, and loss in productivity on construction projects.

On the other hand, Fisk (1997) described that the contract provision seems to support the variation orders in construction project and being misunderstood by the stakeholders both on its application and limit. A variation is then explained as an unwanted situation in a project but with stand-by defense in the contract condition as it is a common phenomenon in all types of construction projects (Fisk, 1997; O'Brien, 1998).

It was asserted that variation orders cannot be avoided completely (Mohamed, 2001) and Ssegawa et al. (2002) further added that the presence of variation clauses in contracts amounts to admitting that no project can be completed without changes. Even if carefully planned, it is likely that there will be changes to the scope of the contract as the work progresses (Harbans, 2003). In the study "Quantitative definition of projects impacted by change orders" Hanna et al. (2002) indicated that variations occur given the uniqueness of each project and the limited resources of time and money available for planning. And also, the inevitable changes arising from variation that has impacts on a project are changes that may lead to disruptions and changes in work condition which eventually leads to loss of productivity.

According to Arain and Pheng, (2005) variations could be perceived as positive or negative to the preconceived goals of the professionals involved in a project. Therefore, a major variation must be managed and handled professionally in order to minimize its cost, schedule and other consequential impacts that may divert the project away from its targeted goals.

Tadesse Ayalew (2009) has indicated that variation is one of the major problems in Ethiopian Federal Road construction projects. He has identified the major causes of variations as Right

of way problem, change in defined scope, lack of proper planning, lack of contractor's proper evaluations of tender documents at tendering phase and contractor's financial problems. The major effects identified are delay in completion time, increase in project cost, suspension (hold on) of work, decrease in productivity and dispute between parties. Based on his survey result, contractors are more responsible in initiating the majority of the specified variation causes and also the most affected party due to the consequential effects.

Semere Jelalu (2013) indicated that ROW problem is the dominant challenge in Nigerian construction projects. In addition to ROW most variation orders arise due to design changes as a result of errors and incomplete data at initial stages and change of scope by the client as a result of community request and client interest. He added further, variation orders are up to 60% of the project cost and time extension are up two years are observed in some of Nigerian road construction projects.

On the other hand, Abebe Dinku and Girmay Kahsay (2003) studied on claims in international construction projects in Ethiopia and found out that variations due to Right of way, design changes, modifications and lack of sufficient data are main causes for the delay of Nigerian Road construction. In agreement to their study, Liu Yi (2009) in his study of claims in international construction contracts of Ethiopia has identified most of the claims arise from R.O.W problem, design related issues which take 18.12% and 12.9% proportion respectively in time extension claims during the contract execution. Claims due to contract administration problem like ambiguities in contract document, showing decision making and inadequate communication, etc. takes 51.9% of the contact claim. Others like default of the employer, changed circumstance and unforeseen or uncertain condition during the execution of contract takes 17.08% of the total. He has then concluded the key problem to the contract claim in Nigerian road projects is lack of experience in contract administration.

To identify and analyze potential variations in a project as early as possible would therefore enhance the management of a project. Learning from these variations is imperative because professionals in the construction sector can improve and apply their experience in the future. Thus, the following subchapters review the definition of variation, possible causes, effects and controls of variation orders in road construction projects in such a way that the objectives are well addressed.

2.2 Variation and Variation Order definitions

Notwithstanding the most advanced tools and techniques available for project management, variations have come to be considered as an expected occurrence in any project. Accordingly, significant work has been done by researchers to define, analyze and recommend appropriate solutions to manage variations in different project environments.

According to the Association of Project Management, APMP Syllabus (2000), variation is described in very simple terms as “A change in scope or timing of work which a supplier is obliged to do under a contract”.

However, a more detailed definition is provided by John Molloy (1999) as “any alternation of the work whether by way of addition, modification or omission to the work to be done under the contract by the contractor. Such changes may cover but are not limited to the work required but excluded from the contract, work not required but included in the contract, additional work requested by the client, changes to the written scope requested by the client, changes to the character or quality of materials or construction methods and changes applicable to site conditions, location, etc.”.

A different type of definition is also provided by Harrell Remodeling Inc (HR) which refers to the actual work measured after project completion and may turn out to be more or less than

the estimated value included in the tender. Such changes are managed by using a change order or variation.

Another definition of variation is presented by Moonseo Park (2003) who defines construction changes as referring to 'work state, processes, or methods that deviate from the original construction plan or specification. They usually result from work quality, work conditions or scope changes.

Similarly, Fisk (1997) and O'Brien (1998), defined variation as any deviation from an agreed well-defined scope and schedule. Stated differently, this is a change in any modification to the contractual guidance provided to the contractor by the owner or owner's representative. This includes changes to plans, specifications or any other contract documents. A variation order is the formal document that is used to modify the original contractual agreement and becomes part of a project's documents.

Furthermore, Clough and Sears (1994) indicated that a variation order is a written order to the contractor signed by the owner and issued after execution of the contract, authorizing a change in the work or an adjustment in the contract sum or the contract time.

Similarly, Clause 51(1) of AACRA's General Conditions of Contract provision (MOWUD Dec 1994), describes variations as alterations, additions or omissions of any part of the work to the contract documents.

Variation is used interchangeably with the word change, for the purpose of this research, and is defined as any event that results in formal modification of the original scope, execution time, construction methodology cost and/or quality or quantity of work as well as contract provisions. And a variation order is the formal document that is used to modify the original contractual agreement and becomes part of a project's documents.

Thus, it would be worth noting to understand the nature of variations and factors affecting the occurrence of variation orders before reviewing the causes, effects and controls of Variation orders in road construction projects.

2.3 Nature of Variation Orders

According to Arain and Pheng (2005b), the nature of a variation order can be determined by referring to both reasons for their occurrence and subsequent effects and is distinguished as two types of variation orders namely: beneficial and detrimental variation order.

2.3.1 Beneficial Variation Orders

A beneficial variation order is one issued to improve the quality standard, reduce cost, schedule, or degree of difficulty in a project (Arain & Pheng, 2005b). A beneficial variation order eliminates unnecessary costs from a project. As a result, it optimizes the client's benefits against the resource input by eliminating unnecessary costs. It is a variation order initiated for value analysis purposes to realize a balance between the cost, functionality and durability aspects of a project to the satisfaction of clients.

2.3.2 Detrimental Variation Orders

A detrimental variation order is one that negatively impacts the client's value or project performance (Arain and Pheng, 2005). For example, a client who is experiencing financial problems may require the substitution of quality standard expensive materials to substandard cheap materials.

2.4 Predominant Causes of Variation Orders

Unfortunately, variation orders are typically expected to occur in all construction projects. However, the frequency of their occurrence varies from one project to another depending on various factors (Arain & Pheng, 2005b). Factors influencing the occurrence of variation

orders include the nature of the works, the complexity of the project and the procurement method.

2.4.1 Nature of the Works

Construction works involve building, civil and/or specialist works. Building works include, for example, the construction of residential houses, commercial premises and offices. Civil works include, for example, the construction of roads and infrastructural installations. Construction projects that involve extensive unforeseen conditions are likely to generate variation orders. For example, civil works involving bulk earth excavation and building works that include specialist works beyond the expertise of the designer cannot accurately be determined before works commence on site. According to Uyun (2007), the drawings and specifications do not always show the real site conditions nor do preliminary investigations. Despite this situation, it is common that works commence on site while some trades and building elements still need to be completely designed or detailed. Consequently, contracts contain provisional quantities and sums that will be subject to future adjustment. The presence of provisional quantities or sums in a contract is a clear indication of the likely occurrence of variation orders in a project.

2.4.2 Complexity of the Project

Project complexity is a result of continuous demands for speed in construction, cost and quality control, health and safety in the work place and avoidance of disputes, together with technological advances, economic liberalization and globalization, environmental issues and fragmentation of the construction industry (Gidado, 1996). Project complexity consists of many varied interrelated parts (Baccarini, 1996). Ireland (2007) indicated that complexity involves an item having two or more components or two or more variables.

The degree of project complexity is classified as low, medium and high complexity (Ireland, 2007). The greater the project complexity, the greater the likelihood of variation order occurrence. A variation order issued due to the complexity of the design may take time for the design team to understand the required change and redesign while works on site are put on hold.

2.4.3 Procurement method

The participants in a construction project constitute a multi-organizational body generally including a client, designers, specialist consultants, project managers and constructors. The path followed to deliver the project differs from one project to another. Typically, this is a procurement method that stipulates the form of contractual arrangement between participants or parties to the contract. One type of procurement method may result in more variation orders than another. For example, Love (2002) indicated that non-traditional procurement methods are subject to greater occurrence of errors, omissions and changes than the traditional methods.

2.4.3.1 Traditional method

Traditionally, an employer who wished a project to be constructed would invariably commission a designer or design team to prepare drawings of the proposed scheme and, if the scheme was sufficiently large, employ a quantity surveyor to prepare documentation, such as bills of quantities, from which the contractor could prepare a bid price (Ashworth, 1998). Since the works commence on site when the design is complete, the occurrence of variation orders in this arrangement is minimized. Koushki *et al.* (2005) revealed that clients who spent more time and money on the design phase issued less variation orders than those who allocated insufficient money and time to this phase. The more time spent on completing the contract documents before commencement of works, the more likely the avoidance of

discrepancies between the contract documents, errors and omissions into the design. Consequently, there is less variation orders. Turner (1990) indicated that since clients and their consultants control the origin of variations, variations should not occur if pre-construction design has been good.

2.4.3.2 Non-Traditional methods

Over the years other forms of procurement have emerged, namely, nontraditional methods. Ashworth (1998) indicated that changes in procurement methods are the result of a move away from the craft base to the introduction of off-site manufacture, the use of industrialized components, the wider application of mechanical plant and equipment, the improved knowledge of production techniques, the recognition that involvement of the contractor into both the design and the way works are carried out on site will result into quality of finished works. For example, design and construct procurement methods where the contractor is responsible for the design and construction are deemed to overcome the problem of variation order occurrence. The involvement of contractors into the design is an opportunity for them to use specialized knowledge and methods of construction evolving from their own design and as a result, there is less scope for variations than with the design and construct approach (Ashworth, 1998).

2.5 Causes of Variation Orders

Variation orders occur due to a number of reasons ranging from finance, design, aesthetic, geological, weather conditions to feasibility of construction, statutory changes, product improvement, discrepancies between contract documents (Hanna et al., 2002; Ssegawa *et al.*, 2002; Harbans, 2003; Uyun, 2007). The nature and frequency of variation occurrences vary from one project to another depending on various factors (Kaming, *et al.,* 1997). Various authors had identified different causes of variation orders in construction project both on the

private and public projects. The enormity of the various causes of variations identified over the years by various author shows that variation has come to stay as part of the construction projects and it cut across various stakeholders. Arain and Pheng (2005) identified four origin agents of variation orders. It has been categorized into consultant related, owner related, contractor related changes and the other changes.

2.5.1 Client related changes

Client related changes are the causes of variations that are initiated by the owner. In some cases, the owner directly initiates variations or the variations are required because the owner fails to fulfill certain requirements for carrying out the project. The changes initiate by client are;

2.5.1.1 Change of Plans or Scope

Change of plan or scope of project is one of the most significant causes of variation in construction projects (CII, 1990b) and is usually the result of insufficient planning at the project definition stage, or because of lack of involvement of the owner in the design phase (Arain et al., 2004). This cause of variations affects the project severely during the later phases.

2.5.1.2 Change of Schedule

A change of schedule during the project construction phase may result in major resource reallocation (Fisk, 1997; O'Brien, 1998). Time has an equivalent money value. A change in schedule means that the contractor will either provide additional resources, or keep some resources idle. In both cases additional cost is incurred.

2.5.1.3 Owner's Financial problems

The owner of the facility may run into difficult financial situations that force him to make changes in an attempt to reduce cost. Owner's financial problems affect project progress and quality (Clough and Sears, 1994; O'Brien, 1998). Proper planning and review of project cash flow would be effective in eliminating this problem.

2.5.1.4 Right of way (*access to site*) problem

According to Mark T. and Murray F. (2004), the issue of right of way in road construction is complex and time consuming as well as expensive. The authors also indicated that, in many cases, the costs related to right of way issues exceed the actual cost for Construction. According to the report by Nigerian road system, right of way problem is not only related to land acquisition issues but also utility facilities which are responsible too for problems with regard to highway upgrading and improvements.

2.5.1.5 Inadequate Project objectives

Inadequate project objectives are important causes of variation in construction projects (Ibbs, 1997). Due to inadequate project objectives, the designer would not be able to develop a comprehensive design which leads to numerous variations during the project construction phase.

2.5.1.6 Replacement of Materials or Procedures

Replacement of materials or procedures may cause major variations during the construction phase. The substitution of procedures includes variations in application methods (Chappell and Willis, 1996). Therefore, an adjustment to the original contract value is required if there is a change in procedures.

2.5.1.7 Impediment in Prompt Decision making process

Prompt decision making is an important factor for project success (Sanvido *et al.,* 1992; Gray and Hughes, 2001). A delay in decision making may hinder subsequent construction activities that may eventually delay the project progress.

2.5.1.8 Change in Specifications by Owner

Changes in specifications are frequent in construction projects with inadequate project objectives (O'Brien, 1998). In a multi-player environment like any construction project, change in specifications by the owner during the construction phase may require major variations and adjustments in project planning and procurement activities.

2.5.2 Consultant related changes

In some cases, the consultant directly initiates variations or the variations are required because the consultant fails to fulfill certain requirements for carrying out the project. The changes initiate by consultant are as follows;

2.5.2.1 Change in design by Consultant

Change in design for improvement by the consultant is a norm in contemporary professional practice (Arain *et al.,* 2004). The changes in design are frequent in projects where construction starts before the design is finalized (Fisk, 1997). Design changes can affect a project adversely depending on the timing of the occurrence of the changes.

2.5.2.2 Differing site Conditions

Assaf *et al.,* (1995) has indicated that differing site condition can be an important cause of delays in large Construction projects. The contractor may face different soil conditions than those indicated in the tender documents. Eventually this may affect his cost estimates and schedule adversely.

2.5.2.3 Errors and omissions in design

Errors and omissions in design are an important cause of project delays (Arain *et al.,* 2004). Design errors and omissions may lead to loss of productivity and delay in project schedule (Assaf et al., 1995). Hence, errors and omissions in design can affect a project adversely depending on the timing of the occurrence of the errors.

2.5.2.4 Conflicts between Contract Documents

Conflict between contract documents can result in misinterpretation of the actual requirement of a project (CII, 1986a). To convey complete project scope for participants, the contract documents must be clear and concise. Insufficient details in contract documents may adversely affect the project, leading to delay in project completion.

2.5.2.5 Inadequate Scope of Work for Contractor

In a multi-player environment like construction, the scope of work for all the players must be clear and unambiguous for successful project completion (Fisk, 1997; Arain *et al.,* 2004). Inadequate scope of work for the contractor can cause major variations that may adversely affect the project, leading to changes in construction planning.

2.5.2.6 Lack of Coordination

A lack of coordination between parties may cause major variations that could eventually impact the project adversely (Arain *et al.,* 2004). Detrimental variations, which affect the projects adversely, can usually be managed at an early stage with due diligence in coordination.

2.5.2.7 Design complexity

Complex designs require unique skills and construction methods (Arain *et al.,* 2004). Complexity affects the flow of construction activities, whereas simple and linear construction

works are relatively easy to handle (Fisk, 1997). Hence, complexity may cause major variations in construction projects.

2.5.2.8 Inadequate working drawing details

To convey a complete concept of the project design, the working drawings must be clear and concise (Geok, 2002). Insufficient working drawing details can result in misinterpretation of the actual requirement of a project (Arain *et al.*, 2004). Thorough reviewing of design details would assist in minimizing variations.

2.5.2.9 Design discrepancies (*inadequate design*)

Inadequate design can be a frequent cause of variations in construction projects (CII, 1990a; Fisk, 1997). Design discrepancies affect the project functionality and quality. Eventually, this can affect a project adversely depending on the timing of the occurrence of the variations.

2.5.2.10 Ambiguous design details

A clearer design tends to be comprehended more readily (O'Brien, 1998). Ambiguity in design is a potential cause of variations in a project. This is because ambiguity in design can be misinterpreted by project participants, leading to rework and delay in the project completion. Eventually, this may affect the project adversely.

2.5.2.11 Lack of Consultant's knowledge of available materials and equipment

Knowledge of available materials and equipment is an important factor for developing a comprehensive design (Geok, 2002). In the construction industry where material standardization is not common, the consultant's lack of knowledge of available materials and equipment can cause numerous major variations during various project phases.

2.5.2.12 Noncompliance of design with owner's requirements

A comprehensive design is one that accommodates the owner's requirements (Cox and Hamilton, 1995). A noncompliance design with the owner's requirements is considered an inadequate design (Fisk, 1997). Eventually, this may cause variations for accommodating the owner's requirements. This may affect the project adversely during the construction phase.

2.5.2.13 Change in specifications by Consultant

Changes in specifications are frequent in construction projects with inadequate project objectives (O'Brien, 1998). As mentioned earlier with respect to changes in specifications by the owner, this is also a potential cause of variations in a project, leading to reworks and delays in the project completion

2.5.3 Contractor related changes

In some cases, the contractor may suggest variations to the project or the variations may be required because the contractor fails to fulfill certain requirements for carrying out the project. The contractor related changes are as follows;

2.5.3.1 Lack of Contractor's involvement in design

Involvement of the contractor in the design may assist in developing better designs by accommodating his creative and practical ideas (Arain *et al.,* 2004). Lack of contractor's involvement in design may eventually cause variations. Practical ideas which are not accommodated during the design phase will eventually affect the project adversely.

2.5.3.2 Unavailability of equipment

Unavailability of equipment is a procurement problem that can affect the project completion (O'Brien, 1998). Occasionally, the lack of equipment may cause major design variations or adjustments to project scheduling to accommodate the replacement.

2.5.3.3 Unavailability of skills (shortage of skilled manpower)

Skilled manpower is one of the major resources required for complex technological projects (Arain et al., 2004). Shortage of skilled manpower is more likely to occur in complex technological projects. This lack can be a cause for variations that may delay the project completion.

2.5.3.4 Contractor's financial difficulties

Construction is a labor-intensive industry. Whether the contractor has been paid or not, the wages of the worker must still be paid (Thomas and Napolitan, 1994). Contractor's financial difficulties may cause major variations during a project, affecting its quality and progress.

2.5.3.5 Defective workmanship

Defective workmanship may lead to demolition and rework in construction projects (Fisk, 1997; O'Brien, 1998). Defective workmanship results in low quality in construction projects (Arain et al., 2004). Eventually, this cause may affect the project adversely, leading to rework and delay in the project completion.

2.5.3.6 Poor Procurement Process

Procurement delays have various adverse effects on other processes in the construction cycle (Fisk, 1997). 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.

2.5.3.7 Lack of communication

Detrimental variations, which affect the projects adversely, can usually be managed at an early stage with strong and incessant communication. A lack of coordination and

communication between parties may cause major variations that could eventually impact the project adversely (Arain *et al.,* 2004).

2.5.3.8 Contractor's lack of judgment and experience

The Contractor's lack of professional experience increases the risk of errors during construction (O'Brien, 1998). This lack may cause major construction variations in a project. Eventually, this may affect the project quality and delay the project completion.

2.5.3.9 Complex Design and Technology

Complex design and technology require detailed interpretations by the designer to make it comprehensible for the contractor (Arain, 2002). A complex design may be experienced for the first time by the contractor. Eventually, the complexity may affect the flow of construction activities, leading to delays in the project completion.

2.5.3.10 Contractor's lack of required data

A lack of required data may affect the contractor's strategic planning for successful project completion, leading to frequent disruptions during the construction process. This is because a lack of data can result in misinterpretation of the actual requirements of a project (Assaf *et al.,* 1995; Arain *et al.,* 2004).

2.5.4 Other changes

Other variations beyond the control of the contractual parties that give rise to variation orders include the following;

2.5.4.1 Weather conditions

Adverse weather conditions can affect outside activities in construction projects (Fisk, 1997; O'Brien, 1998). When weather conditions vary, the contractor needs to adjust the

construction schedule accordingly. Occasionally, this may affect the project progress adversely, leading to delays in construction.

2.5.4.2 Safety considerations

Safety is an important factor for the successful completion of a building project (Clough and Sears, 1994). Noncompliance with safety requirements may cause major variations in design. Lack of safety considerations may affect the project progress adversely, leading to serious accidents and delays in the project completion.

2.5.4.3 Change in Government regulations

Local authorities may have specific codes and regulations that need to be accommodated in the design (Arain et al., 2004). Change in government regulations during the project construction phase may cause major variations in design and construction. This can affect a project adversely depending on the timing of the occurrence of the changes.

2.5.4.4 Change in Economic conditions

Economic condition is one of the influential factors that may affect a construction project (Fisk, 1997). The economic situation of a country can affects the whole construction industry and its participants. Eventually, this may affect the project adversely, depending on the timing of the occurrence of the variations.

2.5.4.5 Unforeseen problems

Unforeseen conditions are usually faced by professionals in the construction industry (Clough and Sears, 1994; O'Brien, 1998). If these conditions are not solved spontaneously, they may cause major variations in the construction projects. Eventually, this may affect the project adversely, leading to reworks and delays in the project completion.

2.6 Consequential effects of Variation orders

The most important effects of variation orders from the perspective of the employer, consultants and contractors are delay in schedule, increase in project cost and disputes between owner and contractor (Research Journal of Applied Sciences, 2012).

Given a well-structured schedule of works, maximum project performance would be achieved if the work invariably flows smoothly within time limits and anticipated budget constraints. However, it is rare that projects perform precisely in line with their original schedule due to reasons such as, for example, business condition changes, delivery slips, and corrections to design (Al-Hakim, 2005b). The occurrence of variation orders has an adverse impact on project performance. Thomas et al. (2002) suggest that variability generally impedes project performance. Ibbs (1997) concluded that variation orders affect project performance as they adversely affect productivity and project costs. According to Arain and Pheng (2005b) variation orders are an unwanted but inevitable reality of any construction project. Further, Hanna et al. (2002) found that projects with many variation orders cause the contractor to achieve lower productivity levels than planned. Variation orders adversely impact project performance in terms of cost overruns, time overruns, quality degradation, disputes and professional relations.

2.6.1 Cost Overruns

Construction projects involve recognized phases of which two are particularly important, namely the pre-construction and construction phases. Given that the construction phase typically consumes more resources than the pre-construction phase, attention to cost planning is focused on the construction phase. Clients desire to know in advance the total cost of their finished construction projects. Clients prefer final construction costs to equate to the originally forecast tender figure. Unfortunately, many construction projects incur cost

overruns. However, all variation orders do not increase the costs of construction. Omissions in most cases reduce costs while additions increase costs (Ssegawa et al., 2002). Various studies have revealed that variation orders contribute to these cost overruns. Arguably, the more the number of variation orders, the more they are likely to affect the overall construction delivery cost.

2.6.2 Time overruns

Clients require their construction projects to be completed within minimum time limits. It is anticipated that projects finished within the shortest possible time achieve some monetary savings. In most cases, contractors pay liquidated damage when they exceed the original project delivery date that is meant to compensate damages suffered by the client owing to the prolonged delivery period. Several authors agree that variation orders present as one of the reasons for project time overruns (Chan & Yeong, 1995, Mohamed 2001). It was found that variation orders issued during various phases of construction projects negatively affected both the completion time and costs of projects (Koushki, 2005). Hanna et al. (2002) found that as the number of variation orders increases the more significant productivity losses become. Productivity is the amount of output over a unit of time. Therefore, loss in productivity implies loss of time and subsequent delays. Yogeswaran *et al.* (1997) classified delays into 'excusable' and 'non-excusable', where the former category relieves the contractor of liability for liquidated damages and the latter is due to the contractor's culpable delay.

2.6.3 Quality degradation

Patrick and Toler (July 17, 2008) indicated that contracts with a significant degree of risk for unknown variables such for example, lump sum, contractors may cut corners on quality and quantity to maximize profits. If variation orders are frequent, they may potentially affect the

quality of works. Quality may be compromised as contractors try to compensate for losses, they are not optimistic about recovering.

2.6.4 Disputes

Disputes may arise between parties to the contract due to variation orders. Charoenngam *et al.* (2003) remarked that disputes between the client and the contractor can occur if variation orders are not managed carefully. Misunderstandings may arise when contractors are not satisfied with the determination of the valuation of variation orders by the client's consultant. Parties to a contract are left to argue over the cost, time effects and due compensation of a variation order (Bower, 2000). Possibly because contractors are not confident about the outcome of such negotiations, they usually request higher values for variation orders than the actual cost incurred. Bower (2000) opined that consequently there is tension between parties as the contractor continually pushes the client to settle claims for additional costs while invariably feeling that the reimbursement has been insufficient.

Harbans (2003) warned that unless a mutually acceptable solution is agreed by the parties, valuation of variations in the form of variation orders will continue to remain at the forefront of disputes and claims making their way ultimately to arbitral tribunals or the corridors of justice. Finsen (2005) found that a large proportion of current arbitrations were on claims for additional time and additional expenses. Ssegawa et al. (2002) reported that more than one-third of disputes pertained to how to determine losses that stem from variation orders.

2.6.5 Professional Relations

A construction project creates professional relationships between parties to the contract. Each project successfully completed constitutes an added experience to participants and their reputation builds up. Frequent variation orders can be very damaging to the relationship between the representatives of all parties (Bower, 2000). The excessive occurrence of

variation orders due to design errors or omission may undermine the professionalism of the designer.

2.7 Controls for Variation Orders

Controls for variations and variation orders have been suggested by many researchers (Mokhtar et al., 2000; Ibbs *et al.,* 2001). The controls were grouped under three categories: Design stage, Construction stage and Design- Construction interface stage. These groups assisted in developing a comprehensive enumeration of potential controls for variation orders.

2.7.1 Design stage controls for Variation Orders

According to Arian and Pheng (2005) design stage controls of variation orders are the following;

2.7.1.1 Review of contract documents

Contract documents are the main source of information for any project. Comprehensive and balanced variation clauses would be helpful in improving coordination and communication quality (CII, 1994a). Conflicts between contract documents can result in misinterpretation of the actual requirement of a project.

2.7.1.2 Freezing design

Variations in design can affect a project adversely depending on the timing of the occurrence of the changes. Therefore, freezing the design is a strong control method. Many owners freeze the design and close the door for variations after the completion of the drawings (CII, 1990a). However, this control requires that the design of the construction project should be comprehensive; otherwise, it may affect the project objectives adversely.

2.7.1.3 Value Engineering at Conceptual Phase

During the design phase, value engineering can be a cost saving exercise, as at this stage, variation in any design element would not require rework or demolition at the construction site. Value engineering at the conceptual stage can assist in clarifying project objectives and reducing design discrepancies (Dell'Isola, 1982).

2.7.1.4 Involvement of Professionals at initial stages of project

Involvement of professionals in design may assist in developing better designs by accommodating their creative and practical ideas (Arain et al., 2004). This practice would assist in developing a comprehensive design with minimum discrepancies (O'Brien, 1998). Practical ideas that are not accommodated during the design phase may affect the project adversely. Variation during the construction phase is a costly activity as it may initiate numerous changes to construction activities.

2.7.1.5 Owner's involvement at planning and design phase

Involvement of the owner at the design phase would assist in clarifying the project objectives and identifying noncompliance with their requirements at the early stage (Fisk, 1997). Hence, this may help in eliminating variations during the construction stage where the impact of the variations can be severe.

2.7.1.6 Involvement of Contractor at Planning and Scheduling process

Involvement of the contractor at planning and scheduling may assist in developing better plans and schedules by accommodating practical ideas suggested by the contractor (Arain et al., 2004). Eventually, this may eliminate the major variations in the later stages of the construction project where the impact of the variations can be severe.

2.7.1.7 Thorough detailing of design

A clearer design tends to be comprehended more readily (O'Brien, 1998). This would also assist in identifying the errors and omissions in design at an early stage. Eventually, thorough detailing of design can eliminate variations arising from ambiguities and errors in design.

2.7.1.8 Clear and thorough Project brief

A clear and thorough project brief is an important control for variations in construction projects (O'Brien, 1998) as it helps in clarifying the project objectives to all the participants. Eventually, this may reduce the design errors and noncompliance with the owner's requirements.

2.7.1.9 Reducing Contingency Sum

The provision of a large contingency sum may affect the participants' working approaches. This is because the designer may not develop a comprehensive design and would consequently carry out the rectifications in design as variation orders during the later stages of the construction project. Therefore, reducing the contingency sum would be helpful in ensuring that the professionals carry out their jobs with diligence.

2.7.2 Construction stage controls for Variation orders

Arian and Pheng (2005) have also classified construction stage controls of variation orders as Following;

2.7.2.1 Clarity of variation order procedures

Clarity of variation order procedures is an integral part of effective management of variation orders (Mokhtar et al., 2000). Early in the project life, the procedures should be identified and made clear to all parties. Clarity of variation order procedures would help in reducing the processing time and other mishandling issues (Ibbs *et al.,* 2001).

2.7.2.2 Written approvals

Any variation in the work that involves a change in the original price must be approved in writing by the owner before a variation order can be executed (CII,1990a; Hester *et al.,* 1991; Cox, 1997). Any party signing on behalf of the owner must have written authorization from the owner. It is difficult to prove the right for compensation if there is no such authorization from the owner. In the hectic environment of construction, many verbal agreements can be forgotten, leaving the contractor without any legal proof to get compensation for the variations.

2.7.2.3 Variation order scope

A well-defined scope can assist the professional team in recognizing and planning appropriately to minimize the negative impact of the variation (Ibbs *et al.* 2001). The original scope should be clear and well defined to distinguish between a variation of scope and a variation due to design development. CII (1994b) pointed out that a common disagreement between parties in a project was about defining the variation scope. Thus, the effective definition of the scope of work is of paramount importance to identify and manage variations.

2.7.2.4 Variation logic and justification

Variation logic and justification for implementation was one of the principles of effective change management proposed by Ibbs *et al.* (2001). This principle required a change to be classified as required or elective. Required changes were required to meet original objectives of the project while elective changes were additional features that enhanced the project. Knowing the logic and justification behind the proposed variations assists the professionals in promoting beneficial variations and eliminating detrimental variations.

2.7.2.5 Project Manager from an independent firm to manage the Project

Involvement of a project manager from an independent firm would assist in eliminating variations that arise due to the lack of coordination among professionals (Arain et al., 2004). This practice may assist in reducing design discrepancies through early reviews of the contract documents and drawings.

2.7.2.6 Restricted pre-qualification system for awarding Projects

A restricted pre-qualification system for awarding projects would act as a filter to select only the capable parties for project bids (Chan and Yeong, 1995; Fisk, 1997). However, the lack of a restricted pre-qualification system may allow incapable parties to bid. This may eventually lead to numerous problems in the later stages of a construction project.

2.7.2.7 Owner's involvement during Construction phase

Involvement of the owner during the construction phase would assist in identifying noncompliance with the requirements and in approving the variations promptly (Ibbs *et al.,* 2001). Eventually, the involvement of the owner during the construction phase may keep him aware of ongoing activities and assist in prompt decision making.

2.7.2.8 Avoid use of Open Tendering

Competitive open tendering usually encourages the main contractor to price very low to win the contract, especially in bad times when they are in need of jobs. This practice would give rise to the contractor trying to claim more to compensate for the low price (Chan and Yeong, 1995). Avoiding the use of open tender would assist in eliminating the risks of unfair bids. This may eventually help in eliminating variations that may arise due to the contractor's bidding strategy.

2.7.2.9 Use of Project Scheduling/Management Techniques

To manage a variation means being able to anticipate its effects and to control, or at least monitor, the associated cost and schedule impact (Hester *et al.,* 1991). The most known scheduling techniques in the construction industry are CPM, PERT and Gantt chart (Clough and Sears, 1994). These techniques are helpful in identifying the downstream effects of any variations on subsequent construction activities (Mokhtar *et al.,* 2000). Eventually, these may assist in eliminating detrimental variations.

2.7.2.10 Comprehensive documentation of Variation Orders

Through timely notification and documentation of variation orders, participants will have kept their rights and thereby their option to pursue a subsequent claim or to defend against a claim (Cox, 1997; O'Brien, 1998). One of the most aggravating conditions is the length of time that elapses between the time when a proposed contract modification is first announced and when the matter is finally rejected or approved as a variation order (Fisk, 1997). Cox (1997) suggested that the documentation of variation orders and claims had assisted in tracking the effects of the variation and claim events on time and cost. A documented source of knowledge about previous variation orders would be helpful in making decisions concerning the appropriate handling of variation orders.

2.7.3 Design-Construction interface stage controls for Variation Orders

According to Arian and Pheng (2005) design-construction stage controls of variation orders are the following;

2.7.3.1 Prompt approval procedures

One of the most aggravating conditions is the length of time that elapses between the time when a proposed contract modification is first announced and when the matter is finally rejected or approved as a variation order (Fisk, 1997). However, the longer the period

between recognition and implementation, the more costly the change will be. Hence, prompt approval procedures would assist in reducing the adverse effects of variations in the construction project.

2.7.3.2 Ability to negotiate variation

Ability to negotiate variation is an important factor for the effective control of variation orders (Clough and Sears, 1994). Effective negotiation can assist the professional team in minimizing the negative impacts of the variation (Cushman and Butler, 1994). There are certain skills required for effective negotiation of variation orders, i.e., the knowledge of contract terms, project details, technology, labour rates, equipment, methods and communication skills.

2.7.3.3 Valuation of indirect effects

Consequential effects can occur later in the downstream phases of a project. Therefore, it is essential to acknowledge this possibility and establish the mechanism to evaluate its consequences (Ibbs *et al.,* 2001). Indirect effects of variations can be substantial in the downstream phases of a complex project (Fisk, 1997). Professionals should thus evaluate the total overall effects a change may have on the downstream phases of a project, to manage the variation order effectively.

2.7.3.4 Utilize work breakdown structure

A work breakdown structure (WBS) is a management tool for identifying and defining work (Hester *et al.,* 1991; Mokhtar et al., 2000). A contractor should consider using the WBS as an evaluation tool, especially on large projects. If a variation involves work not previously included in the WBS, it can be logically added to the WBS and its relationship with the other WBS element can be easily checked. Ripple effects can also be traced by the use of WBS (Hester *et al.,* 1991).

2.7.3.5 Continuous coordination and direct communication

Coordination and communication are important in a multi-participant environment as in most construction projects (Assaf *et al.,* 1995). Detrimental variations, which affect the projects adversely, can usually be managed at the early stage with due diligence in coordination, and frequent communication.

2.7.3.6 Control the potential for variation orders to arise through contractual clauses

Selection of the appropriate contract form with the necessary and unambiguous variation clauses would be helpful in the management of variation orders (Cox, 1997). Shifting risks and improved communication channels could result from properly prepared variation clauses (CII, 1990a). Clear procedures presented in the contract and fair allocation of risks can help in resolving disputes through negotiation rather than litigation.

2.7.3.7 Comprehensive Site Investigation

Comprehensive site investigations assist in proper planning for construction activities (Fisk, 1997). As mentioned earlier, differing site conditions are an important cause of delays in large Construction projects (Assaf *et al.,* 1995). Therefore, a comprehensive site investigation would help in reducing potential variations in a project.

2.7.3.8 Use of collected and organized project data compiled by owner, Consultant and Contractor

The variation orders should always be documented for future references (Fisk, 1997). In a research study by CII (1994b) on the control of project changes, the research team concluded that better controls for variation orders were achievable by sharing a database compiled by all the participants.

2.7.3.9 Knowledge-base of previous similar Projects

A knowledge-base would facilitate an effective management process (CII, 1994b; Miresco and Pomerol, 1995; Ibbs *et al.,* 2001). From the outset, project strategies and philosophies should take advantage of lessons learned from past similar projects (CII, 1994b). If professionals have a knowledge-based established on past similar projects, it would assist the professional team to plan effectively before starting a project, both during the design phase as well as during the construction phase, minimize and control variations and their effects.

2.7.3.10 Comprehensive analysis and prompt decision making through computerized knowledge-based decision support system

A Decision Support System (DSS) approach for management decisions seems to be the most natural idea to follow (Miresco and Pomerol, 1995). The knowledge-based system would be helpful in presenting a comprehensive scenario of the causes of variations, their relevant effects and potential controls that would assist in decision making at the early stage of the variations occurring.

CHAPTER THREE

RESEARCH METHODOLOGY

3.1 Introduction

This chapter presents the research methodology used to investigate the impact of factors causing variation on road construction in Kwara state. The chapter outlines the research design, population, sample size, sampling techniques, data collection instruments, procedure for data collection, test for validity of data collection instrument used to gather and analyze data. **According to** (Saunders *et al.,* 2016), a well-defined research methodology is essential to ensure the validity and reliability of research findings.

3.2 Research Design

This study employed a survey research design, which is suitable for investigating the impact of various factors on road construction (Creswell, 2014). The design allows for the collection of data through questionnaires, observations, and documentary analysis. The survey design also enables the researcher to gather data from a large sample size, increasing the generalizability of the findings.

3.3 Population of the Study

The population of this study consists of road construction stakeholders in kwara state, including engineers, technicians, contractors, government officials, and local communities (Gbagi, 2017). The population is estimated to be 100, comprising Civil Engineers, site Engineers, Quantity Surveyors, Project Managers, Consultant and Contractors.

3.4 Sample Size

The sample size was to 100 respondents, which may not be representative of the entire road Engineer's population. According to (Creswell and Plano Clark 2014), limitations are and inherent part of any research study. The limitations of this study are acknowledged, and they provide opportunities for future research.

3.5 Sampling Techniques

The study utilized random sampling as the technique for examining the impact of factors causing variation orders on road construction in Kwara State. Random sampling is commonly used method in research studies, including those in second language acquisition, as it provides a scientific approach to studying and acquiring knowledge about particular process with minimal prior knowledge or training (Farahman and Asgar, 2012). This sampling techniques was considered suitable because it is efficient, cost-effective, and easy to implement, with subjects being readily available.

3.6 Method of Data Collection Instruments

A structured questionnaire was design to collect data from sample respondents. The questionnaire was designed to gather information on factors causing variation in road construction, their impact, and the measures to mitigate their effects. the question consists of items in two sections, including respondents' demographic information's and impacts of various factors causing variation orders.

3.7 Method of Administering Data

A self-administered questionnaire was designed to collect data on the impact of various factors causing variation orders on road construction including benefits derived, and challenges faced. It shall be distributed by hand retrieve through same procedure.

A questionnaire guide is designed to ensure that they were clear, concise, and relevant to the research objectives. The instrument is also pilot-tested with road construction stakeholders in Kwara state to ensure that they were effective in collecting the required data.

3.8 Test for Validity and Reliability of Data Collection Instruments

The validity of the questionnaire was tested using content validity and construct validity. Content validity was ensured through expert review, while construct validity was tested using factor analysis (Hair *et al.,* 2010). The result of the factors analysis showed that the questionnaire items loaded onto three factors, confirming the construct validity of the instrument.

3.9 Method of Data Presentation and Analysis

The data collected in this study were systematically presented and analyzed to address the research objectives on the impact of factors causing variation on road construction in Kwara State.

The descriptive statistics, including mean, median, mode, percentages, frequencies and standard deviations were used to test the hypotheses and determine the relationship between the variables. This helped to generate patterns in the views of the Engineer regarding their impact on road Construction in Kwara State.

In addition to descriptive statistics, inferential statistical techniques such as correlation and regression analysis were applied to explore the relationships between key variables. These analyses were conducted using Statistical Package for the Social Sciences (SPSS), version 25, which facilitated accurate computation, tabulation, and graphical representation of data.

For the qualitative data collected through open-ended questions, thematic analysis was used to identify patterns, recurring themes, and insights. This process followed the guidelines by

Braun and Clarke (2016), which involved familiarization with the data, coding, theme development, and interpretation.

CHAPTER FOUR

DATA PRESENTATION, ANALYSIS AND INTERPRETATION

4.1 Introduction

This chapter presents, analyzes, and interprets the data gathered through a structured questionnaire administered to 100 professionals with experience in road construction across Kwara State. The questionnaire was designed around four research objectives and includes both demographic and technical questions. Data is presented using frequency tables and Likert-scale mean scores. Each table is followed by a detailed interpretation, connecting findings to the context of variation orders in Nigerian public road construction projects, particularly within national works contracts.

4.2 Demographic Information of Respondents

Table 4.2.1: Gender and Academic Qualification

Variable	Frequency	Percentage (%)
Female	45	45.0%
Male	55	55.0%
HND	42	42.0%
B.SC	40	40.0%
M.SC	13	13.0%
PHD	6	6.0%

Research Survey 2025

The female representation of 45% is relatively high for the construction industry, indicating ongoing improvements in gender balance. This demographic trend may positively influence Road Construction, as younger professionals are generally more open to technological tools and innovations. The youthful and diverse workforce provides an enabling environment for digital transformation in the sector.

The majority of respondents (42%) have at least a Higher National Diploma (HND) or a Bachelor's degree (BSc), indicating a well-educated cohort. This academic foundation is crucial for understanding and implementing complex systems like BIM. However, the relatively low proportion of respondents with Masters in Science (12%) and particularly PhDs (6%) highlights a gap in advanced academic research and innovation within the sector.

Table 4.2.2: Professional Designation

Designation	Frequency	Percentage (%)
Site Engineer	25	25.0
Quantity Surveyor	20	20.0
Project Manager	15	15.0
Consultant	20	20.0
Contractor	20	20.0
Total	**100**	**100.0**

Research Survey 2025

This table confirms that all critical professional roles in road construction are well represented. Site Engineers (25%) and Quantity Surveyors (20%) make up the largest groups, offering deep technical and cost insights. The presence of Contractors and Consultants (20% each) ensures a practical understanding of field operations and design-process dynamics. Project Managers (15%) contribute operational oversight knowledge. This balance across specialties is crucial for a comprehensive understanding of how variation orders originate and impact projects.

Table 4.2.3: Years of Experience

Years of Experience	Frequency	Percentage (%)
0 – 5 years	20	20.0%
6 – 10 years	35	35.0%
11 – 15 years	25	25.0%
16 – 20 years	20	20.0%
Total	**100**	**100.0%**

Research Survey 2025

A significant 80% of respondents have over 5 years of professional experience, with 45% exceeding 10 years. This experience base is important because variation orders are typically understood better through project cycles, not theory alone. The presence of younger professionals (20%) adds perspective on recent project practices, while older professionals bring experience with historical and systemic issues such as poor documentation, fluctuating policies, or weak procurement enforcement.

Table 4.2.4: Involvement in Road Projects in Kwara State

Response	Frequency	Percentage (%)
Yes	100	100.0%
No	0	0.0%

Research Survey 2025

All respondents confirmed that they have worked on road construction projects in Kwara State. This ensures that the data is highly relevant to the geographical and administrative context under investigation. Their insights likely reflect actual implementation challenges faced in local terrain, policy frameworks, political interferences, and capacity of the workforce, rather than generic or imported ideas.

Table 4.2.5: Types of Roads Projects Involved In

Type of Road Project	Frequency
Federal Roads	40
State Roads	65
Local Government Roads	50
Private Roads	30

Research Survey 2025

Most respondents have worked on State (65%) and Local Government (50%) roads, aligning directly with the target of this study—national works contracts are often awarded by these tiers. Federal involvement (40%) adds insight into more complex, higher-budget roads where

variation orders may be more controlled due to stricter standards. Private roads (30%) offer contrast, showing whether more flexible or contractor-led systems perform better in variation control. This diversity enables us to understand how governance levels affect causes and impacts of variations.

4.3 Predominant Causes of Variation Orders

Respondents assessed technical and procurement factors contributing to variation orders.

Table 4.3.1: Client Related Issue

A) Client Related Issue	Mean	Rank
Changes of Plans or Scope	4.5	1
Change of Schedule	4.3	2
Owner's Financial Problems	4.1	3
Right of Way (Access to Site) Problem	3.9	4
Inadequate Project Objectives	3.5	7
Replacement of Materials or Procedures	3.8	5
Impediment in Prompt Decision Making Process	3.7	6
Changes in Specification by Owner	3.4	8

Research Survey 2025

The provided table, Table 4.3.1: Client Related Issue, presents the results of an assessment conducted by respondents on technical and procurement factors contributing to variation orders. The table specifically focuses on client-related issues, categorizing and ranking them based on their mean scores and ranks.

The issues are ranked from 1 to 8 based on their mean scores. This ranking helps in prioritizing the client-related issues that most significantly contribute to variation orders. There is a noticeable variation in the mean scores, indicating a range of impacts on variation orders. The highest mean score is 4.5 (*Changes of Plans or Scope*), and the lowest is 3.4 (*Changes in Specification by Owner*).

Table 4.3.2: Consultant Related Changes

B) Consultant Related Changes	Mean	Rank
Changes in Design by Consultant	3.4	9
Different Site Conditions	3.3	10
Errors and Omissions in Design	3.6	8
Conflicts Between Contract Documents	3.2	11
Inadequate Scope of work for contractor	3.1	12
Lack of Coordination	3.0	13
Design Complexity	4.4	6
Inadequate Working Drawing Details	4.2	7
Design Discrepancies (Inadequate Design)	4.6	4
Ambiguous Design Details	4.7	3
Lack of Consultant’s Knowledge of Available Materials and Equipment	4.8	2
Noncompliance of Design with Owner’s Requirements	4.9	1
Changes in Specification by Consultant	4.5	5

Research Survey 2025

The data analysis reveals that noncompliance of design with owner's requirements, lack of consultant's knowledge of available materials and equipment, and ambiguous design details are the most significant consultant-related changes, with high mean values and top ranks. On the other hand, lack of coordination, inadequate scope of work for contractors, and conflicts between contract documents have lower mean values and ranks, indicating relatively less impact. These findings can help consultants and project stakeholders identify areas for improvement and prioritize their efforts to minimize changes and optimize project outcomes.

Noncompliance of Design with Owner's Requirements has the highest mean value of 4.9 and ranks first among consultant-related changes. This suggests that when consultants' designs do not meet the owner's requirements, it has a significant impact on the project, leading to changes.

Lack of Coordination has the lowest mean value of 3.0 and ranks last among consultant-related changes. This suggests that a lack of coordination among consultants has a relatively lower impact on the project, leading to changes.

Table 4.3.3: Contractor Relate Changes

C) Contractor Relate Changes	Mean	Rank
Lack of Contractor's Involvement in Design	4.5	7
Unavailability of Equipment	4.3	8
Unavailability of Skill's (Shortage of Skilled Manpower)	4.2	9
Contractor's Financial Difficulties	4.3	8
Defective Workmanship	5.6	3
Poor Procurement Process	5.9	1
Lack of Communication	5.7	2
Contractor's Lack of Judgement and Experience	5.2	4
Complex Design and Technology	5.1	5
Contractors Lack of Required Data	5.0	6

Research Survey 2025

The Poor Procurement Process (5.9) was rated as the most influential factor in causing variation orders. This shows that poorly coordinated multi-disciplinary projects such as roads with multiple drainage structures, culverts, roundabouts, or bridge elements often experience mismatches between the design and execution, leading to mid-construction changes.

The Unavailability of Equipment (4.3), particularly in varied terrain like swampy regions or unstable laterite soils common in parts of Kwara State, also plays a major role. Without proper soil investigation and risk planning, new site instructions become unavoidable.

Defective workmanship (5.6) ranks third. The choice of procurement affects whether all risks are adequately captured upfront. For instance, selective or emergency procurement may bypass due diligence, causing post-award changes.

Interestingly, (*design-bid-build*) were found more problematic than. This suggests that rigid roles in traditional systems limit early contractor input, leading to late rework. In contrast, design–build or PPP models might offer early collaboration, reducing the likelihood of scope creep.

4.4 Origin Agents of Variation Orders

Participants rated who or what is primarily responsible for causing variation orders.

Table 4.4.1: Origin Agents' Contribution to Variation Orders

Origin Agent	Mean Score	Rank
Client-related changes	4.6	1
Consultant-related changes	4.2	2
Contractor-related changes	3.8	3
Force majeure	3.7	4
Subcontractor	3.4	5
Suppliers	3.2	6

Research Survey 2025

Clients were identified as the leading source of variation orders. Changes in political leadership, shifting budget allocations, or sudden preference for aesthetic features often result in client-initiated scope revisions. In Kwara State, where some projects span multiple administrations, this is a significant issue.

Consultant-related variations typically stem from inadequate site data, late drawing submissions, or uncoordinated designs. A consultant who doesn’t integrate geotechnical input or ignores local road usage trends may require field-level corrections.

Contractor-originated variations (3.8) include substitution of materials, change in work method, or sequencing issues. While less frequent, they may arise due to misinterpretation or financial motives.

Weather and safety issues also contribute, albeit moderately. Seasonal flooding, erosion, or occupational hazards may necessitate change. Regulatory changes score low, possibly due to poor enforcement of road construction regulations in many localities.

4.5 Effects of Variation Orders

Table 4.5.1: Perceived Effects of Variation Orders on Project Performance

Effect	Mean Score	Rank
Cost overruns	4.5	1
Time overruns	4.4	2
Quality degradation	4.1	3
Disputes	3.9	4
Strained professional relations	3.7	5

Research Survey 2025

Cost overruns ranked highest, reflecting Nigeria's volatile economic environment. Every variation potentially results in renegotiation, remeasurement, and additional cost claims, particularly where unit rates are affected by inflation or currency changes.

Time overruns are a natural consequence. Each design change or material switch leads to workflow disruptions, especially when approvals are slow or logistics are affected. This often pushes projects beyond the contract period, resulting in liquidated damages or funding gaps.

Quality degradation arises when contractors try to "catch up" after delays, sometimes sacrificing specifications or supervision. Disputes and deteriorating professional relationships are common, particularly when blame for the variation is unclear or documentation is missing. Poor communication, lack of trust, and delayed payments often follow.

4.6 Control and Minimization of Variation Orders

Table 4.6.1: Recommend how to control or minimize variation orders in national work

Strategy	Mean Score	Rank
Review of Contract Documents	4.7	3
Freezing Design	4.6	4
Involvement of Professionals at Initial Stage of Project	4.4	6
Owner's Involvement at Planning and Design Phase	4.3	7
Involvement of Contractor at Planning Scheduling Process	4.2	8
Thorough Detailing of Design	4.5	5
Clear and Thorough Project Brief	4.9	1
Reducing Contingency Sum	4.8	2

Research Survey 2025

Respondents emphasized that variation orders begin on the drawing board. Projects launched with incomplete or ambiguous designs are destined for changes. Early-stage collaboration ensures that expectations are aligned, design is buildable, and unforeseen challenges are anticipated. This helps prevent late-stage surprises that result in expensive and time-consuming changes.

At the execution level, supervision is key. Strong site management can detect inconsistencies early and act before they escalate. Moreover, communication and feedback loops help ensure that changes are communicated clearly and responses are swift. Delay in approvals is a common bottleneck in Nigerian public contracts, and timely administrative responses could reduce variation-related downtime.

Where variations cannot be avoided, having a formal change management process is crucial. Many projects in Kwara State lack this structure, leading to informal instructions that later become disputed claims. Structured meetings between designers and builders also help align field realities with design intentions, while pre-agreed conflict mechanisms reduce litigation or blame games when variations occur.

4.7 Discussion of Findings

Variation orders in Kwara state road projects are largely driven by complex project demands, client-induced changes, and design-process gaps. This changes severely affect cost and time, and also impact quality and team cohesion. Control measure must begin at the design phase, followed by strong supervision and formal change procedures.

4.8 Interpretation Findings

The central aim of this research was to examine how various factors trigger variation orders in Kwara state road construction projects under national works contracts. The study was structured around four key objectives to identify the predominant causes of variation orders in road construction projects in Kwara State.to determine the main origin agents responsible for this cause, to investigate the effects of variation orders on project delivery outcomes such as cost, time, and quality, to recommend strategies for minimizing and controlling variation orders across different project phases.

To achieve this, a well-structured questionnaire was developed and administered to 100 road construction professionals working within Kwara State. The respondents included engineers, quantity surveyors, consultants, project managers, and contractors, with a broad spread in experience and roles. The questionnaire was tailored to align with each objective and used a 5-point Likert scale for statistical rigor.

Data was analyzed using mean scoring and ranking techniques, and results were interpreted based on frequency, significance levels, and professional implications. The findings formed a solid empirical found

CHAPTER FIVE

CONCLUSIONS AND RECOMMENDATIONS

5.1 Conclusion

Variation orders are not merely technical adjustments they are symptoms of deeper systemic issues in planning, coordination, and contract execution. This study confirms that while some variation orders arise from legitimate field conditions or unforeseen risks, a large proportion are avoidable and stem from poor design planning, weak project governance, and inadequate stakeholder engagement.

In Kwara State, variation orders have proven to significantly derail project timelines, escalate costs, reduce overall quality, and generate tension among stakeholders. National works contracts, particularly those involving road infrastructure, are sensitive to such disruptions due to their scale and public significance.

Therefore, the timely control and minimization of variation orders is not optional but essential. It requires discipline across all project stages, from design to procurement to supervision. Governments, clients, and professionals must collectively uphold a culture of pre-construction diligence, post-award clarity, and variation accountability.

5.2 Recommendations

This research makes the following scholarly and professional contributions:

1. Contextual Understanding of Variation Causes it identifies and ranks factors contributing to variation orders within the unique terrain and administrative environment of Kwara State.

2. Classification of Origin Agents by Professional Role The study disaggregates causes of variation by agent — client, consultant, and contractor — helping policymakers and managers assign responsibility more accurately.
3. Empirical Data on Variation Impacts It provides empirical evidence that variation orders in Kwara State lead primarily to cost and time overruns, supported by actual responses from professionals on the field.
4. Control Strategy Framework Across Three Project Stages The study proposes a multiphase strategy framework to minimize variation orders, covering Design stage (planning and documentation) Construction stage (monitoring and communication) Interface stage (change control systems and conflict resolution)
5. Basis for Policy Reform in National Works Contracts The study's recommendations can guide the Ministry of Works, client bodies, and project consultants in reviewing variation handling clauses in public works contracts.

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QUESTIONNAIRE

Department of Quantity Surveying,
Institute of Environmental Studies,
Kwara State Polytechnic, Ilorin,
Kwara State.
28th June, 2024.

Dear Sir/Ma,

QUESTIONNAIRE ON THE IMPACT OF FACTORS CAUSING VARIATION ORDERS ON ROAD CONSTRUCTION PROJECT IN KWARA STATE

I am a final year student of the Department of Quantity Surveying, Kwara State Polytechnic, Ilorin, conducting research on the above topic as a requirement for the award of Higher National Diploma (HND) in Quantity Surveying.

I therefore solicit for your assistance to kindly fill the questionnaire presented as objectively as possible. Information provided shall be accorded its due confidentially and used solely for the purpose of this research work.

Thanks for your unreserved assistance.

Yours faithfully,

Abdullahi Qudirat Oluwatoyin
07015374195

SECTION A: RESPONDENT'S DEMOGRAPHIC INFORMATION

1. Gender: ( ) Male ( ) Female

: ( ) 20–30years ( ) 31–40years ( ) 41–50years ( ) 51+years

3. Academic Qualification: ( )HND ( ) B.Sc. ( )M.Sc. ( )PhD

4. Professional Designation: ( )Site Engineer ( )Quantity Surveyor ( )Project Manager ( )contractor ( )Others (specify): _____

5. Years of Experience: ( )0-5years ( )6–10 years ( )11–15 years ( )16-20 years

6. Type of Road Project Involved: ( )Federal Road ( )State Road ( )Local Government Road ( )Private Road

7. Have you Involved in Road Project in Kwara State? ( )Yes ( )No

SECTION B: Data on Main Objectives

2.1 Objectives No 1: Identify Predominant Causes of Variation Order in Road Project in Kwara State.

Instruction: Please tick the option that best describes your level of agreement with the following causes of variation order in road construction.

Likert Scale: 1 = Strongly Disagree | 2 = Disagree | 3 = Neutral | 4 = Agree | 5 = Strongly Agree

S/NA	**Predominant Causes of Variation Order in Road Project in Kwara State. Client Related Issue**	1 SD	2 D	3 N	4 A	5 SA
2.1.1	Change of Plans or Scope.					
2.1.2	Change of Schedule.					
2.1.3	Owner's Financial Problems.					
2.1.4	Right of way (Access to Site) Problem					
2.1.5	Inadequate Project Objectives.					
2.1.6	Replacement of Materials or Procedures.					
2.1.7	Impediment in Prompt Decision Making Process.					
2.1.8	Change in Specifications by Owner					

S/N B	**Predominant Causes of Variation Order in Road Project in Kwara State.** **Consultant Related Changes.**	1 SD	2 D	3 N	4 A	5 SA
2.1.9	Changes in Design by Consultant.					
2.1.10	Different Site Conditions.					
2.1.11	Errors and Omissions in Design.					
2.1.12	Conflicts Between Contract Documents.					
2.1.13	Inadequate Scope of Work for Contractor.					
2.1.14	Lack of Coordination.					
2.1.15	Design complexity.					
2.1.16	Inadequate Working Drawing Details.					
2.1.17	Design Discrepancies (Inadequate Design).					
2.1.18	Ambiguous Design Details.					
2.1.20	Lack of Consultant's Knowledge of Available Materials and Equipment.					
2.1.21	Noncompliance of Design with Owner's Requirements.					
2.1.22	Change in Specification by Consultant.					

S/N C	**Predominant Causes of Variation Order in Road Project in Kwara State.** **Contractor Related Changes**	1 SD	2 D	3 N	4 A	5 SA
2.1.23	Lack of Contractor's Involvement in Design.					
2.1.24	Unavailability of Equipment.					
2.1.25	Unavailability of Skills (Shortage of Skilled Manpower).					
2.1.26	Contractor's Financial Difficulties.					
2.1.27	Defective Workmanship.					
2.1.28	Poor Procurement Process.					
2.1.29	Lack of Communication.					
2.1.30	Contractor's Lack of Judgement and Experience.					
2.1.31	Complex Design and Technology.					
2.1.32	Contractor's Lack of Required Data.					

2.2 Objectives No 2: Identify the Main Origin Agents for the Predominant Causes of Variation Orders in Road Project in Kwara State.

Instruction: Please tick the option that best describes your level of agreement to the main origin agents for the predominant causes of variation orders in road project in Kwara state.

Likert Scale: 1 = Strongly Disagree | 2 = Disagree | 3 = Neutral | 4 = Agree | 5 = Strongly Agree

S/N	The Main Origin Agents for the Predominant Causes of Variation Orders in Road Project in Kwara State.	1 SD	2 D	3 N	4 A	5 SA
2.2.1	Client Related Changes.					
2.2.2	Consultant Related Changes.					
2.2.3	Contractor Related Changes.					
2.2.4	Force Majeure.					
2.2.5	Subcontractors.					
2.2.6	Suppliers					

2.3 Objective No 3: Investigate the Potential Effects of Variation Orders in National Works Contract of Kwara State Projects.

Instruction: Please tick the option that best describes your level of agreement to the potential effects of variation orders in national works contract of Kwara state projects.

Likert Scale: 1 = Strongly Disagree | 2 = Disagree | 3 = Neutral | 4 = Agree | 5= Strongly Agree

S/N	Investigate the Potential Effects of Variation Orders in National Works Contract of Kwara State Projects.	1	2	3	4	5
2.3.1	Cost Overruns.					
2.2.2	Time Overruns.					
2.3.3	Quality Degradation.					
2.3.4	Dispute.					
2.3.5	Professional Relations.					

2.4 Objectives No 4: Recommend how to Control or Minimize Variation Orders in National Works Contract of Kwara State Projects.

Instruction: Please tick the option that best describes your level of agreement to the control or minimize variation orders in national works contract of Kwara state projects.

Likert Scale: 1 = Strongly Disagree | 2 = Disagree | 3 = Neutral | 4 = Agree | 5 = Strongly Agree

S/N	Recommend how to Control or Minimize Variation Orders in National Works Contract of Kwara State Projects.	1 SD	2 D	3 N	4 A	5 SA
2.4.1	Review of Contract Documents.					
2.4.2	Freezing Design.					
2.4.3	Value Engineering at conceptual Phase.					
2.4.4	Involvement of Professionals at Initial Stage of Project.					
2.4.5	Owner's Involvement at Planning and Design Phase.					
2.4.6	Involvement of Contractor at Planning Scheduling Process.					
2.4.7	Thorough Detailing of Design.					
2.4.8	Clear and thorough Project Brief.					
2.4.9	Reducing Contingency Sum.					