

Assessing the Effects of Contract Variations on Building Construction Delivery

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DOI: <https://doi.org/10.62154/ajesre.2025.021.01015>

Abstract

Contract variations are a common phenomenon in building projects, often leading to time overruns, cost escalations, and dissatisfaction among stakeholders. Despite numerous studies on variation orders, there is limited empirical evidence on their effects on building project delivery within the Nigerian context. This study assessed the effects of contract variations on building construction delivery, with a view to identifying critical causative factors, their impacts on performance, and possible mitigation strategies. A quantitative research approach was adopted using a structured questionnaire administered to 100 construction professionals comprising clients, consultants, and contractors, with a response rate of 92%. Descriptive and inferential analyses were conducted using Frequency, Mean Item Score (MIS), and Spearman's rho correlation. The findings revealed that the most significant factors responsible for contract variations were consultants' lack of experience, design complexity, and additional client instructions (MIS = 5.00 each). The major effects identified included time overruns and end-user dissatisfaction (MIS = 5.00), while loss of efficiency due to work interruption (MIS = 4.84) was the most critical impact on project performance. A strong positive correlation was observed between consultant experience and time overrun, indicating a direct relationship between technical expertise and project timelines. The study further established that loss of profit (MIS = 4.26) and reduced organisational performance were major consequences at the organisational level. Key mitigation strategies include effective communication, proper site investigation, comprehensive design documentation, and interdisciplinary collaboration. The study concludes that effective management of contract variations can significantly enhance project delivery outcomes, cost performance, and client satisfaction in building projects.

Keywords: Contract Variations, Change Orders, Project Performance, Building Construction, Cost and Time Overruns, Nigeria.

Introduction

The construction industry is globally recognised as a vital driver of economic growth and national development, contributing to infrastructure provision, employment generation, and improved living standards (Khalesi *et al.*, 2020). In both developed and developing economies, the sector forms an important share of national GDP and remains central to

socio-economic advancement. Despite this importance, the industry continues to experience persistent challenges such as cost overruns, schedule delays, and quality deficiencies (Juliana *et al.*, 2024). International studies attribute these recurrent challenges to poor planning, inadequate project controls, design-related problems, and management inefficiencies; however, the impacts tend to be more severe in developing economies where institutional and resource constraints are more pronounced.

In Nigeria, the construction industry contributes approximately 1.4% to GDP, yet it has not fully realised its potential in supporting sustainable infrastructure delivery (Ezeudu & Fadeyi, 2024). Empirical studies consistently show that project performance remains suboptimal, particularly in relation to adherence to cost, time, and quality targets (Oladiran *et al.*, 2018; Eboh *et al.*, 2019). Evidence from Enugu, Lagos, and Rivers States demonstrates that Nigerian construction projects frequently suffer from cost and time variations arising from incomplete design information, documentation errors, inconsistent specifications, and client-initiated modifications (Dosumu & Aigbavboa, 2017; Eboh *et al.*, 2019; Okah, 2022). For example, Eboh *et al.* (2019) found that incomplete design information and poor contract documentation were among the most significant contributors to project cost variation in Enugu. Similarly, Lagos-based studies highlight that change orders mostly driven by late client instructions and design modifications are strongly associated with delays and increased final contract sums (Oladiran *et al.*, 2018).

Contract variations, commonly known as change orders, are therefore a major operational challenge in the Nigerian construction industry, mirroring global trends but amplified by contextual issues such as weak regulatory enforcement, insufficient design development, and limited stakeholder coordination. Variations arise from numerous factors, including unforeseen site conditions, design errors, omissions, client requests, and regulatory adaptations (Khalifa & Mahamid, 2019; Alkhatabi *et al.*, 2023). Although variations are sometimes necessary to improve project outcomes, their poor management often leads to workflow disruptions, increased risk of disputes, and substantial cost and schedule impacts. Nigerian evidence suggests that variation-related cost increases can be considerable; a study of selected projects found that design errors alone represented a major proportion of total variation cost (Dosumu & Aigbavboa, 2017). Studies conducted in Lagos and Rivers State further indicate that variation orders frequently trigger time extensions, claims, and strained contractual relationships (Oladiran *et al.*, 2018; Okah, 2022).

While international studies report that variation orders account for significant increases in project cost, with some averaging more than 11% of total project sums (Kim *et al.*, 2020; Alzara, 2022) local studies in Nigeria emphasise that the magnitude and frequency of variations are intensified by systemic challenges such as inadequate design reviews, poor project planning, and insufficient communication among stakeholders. Yet, despite these recurring patterns, there remains limited empirical investigation that specifically links variation factors to quantifiable project outcomes within the Nigerian construction sector.

Therefore, this study assesses the effects of contract variations on building construction delivery in Nigeria, focusing on identifying the most critical causative factors, quantifying their impacts on cost and time performance, and proposing evidence-based strategies to mitigate these challenges. This study contributes to enhanced decision-making, better contract management practices, and improved project outcomes among construction professionals and stakeholders within the Nigerian construction industry.

Problem Statement

The Nigerian construction industry continues to face persistent challenges in delivering building projects on time, within budget, and to the required quality standards. Contract variations commonly arising from consultants' inexperience, design complexity, unclear client instructions, and poor coordination among stakeholders have been identified as major contributors to these inefficiencies (Khalifa & Mahamid, 2019; Oluwajana *et al.*, 2022; Gheraba *et al.*, 2023). While international studies highlight similar issues, variations in Nigeria are often exacerbated by systemic weaknesses, including limited regulatory oversight and low adoption of modern project management tools (Kim *et al.*, 2020; Taher *et al.*, 2025). Despite the frequency and impact of variations, empirical research quantifying their effects on cost, time, and efficiency in Nigerian building projects remains scarce. This gap limits the development of evidence-based strategies for mitigating variations and improving project delivery. Accordingly, this study investigates the causes and effects of contract variations and identifies practical mitigation strategies to enhance the efficiency and reliability of building construction projects in Nigeria.

Research Questions

Based on the study's focus on the effects of contract variations on building construction delivery in Nigeria, the research questions can be formulated as follows:

1. What are the main causes of contract variations in building construction projects in Nigeria?
2. How do contract variations impact project performance in terms of cost, time, and quality?
3. What is the relationship between key causative factors of contract variations and their effects on project delivery?
4. What strategies are most effective in mitigating the occurrence and impact of contract variations in Nigerian building projects?

Literature Review

Overview of the Construction Industry

The construction industry is widely acknowledged as a major catalyst for economic growth because it drives investment, creates employment, and delivers essential infrastructure (Ikediashi & Okolie, 2022). Reichert and Linß (2025) similarly emphasise its importance,

noting that construction contributes substantially to national income and engages millions of workers worldwide. Aghimien *et al.* (2025) reinforce this view, describing the industry as a vital barometer of socio-economic progress. While these authors agree on the sector's macroeconomic significance, their analyses tend to adopt a macro-structural orientation without adequately addressing the internal operational inefficiencies that undermine performance, particularly in developing economies.

In Nigeria, scholars consistently highlight the industry's central role in national development, yet they also point to persistent performance failures. Oluwajana *et al.* (2022) and Akintola *et al.* (2020) identify chronic cost escalation, time overruns and persistent quality shortfalls. Although these studies provide important empirical evidence, they often treat these challenges as isolated outcomes rather than symptoms of deeper systemic issues. For example, while Oluwajana *et al.* (2022) attribute delays largely to poor site management, Akintola *et al.* (2020) emphasise governance-related concerns such as corruption and inadequate oversight. A comparative reading suggests that Nigeria's challenges arise from the interaction between weak institutional structures, capacity deficits, and fragmented project delivery systems, yet few studies explicitly integrate these themes.

Asadi *et al.* (2023) report that more than 65% of Nigeria's public procurement spending is construction-related, underscoring the strategic importance of the industry. However, their analysis stops short of assessing whether procurement frameworks effectively support value-for-money outcomes. Taken together, the literature reveals consensus on the industry's significance but insufficient synthesis on how structural, managerial and regulatory factors collectively shape performance.

Concept of Contract Variations in Construction

Contract variations, or change orders, involve modifications to the original contract scope, design, cost or schedule (Khalifa & Mahamid, 2019). Scholars such as Assbeihat and Sweis (2015) argue that these variations are inevitable due to design omissions, unforeseen conditions, or shifting client requirements. While their argument captures the realities of dynamic construction environments, it risks normalising avoidable variations arising from poor design management and inadequate planning.

Taher *et al.* (2025) provide a global perspective, asserting that more than one-third of construction projects worldwide experience major change orders. However, their quantitative emphasis may obscure contextual differences between developed and developing countries, where regulatory enforcement, design maturity, and contractor capacity differ significantly. Alkhatabi *et al.* (2023) deepen the discussion by highlighting that variations originate from diverse stakeholders, including clients, consultants, contractors, and regulators. This multi-stakeholder orientation expands earlier studies that tended to attribute responsibility primarily to designers or clients.

A comparative evaluation shows that while earlier studies focus on the inevitability of variations, more recent research stresses the role of governance, coordination, and risk allocation in either amplifying or mitigating variation-related disruptions. This shift reflects growing recognition that variations are not merely technical adjustments but also indicators of systemic weaknesses.

Types and Sources of Contract Variations

Maarouf and Habib (2022) categorise variations as either beneficial, enhancing functionality or value or detrimental, increasing cost and reducing performance. While this classification is useful, it oversimplifies complexities, as a change may be beneficial from a client's perspective yet impose operational burdens on the contractor. Assbeihat and Sweis (2015) identify design errors, professional misjudgement, and regulatory changes as common sources of variations. Their categorisation, however, pays limited attention to organisational culture, communication dynamics, and the contractual environment factors increasingly recognised in contemporary literature.

Table 1: Types and Causes of Contract Variations in Construction Projects

Type of Variation	Cause	Description
Change in scope	Client	Alteration of project objectives or deliverables
Unforeseen site conditions	Contractor / Consultant	Discovery of unexpected conditions
Design errors or omissions	Consultant	Defective or incomplete design documentation
Professional misjudgment	Architect/ Engineer	Incorrect specifications or calculations
Material substitution	Contractor	Replacement of materials due to unavailability
Regulatory changes	Authorities	Modifications in codes, laws, or standards

Source: Alhilli & Rezouki (2022)

Many of these sources are symptoms of earlier project management deficiencies, such as inadequate feasibility studies or weak design review, suggesting that effective early-stage planning could substantially reduce downstream variations.

Causes of Contract Variations

Ismaeil and Sobaih (2024) and Gheraba *et al.* (2023) identify design errors, incomplete information, and poor coordination as dominant causes of variations. While both studies highlight similar factors, Gheraba *et al.* (2023) link these issues more directly to weak project governance and limited stakeholder engagement, offering a more systemic interpretation. Kim *et al.* (2020) emphasise scope changes, yet their focus on administrative

inefficiencies may understate the influence of inadequate design development or poorly structured client briefing processes.

Khalifa and Mahamid (2019) highlight inadequate project objectives and stakeholder financial instability as contributing factors. Their analysis is valuable, but it insufficiently explores how institutional pressures and contractual risk allocation shape these outcomes. The fact that these causes appear consistently across different regions suggests universal patterns, yet their severity varies with local capacity, regulatory enforcement, and professional culture.

Table 2: Common Causes of Contract Variations in Building Projects

Cause	Supporting Authors
Design errors and omissions	Gheraba <i>et al.</i> (2023); Khalifa & Mahamid (2019)
Change in scope or specifications	Kim <i>et al.</i> (2020); Ismaeil and Sobaih (2024)
Unforeseen site conditions	Gheraba <i>et al.</i> (2023)
Inadequate project objectives	Khalifa & Mahamid (2019)
Owner-initiated changes	Gheraba <i>et al.</i> (2023); Khalifa & Mahamid (2019);
Poor coordination among stakeholders	Alkhatabi <i>et al.</i> (2023)
Financial difficulties (owner or contractor)	Khalifa & Mahamid (2019)
Weather conditions and safety concerns	Gheraba <i>et al.</i> (2023)

Overall, these studies show considerable overlap but differ in emphasis. A synthesis reveals that most causes stem from either inadequate early-stage planning or systemic weaknesses in communication and coordination.

Effects of Contract Variations

Most scholars identify cost escalation and time overruns as dominant effects of variations. Mahamid (2020) focus on operational consequences such as rework and demolition, while Alkhatabi *et al.* (2023) report average cost increases exceeding 10% in Kuwait. However, comparing these findings shows that the magnitude of impact varies across contexts, suggesting that project governance maturity moderates the severity of variation effects. Naji *et al.* (2022) emphasise financial implications, including profit loss, yet their analysis underplays intangible impacts such as strained professional relationships and declining client satisfaction, which Gheraba *et al.* (2023) identify as critical long-term consequences. Alzraiee (2024) links time overruns to poorly structured variation approval processes, highlighting how bureaucratic delays compound technical challenges.

Table 3: Common Effects of Contract Variations on Project Performance

Effect	Supporting Studies
Cost overruns	Alkhattabi <i>et al.</i> (2023); Naji <i>et al.</i> (2022)
Time overruns	Alzraiee (2022); Rashid <i>et al.</i> (2012)
Quality degradation	Gheraba <i>et al.</i> (2023)
Rework and demolition	Mahamid (2020)
Loss of profit	Naji <i>et al.</i> (2022)
Client dissatisfaction	Khalifa & Mahamid (2019)
Poor professional relationships	Gheraba <i>et al.</i> (2023)

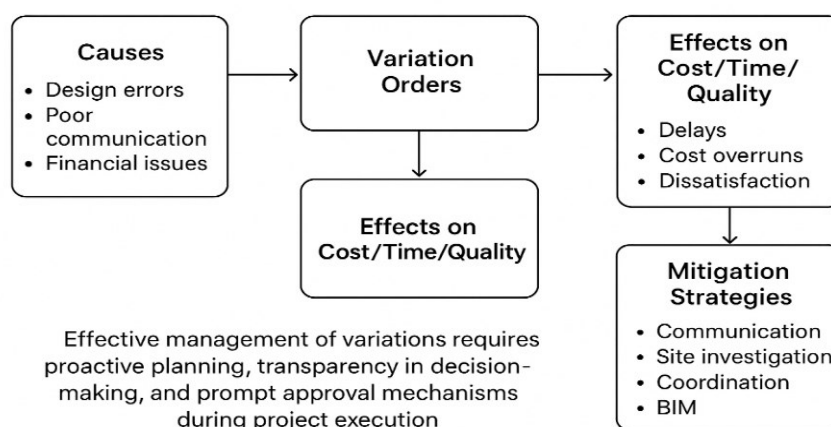
Collectively, the literature demonstrates that contract variations impose both direct (cost/time) and indirect (trust, communication, morale) consequences. However, most studies evaluate these effects in isolation; fewer integrate financial, relational, and organisational impacts into a holistic framework.

Mitigation Strategies for Contract Variations

Mitigation strategies identified in the literature include detailed design documentation, thorough feasibility studies, proper site investigation, and improved communication (Naji *et al.*, 2022). Although these strategies are widely recommended, scholars rarely discuss contextual barriers to their implementation, such as limited design budgets, fragmented supply chains, and weak enforcement of design standards.

Taher *et al.* (2025) advocate for advanced collaborative tools such as Building Information Modelling (BIM) and Integrated Project Delivery (IPD). While these technologies offer clear coordination benefits, their adoption is uneven across developing countries due to cost, training requirements, and organisational resistance. A comparative reading suggests that technological solutions are only effective when supported by institutional reforms and cultural shifts towards collaboration.

Framework for Managing Contract Variations

**Figure 1: Framework for Managing Contract Variations**

Research Methodology

Research Design

This study adopted a quantitative survey design to examine the effects of contract variations on building construction delivery in Nigeria. The design supports the systematic collection of numerical data that enables relationships among variables to be statistically evaluated (Pajo, 2022). Structured questionnaires were administered to professionals directly involved in construction delivery, clients, consultants, and contractors to ensure that responses reflected practical experience with variation orders.

Study Area and Population

The research was conducted within the Nigerian building construction sector, covering professionals engaged in public and private building projects. The target population comprised quantity surveyors, architects, engineers, project managers, and contractors. These groups were selected because they play central roles in initiating, approving, implementing, and managing variation orders (Creswell & Creswell, 2022). Their involvement positions them as the most credible sources of firsthand information on the causes and impacts of variations on project performance.

Sample Size and Sampling Technique

A purposive sampling technique was employed to ensure that only respondents with demonstrable experience in managing contract variations were included. This approach enhances representativeness in a functional sense because the sampling frame was restricted to professionals actively participating in decision-making and documentation processes related to variations. By focusing on individuals with direct experiential knowledge, the sample adequately reflects the population segment most capable of providing valid and informed responses.

Using Krejcie and Morgan's (1970) sample size determination table, a minimum sample of 100 respondents was deemed appropriate for a population exceeding 500. A sample of this size typically yields a 95% confidence level with an approximate $\pm 10\%$ margin of error, which is acceptable for behavioural and construction management research. Out of the 100 questionnaires distributed, 92 valid responses were retrieved, representing a 92% response rate. This high response rate further improves the reliability and statistical stability of the dataset (Babbie, 2022).

Research Instrument for Data Collection

Data were collected using a structured questionnaire divided into four sections:

- Section A: Demographic information
- Section B: Causes of contract variations
- Section C: Effects of variations on project delivery

- Section D: Mitigation strategies

All items were measured on a five-point Likert scale (1 = Strongly Disagree to 5 = Strongly Agree). The instrument underwent a pilot test among selected practitioners to confirm clarity and relevance. A Cronbach's Alpha (α) value of 0.84 indicated strong internal consistency (Pallant, 2020).

Data Analysis Techniques

The data collected were analysed using descriptive and inferential statistical tools. Descriptive statistics such as frequency, percentage, and Mean Item Score (MIS) were used to rank the causes, effects, and mitigation strategies of contract variations. The MIS was computed using Equation (1):

$$MIS = \frac{\sum f \times s}{N} \quad \text{..... Equation (1)}$$

Where:

(f) = frequency of responses, (s) = scale value (1–5), and (N) = total number of respondents. Inferential statistics were conducted using **Spearman's Rank Correlation Coefficient (p)** to determine the strength and direction of relationships between major causes and their corresponding effects on project delivery. The correlation coefficient was computed as shown in Equation (2):

$$P = 1 - \frac{6 \sum d^2}{n(n^2 - 1)} \quad \text{..... Equation (2)}$$

Where:

(d) = difference between paired ranks, and (n) = number of paired observations.

Validity and Reliability of Data

To ensure data validity, the questionnaire items were reviewed by academic experts and experienced practitioners in construction project management. Their feedback was incorporated before the final administration. The high Cronbach Alpha coefficient (0.84) further validated the internal consistency and dependability of the research instrument (Pallant, 2020).

Ethical Considerations

All respondents participated voluntarily, and their responses were treated with confidentiality. The purpose of the research was explained, and participants were assured that their data would be used solely for academic purposes. No personal identifiers were recorded, in compliance with ethical standards of academic research (Creswell & Creswell, 2022).

Results and Discussion

Respondents' Profile

Ninety-two valid questionnaires were analysed, giving a response rate of 92%, which meets acceptable thresholds for construction management studies. Respondents consisted of quantity surveyors (30%), engineers (25%), architects (20%), contractors (15%), and project managers (10%). Importantly, 68% had over ten years of experience, and more than 70% had managed multiple projects involving variation orders.

The dominance of mid-to-senior-level professionals strengthens the credibility of the dataset, as variation orders are typically administered by personnel with substantial field experience. However, reliance on purposively selected respondents introduces the possibility of response alignment bias, as experienced professionals may share similar perspectives formed by long-term exposure to systemic challenges within the Nigerian construction sector. Thus, while the profile enhances internal validity, it may slightly constrain broader generalisability.

Causes of Contract Variations

The study identified several factors contributing to contract variations in building construction. Table 4 presents the ranked Mean Item Scores (MIS) of the key causative factors.

Table 4: Causes of Contract Variations

Cause of Variation	Mean Item Score (MIS)	St.Deviation	Rank
Consultants' lack of experience	5.00	0.00	1
Design complexity	5.00	0.00	1
Additional client instructions	5.00	0.00	1
Lack of coordination among parties	4.93	0.12	2
Unclear client requirements	4.90	0.18	3
Financial difficulties of the contractor	4.87	0.21	4
Unforeseen site conditions	4.83	0.26	5
Poor communication	4.79	0.30	6
Change in project scope	4.76	0.34	7
Regulatory or policy change	4.63	0.40	8

Source: Field Survey (2025)

Consultants' inexperience, design complexity, and additional client instructions ranked highest (MIS = 5.00). These findings highlight an industry where technical capacity and front-end planning are critical weaknesses. Unlike contexts in Europe or East Asia, where sophisticated design review systems and regulatory enforcement limit such failures, Nigeria's consultant selection processes often prioritise cost over competence, contributing to frequent project variations.

Several contextual factors explain why consultants' inexperience ranked highest. First, skill gaps and professional fragmentation are significant. Nigerian studies (Aghimien *et al.*, 2020; Oluwajana *et al.*, 2022) repeatedly show that inadequate training, weak continuing professional development, and reliance on junior staff for major design tasks undermine the quality of construction design, leading to preventable variation orders. Second, the limited use of digital modelling and coordination tools exacerbates the problem. Unlike the UK or Singapore, where BIM-integrated design coordination minimises technical errors, most Nigerian firms rely on manual drafting or fragmented CAD outputs, which increases the risk of errors progressing into construction. Third, weak regulatory oversight allows incomplete and sometimes erroneous designs to advance unchecked, as pre-design checks are seldom enforced, leaving projects vulnerable to errors that manifest as contract variations.

Comparing this with international research trends, design changes remain a major cause of variation globally (Kim *et al.*, 2020; Mahamid, 2011), but the mechanisms differ. In developed countries, variations often stem from evolving client needs or technical optimisation, whereas in Nigeria, they largely arise from avoidable deficiencies, such as incomplete drawings, miscalculations, or coordination failures, problems that are effectively mitigated elsewhere through technology adoption, rigorous peer review, and standardised quality assurance procedures.

The prominence of additional client instructions also reflects the socio-political environment of Nigerian construction. Clients, particularly in the public sector, frequently modify project scope in response to administrative changes, shifting political priorities, or budget adjustments. Such client-induced scope drift is comparatively less pronounced in countries with stricter contract governance and formalised approval protocols, highlighting how contextual and institutional factors amplify the impact of otherwise manageable variations.

Effects of Contract Variations on Project Delivery

The study further examined how contract variations affect project outcomes, including cost, time, and quality. Table 5 presents the top-rated effects based on respondents' perceptions.

Table 5: Effects of Contract Variations on Project Delivery

Effect	Mean Item Score (MIS)	St.Deviation	Rank
Time overrun	5.00	0.00	1
End-user dissatisfaction	5.00	0.00	1
Loss of efficiency due to work interruption	4.84	0.19	2
Cost overrun	4.79	0.22	3
Quality compromise	4.71	0.28	4
Disputes among project participants	4.65	0.31	5

Effect	Mean Item Score (MIS)	St.Deviation	Rank
Reduction in the contractor's profit	4.26	0.42	6
Extension of project duration	4.20	0.45	7
Rework and demolition	4.14	0.48	8
Reduced organisational performance	4.12	0.51	9

Source: Field Survey (2025)

Time overruns and end-user dissatisfaction ranked highest (MIS = 5.00), followed by loss of efficiency (MIS = 4.84) and cost overruns (MIS = 4.79). These results reveal patterns that go beyond simple ranking, highlighting systemic issues in project delivery.

The unanimous agreement on time overruns suggests that delays are not occasional consequences but structural outcomes of variation management practices in Nigeria. This finding aligns with Naji *et al.* (2022), who argue that Nigerian projects generally lack buffer capacity and contingency planning, making even minor variations immediately disruptive. End-user dissatisfaction ranks equally with delays, reflecting service delivery concerns unique to the local context. Unlike international studies where cost escalation often dominates the impact of variations, Nigerian respondents emphasised the consequences on user experience, consistent with reports of chronic underperformance in public building projects (Adewuyi, 2020), where variations frequently result in rushed finishing, compromised workmanship, and delayed occupancy.

Loss of efficiency emerges as a hidden mechanism by which variations affect projects. International research identifies productivity loss as a "hidden impact" of variations (Mahamid, 2020), and this study confirms the same pattern in Nigeria, but at a more severe scale. The rigidity of supply chains, limited mechanisation, and reliance on manual labour magnify the effect of work stoppages, which often require re-sequencing and remobilisation, thereby amplifying inefficiency.

From a methodological standpoint, while the Mean Item Score effectively ranks perceived impacts, it does not quantify actual cost or time deviations. Consequently, conclusions drawn here reflect relative severity as perceived by professionals rather than precise effect sizes. Future research could employ earned value analysis or incorporate actual project performance records to generate more granular empirical insights into the magnitude of variation impacts.

Correlation Between Causes and Effects of Contract Variations

To assess the relationship between causative factors and project performance, Spearman's Rank Correlation Coefficient (ρ) was computed. The results are summarised in Table 6.

Table 6: Spearman's Rank Correlation Between Causes and Effects of Contract Variations

Variable Pair	Correlation Coefficient (ρ)	Relationship Strength	Significance (p)
Consultants' experience ↔ Time overrun	0.812	Strong positive	0.001
Design complexity ↔ Cost overrun	0.768	Strong positive	0.004
Additional client instruction ↔ Quality compromise	0.695	Moderate positive	0.010
Poor communication ↔ Client dissatisfaction	0.722	Strong positive	0.006
Financial difficulty ↔ Loss of efficiency	0.653	Moderate positive	0.013

Source: Field Survey (2024)

Spearman's correlation analysis demonstrates statistically significant positive relationships between key causes and their corresponding effects. The strongest correlation between consultants' inexperience and time overrun ($\rho = 0.812$, $p < 0.05$) indicates that technical deficiencies at the design stage strongly influence downstream project delays, confirming that variations are often rooted in preventable front-end errors.

Comparative analysis with the literature shows that similar strong correlations were reported by Mahamid (2011), who linked design errors with prolonged project duration in Sri Lanka. In contrast, studies from more technologically advanced markets, such as Kim *et al.* (2020), report weaker correlations because widespread adoption of BIM and integrated project delivery mitigates design-related delays. This highlights that the strength of correlation is highly context-sensitive, and Nigeria's elevated coefficients reflect underdeveloped design coordination mechanisms, limited regulatory enforcement, and reliance on manual processes.

The practical implications are clear. Consultant selection must prioritise technical competence over cost considerations, as design errors have measurable consequences for project timelines. Additionally, investing in digital pre-construction processes, including BIM and clash detection, could substantially reduce the risk of cost and time escalation. Strong client discipline and structured briefing processes are also necessary to minimise the impact of client-driven changes on quality and schedule.

From a methodological perspective, it is important to note that correlation does not imply causation. While statistically significant relationships exist, the strength of association may be influenced by respondents' subjective perceptions, the non-probability sampling approach, and the absence of triangulation with actual project performance data. Consequently, these findings should be interpreted as indicative of relationships rather than definitive proof of causal links.

Mitigation Strategies for Contract Variations

Identifying strategies to minimise the occurrence and impact of contract variations. Table 7 shows the most effective measures as ranked by respondents.

Table 7: Mitigation Strategies for Managing Contract Variations

Strategy	Mean Item Score	St.Deviation	Rank
Effective communication among stakeholders	5.00	0.00	1
Proper site investigation before design	4.93	0.14	2
Comprehensive design documentation	4.91	0.18	3
Coordination between the client and consultant	4.88	0.22	4
Adoption of digital technologies (BIM/IPD)	4.80	0.27	5
Detailed feasibility and planning studies	4.72	0.33	6
Timely approval of changes	4.69	0.36	7
Training and capacity building	4.65	0.39	8

Source: Field Survey (2024)

The analysis of mitigation strategies identified measures that respondents perceive as most effective in reducing both the frequency and impact of contract variations. The top-ranked strategies include effective communication among stakeholders, thorough site investigation prior to design, and comprehensive design documentation, indicating that proper planning and proactive engagement are critical in managing project uncertainties. Adoption of digital technologies such as Building Information Modelling (BIM) and Integrated Project Delivery (IPD) also received high ratings, reflecting the growing recognition that technology can enhance coordination, detect design clashes early, and minimise errors before construction begins.

These findings align with international research, where collaborative approaches and digital integration are widely recommended to reduce variation-induced inefficiencies (Naji *et al.*, 2022; Taher *et al.*, 2025). However, the Nigerian context presents additional challenges: limited technological adoption, fragmented communication channels, and insufficient regulatory oversight often hinder the effective implementation of these strategies. For instance, while BIM adoption is standard in developed countries, in Nigeria it remains sporadic, which partially explains the persistence of preventable variations despite awareness of mitigation measures.

Practically, the results suggest that focusing on front-end planning, stakeholder collaboration, and capacity-building initiatives could substantially reduce variation impacts. Investing in training programs to enhance consultant competence, enforcing stricter pre-construction design reviews, and institutionalising structured communication protocols are critical steps for sustainable project delivery. Nevertheless, it is important to

note that while these strategies are strongly recommended by respondents, their effectiveness in practice may vary depending on project scale, client involvement, and organisational culture. Therefore, mitigation efforts must be context-sensitive and integrated across technical, managerial, and regulatory dimensions to achieve measurable improvements in project outcomes.

Discussion of Findings

The findings reveal a construction environment in Nigeria where technical, managerial, and contextual weaknesses converge to generate contract variations. Unlike simple narrative summaries, the analysis indicates that variation drivers in Nigeria differ fundamentally from international patterns. While global studies emphasise complex technological demands, design optimisation, and unforeseen site conditions as primary sources of variation (Kim *et al.*, 2020; Khalifa & Mahamid, 2019), the Nigerian context is characterised by technical inadequacies such as incomplete or inaccurate design documentation, poor inter-stakeholder communication, and shifting client directives. These factors point to a structural deficit linked to professional capacity and governance, highlighting that variations are often preventable rather than inevitable.

The consequences of contract variations are deeply entrenched in project delivery systems. In Nigeria, variations create a chain of disruptions extending beyond cost and time impacts to affect workflow stability, user satisfaction, productivity, and contractual relationships. This holistic disruption aligns with findings by Gheraba *et al.* (2023), yet the severity observed in this study suggests that weaker institutional controls and inadequate risk management exacerbate the negative effects. The findings underscore that variation impacts are multidimensional, affecting both operational and organisational performance. Correlation patterns observed in the study reflect systemic weaknesses rather than isolated issues. Strong positive correlations between consultant inexperience, design complexity, and project delays indicate that poor inputs escalate into operational disruptions such as workflow interruptions, which in turn manifest as performance failures, including delays, rework, and client dissatisfaction. This causal chain is consistent with established construction management theory but is intensified in the Nigerian context due to limited digitalisation, inadequate regulatory enforcement, and fluctuating client priorities. Overall, the study illustrates that effective variation management requires not only technical competence but also robust institutional frameworks, structured communication, and proactive stakeholder engagement to mitigate systemic risks and improve project outcomes.

Conclusion and Recommendations

Conclusion

The study concludes that the high incidence of variations in building projects reflects deeper systemic weaknesses, such as poor planning, lack of design review processes, and limited

adoption of modern project management tools. By addressing these root causes, the construction industry can achieve improved efficiency, reduced disputes, and enhanced client satisfaction.

Recommendations

Based on the findings, the following recommendations are proposed to minimise the frequency and adverse effects of contract variations:

1. Clients are expected to provide clear project briefs, approve changes on time, and strengthen their capacity to understand design and planning implications.
2. Consultants are required to enhance technical competence through continuous training, conduct rigorous design reviews, and integrate digital coordination tools such as BIM into project workflows.
3. Contractors are encouraged to implement robust planning and scheduling systems, maintain proactive communication channels, and invest in skilled labour and mechanisation to minimise the impact of variations.
4. Regulators are mandated to enforce design and construction standards, oversee variation approval processes, and drive the adoption of modern project management and digital coordination tools across the industry.

Contribution to Knowledge

The study contributes to existing knowledge by providing empirical evidence on the relationship between contract variation factors and project delivery outcomes in the Nigerian construction sector. It establishes the quantitative linkage between consultant expertise, client behaviour, and variation impacts.

Study Limitations

The major limitations include the use of non-probability sampling, which restricts statistical generalisation beyond the sampled professionals. The study also relies on self-reported perceptions, which may be influenced by personal experience or organisational bias. Additionally, the research focuses on building projects and does not include infrastructure or industrial projects, limiting sectoral coverage. Despite these limitations, the study provides credible insights due to its strong response rate and use of reliability-tested instruments.

Future Research Directions

Future research could address these limitations by employing probability-based sampling, integrating project performance records for more precise measurement of cost and time impacts, and conducting longitudinal studies to examine how contract variations evolve over the project lifecycle. Comparative studies across different Nigerian regions or between

public and private projects could also provide deeper insight into contextual differences in variation management practices.

Authors' Contributions

This work was carried out in collaboration among all authors. Author Abdullahi Nuhu Jega initiated the research idea, designed the study, coordinated data acquisition, and compiled the first draft of the manuscript. Author Grace Thomas Rango supervised major stages of the work, ensured methodological compliance, and proofread the original manuscript. Author Muhammad Bello Fakai managed data processing, performed the statistical analysis, and contributed to interpreting the findings. Author Bunyamin Ayodeji Olawumi conducted the literature searches and strengthened the theoretical and empirical foundations of the study. Author Abdulhamid Isyaku Shagari assisted in data collection, verified analytical outputs, and contributed to refining the final manuscript. All authors read and approved the final version of the manuscript.

References

- Aghimien, D., Aliu, J., Akinradewo, O., Aghimien, L., Aigbavboa, C., & Ditsele-Rapodile, K. (2024). PLS-SEM assessment of the impact of job satisfaction on the organisational commitment of women quantity surveyors. *International Journal of Construction Management*, 25(1), 115–123. <https://doi.org/10.1080/15623599.2024.2304485>
- Akintola, B. F., Jagboro, G. O., Ojo, G. K., & Odediran, S. J. (2020). Effectiveness of Mechanisms for Enforcement of Ethical Standards in the Construction Industry. *Journal of Construction Business and Management*, 4(1), 1–12. <https://doi.org/10.15641/jcbm.4.1.530>
- Alhilli, H. K., & Rezouki, S. E. (2022). The causes influencing the occurrence of variation orders in the construction of buildings. *Journal of Engineering*, 8(8), Article 3. <https://doi.org/10.31026/j.eng.2022.08.03>
- Alkhatabi, L., Alkhard, A., & Gouda, A. (2023). Effects of change orders on the budget of the public sector construction projects in the Kingdom of Saudi Arabia. *Results in Engineering*, 20, Article 101628. <https://doi.org/10.1016/j.rineng.2023.101628>
- Alzara, M. (2022). Exploring the impacts of change orders on the performance of construction projects in Saudi Arabia. *Advances in Civil Engineering*, 2022(1), 5775926. <https://doi.org/10.1155/2022/5775926>
- Alzraiee, H. (2022). Quantifying labour impact cost due to change orders. *International Journal of Construction Management*, 24(4), 467–475. <https://doi.org/10.1080/15623599.2022.2123631>
- Asadi R, Wilkinson S, Rotimi JOB (2023), "The common causes of rework in construction contracts: a diagnostic approach". *Journal of Engineering, Design and Technology*, Vol. 21 No. 4 pp. 1107–1133, doi: <https://doi.org/10.1108/JEDT-04-2021-0215>
- Assbeihat, J. M., & Sweis, G. J. (2015). Factors affecting change orders in public construction projects. *International Journal of Applied Science and Technology*, 5(6), 1–10. <https://www.ijastnet.com>
- Babbie, E. (2022). *The practice of social research* (15th ed.). Cengage Learning.
- Creswell, J. W., & Creswell, J. D. (2022). *Research design: Qualitative, quantitative, and mixed methods approach* (6th ed.). Sage Publications.
- Dosumu, O. S., & Aigbavboa, C. O. (2017). Impact of design errors on variation cost of selected building projects in Nigeria. *Procedia Engineering*, 196, 847–856. <https://doi.org/10.1016/j.proeng.2017.08.016>
- Dosumu, O. S., & Aigbavboa, C. O. (2018). An assessment of the causes, cost effects and solutions to design-error-induced variations on selected building projects in Nigeria. *Acta Structilia*, 25(1). <https://doi.org/10.18820/24150487/as25i1.2>

- Eboh, E. E., Egolum, C. C., Ezeokoli, F. O., & Onyia, C. I. (2019). Analysis of factors responsible for project cost variation in Enugu, Nigeria. *Journal of Scientific Research & Reports*, 25(3-4), 1-8. <https://doi.org/10.9734/JSRR/2019/v25i3-430180>
- Ezeudu, T. S., & Fadeyi, T. J. (2024). Examining the Influence of Infrastructure Deficit on Economic Activities, Education, and Healthcare in Rural Areas of Nigeria. *Nnamdi Azikiwe Journal of Political Science*, 9(1), 155-176. Retrieved from <https://najops.org.ng/index.php/najops/article/view/229>
- Gheraba, A. R., Fedler, C. B., Pati, D., Schmidt, M., Darwish, M., Nejat, A., & Wade, B. (2023). Causes, effects, and control measures of construction change orders in the U.S. *Journal of Civil Engineering and Architecture*, 17, 57-73. <https://doi.org/10.17265/1934-7359/2023.02.001>
- Ikediashi, D. I., & Okolie, K. C. (2020). An assessment of risks associated with contractor's cash flow projections in South-South, Nigeria. *Construction Innovation*, 20(4), 2051-2058. <https://doi.org/10.1080/15623599.2020.1764752>
- Ismaeil, E. M. H., & Sobaih, A. E. E. (2024). A Proposed Model for Variation Order Management in Construction Projects. *Buildings*, 14(3), 726. <https://doi.org/10.3390/buildings14030726>
- Juliana, A., Oladimeji, O., Abiodun, A. O., Haddad, A. N., & Tam, V. W. Y. (2023). Influence of rework on construction project performance in Nigeria. *International Journal of Construction Management*, 24(8), 888-893. <https://doi.org/10.1080/15623599.2023.2239439>
- Khalesi, H., Balali, A., Valipour, A., Antucheviciene, J., Migilinskas, D., & Zigmund, V. (2020). Application of Hybrid SWARA-BIM in Reducing Reworks of Building Construction Projects from the Perspective of Time. *Sustainability*, 12(21), 8927. <https://doi.org/10.3390/su12218927>
- Khalifa, W. M. A., & Mahamid, I. (2019). Causes of change orders in construction projects. *Engineering, Technology & Applied Science Research*, 9(6), 4956-4961. <https://doi.org/10.48084/etasr.3168> (etasr.com)
- Kim, J. J., Miller, J. A., & Kim, S. (2020). Cost impacts of change orders due to unforeseen existing conditions in building renovation projects. *Journal of construction engineering and management*, 146(8), 04020094. [https://doi.org/10.1061/\(ASCE\)CO.1943-7862.0001888](https://doi.org/10.1061/(ASCE)CO.1943-7862.0001888)
- Mahamid, I. (2020). Impact of rework on material waste in building construction projects. *International Journal of Construction Management*, 22(8), 1500-1507. <https://doi.org/10.1080/15623599.2020.1728607>
- Naji, K. K., Gunduz, M., & Naser, A. F. (2022). The effect of change-order management factors on construction project success: a structural equation modeling approach. *Journal of Construction Engineering and Management*, 148(9), 04022085. [https://doi.org/10.1061/\(ASCE\)CO.1943-7862.0002350](https://doi.org/10.1061/(ASCE)CO.1943-7862.0002350)
- Okah, J. C. (2022). Investigating the causes, effects, and remedies to building collapses in Rivers State, Nigeria. *International Journal of Engineering and Modern Technology*, 8(2), 53-71. <https://doi.org/10.56201/ijemt.v8.no2.2022.pg53.71>
- Oladiran, O., Umeadi, C., & Onatayo, D. (2019). Evaluating change orders and their impacts on construction project performance in Lagos, Nigeria. *FUTY Journal of the Environment*, 12(2), 81-89. <https://doi.org/10.4314/fje.v12i2>
- Oluwajana, S., Ukoje, J., Okosun, S., & Aje, I. (2022). Factors affecting time and cost performance of road construction projects in Nigeria. *African Journal of Applied Research*, 8(1), 72-84. Retrieved from <https://www.ajol.info/index.php/ajapres/article/view/229276>
- Pajo, K. (2022). *Introduction to research methods: A hands-on approach* (2nd ed.). SAGE Publications, Inc.
- Pallant, J. (2020). *SPSS Survival Manual: A Step-by-Step Guide to Data Analysis Using SPSS for Windows* (Version 12). Published by Allen & Unwin, 83 Alexander Street Crows Nest NSW 2065 Australia.
- Reichert, I., & Linß, E. (2025). Automated volume estimation of particles based on arbitrary 2D shadow images applied to recycled aggregates. *Results in Engineering*, 27, Article 105662. <https://doi.org/10.1016/j.rineng.2025.105662>
- Taher, A., Khan, R. A., & Khan, M. A. (2025). Construction project change management in Indian construction industry: Status, importance and impact. *Journal of Engineering and Applied Science*, 72, Article 40. <https://doi.org/10.1186/s44147-025-00605-z>

Weerakoon, C. A., Withanage, K. T., & Disaratne, V. (2020). Impact of poor quantity surveying practices on small scale contractors in Sri Lanka. In *Conference Proceedings-FARU* (pp. 177-185). <https://doi.org/10.31705/FARU.2020.20>