International Journal of Innovative Research in Education, Technology & Social Strategies
p-ISSN: 2465-7298 | e-ISSN: 2467-8163
Volume 10, Number 2 November, 2023
IJIRETSS

The Dimensional Effect of Optimal Project Risk Management Practices on Project Quality of Selected Construction Companies in Nigeria

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Article DOI: 10.48028/iiprds/ijiretss.v10.i2.08

Abstract

In the construction industry, ensuring high-quality standards is a critical aspect of construction projects and plays a pivotal role in the sustained viability and triumph of contemporary construction companies. However, existing literature highlights the persistently subpar levels of project quality within the construction sector. This situation is manifested through cost overruns, time delays, deficient project definition, and fluctuations in project scope, which are indicative of insufficient project risk management practices. Although several studies have examined project risk management practices, little emphasis has been placed on evaluating their impact on quality in the construction industry. Hence, this study examined the dimensional effect of optimal project risk management practices on project quality of selected construction companies in Nigeria. Survey research design was adopted. The population was 202 top management and mechanical department staff of three selected construction companies in Lagos State, Rivers State, and the Federal Capital Territory of Abuja, Nigeria. A sample size of 176 was found to be usable. A validated questionnaire was adopted for data collection. Cronbach's alpha reliability coefficients for the constructs ranged from 0.74 to 0.98. The response rate was 87.1%. Data were analyzed using the Smart partial least squares structural equation modeling (PLS-SEM) software, which allowed for the testing of path analysis and hypotheses. A confirmatory factor analysis (CFA) was employed to assess the factor loading of the variables. Findings indicated that project risk management practices had significant effect on project quality of selected construction companies in Nigeria ($Adj\ R^2 = 0.54$, $F^2 = 0.058$, $Q^2 = 0.507$, $p < 0.05$). The study concluded that project risk management practices improved the quality of the selected construction companies in Nigeria. The study recommended that project managers should establish and implement effective quality management systems that outline clear processes and procedures for ensuring project quality. Develop quality control plans that include inspection, testing, and monitoring activities throughout the project lifecycle. Incorporate quality management standards and best practices, such as ISO 9001, to enhance quality assurance processes.

Keywords: *Project quality, Project risk management practices, Risk assessment, Risk mitigation*

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Background to the Study

Project quality is essential for construction companies to ensure the safety, durability, and client satisfaction of their projects while also maintaining industry standards and reputation (Wang et al., 2022). However, despite its importance, existing literature highlights the persistently subpar levels of project quality in the construction sector (Amoah & Sibelekwana, 2023; Okpala et al., 2020; Zhang et al., 2022). This situation is manifested through cost overruns, time delays, deficient project definition, and fluctuations in project scope, which are indicative of insufficient project risk management practices (Cox et al., 2020).

The global decline in project quality within construction companies in developed countries is a growing concern, with several key factors, such as cost-cutting measures, the demand for faster project delivery, skilled labor shortages in the construction industry, complex and changing regulations, Poor communication among project stakeholders, including contractors, subcontractors, and project owners, economic downturns, inadequate risk management practices, and compromised project outcomes contribute to this issue (Alonso-Conde & Rojo-Suarez, 2020; Dohale et al., 2021; El Khatib et al., 2023; Stergiopoulos et al., 2022). While it is important to note that not all projects or construction companies are affected equally, there are common trends that highlight this decline (Zaray et al., 2022).

According to the World Bank (2022), infrastructure safety errors cause over 100,000 fatalities and trillions in losses annually. Construction defects also contribute up to 15% of project costs, according to an analysis by MacDonald (2005). According to a 2021 study by the McKinsey Global Institute, the global construction industry is facing a productivity crisis, with productivity growth rates lagging behind those of other industries. Thus, construction projects are increasingly running over budget and behind schedule. A 2022 report by the National Academies of Sciences, Engineering, and Medicine found that the average cost overrun for construction projects in the United States is 20%, and the average time overrun is 30%. A 2023 report by the Chartered Institute of Building found that the UK construction industry is facing a quality crisis, with only 40% of projects being completed to the required standard. A 2023 report by the Australian Construction Industry Forum found that the Australian construction industry is facing a quality crisis, with only 30% of projects being completed to the required standard. While Asia is experiencing an infrastructure boom, project quality has weakened in many nations, according to construction industry data.

In India, nearly 60% of developers report quality issues, with defects rising up to 25% over 5 years. Rework costs are estimated at 10–15% of total project expenses (Construction Industry Development Council, 2021). In Thailand, structural defects increased from 13% to 28% of buildings inspected over the past decade (Thailand's Construction Industry, 2021). Singapore has seen reported issues double since 2020, with negligence cited in 30% of cases (Singapore Building and Construction Authority, 2022). Indonesia averages 6-7 quality audits per project, reflecting systemic problems (Indonesian Chamber of Commerce and Industry, 2022). Malaysia recorded a 20% rise in contractor license revocations due to shoddy workmanship just in 2022 (Royal Institution of Surveyors Malaysia, 2021). Across Asia's dynamic construction sector, poor quality control is creating safety risks and necessitating costly

corrections. With regional infrastructure investment set to surpass $5 trillion in the next decade, ensuring quality is an urgent imperative. Construction firms must prioritize rigorous quality assurance practices, workmanship training, and prevention of errors and corner-cutting to complete projects safely, efficiently, and defect-free.

In Africa, the challenges in the construction industry are more felt in developing and emerging economies, where the industry plays a vital role in boosting economic macro- and micro-variables (Abdilahi et al., 2020). A 2022 report by the South African Forum of Civil Engineering Contractors found that the average cost overrun for construction projects in South Africa is 15%, and the average time overrun is 25%. The report also found that only 40% of construction projects in South Africa are completed to the required standard. A 2021 study by the Kenya Association of Building Contractors found that the average cost overrun for construction projects in Kenya is 10%, and the average time overrun is 20%. The study also found that only 45% of construction projects in Kenya are completed to the required standard. A 2023 report by the Egyptian Federation for Construction and Building Contractors found that the average cost overrun for construction projects in Egypt is 15%, and the average time overrun is 25%. The report also found that only 30% of construction projects in Egypt are completed to the required standard.

In Nigeria, despite the huge financial investments in construction and its associated economic benefits, construction projects are characterized by poor quality in aesthetics, high costs in maintenance and failure to meet or exceed the customers' quality expectations (Akinradewo & Aigbavboa, 2019). A 2023 study by the Nigerian Institute of Architects found that the average cost overrun for construction projects in Nigeria is 20%, and the average time overrun is 30%. The study also found that only 35% of construction projects in Nigeria are completed to the required standard.

Project quality in the construction industry is profoundly influenced by project risk management practices that involve processes like risk identification, assessment, monitoring, control, and mitigation (Zarewa, 2019). Success in construction projects is typically evaluated based on their adherence to critical benchmarks, including time, cost, scope, and quality. Within Nigeria, particularly in cities like Lagos, Port Harcourt, and Abuja, construction projects tend to be at high risk of exceeding their budgets and experiencing significant delays (Abdilahi et al., 2020; Adinyira et al., 2020; Akande et al., 2018). While some degree of cost and schedule risk is inherent in construction projects, improvements in risk management practices can help mitigate their detrimental impacts (Omajuwa & Ngwu, 2021).

Quality considerations within the construction sector are of paramount importance, but they are often overlooked, especially in the early stages of project development, such as design and construction (Amani & Safarzadeh, 2022). However, the pursuit of improved quality has become a substantial challenge facing the industry, aiming to reduce rework costs, lower maintenance expenditures, and enhance the overall value throughout the project's life cycle (Igwe & Ude, 2018). Subpar quality issues are widespread in construction projects globally and are attributed to a multitude of factors, including mismanaged project schedules, cost-

saving prioritization, delayed involvement of contractors and consultants, contractor selection based solely on the lowest bid, hasty and erroneous decision-making, unrealistic client expectations, task omissions, a lack of construction control administration checklists, deficient communication, and noncompliance with quality management plans (Uwanyirigira & Rusibana, 2020).

According to Latham (2023) no construction project is risk free. Risk can be managed, minimized, shared, transferred or accepted. It cannot be ignored. Risks and uncertainties can cause losses that could lead to increased costs, schedule delays and lack of quality during the progression of a project from its beginning to its end. Compared to other industries, the construction industry is subjected to more risks prone events due to its unique features, such as long period, complicated processes, unpredictable environment, financial intensity and dynamic organization structures (Akintoye & MacLeod, 1997; Smith & Wong, 2022). Hence, applying effective risk management techniques to manage risks associated with various construction activities has become imperative for the successful delivery of a project.

Huang et al (2021) and Zaray, et al (2022) affirmed that constructions project quality has been identified to be negatively influenced by low-quality materials, lack of auditing, lack of proper supervision, design complexity, design concept among others is some of the common sources of construction defects. Also, constructions project quality is negatively influenced by conflicts between project managers and other outside stakeholders such as sub-contractor and owner, suspending important decisions, unawareness of proper planning tools and techniques by project managers, poor monitoring and feedback tools, negative attitude of project managers and project participants, disorganized resources allocation (Amoah & Sibelekwana, 2023; El Khatib et al., 2023; Hijazi, 2021; Mohammed & Adindu, 2021). In response to this gap, the present study examined the influence of project risk management practices on project quality, specifically within the context of developing nations such as Nigeria. Hence, this study filled this knowledge gap on project risk management practices and quality of construction companies in Nigeria.

Literature Review

This section focused on concepts of project risk management practice, risk identification, risk assessment, risk monitoring and control, risk mitigation and project quality along theoretical, conceptual and empirical lines.

Project Quality

According to Alonso-Conde and Rojo-Suarez (2020) project quality is the adherence to a project's legal, aesthetic, and functional standards. In the context of construction projects, project quality entails ensuring that all activities are carried out in accordance with the plans, specifications, and regulatory requirements. Mohamed (2019) adds that project quality also encompasses how closely the final outcome aligns with the client's expectations. Amoah and Sibelekwana (2023) define project quality as the implementation of construction projects in line with predetermined quality criteria. In contrast, Hoque and Hasan (2022) propose a definition that encompasses elements influencing project completion, budget adherence, and

customer satisfaction. Hulshult and Krehbiel (2019) emphasize that project quality in construction entails adhering to the guidelines established by the project's scope of work. Completing the project on schedule, meeting agreement requirements, and staying within the budget are all crucial facets of project quality. Hoque et al. (2021) define project quality as the achievement of acceptable levels of quality in construction activities. Considering the various definitions in the literature, the researcher defines project quality as the processes and activities that establish quality policies, objectives, and responsibilities to ensure that the project fulfills the intended purpose and meets the required needs.

Project Risk Management Practices

The Project Management Body of Knowledge (PMBOK, 2021) defines project risk management practices as the identification, assessment, and prioritization of risks, followed by the coordinated and economical application of resources to reduce, monitor, and control the possibility and/or impact of unfortunate events. According to Cantillo and Van Caillie (2023), project risk management practices involve the process of identifying, analyzing, and responding to any risk that arises over the life cycle of a project to help the project remain on track and meet its goal. Project risk management practice is a systematic process of identifying, analyzing, and responding to project risks in order to maximize positive outcomes and events and reduce the likelihood or impact of adverse consequences on project goals that can affect time, cost, quality, and efficiency (Alfreahat & Sebestyen, 2022).

Project risk identification is the process of determining which risks may affect the project and documenting their characteristics (Kalpana, 2023). The key benefit of this process is documentation of existing risks and the knowledge and skills offered by the project team anticipate risk events (Tazikova et al., 2023). Project risk identification is the process of identifying individual project risks and opportunities in a manner which makes analysis possible (Deiva & Kalpana, 2022). A project risk assessment is a process that aims to gain a deeper understanding of which project tasks, deliverables, or events could influence its success (Koelmans et al., 2022). Project risk assessment is a process of identification, classification, and quantitative and qualitative analysis of risks affecting projects (Shahed et al., 2021).

Project risk assessment is the overall process of risk identification, risk analysis and risk evaluation (Can Saglam et al., 2021). According to PMBOK (2021) project risk assessment consists of risk identification (the process of finding, recognising and describing risks), risk analysis (the process to comprehend the nature of risk and to determine the level of risk, and risk evaluation (the process of comparing the results of risk analysis with risk criteria to determine whether the risk and/or its magnitude is acceptable and tolerable). Project risk assessment is an integral part of risk management. In any risk assessment it must be understood what questions the risk assessment is trying to answer. Ultimately, this is driven by the stakeholders needs (Zhang et al., 2022). Project risk monitoring and control is the systematic collection and analysis of information at regular intervals on a current project so as to relate the actual impacts of the project against the objectives set for facilitating making decisions (Tariq, 2023). Project risk monitoring and control means actively reviewing the status of your project as it proceeds, evaluating potential obstacles, and implementing necessary changes (Obondi, 2022).

Project risk mitigation on the other hand refers to practices to minimize risks (Lapidus et al., 2022). Project risk mitigation to the different methods of dealing with threats to a project (Ibrahim & Elshwadfy, 2021). Risk Mitigation involves the development of plans to manage, prevent or reduce potential risk to an acceptable level (Sharma et al., 2021). Project risk mitigation is a strategy to prepare for and lessen the effects of threats faced by a business (Akinradewo & Aigbavboa, 2019). Comparable to risk reduction, risk mitigation takes steps to reduce the negative effects of threats and disasters on business continuity (Ajmal et al., 2020). Project risk mitigation refers to the process of planning and developing methods and options to reduce threats or risks to project objectives (Durdyev, 2021). A project team might implement risk mitigation strategies to identify, monitor and evaluate risks and consequences inherent to completing a specific project, such as new product creation (Can Saglam et al., 2021).

Empirical Review

El Khatib et al. (2023) indicated that project quality management had a positive effect on risk management. Nc and Menzies (2023) found out that risk management project had a significant influence on project quality. In addition, Amoah and Sibelekwana (2023) showed that project risk management had a positive impact on project quality success. The study of Naveed and Khan (2022) further revealed that project risk management had a significant impact on project success and Zaray et al. (2022) also revealed that project risk management had a significant effect on project quality. If the study of Hoque and Hasan (2022), it was revealed that project quality success had a significant influence on project risk management as previously postulated by the study of Hoque et al. (2021) who reported that quality of project had a positive influence on project risk management. Sang et al. (2021) showed that project risk management, big data and technology capability had a beneficial influence project quality.

Furthermore, the study of Huang et al. (2021) indicated that project quality had a positive effect on project risk management. Motta (2020) found out that project risk management had a significant influence on project quality success. ONeill et al (2020) showed that project quality had a positive impact on risk management. Snell et al. (2022) revealed that project risk management had a significant impact on improvement quality project. Alonso-Conde and Rojo-Suárez (2020) discovered that project risk management had a significant effect on profitability quality of project while Mohamed et al (2019) also reported that managing risks significantly project quality. Hulshult and Krehbiel (2019) found out that project risk management had a positive influence on project quality.

Corroboratively, Chadee et al. (2023) study on minimizing liability of the covid-19 pandemic on construction contracts: a structural equation model for risk mitigation of force majeure impacts discovered that risk mitigation had significant effect on project quality. Mesta et al. (2023) conducted a study on quantifying the potential benefits of risk-mitigation strategies on present and future seismic losses in Kathmandu valley, Nepal. The study found out that risk-mitigation strategies positively influenced project quality. Conway et al. (2023) examined the association between COVID-19 risk-mitigation behaviors and specific mental disorders in

youth. The study indicated that risk-mitigation had positive effect on project quality. Gondia et al. (2022) study on machine learning based decision support framework for construction injury severity prediction and risk mitigation, showed that risk-mitigation had positive and significant effect on project quality.

The study of Wang et al. (2022) on metabolism-based ventilation monitoring and control method for covid-19 risk mitigation in gymnasiums and alike places affirms that risk-mitigation had positive impact on construction project quality. Stergiopoulos et al. (2022) study on automatic analysis of attack graphs for risk mitigation and prioritization on large-scale and complex networks in Industry 4.0, revealed that risk-mitigation had positive influence on project quality. The study of Dohale et al. (2021) on COVID-19 and supply chain risk mitigation: A case study from India, also corroborated that project risk-mitigation had positive effect on project quality. The study of Shahed et al. (2021) on supply chain disruption risk mitigation model to manage COVID-19 pandemic risk, indicated that risk-mitigation had positive effect on project quality. Zhang et al. (2022) carried a study on the review of seismic risk mitigation policies in earthquake-prone countries: lessons for earthquake resilience in the United States. The study revealed that risk-mitigation had positive effect on project quality.

Conversely, the study of Can Saglam et al. (2021) on proactive risk mitigation strategies and supply chain risk management quality: An empirical analysis for manufacturing firms in Turkey, showed that risk-mitigation had negative and insignificant impact on project quality. Majumdar et al. (2021) study on prioritizing risk mitigation strategies for environmentally sustainable clothing supply chains: Insights from selected organisational theories, also indicated that risk-mitigation had negative effect on project quality. The study of De Bruin et al. (2020) on initial impacts of global risk mitigation measures taken during the combatting of the COVID-19 pandemic also affirms that risk-mitigation had negative effect on project quality. Cox et al. (2020) study on a proposed process for risk mitigation during the COVID-19 pandemic, found out that risk-mitigation had insignificant impact on project quality. Muhs et al. (2020) study on wildfire risk mitigation: A paradigm shift in power systems planning and operation, revealed that risk-mitigation had negative effect on project quality and the study of Okpala et al. (2020) on utilizing emerging technologies for construction safety risk mitigation also indicated that risk-mitigation had negative effect on project quality.

Research Conceptual Model

The conceptual model for this study is diagrammatically shown below:

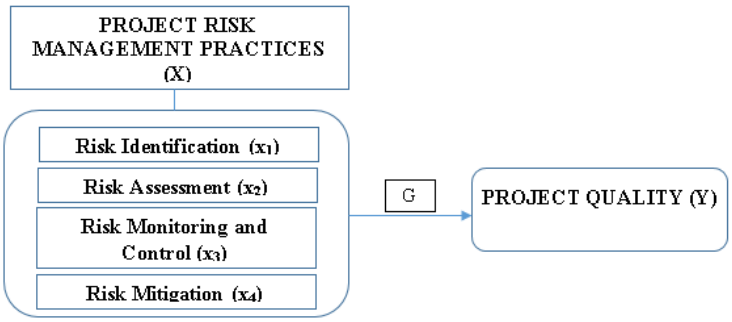

Figure 1: Research Conceptual Model (2023)

The conceptual model presented in Figure 1 illustrates the effects of the variables in this study. The independent variable, project risk management practices, is denoted as X, with its sub-variables represented by x_1 (risk identification), x_2 (risk assessment), x_3 (risk monitoring and control), and x4 (risk mitigation). The dependent variable, project quality, is represented by Y, reflecting its overall measurement. The model demonstrates how project risk management practices, including risk identification, risk assessment, risk monitoring and control, and risk mitigation, interact and impact project quality in selected construction companies in Nigeria. In essence, the model highlights the effects of project risk management practices and the lack of project quality observed in the chosen construction companies in Nigeria.

Theoretical Review

This study draws upon the theoretical frameworks of contingency theory and the iron triangle theory to provide a robust conceptual foundation. Developed by Fred Fiedler in 1967, contingency theory recognizes the significance of contextual variables, such as risks, which exert influence on the project under investigation. The central objective of contingency theory is to enhance organizational risk management practices, enabling effective responses to the uncertainties associated with project quality. Contingency measures are primarily designed to mitigate or minimize the adverse consequences of unforeseen events. In this study, contingency theory is employed to elucidate an approach to managing risks in projects that aligns with the specific conditions prevalent in Nigeria's construction industry. Consequently, the utilization of contingency theory facilitates a deeper understanding of project risk management practices and their impact on project quality.

The iron triangle theory, developed by Barnes in 1956 and also referred to as the golden triangle or the triple constraints theory (Scheuchner, 2017), provides a framework for project managers to evaluate and balance the competing demands of Cost, Time, and Quality within their projects (Atkinson, 1999). It focuses specifically on project time, cost, and scope, serving two main purposes. Firstly, it identifies the critical success factors of a project, namely time, cost, and scope. Secondly, it provides a tool to measure project quality based on the quality of

these three factors. The iron triangle theory offers a dynamic approach to prioritize project elements and helps define value within a project team.

According to the iron triangle theory, any changes to one of the three constraints of time, cost, and scope will inevitably affect the other two constraints. Therefore, achieving a balance among the three project constraints is vital in determining the overall project quality. In this context, the contingency theory and the iron triangle theory are well-suited for studying the impact of project risk management practices on project quality, as their perspectives align with the variables investigated in this study. In summary, both contingency theory and the iron triangle theory are highly relevant to project risk management practices and have a significant influence on project quality. Contingency theory allows for the customization of risk management approaches, promotes flexibility and stakeholder alignment, and enables adaptation to changing circumstances. The iron triangle theory provides guidance for effectively managing project scope, time, and cost, facilitating trade-off decisions and ensuring project control. Integrating these theories into risk management practices enhances the probability of project success and leads to improved overall project quality.

Methodology

In this study, a survey research design was adopted to gather data. The target population consisted of 202 individuals comprising top management and mechanical department staff from three selected construction companies located in Lagos State, Rivers State, and the Federal Capital Territory of Abuja, Nigeria. From this population, a sample size of 176 respondents was deemed usable for analysis. Data collection was done using a validated questionnaire, and the reliability of the constructs was assessed using Cronbach's alpha reliability coefficients, which ranged from 0.74 to 0.98.

The overall response rate for the survey was 87.1%. The collected data were analyzed using Smart partial least squares structural equation modeling (PLS-SEM) software, which allowed for path analysis and hypothesis testing. Confirmatory factor analysis (CFA) was employed to evaluate the factor loading of the variables. The main factors investigated in the study were measured using a six-point scale, ranging from Very High (VH) to Very Low (VL) for the independent variables and the dependent variable. The relationships between the dependent and independent variables were examined using multiple regression equations.

A total of 202 questionnaires were distributed to top management and mechanical department staff from three selected Nigerian construction companies operating in Abuja, Lagos, and Port Harcourt. Out of these, 176 questionnaires were successfully completed and returned, resulting in a response rate of 87.1%. According to Bell et al. (2022), a response rate of 50% or higher is generally considered acceptable for analyzing the results of a study. Therefore, the achieved response rate of 87.1% is considered satisfactory for the purposes of this study.

Data Analysis, Results and Discussion

To test hypothesis, partial least square structural equation modelling (PLS-SEM) was deployed with project risk management practices as an independent variable and project

quality as the dependent variable. The results of the analysis and parameter estimates obtained are presented below:

Figure 2 displays the outcomes of the bootstrapping procedure, illustrating the obtained results and their implications for the structural model analysis for objective four which is to evaluate the effect of project risk management practices on project quality.

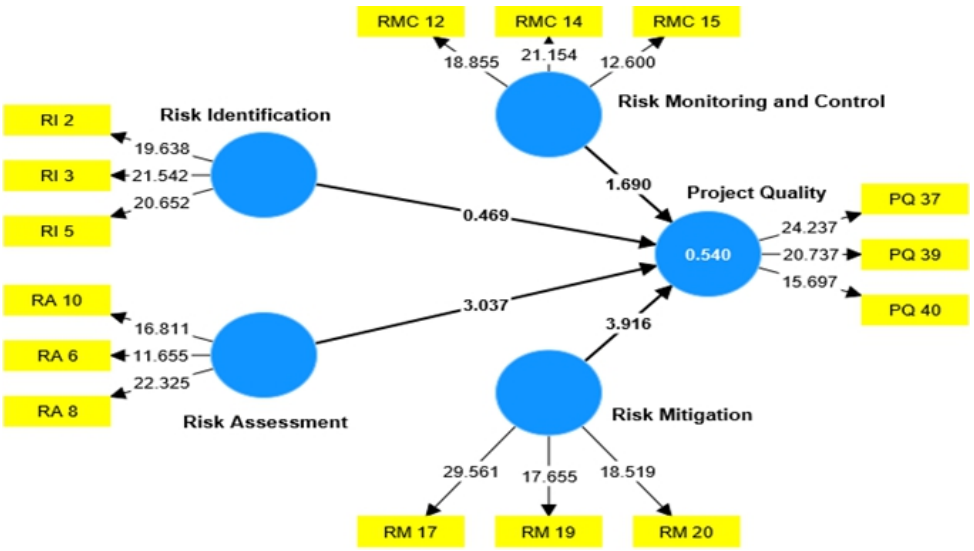

Figure 1: Bootstrapping Outcome for Project Risk Management Practices and Project Quality

The results of the structural equation modelling analysis showed a substantial overall effect size since it is above the moderate effect of 0.5, with an R^2 value of 0.55 and an Adjusted R^2 value of 0.54 for project quality. This indicates a strong predictive power according to the classification by Hussain et al. (2018), where an R^2 value of 0.75 is considered substantial, 0.50 is moderate, and 0.26 is weak. Furthermore, the structural model, Goodness of Fit: Standardized Root Mean Square Residual (SRMR) = 0.087; d_ULS = 0.917; d_G = 0.399; Chi-Square = 398.851; Normed Fit Index (NFI) = 0.651, indicating an acceptable fit (Hair et al., 2014; Sanchez, 2013; Chinn, 2010).

The findings also, reveal that Risk Assessment ($\beta = 0.232$, $t = 3.037$, $p = 0.003$) and Risk Mitigation ($\beta = 0.356$, $t = 3.916$, $p = 0.000$) positively and significantly impact the project quality of the chosen construction companies in Nigeria. However, Risk Identification ($\beta = 0.045$, $t = 0.469$, $p = 0.639$), Risk Monitoring and Control ($\beta = 0.202$, $t = 1.69$, $p = 0.092$) only have positive influence on project quality but are not statistically significant. The p-value indicates that the model successfully predicted the variables' outcomes. Finally, the Q^2 value measures whether a model has predictive relevance or not when > 0 indicates good predictive relevance. Q^2 according to Hair et al (2013) classified the degree of predictive relevance as 0.02, 0.15 and 0.35 as weak, moderate and strong respectively. The values of Q^2 PQ 37(0.350), PQ

39(0.294), PQ 40(0.312) and Project Quality (0.507) for the endogenous variable were over 0, hence predictive relevance was achieved, and it has a strong predictive degree of relevance. Table 1 shows a summary of the path result obtained using SmartPLS.

Table 1: Path analysis results for Project Risk Management Practices and Project Quality

Path	Beta	Standard Error	T Statistics	R^2	Adj.R^2	Prob	Decision
Risk Assessment -> Project Quality	0.232	0.077	3.037	0.55	0.54	0.003	Supported
Risk Identification -> Project Quality	0.045	0.095	0.469			0.639	Not Supported
Risk Mitigation -> Project Quality	0.356	0.091	3.916			0.000	Supported
Risk Monitoring and Control -> Project Quality	0.202	0.120	1.69			0.092	Not Supported

Source: Researchers' Findings 2023

In the same view, according to Cohen's f^2 value interpretation, can significantly show the effect size of the independent variable on the dependent variable. The Cohen value effect size classification can be interpreted as follows "0.02, 0.15, and 0.35 represent small, medium, and large effects", respectively (Hair et al., 2014). Table 2 shows the effect sizes of the variables.

Table 2: Effect Size for Project Risk Management Practices

	F-Square (F^2)	**Effect Size**	**97.5% CI**
Risk Assessment -> Project Quality	0.058	Small	0.379
Risk Identification -> Project Quality	0.002	Low	0.242
Risk Mitigation -> Project Quality	0.106	Small	0.518
Risk Monitoring and Control -> Project Quality	0.030	Small	0.437

Source: Researchers' Findings 2023

According to Hair et al. (2017), a significant effect is confirmed by a lack of zero in the confidence intervals for an estimated path coefficient leading to the rejection of the null. The significance of the effect is confirmed when the confidence intervals for the estimated path coefficient do not include zero, leading to the rejection of the null hypothesis (Hair et al., 2014, 2017). Consequently, it is strongly advised that construction companies deliberately concentrate their efforts on risk identification, risk assessment, risk monitoring and control, and risk mitigation in order to enhance project quality and thus effectively practice risk management to improve project quality. The model equation is as follows:

$$PQ = \beta 0 + 0.134RI + 0.199RA + 0.425RMC + 0.169RM + \varepsilon i \text{ ----------Eqn1}$$

Where:
PQ = Project Quality
RI= Risk Identification
RA = Risk Assessment
RMC = Risk Monitoring and Control
RM = Risk Mitigation

The path regression model above revealed that when combining all the dimensions of project risk management together as the independent variable, it positively and significantly predicted the project quality. Moreover, the unit of change in risk identification resulted in 0.134 improvements in the project quality reviews of the selected construction companies in Nigeria, keeping other variables constant. Likewise, a unit of change or increase in risk assessment would lead to a 0.199 improvement in the project quality. Also, a unit change in risk monitoring and control resulted in 0.425 improvements in the project quality, and a unit change in risk mitigation would lead to 0.169 improvements in the project quality in the same project construction market. Based on the results above, the null hypothesis that project risk management practices have no significant effect on project quality has no evidence to support it, therefore based on the path results, this study fail to accept the null hypothesis. This indicates that project risk management practices have a significant effect on project quality.

Discussion

The findings from the PLS-SEM path analysis conducted on the hypothesis above revealed that project risk management practices, including risk identification, risk assessment, risk monitoring and control, and risk mitigation, have a significant effect on project quality in selected construction companies in Nigeria. This result have important implications in conceptual, empirical, and theoretical contexts. The result of this study supports the findings of various empirical studies on project risk management practices and project quality such as Adinyira et al. (2020), Butt et al. (2021), Hartono et al. (2019), and Omajuwa and Ngwu (2021).

This empirical is consistent with previous studies that have also provided empirical evidence for the positive influence of project risk management practices on project quality. El Khatib et al. (2023) indicated that project quality management had a positive effect on risk management. NC and Menzies (2023) affirmed that risk management project had a significant influence on project quality. Similarly, Amoah and Sibelekwana (2023) showed that project risk management had a positive impact project quality success. Naveed and Khan (2022) discovered that project risk management had a significant impact on project success. Zaray et al. (2022) revealed that project risk management had a significant effect on project quality. Hoque and Hasan (2022) revealed that project quality success had a significant influence on project risk management. Hoque et al. (2021) discovered that quality of project had a positive influence on project risk management. Sang et al. (2021) showed that project risk management, big data and technology capability had a beneficial influence project quality.

Huang et al. (2021) indicated that project quality had a positive effect on project risk management. Motta (2020) found out that project risk management had a significant influence on project quality success. ONeill et al (2020) showed that project quality had a positive impact on risk management. Snell et al. (2022) revealed that project risk management had a significant impact on improvement quality project. Alonso-Conde and Rojo-Suárez (2020) discovered that project risk management had a significant effect on profitability quality of project. Mohamed et al (2019) indicated that project risk management had a significant influence on improving project quality performance. Hulshult and Krehbiel (2019) found out that project quality performance had a positive influence on project risk management.

Corroboratively, Chadee et al. (2023), study on minimizing liability of the covid-19 pandemic on construction contracts: a structural equation model for risk mitigation of force majeure impacts discovered that risk mitigation had significant effect on project quality. Mesta et al. (2023) conducted a study on quantifying the potential benefits of risk-mitigation strategies on present and future seismic losses in Kathmandu valley, Nepal. The study found out that risk-mitigation strategies positively influenced project quality. Conway et al. (2023) examined the association between COVID-19 risk-mitigation behaviors and specific mental disorders in youth. The study indicated that risk-mitigation had positive effect on project quality. Gondia et al. (2022) study on machine learning based decision support framework for construction injury severity prediction and risk mitigation, showed that risk-mitigation had positive and significant effect on project quality.

The study of Wang et al. (2022) on metabolism-based ventilation monitoring and control method for covid-19 risk mitigation in gymnasiums and alike places, affirms that risk-mitigation had positive impact on construction project quality. Stergiopoulos et al. (2022) study on automatic analysis of attack graphs for risk mitigation and prioritization on large-scale and complex networks in Industry 4.0, revealed that risk-mitigation had positive influence on project quality. The study of Dohale et al. (2021) on COVID-19 and supply chain risk mitigation: A case study from India, also corroborated that project risk-mitigation had positive effect on project quality. The study of Shahed et al. (2021) on supply chain disruption risk mitigation model to manage COVID-19 pandemic risk, indicated that risk-mitigation had positive effect on project quality. Zhang et al. (2022) carried a study on the review of seismic risk mitigation policies in earthquake-prone countries: lessons for earthquake resilience in the United States. The study revealed that risk-mitigation had positive effect on project quality.

Conversely, the study of Can Saglam et al. (2021) on proactive risk mitigation strategies and supply chain risk management performance: An empirical analysis for manufacturing firms in Turkey, showed that risk-mitigation had negative and insignificant impact on project quality. Majumdar et al. (2021) study on prioritizing risk mitigation strategies for environmentally sustainable clothing supply chains: Insights from selected organisational theories, also indicated that risk-mitigation had negative effect on project quality. The study of De Bruin et al. (2020) on initial impacts of global risk mitigation measures taken during the combatting of the COVID-19 pandemic also affirms that risk-mitigation had negative effect on project quality. Cox et al. (2020) study on a proposed process for risk mitigation during the COVID-19

pandemic, found out that risk-mitigation had insignificant impact on project quality. Muhs et al. (2020) study on wildfire risk mitigation: A paradigm shift in power systems planning and operation, revealed that risk-mitigation had negative effect on project quality and the study of Okpala et al. (2020) on utilizing emerging technologies for construction safety risk mitigation also indicated that risk-mitigation had negative effect on project quality.

Theoretical implications arise from the contribution of this study to the existing theories and models related to project risk management practices. By providing evidence of the link between project risk management practices and enhanced project quality, this study strengthens the theoretical foundations and understanding of how risk management contributes to project outcomes. This study findings are validated by contingency theory and the iron triangle theory which are essential in project risk management practices and have a direct impact on project performance. Contingency theory enables project managers to identify and assess project-specific risks, develop tailored risk response strategies, and maintain adaptability in the face of uncertainties. The iron triangle theory guides project managers in managing the interdependencies among scope, time, and cost, facilitating trade-off decisions and providing a framework for performance monitoring and control.

Integrating contingency theory and the iron triangle theory into risk management practices allows project managers to improve project performance by effectively managing risks, maintaining alignment with project objectives, and adapting to changing circumstances. These implications underscore the importance of project risk management practices in achieving project quality and emphasize the need to consider risk management as an integral part of project risk management practice. Consequently, based on the conceptual, empirical, and theoretical support for this study's findings, it can be concluded that project risk management practices significantly affect project quality in selected construction companies in Nigeria. As a result, the null hypothesis (H_{01}) stating that project risk management practices have no significant effect on project quality is rejected.

Conclusion and Recommendations

This study examined the dimensional effect of optimal project risk management practices on project quality of selected construction companies in Nigeria. It began by examining global trends and perspectives of project quality in the construction industry, with specific attention given to the Nigerian context. The study also addressed the major challenges faced by the construction industry and their historical implications. Empirical evidence was presented to support the significant influence of project risk management practices on project quality in Nigerian construction companies.

The study made conceptual contributions by developing a framework that advanced theories in production and operations management. It also filled a gap in the literature by being the first to apply this framework in investigating the topic. The empirical findings of the study supported existing theories, such as contingency theory and the iron triangle theory, thereby providing further validation for these theoretical perspectives. Moreover, the study's empirical contributions served as a valuable reference for future researchers in the field of production and operations management.

Based on the study's results, it is recommended that project managers establish and implement effective quality management systems, including clear processes and procedures for ensuring project quality. The development of comprehensive quality control plans that incorporate inspection, testing, and monitoring activities throughout the project lifecycle is also suggested. Integration of quality management standards and best practices, such as ISO 9001, is recommended to enhance quality assurance processes. Furthermore, future research should explore the adoption and utilization of technology, such as building information modeling (BIM), data analytics, and artificial intelligence, in project risk management practices within the Nigerian context. The benefits, challenges, and impact of these technological advancements on risk identification, analysis, and response planning should be thoroughly assessed. Such investigations can provide valuable insights into the potential of technology to improve project risk management practices.

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