Effect of Supply Chain Risk Management on Organizational Performance of Nigeria Liquefied Natural Gas Limited (NLNG)

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ABSTRACT

The performance of Nigeria Liquefied Natural Gas (NLNG) Company, a key player in Nigeria's economy, is vital for operational efficiency and financial stability in the global LNG market. Supply Chain Risk Management (SCRM), encompassing risk identification, risk assessment, risk mitigation strategies, and risk monitoring and control, is critical for mitigating disruptions and enhancing performance. This study examined the effect of SCRM on NLNG's performance, measured through operational performance (on-time delivery rate) and financial performance (cost efficiency/reduction and revenue stability). A cross-sectional survey design was adopted, collecting data from 207 management and senior staff across NLNG's supply chain operations using a structured questionnaire distributed via a census approach. Partial Least Squares Structural Equation Modeling (PLS-SEM) was employed for data analysis. Results indicated that risk identification ($\beta = 0.328$, $p = 0.003$), risk assessment ($\beta = 0.154$, $p = 0.013$), risk mitigation strategies ($\beta = 0.226$, $p = 0.005$), and risk monitoring and control ($\beta = 0.252$, $p = 0.034$) significantly and positively influence NLNG's performance, collectively explaining 76.1% of the variance in performance ($R^2 = 0.761$). These findings revealed that robust SCRM practices enhance NLNG's operational and financial outcomes, though challenges like infrastructure deficits and regulatory instability persist. Recommendations include adopting advanced risk detection technologies, integrating probabilistic risk assessment models, expanding mitigation strategies like dual sourcing, and implementing real-time risk monitoring systems to bolster performance.

Keywords: Risk Identification, Risk Assessment, Risk Mitigation Strategies, Risk Monitoring and Control, NLNG Performance.

INTRODUCTION

The contemporary global economic landscape is characterized by increasingly intricate and interconnected supply chains, especially within the high-stakes energy sector. This complexity, while driving efficiency and specialization, introduces substantial vulnerabilities that can severely impact organizational performance (Golobrodska, 2024; Thomas, 2023). Organizational performance, defined by Sukdeo (2017) as the efficiency and effectiveness in meeting goals and customer demands, is fundamentally tied to the stability of the supply chain. Globally, the oil and gas industry, particularly the Liquefied Natural Gas (LNG) segment, operates on an enormous scale, involving complex, multimodal logistics from gas field to liquefaction plant and then to global markets via specialized carriers. This end-to-end process is susceptible to a myriad of geopolitical, technological, and environmental risks (Arıcan and Ünal, 2025).

The global LNG market is characterized by a high concentration of both suppliers and consumers, creating a fragile equilibrium (IEF Report, 2025). Countries such as the United States, China, Japan, and Germany have pioneered sophisticated Supply Chain Risk Management (SCRM) practices due to their roles as leading global manufacturers, consumers, and distributors (Okoye et al., 2023; Jones, 2025). Their advanced strategies in

managing supply chain risks have significantly contributed to their economic resilience and performance across sectors (Um & Han, 2021). For instance, the U.S., as a major player in both energy production and consumption, integrates cutting-edge technologies like artificial intelligence (AI) and big data analytics in its SCRM practices to enhance the robustness of supply chains, particularly in energy and oil sectors (Jahin et al., 2023). Similarly, China, a manufacturing hub and leader in global trade, has developed highly integrated risk management systems that prioritize diversification, technological investment, and strategic stockpiling to mitigate the risks posed by geopolitical tensions, economic shifts, and natural disasters (Huet al., 2024; Arowosegbe et al., 2024).These nations' experience with SCRM offers valuable lessons for the Nigerian context, specifically for Nigeria Liquefied Natural Gas (NLNG), one of Africa's largest and most significant exporters of Liquefied Natural Gas. NLNG's performance, which is integral to Nigeria's GDP and its role in the global energy market, faces threats from both local and global risks

(Udomeh et al., 2025). The sophistication of risk management in the global economies of the U.S., China, and others serves as a benchmark for the way NLNG can refine its supply chain resilience through proactive measures (Vaiyaicheri& Srinivasan, 2024).

The success of countries with advanced SCRM practices has demonstrated that effective identification, assessment, and mitigation of risks directly correlate with enhanced operational performance and financial stability (Alkhatib & Momani, 2023). For NLNG, which operates in a highly volatile environment marked by local challenges such as pipeline vandalism, regulatory uncertainty, and security threats, the application of these global SCRM principles is crucial. By aligning its practices with internationally recognized standards, NLNG can bolster its operational efficiency and ensure consistent on-time delivery rates, cost-effectiveness, and revenue stabilityfactors that are vital to its competitiveness in the global LNG market (Munir et al., 2020; Arıcan & Ünal, 2025).Countries with robust SCRM frameworks also focus on continuous improvement through technology adoption, proactive threat analysis, and partnerships with other global players to ensure a resilient supply chain. For instance, Japan's focus on risk mitigation strategies, such as redundancy in logistics and enhancing real-time monitoring systems, could offer NLNG valuable insights into protecting its supply chain against disruptions (Maharjan& Kato, 2023). These practices emphasized the importance of not only reacting to disruptions but also preparing for unforeseen risks, which is a critical strategy for NLNG's sustained performance amidst the geopolitical and logistical challenges it faces.

In Africa, where supply chains face unique structural and socio-political hurdles. Infrastructure deficits, institutional instability, high levels of corruption, and security challenges often escalate the probability and impact of risks (Asikhia et al., 2022). In the African energy sector, the complexity of managing risks associated with upstream exploration, pipeline security, and international shipping requires highly sophisticated SCRM practices (Hatami-Marbini et al., 2024). Studies in the region, such as those by Kiarie et al. (2017) in Kenya, underscored the significant positive influence of proactive Risk Identification strategies on supply chain performance in manufacturing, a principle directly applicable to large-scale operations like LNG.

In Nigeria, the Nigeria Liquefied Natural Gas (NLNG) Company is a major global player, contributing significantly to Nigeria's GDP and global energy supply. Its performance is central to the nation's economy. The Performance of NLNG Company LNG, defined in this study by the attainment of high On-Time Delivery Rate, stable Cost Efficiency/Reduction, and consistent Revenue Stability, is under constant threat from context-specific risks. These threats include disruptions in feed gas supply due to pipeline vandalism, port congestion, security risks in the Niger Delta, and regulatory instability, all of which necessitate rigorous Supply Chain Risk Management (Aliu Ogbaini, 2025).

A proactive approach, Supply Chain Risk Management (SCRM), is universally recognized as critical for mitigating these threats. SCRM, according to Obi &Fadun (2025), is the systematic process of identifying, assessing, mitigating, monitoring, and controlling risks to enhance organizational performance and resilience. At its core, the systematic Risk Identification process (Fozia, 2022), which proactively pinpoints threats like geopolitical instability or technical failures, directly contributes to maintaining high On-Time Delivery Rates by

allowing for early intervention. This identification must be followed by robust Risk Assessment (Kaka et al., 2024), where the probability and impact of these identified risks are quantified. Global energy firms use this assessment to prioritize vulnerabilities, such as potential LNG cargo delays, ensuring resources are optimally allocated to protect Cost Efficiency/Reduction and prevent financial losses (Song et al., 2025). Furthermore, tailored Risk Mitigation Strategies (Arndt, 2025)like redundancy in shipping routes or contractual risk transfer are deployed globally to actively reduce both the probability and negative consequences of identified risks, which is vital for securing consistent revenue and bolstering Revenue Stability (Can Saglam et al., 2021). The final, continuous loop of Risk Monitoring and Control (Hodgson, 2025) ensures that all strategies remain effective against constantly evolving threats, directly enabling sustained operational flow and reliable delivery, thus linking SCRM to performance (Shad and Lai, 2019). The global evidence consistently shows that a mature SCRM system leads to superior financial and operational outcomes, forming a competitive advantage (Munir et al., 2020).

The four dimensions of SCRM (risk identification, risk assessment, risk mitigation strategies, and risk monitoring and control) are critical for NLNG's sustained success. By effectively implementing Risk Identification, NLNG can preemptively address threats like equipment failure or shipping hazards, thereby maintaining the On-Time Delivery Rate (Peter et al., 2018). Furthermore, detailed Risk Assessment of high-impact, high-probability risks, such as geopolitical shocks, provides the foundation for cost-effective interventions, directly safeguarding Cost Efficiency/Reduction (Obi and Fadun, 2025). The deployment of effective Risk Mitigation Strategies, like robust security protocols and supplier diversification, is essential for reducing exposure to disruptions that threaten Revenue Stability (Olawore et al., 2023). Continuous Risk Monitoring and Control allows NLNG to adapt to the volatile local and global market, ensuring that its operational and financial performance remains resilient against any emerging threat (Asikhia et al., 2022). The study aims to empirically validate how these specific SCRM practices collectively and individually affect the operational and financial performance of NLNG.

Despite NLNG's global significance and established operations, the company operates within an extremely volatile environment, characterized by feedstock supply disruptions due to pipeline vandalism and community conflicts, logistical bottlenecks at ports, and exposure to volatile global market pricing and stringent international regulatory changes. Anecdotal and general industry evidence suggests that these persistent threats translate into tangible performance issues. For instance, disruptions directly lead to missed delivery windows, lowering the on-time delivery rate and risking contractual penalties. Furthermore, unmitigated risks necessitate costly emergency measures, eroding Cost Efficiency, while market volatility and production shortfalls destabilize cash flow, impacting Revenue Stability. The core problem, therefore, is the lack of empirical, context-specific evidence detailing the precise effect of supply chain risk management (SCRM), broken down into its fundamental components (risk identification, risk assessment, risk mitigation strategies, and risk monitoring and control), on the specific operational and financial Performance of NLNG Company LNG. Existing studies in Nigeria often focus on the broader oil and gas marketing or downstream sector (Asikhia et al., 2022; Aliu Ogbaini, 2025), lack the specificity of the complex LNG upstream and midstream supply chain, or rely on general global models. This gap in knowledge leaves NLNG managers without a validated, datadriven framework to confirm which specific SCRM dimensions are most effective in buffering their unique operation against local and international risks to demonstrably enhance their on-time delivery rate, cost efficiency/reduction, and revenue stability.This research is necessary to fill this empirical void by providing a quantitative, evidence-based assessment that will inform strategic decision-making, justify investments in targeted SCRM strategies, and ultimately secure the operational resilience and financial stability of one of Nigeria’s most critical economic assets.The main objective of this research is to empirically assess the effect of Supply Chain Risk Management (SCRM) on the performance of Nigeria Liquefied Natural Gas (NLNG) Company. The specific objectives are to:

i. Examine the effect of risk identification on the performance of NLNG Company.

ii. Assess the effect of risk assessment on the performance of NLNG Company.

iii. Evaluate the effect of risk mitigation strategies on the performance of NLNG Company.

iv. Investigate the effect of risk monitoring and control on the performance of NLNG Company.

To guide the research, the following null hypotheses are proposed:

H_{01}: Risk Identification (RISI) has no significant effect on the Performance of NLNG Company

H_{02}: Risk Assessment has no significant effect on the Performance of NLNG Company

H_{03}: Risk Mitigation Strategies have no significant effect on the Performance of NLNG Company

H_{04}: Risk Monitoring and Control has no significant effect on the Performance of NLNG Company

LITERATURE REVIEW

Conceptual Review

Performance Of Nigeria Liquefied Natural Gas (NLNG) Company

The Performance of Nigeria Liquefied Natural Gas (NLNG) Company LNG reflects the effectiveness of the entire supply chain in generating value, maintaining production, and meeting global delivery commitments reliably. Sukdeo (2017) described organizational performance as the efficiency and effectiveness of the supply chain in delivering high-quality products, meeting customer demands, and achieving financial and operational goals. Olawore et al. (2023) state that NLNG's performance refers to the operational and financial outcomes of its LNG supply chain, measured by efficiency, cost savings, delivery reliability, and market competitiveness. Shad and Lai (2019) narrow the focus to firm performance, measured as Return on Assets (ROA), reflecting profitability relative to total assets, which is essential for assessing NLNG's operational efficiency.

Furthermore, Hatami-Marbini et al. (2024) highlighted that NLNG's performance reflects its resilience, measured by business continuity, environmental impact, and stakeholder satisfaction against supply chain disruptions. Ugoani (2020) described performance as the extent to which employees fulfill rolespecific tasks, which is indirectly tied to the efficiency of daily operations. Conversely, Richard et al. (2016) provided a broader classification, categorizing performance into financial metrics (e.g., return on investment), product market outcomes (e.g., market share), and shareholder value.The performance of NLNG is defined as the successful achievement of its business objectives through the reliable and cost-effective management of its end-to-end LNG supply chain, from feed gas acquisition to global delivery. Hatami-Marbini et al. (2024) demonstrated the importance of mitigating risks like theft and logistics failures to enhance NLNG's output.

In this study, the performance of Nigeria Liquefied Natural Gas (NLNG) Company LNG is measured through both Operational Performance and Financial/Business Performance Metrics. Operational performance is primarily captured by the On-Time Delivery Rate (or Shipment Reliability), which is assessed as the percentage of scheduled LNG cargoes delivered within the agreed time window. This metric directly reflects the effectiveness of Supply Chain Risk Management (SCRM) in mitigating risks like shipping delays, port disruptions, and feed gas supply issues. A high delivery rate indicates stable logistics and strong risk control, which is essential for consistent operational efficiency (Faizal and Palaniappan, 2014; Munir et al., 2020). Financial performance is evaluated using Cost Efficiency/Reduction and Revenue/Profitability Stability. Cost efficiency is assessed by comparing actual supply chain costs (procurement, logistics, inventory holding) against budgeted costs. This measure highlights how risk mitigation measures, such as dual sourcing or hedging, prevent expensive disruptions and unnecessary operational expenditures (Nyamah et al., 2023; Kaka et al., 2024).

Additionally, revenue stability is measured by examining the consistency of LNG sales over time, which is directly influenced by robust risk control strategies that safeguard against market volatility, thereby ensuring overall financial stability (Obi and Fadun, 2025; Ajani, 2021). This study defined Performance of Nigeria Liquefied Natural Gas (NLNG) Company LNG as the outcome of efficient and effective management of the LNG supply chain, measured specifically by the attainment of operational goalslike high shipment reliability and continuous productionand the stability of core financial outcomes, including cost efficiency and revenue generation.

Supply Chain Risk Management (SCRM)

Supply Chain Risk Management (SCRM) encompasses the methodical steps to identify, assess, and address uncertainties across the value chain, crucial for sustained performance in energy companies like NLNG.Obi &Fadun (2025) defined SCRM as systematic processes of identifying, assessing, mitigating, monitoring, and controlling risks across supply chains to enhance organizational performance. Similarly, Andeobu et al. (2015) described SCRM as involving the planning, identification, assessment, mitigation, and monitoring of uncertainties in supply chains that could disrupt operations. Aliu Ogbaini (2025) states that it encompasses systematic processes for identifying, assessing, mitigating, monitoring, and controlling risks to ensure supply chain resilience and performance. McGrath & Jonker (2025) defined SCRM as the process of finding and addressing potential supply chain vulnerabilities to minimize their negative impact on a company's operations. For Marotta (2025), it refers to the strategic process of identifying, assessing, mitigating, and monitoring risks across end-to-end operations to ensure continuity and performance. Golobrodska (2024) defined it as a systematic process for identifying, assessing, mitigating, and monitoring potential disruptions in the flow of goods, services, and information across a supply chain.Thomas (2023) refers to SCRM as the systematic process of identifying, assessing, mitigating, and monitoring potential disruptions in the supply chain, encompassing direct and indirect suppliers.

Supply Chain Risk Management (SCRM) is not merely a reactive measure but involves planning and a structured cycle to maintain operational stability and performance (Pham et al., 2023). The concept is defined by a sequence of actions: identifying all potential weaknesses, assessing their probability and potential impact on operations, mitigating these vulnerabilities through strategies like diversification or contingency planning, and finally, monitoring and controlling risks on an ongoing basis. This structured approach, as emphasized by Djalilvand (2023), ensures continuity by managing risks from upstream sourcing to downstream delivery, particularly in complex sectors like LNG. This study defined Supply Chain Risk Management (SCRM) as the systematic process of identifying, assessing, mitigating, and monitoring uncertainties in the NLNG value chainfrom feedstock to deliveryto ensure operational resilience, enhance organizational performance, and minimize the impact of potential disruptions. In this study, Supply Chain Risk Management (SCRM) is measured through four distinct, sequential dimensions: risk identification, risk assessment, risk mitigation strategies, and risk monitoring and control. These dimensions are explained below:

Risk Identification

Risk identification is the foundational step in supply chain risk management, concentrating on proactively pinpointing potential threats that could disrupt NLNG's complex operations, from gas sourcing to LNG delivery.Risk identification is defined by numerous authors such as Fozia (2022) who defined it as the systematic process of recognizing potential threats that could disrupt supply chain operations, involving documentation in risk registers. Chebulobi et al. (2019) described it as the systematic process of recognizing potential disruptions like late delivery and stock-outs in operations to enhance performance. Roller (2025) stated it is an element of risk management involving the process of searching for and documenting potential threats that may affect the organization. Similarly, Wawire et al. (2022) described it as the systematic process of recognizing potential events that could disrupt supply chain operations, including supplier failures or forecasting errors.

According to Song et al. (2025), it proactively detects uncertainties like environmental hazards, enabling early mitigation for sustainable outcomes. Faizal and Palaniappan (2014) explain that it involves creating a list of potential events that could harm any aspect of the supply chain's performance. Peter et al. (2018) defined it as a process in energy supply chains that boosts timeliness by preventing incidents through the use of hazard registers. Risk identification is consistently described as the initial, systematic, and proactive search for potential vulnerabilities and threats that could negatively impact the supply chain. The process goes beyond mere acknowledgment; it involves recognizing, documenting, and prioritizing these uncertainties in an organized manner, often in risk registers, as noted by Fozia (2022). Its core purpose is to enable early detection and anticipation of problems, such as supplier failure in gas procurement (Hosseini et al., 2019) or transportation hazards (Andeobu et al., 2015), before they escalate into major disruptions.

By actively pinpointing internal and external factors ranging from financial and technical issues to geological hazards (Alnoaimi & Mazzuchi, 2021) organizations like NLNG can develop informed strategies, ensuring resilience and stable operations, as Wawire et al. (2022) showed that poor identification leads to significant losses. This study defined Risk Identification as the systematic, proactive process of employing techniques like expert brainstorming, literature review, and hazard registers to thoroughly recognize and document all potential internal and external events that could disrupt NLNG's feedstock, liquefaction, or shipping operations, thereby enabling timely assessment and mitigation.

Risk Assessment

Risk assessment is the logical next step after identifying potential supply chain threats, systematically evaluating the nature, magnitude, and potential impact of risks on NLNG's ability to achieve its performance objectives. According to Kaka et al. (2024) risk assessment is a systematic process to identify, analyze, and evaluate potential hazards and their consequences in operations, utilizing various approaches like quantitative and qualitative methods. Tran et al. (2018) defined it as all activities to qualitatively or quantitatively judge, analyze, calculate, quantify, measure, evaluate, and model identified risks to provide a sound basis for mitigation decisions. Yasar and Gillis (2025) defined it as the systematic process of identifying potential hazards that could negatively impact an organization's capacity to achieve its objectives. Zhu and Wu (2022) viewed it as evaluating the capacity of supply chains to mitigate shock consequences. Song et al. (2025) described it as evaluating the likelihood and impact of identified risks, improving economic performance by optimizing resource allocation.

Blending these views, risk assessment is clearly described as a systematic evaluation of the risks that were previously identified. The process is defined by three main integrated steps: analysis, quantification, and evaluation. As noted by Kaka et al. (2024) and Tran et al. (2018), this involves judging the likelihood of a risk occurring and the potential severity or impact of its consequences, which can be done through qualitative descriptive judgments or quantitative numerical simulations. For NLNG, this means assessing the probability of a feedstock shortage and quantifying its impact on revenue and production. Kilic et al. (2023) and Animah and Shafiee (2020) emphasized that the systematic analysis provides the necessary data to prioritize vulnerabilities, allowing the company to allocate resources effectively to the threats with the highest potential loss, like geopolitical or weather risks. The ultimate goal of the process is to provide a sound, data-driven foundation for selecting and implementing the most appropriate risk mitigation strategies (Beckley, 2025). This study defined Risk Assessment as the systematic process of analyzing and quantifying the probability and severity of identified supply chain risks using qualitative and quantitative metrics, enabling NLNG to prioritize vulnerabilities such as feedstock volatility or shipping delaysto optimize resource allocation and provide a sound basis for targeted mitigation strategies.

Risk Mitigation Strategies

Risk mitigation strategies involve developing and implementing actionable plans to reduce the probability and negative impact of identified supply chain threats on NLNG's operations.According to Arndt (2025), risk mitigation is defined as the systematic process of identifying, assessing, and controlling potential risks to

minimize their impact on business operations and objectives, involving proactive strategies like reduction, transfer, avoidance, and acceptance. Can Saglam et al. (2021) defined these as proactive measures to identify, assess, and counteract disruptions in supply networks, enhancing overall chain robustness against uncertainties. Ali et al. (2023) found that vulnerability mitigation strategies (VMSs) significantly minimized supply chain risk, which, in turn, subsequently enhanced firm performance. For Afifa and Santoso (2022), mitigation is the proactive framework via 3R strategies (ready, respond, recover) that significantly boosts performance. Karim (2025) emphasizes that mitigation strategies must integrate supplier diversification, predictive analytics, and cross functional collaboration to ensure operational continuity. Khalilzadeh et al. (2025) define them as practical measures, such as installing specialized safety systems, to reduce oil leakage risks in production facilities.

Blending these explanations, risk mitigation strategies are consistently described as the proactive implementation phase of SCRM, focused on implementing countermeasures to the risks already identified and assessed. The core objective, as Arndt (2025) emphasizes, is to control potential risks to minimize their severity and likelihood, ensuring business continuity. Strategies are broadly categorized into four types: avoidance (eliminating the risky activity), reduction (decreasing the risk's probability or impact, often via redundancy or backups), transfer (shifting the risk, typically through insurance or contracts), and acceptance (managing the retained risk). For NLNG, Faizal and Palaniappan (2014) provide an example of reduction through redundant gas suppliers to prevent bottlenecks, while Olawore et al. (2023) suggest nearshoring to reduce dependency risks. Asikhia et al. (2022) underscore that these strategies, like contingency planning and diversified sourcing, enhance operational performance in Nigeria's volatile oil sector by reducing downtime and delays. Hatami-Marbini et al. (2024) further explain that collaboration and domestic refining address shortfalls in high-risk areas like criminality, underscoring the necessity of tailored, context-specific solutions. This study defined Risk Mitigation Strategies as the set of deliberate, proactive actions including risk reduction, avoidance, transfer, and acceptance implemented by NLNG to decrease the probability and negative consequences of supply chain threats, thereby enhancing operational performance and resilience.

Risk Monitoring and Control

Risk monitoring and control is the continuous oversight process that tracks identified threats, ensures mitigation measures are effective, and responds to emerging risks to safeguard NLNG's stable performance. According to Hodgson (2025), risk monitoring and control refers to the continuous process of identifying risks at project start and tracking them throughout, while implementing optimal mitigation methods. Bigelow (2025) defined risk monitoring as the ongoing process of identifying, understanding, assessing, monitoring, managing, and mitigating risks that could adversely affect an organization's operations, value, assets, and reputation. Furthermore, Obondi (2021) described it as involving tracking identified risks, identifying new risks, implementing risk response plans, and evaluating risk management effectiveness throughout a project's lifecycle. Zhong and Jia (2025) defined this concept as the continuous tracking and management of supply chain risks using tools like control charts to detect deviations and enable timely interventions. Alsmairat and Al-Shboul (2023) viewed risk monitoring as ongoing control to maintain supply chain efficacy post-disruption. Khalilzadeh et al. (2025) defined it as using real-time data and models, such as BIM, to enable predictive maintenance and improve operational safety.

Risk monitoring and control is not a one-time activity but an ongoing loop that spans the operational life of the supply chain. This process is defined by two key actions: monitoring (tracking, observing, and identifying new or evolving risks) and control (implementing or adjusting the mitigation plans). As emphasized by Obondi (2021) and Bigelow (2025), this ensures risk response plans are implemented effectively, new threats are quickly incorporated, and existing risks remain within acceptable limits. For NLNG, Nyamah et al. (2023) stress that effective monitoring prevents performance degradation by enabling real-time adjustments, such as controlling supplier defaults. Authors like Zhong and Jia (2025) and Karim (2025) point to the use of advanced tools, such as control charts and predictive analytics, which enhance visibility and enable timely interventions. This continuous oversight, confirmed by Yanginlar et al. (2023) to positively impact logistics performance, directly supports NLNG's sustained output and on-time delivery. This study defined risk monitoring and control as the

continuous process of tracking identified and emerging supply chain risks and evaluating the effectiveness of mitigation strategies through tools like real-time data and audits, enabling NLNG to make timely corrective adjustments and maintain stable operational performance.

Empirical Review

Risk Identification and Performance

Ankhi (2017) analyzed supply chain risk management of liquefied natural gas (lng) in australia. The study developed and applied a comprehensive scr method to identify, assess, prioritize supply chain risks (scrs) such as high labor costs, remoteness of projects, and geopolitical issues, and risk mitigation strategies (rmss) including resource allocation and optimization techniques for the australianlng industry. It employed a mixed-methods approach with qualitative literature review for scr and rms identification, validated by anlng expert, and quantitative survey of six global lng experts using a structured questionnaire to assess risk probability and impact via the formula risk = probability × impact, quality function deployment (qfd) for rms prioritization, optimization modeling for cost scenarios, and simulation for generalization. Data analysis introduced novel concepts like risk flexibility index (rfi) and strategy effectiveness, yielding 33 prioritized scrs and 30 rms, optimal rms sets for various budgets, and a decision tool for risk mitigation levels. Findings revealed practical rms for resource-constrained managers and enriched scr theory with a generalizable method. The study recommended its adoption by australianlng risk managers. A key strength was its comprehensive, endto-end scr method bridging identification to simulation. However, the small expert sample size limited generalizability, and reliance on subjective expert judgments introduced potential bias.

Kiarie et al. (2017) analyzed the relationship between risk identification management strategy and supply chain performance among manufacturing companies in Kenya. The study aimed to determine how risk identification strategies impacted the performance of supply chains. It adopted a crosssectional survey methodology, targeting 412 manufacturing companies in Nairobi County that were members of the Kenya Association of Manufacturers (KAM). Using the Fisher et al. formula, a sample size of 199 companies was selected. Data was collected through questionnaires and analyzed using SPSS version 21. The results indicated that risk identification strategies significantly influenced supply chain performance, with a p-value of 0.000, suggesting a strong relationship. The study recommended that manufacturing companies implement comprehensive risk analysis and evaluation management strategies, including whole life costing of suppliers and assessing the internal quality of suppliers, to improve their supply chain performance. The strength of this study lies in its robust statistical analysis and clear policy recommendations. However, its limitation is that it focused only on companies in Nairobi, which may not fully represent the entire manufacturing sector in Kenya.

Wawire et al. (2022) examined risk management practices and supply chain performance in county governments of western Kenya focusing on risk identification. The study determined the influence of risk identification (pre-screening of suppliers, periodic procurement audit, inventory forecasting) on supply chain performance (stock replenishment). It adopted a descriptive research design targeting 150 procurement, logistics, audit, finance, and quality assurance employees from four counties, using census sampling of all 150. Primary data were collected via closed-ended questionnaires and secondary data from auditor general reports; analysis employed Pearson correlation and linear regression. Findings revealed a significant positive correlation ($r=0.640$, $p=0.028$) and regression coefficient ($\beta=0.191$, $p=0.010$), indicating a unit increase in risk identification enhances supply chain performance by 0.191 units. It recommended thorough supplier screening and inventory forecasting to boost stock turnover. The study's strength lies in its comprehensive primary-secondary data integration and robust statistical validation confirming risk identification's impact. However, it narrowly focused on one risk practice, limiting generalizability to multifaceted supply chain risk management in LNG contexts like NLNG.

Risk Assessment and Performance

Arıcan and Ünal (2025) conducted a comprehensive risk assessment in LPG and LNG operation processes in maritime transport using a Delphi and fault tree analysis approach. The study examined objectives to identify and mitigate explosion risks in loading, unloading, and storage processes through variables including risk identification (human faults, machinery faults, natural events), risk assessment (probability calculations), risk mitigation strategies (training, monitoring technologies), and risk monitoring/control (maintenance protocols). Methodology integrated two-round Delphi surveys with eight experts (population: LPG/LNG shipping professionals with ≥10 years experience; sample size: 8) for qualitative consensus and fault tree analysis (FTA) for quantitative failure pathways, using data collection via structured questionnaires (October-December 2024) and analysis through mean, standard deviation, interquartile range, and Monte Carlo simulations. Findings revealed human faults (probability 0.917) as the primary risk contributor, followed by natural events (0.853) and machinery faults (0.829), with sub-factors like inadequate maintenance (highest impact) and overwork leading to explosions. Recommendations included enhanced training programs, advanced sensor technologies, regular audits, and safety culture reinforcement. The study's strength lies in its robust hybrid methodology integrating expert consensus with probabilistic modeling for practical maritime applicability. However, it is critiqued for focusing solely on explosion risks, limited sample size, and short-term data (2024), overlooking longitudinal technological evolutions and broader hazards like leaks.

Animah and Shafiee (2020) conducted a systematic review of risk analysis applications in the liquefied natural gas (LNG) sector. The study examined risk assessment methods, tools, data sources, and applications across LNG carriers, terminals, offshore units, and plants, with variables including qualitative/quantitative methods, event tree analysis (ETA), fault tree analysis (FTA), failure mode and effects analysis (FMEA), Bayesian networks, risk-based inspection (RBI), and data from OREDA handbook and UK HSE databases. Using a content analysis methodology, the population comprised peer-reviewed articles and conference papers from 2000 to 2019, with a sample size of 66 publications sourced from databases like ScienceDirect and Web of Science via keyword searches; data collection involved systematic screening and classification, analyzed through descriptive categorization and bar chart visualization. Findings revealed growing literature since 2009, dominance of quantitative probabilistic tools like FTA for hazard identification and consequence modeling in LNG terminals and carriers, and recommendations for dynamic approaches, integrated data sources, and tailored models for regulators and operators. The study's strength lies in its comprehensive classification framework enhancing stakeholder understanding. However, it critiques the lack of focus on supply chain-specific risks and empirical performance linkages in LNG operations.

James and Renjith (2021) explored the risk assessment and vulnerability analysis of liquefied natural gas (LNG) regasification terminal to analyze failures that could result in LNG release into the environment. The study focused on risk identification, risk assessment, and mitigation strategies. A fuzzy risk matrix and layer of protection analysis (LOPA) method were employed to assess the safety integrity level (SIL) for seven identified scenarios, using tools such as PHAST 8.11 and ALOHA for consequence analysis. The study found that fuzzy LOPA provided more accurate results in determining SIL values compared to other methods. The key findings also emphasized the importance of effective risk identification in maintaining operational safety in LNG terminals, particularly under natural and man-made disruptions. This work offers valuable insights into managing LNG-related risks but lacks in-depth consideration of ongoing LNG production operations, a potential gap for future research. The strength of this study lies in its use of advanced risk analysis methods tailored to LNG terminals. However, a limitation is the narrow scope of its focus on only regasification terminals and not the broader LNG supply chain processes.

Onoh et al. (2025) examined risk assessment and the performance of manufacturing companies in north-central nigeria. The study determined the effect of risk assessment on non-financial performance, using risk assessment (identification of risks, assessment of severity, prioritization of risks, implementation of risk responses) as independent variables and growth as the dependent variable proxy. Survey methodology was adopted with a population of employees from eight manufacturing companies, a sample size of 336, primary data collected via

questionnaire, and analyzed using correlation, ANOVA, and simple linear regression. Findings revealed a positive and significant effect (β=0.924, p=0.000, R^2=0.682), explaining 68.2% variation in performance. The study recommended intensifying efforts in risk identification, assessment, prioritization, and response implementation. A strength was the use of COSO 2017 framework for robust proxy measurement. However, the study critiqued the lack of population specification and unclear sampling method.

Risk Mitigation Strategies and Performance

Aliu Ogbaini (2025) examined supply chain management strategies on oil and gas companies' performance in Nigeria. The study assessed technology integration, third-party logistics, and risk management strategies as independent variables impacting supply chain performance, operational efficiency, and company performance as dependent variables. Employing a mixed-methods design, it targeted 100 respondents from upstream, midstream, and downstream sectors using stratified random and purposive sampling, with data collected via questionnaires and interviews and analyzed through descriptive statistics and chi-square tests. Findings revealed technology optimizes decision-making (37%), 3PL streamlines supply chains (40%), and risk management is highly effective (54%) in mitigating disruptions, rejecting null hypotheses (p=0.000). It recommended adopting AI, blockchain, IoT, ERP, and robust business continuity plans. The study's strength lies in its contextual Nigerian focus and empirical validation via hypothesis testing. However, overreliance on a small sample limits generalizability, and self-reported data risks bias.

Ngii (2017) examined effects of supply chain risk management on organization performance at Accelar Global Logistics. The study assessed supply chain risk identification, risk sources, and risk mitigation strategies as independent variables and organization performance as the dependent variable. It employed a descriptive quantitative design targeting 50 management staff, using stratified sampling for a census of 50 and questionnaires for primary data collection, analyzed via SPSS with descriptive statistics, correlations, and regression. Findings revealed strong positive effects of risk identification (87% agreement on formal processes) and mitigation on performance, with risks from internal/external sources disrupting profitability. It recommended proactive risk registers and contingency plans. The study's strength lay in its empirical focus on a logistics firm, offering practical frameworks. However, its small sample and single-case limitation reduced generalizability, overlooking financial metrics and broader Kenyan contexts.

Afifa and Santoso (2022) conducted a mini review on proactive risk mitigation strategies and building strategic resilience in the food supply chain. The study explored strategies for proactive risk mitigation in general supply chains, resilience strategies in food supply chains, and their interrelationships. Variables included proactive risk mitigation (management/retailer development, supply chain contracts, product/process management, supplier relations), supply chain resilience (re-engineering, collaboration, agility, risk awareness), and performance proxies (efficiency, responsiveness, flexibility, product quality). A literature review methodology was employed, drawing from 50+ peer-reviewed articles published between 2002 and 2020, with no empirical population or sample size as it was secondary data synthesis; data collection involved systematic database searches (e.g., Scopus, Google Scholar), and analysis used thematic synthesis and framework development. Findings revealed proactive strategies enhance resilience via 3R aspects (ready, respond, recover), with collaboration and agility significantly improving performance; recommendations included integrating risk awareness training and re-engineering for future disruptions. Strengths encompassed comprehensive theoretical integration and practical frameworks. However, the review critiqued overreliance on secondary data, limited empirical validation, and food-specific focus neglecting energy sectors like LNG.

Risk Monitoring & Control and Performance

Asikhia et al. (2022) analyzed the impact of supply chain risk management on business performance in selected oil and gas marketing companies in Lagos State, Nigeria, with a focus on the moderating role of firm size. The study examined the effect of risk management strategies, such as risk identification, assessment, mitigation, and control, on business performance, which included financial performance, operational efficiency, and customer

satisfaction. A survey research design was used, with a population of 1,044 full-time employees from five selected oil and gas marketing companies in the downstream sector. The sample size consisted of 362 employees, and data were collected using a validated questionnaire. The analysis was conducted using descriptive and hierarchical multiple regression techniques. The findings indicated that supply chain risk management strategies significantly impacted the business performance of the oil and gas companies, with firm size playing a significant moderating role. The study recommended that oil and gas marketing companies adopt strategic agility measures to understand the evolving market dynamics and build a resilient framework to enhance performance. A strength of this study lies in its consideration of firm size as a moderating factor, which provides a deeper understanding of the variables at play. However, a limitation is the use of only a single industry and location, which may affect the generalizability of the findings.

Munir et al. (2020) examined supply chain risk management and operational performance: the enabling role of supply chain integration. The study aimed to explore the association between supply chain integration (SCI; internal, supplier, and customer dimensions) and supply chain risk management (SCRM; including risk identification, assessment, mitigation, and monitoring) as antecedents to operational performance (measured via cost, quality, delivery, flexibility, and productivity proxies). Using covariance-based structural equation modeling, data were collected via survey from a population of global manufacturing firms in the sixth International Manufacturing Strategy Survey (IMSS VI), yielding a sample size of 931 companies across multiple countries. Primary data collection involved self-reported questionnaires, analyzed through confirmatory factor analysis and mediation testing in AMOS software. Findings revealed that SCI positively influenced SCRM, with SCRM partially mediating internal integration's effect on performance and fully mediating supplier/customer integration's effects, enhancing overall operational outcomes. The study recommended fostering intra- and inter-firm collaboration for risk information sharing to bolster resilience. A key strength lies in its large-scale, cross-national empirical validation, providing robust generalizability. However, reliance on single-respondent perceptual data risks common method bias, and the manufacturing focus limits applicability to service-oriented sectors like energy.

Saptarini and Nainggolan (2022) assessed risk management in oil and gas field development projects with marginal resources: a case in mature field in East Kalimantan. The study examined objectives to identify, analyze, evaluate, and mitigate risks in the Field Development Package (FDP) 2.3 infill drilling project for PT MNO, listing variables including risk identification (business, technical, management, commercial, external, HSSE risks), risk assessment (likelihood and impact via AHP), risk mitigation strategies (avoid, mitigate, transfer), and risk monitoring/control (project monitoring and HSSE dashboard). Methodology involved literature review, fault tree analysis, brainstorming, questionnaire surveys, and focus group discussions. The population comprised 30 experts (risk owners, petroleum architects, economists) from PT MNO; sample size was 25 respondents. Data collection used primary questionnaires and secondary historical data (oil prices, drilling/facility costs). Data analysis employed Analytical Hierarchy Process (AHP), Pareto analysis, and risk priority number calculation. Findings revealed top risks as oil price below assumption, production target not achieved, and no firm gas contract, with recommendations for production adjustment, portfolio diversification, and continuous HSSE socialization. The study's strength lies in its practical application of ISO 31000 to a real mature field case, enhancing project value. However, it critiqued qualitative risk treatment lacking quantitative cost evaluation and incremental assessment ignoring baseline facility risks.

THEORETICAL FRAMEWORK

The underpinning theory of this study is the Dynamic Capabilities Theory, developed by Teece et al. (1997), is advocated as the most suitable framework to explain the relationship between Supply Chain Risk Management (SCRM) and the performance of Nigeria Liquefied Natural Gas (NLNG) Company. This theory posits that firms achieve competitive advantage by developing dynamic capabilities, abilities to integrate, build, and reconfigure internal and external competences to address rapidly changing environments (Teece et al., 1997). It emphasizes three core processes: sensing (identifying opportunities and threats), seizing (mobilizing resources to address them), and transforming (continuous renewal of capabilities). In the context of NLNG, dynamic capabilities

align with SCRM processes (risk identification, assessment, mitigation, and monitoring) enabling the firm to navigate uncertainties like feedstock volatility, geopolitical disruptions, and logistics failures, thereby enhancing operational and financial performance (Obi &Fadun, 2025).

The theory's strength lies in its focus on adaptability and resilience, critical for NLNG's volatile operating environment. Scholars like Munir et al. (2020) suggest that dynamic capabilities facilitate supply chain integration, enhancing shipment reliability and cost efficiency, key NLNG performance metrics. Hatami-Marbini et al. (2024) underscore its applicability in mitigating Nigerian oil supply chain risks, such as criminality, through adaptive strategies like stakeholder collaboration.

However, the theory is critiqued for its abstract nature and difficulty in operationalizing constructs (Barreto, 2010). Critics like Eisenhardt and Martin (2000) caution that it may lack specificity for industry contexts, potentially limiting its predictive power for LNG-specific risks.For NLNG, dynamic capabilities explain how proactive risk identification (sensing) and assessment (seizing) enable mitigation strategies (transforming), such as dual sourcing, to ensure delivery reliability and revenue stability (Nyamah et al., 2023). Continuous monitoring aligns with transforming, maintaining resilience against disruptions (Khalilzadeh et al., 2025). This theory robustly links SCRM to NLNG's performance by emphasizing adaptive capacity in a high-risk sector.

METHODOLOGY

This study adopted a cross-sectional survey design to investigate the effect of Supply Chain Risk Management (SCRM) on the Performance of Nigeria Liquefied Natural Gas (NLNG) Company LNG. A cross-sectional survey design was appropriate because it enabled the collection of standardized data from a comprehensive sample of managers at a single point in time, thereby allowing the researcher to efficiently examine the hypothesized relationships between the SCRM dimensions and organizational performance metrics specific to the LNG sector. The design was also cost-effective and suitable for examining organizational constructs across functional departments within the complex NLNG supply chain.

The study population comprised 242 management and senior staff directly involved in the core operational and supply chain activities of the NLNG facility on Bonny Island, Rivers State, Nigeria. To ensure data richness and knowledge alignment, a census approach was employed, targeting all 242 qualifying staff across four key departments: Supply Chain/Procurement/Logistics Managers, Operations/Production Managers, Risk Management/HSE Managers, and Finance/Planning Managers. This comprehensive inclusion of personnel with direct knowledge of both SCRM processes and performance outcomes aimed to maximize data validity and enhance the generalizability of findings to NLNG's entire operation.

Data were collected using a structured questionnaire designed on a five-point Likert scale (Strongly Agree = 5 to Strongly Disagree = 1). The instrument captured five main constructs: Risk Identification (RISI), Risk Assessment (RISA), Risk Mitigation Strategies (RSMS), Risk Monitoring and Control (RSMC), and Performance of NLNG Company (PNLN). Items for the independent variables were adapted from prior empirical studies, including Fozia (2022) for Risk Identification, Kaka et al. (2024) for Risk Assessment, Ali et al. (2023) for Risk Mitigation Strategies, and Obondi (2021) for Risk Monitoring and Control. Performance was measured using both operational (Faizal & Palaniappan, 2014) and financial metrics (Zubairu et al., 2021; Kaka et al., 2024).

The reliability of the constructs was established using Cronbach's Alpha, with all values demonstrating strong internal consistency and exceeding the recommended 0.70 threshold. Specifically, the results were: Risk Mitigation Strategies (0.891), Performance of NLNG Company (0.876), Risk Assessment (0.875), Risk Monitoring & Control (0.872), and Risk Identification (0.854). These robust values confirmed that the questionnaire items consistently and reliably measured their intended latent constructs, ensuring the credibility of the data collected.

For data analysis, Partial Least Squares Structural Equation Modeling (PLS-SEM) using SmartPLS 3 was employed. PLS-SEM was deemed appropriate due to its effectiveness in analyzing complex relationships among multiple latent variables, its tolerance for non-normal data distributions, and its suitability for obtaining reliable results with the study's sample size derived from a specific population (Hair et al., 2014). The analysis focused on both the measurement model (assessing reliability and validity) and the structural model (examining the hypothesized effect of SCRM dimensions on NLNG's performance). Out of the 242 questionnaires administered, 207 were properly completed and returned, representing a high response rate of 85.5%. This rate was considered excellent for statistical analysis and ensured that the findings were highly representative of the target management population at NLNG. Ethical considerations, including informed consent and confidentiality, were strictly observed throughout the data collection process.

RESULTS AND DISCUSSION

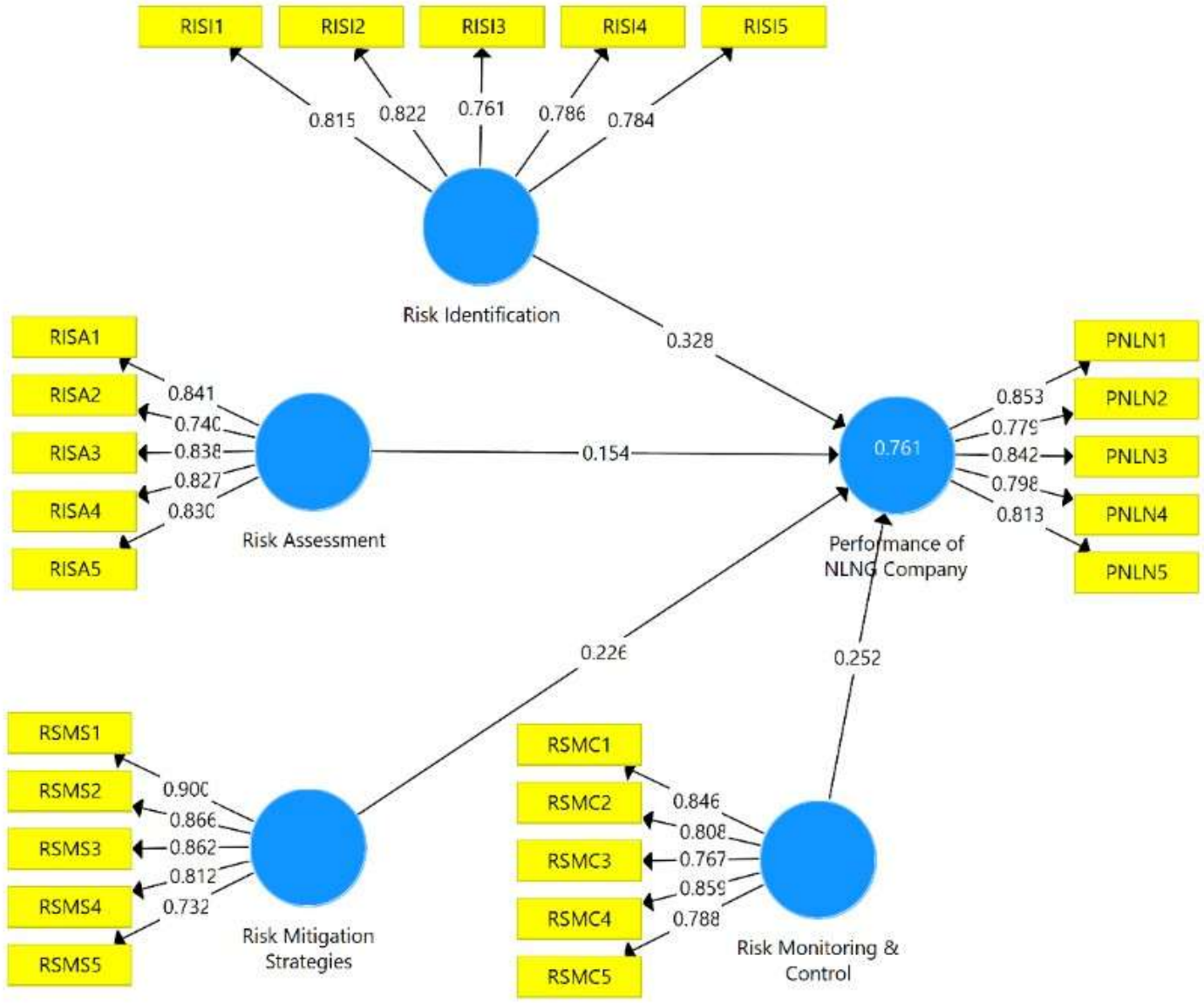

Figure 2: Measurement model of the study constructs and indicators.

Source: SmartPLS Output, 2025.

Table 1: Factor Loadings

Items	**Loadings**	**Items**	**Loadings**
RISI1	0.815	RISA1	0.841
RISI2	0.822	RISA2	0.740
RISI3	0.761	RISA3	0.838
RISI4	0.786	RISA4	0.827
RISI5	0.784	RISA5	0.830
RSMS1	0.900	RSMC1	0.846
RSMS2	0.866	RSMC2	0.808
RSMS3	0.862	RSMC3	0.767
RSMS4	0.812	RSMC4	0.859
RSMS5	0.732	RSMC5	0.788
Dependent Variable			
PNLN1	0.853		
PNLN2	0.779		
PNLN3	0.842		
PNLN4	0.798		
PNLN5	0.813		

Source: SmartPLS Output, 2025.

Table 1 presents the factor loadings of the measurement model for all constructs: Risk Identification (RISI), Risk Assessment (RISA), Risk Mitigation Strategies (RSMS), Risk Monitoring and Control (RSMC), and Performance of NLNG Company (PNLN). All item loadings exceeded the recommended threshold of 0.70 (Hair et al., 2022), thereby confirming convergent validity at the indicator level. The factor loadings ranged from 0.732 (RSMS5) to 0.900 (RSMS1). These consistently high item-construct relationships indicate that the observed variables reliably represent their respective latent constructs. Notably, even the relatively lower loading of 0.732 remains substantially above the acceptable minimum, affirming the robustness of the measurement model. The strength of these loadings confirms that the managers' responses accurately capture the dimensions of SCRM

and NLNG's performance, consistent with the requirements for Partial Least Squares Structural Equation Modeling (Fornell & Larcker, 1981).

TABLE 2: Construct Reliability and Validity

Construct	Cronbach's Alpha	rho_A	Composite Reliability	Average Variance Extracted (AVE)
Risk Identification	0.854	0.860	0.895	0.630
Risk Assessment	0.875	0.883	0.909	0.666
Risk Mitigation Strategies	0.891	0.896	0.921	0.700
Risk Monitoring and Control	0.872	0.876	0.908	0.663
Performance of NLNG Company	0.876	0.881	0.910	0.668

Source: SmartPLS Output, 2025.

Table 2 presents the construct reliability and validity results for all variables in the model. All constructs recorded Cronbach's Alpha and Composite Reliability values above the 0.70 benchmark (Hair et al., 2019), indicating excellent internal consistency and reliability of the measurement scales. Specifically, Composite Reliability values ranged from 0.895 (Risk Identification) to 0.921 (Risk Mitigation Strategies).The Average Variance Extracted (AVE) values exceeded the required 0.50 threshold for all constructs, ranging from 0.630 (Risk Identification) to 0.700(Risk Mitigation Strategies). This confirms that each construct explains well over half of the variance in its respective indicators, thereby establishing strong convergent validity. Taken together, the results affirm that the measurement model for Supply Chain Risk Management and NLNG Performance is both reliable and valid, providing a solid and trustworthy foundation for proceeding to the structural model analysis.

TABLE 3: HETEROTRAIT-MONOTRAIT RATIO (HTMT)

Construct	RISI	RISA	RSMS	RSMC	PNLN
Risk Identification (RISI)					
Risk Assessment (RISA)	0.761				
Risk Mitigation Strategies (RSMS)	0.741	0.824			
Risk Monitoring and Control (RSMC)	0.755	0.751	0.800		
Performance of NLNG Company (PNLN)	0.808	0.772	0.795	0.804	

Source: SmartPLS Output, 2025.

Table 3 presents the Heterotrait-Monotrait Ratio (HTMT) results. All HTMT values were below the conservative threshold of 0.90 recommended by Henseler, Ringle, and Sarstedt (2015), thereby confirming discriminant validity across all constructs. The highest correlation observed was 0.824 (between Risk Assessment and Risk Mitigation Strategies), which is well within the acceptable limit. These results affirm that the four dimensions of Supply Chain Risk Management (RISI, RISA, RSMS, RSMC) and the dependent variable (PNLN) are empirically distinct constructs. This indicates that the constructs are sufficiently independent and measure unique functional and performance dimensions of the NLNG supply chain without excessive measurement overlap.

TABLE 4: Structural Model Evaluation Results

Indicator	**Value**	**Interpretation / Threshold**
Collinearity Statistics (Inner VIF Values)		
Risk Identification	2.816	< 5.0 (No multicollinearity concern)
Risk Assessment	3.741	< 5.0 (No multicollinearity concern)
Risk Mitigation Strategies	4.164	< 5.0 (No multicollinearity concern)
Risk Monitoring & Control	3.314	< 5.0 (No multicollinearity concern)
Coefficient of Determination (R^2 Values)		
Performance of NLNG Company (R^2)	0.761	Substantial predictive power (explains 76.1% variance)
Adjusted R^2	0.759	Reflects strong model fit
Effect Size (f^2 Values)		
Risk Identification	0.160	Medium effect (Cohen, 1988)
Risk Assessment	0.026	Small effect
Risk Mitigation Strategies	0.051	Small effect
Risk Monitoring & Control	0.080	Small effect
Model Fit Indices		
SRMR (Saturated/Estimated Model)	0.064	< 0.08 (Acceptable model fit; Henseler et al., 2015)
d_ULS	1.329	Lower values indicate better fit
d_G	0.656	Lower values indicate better fit
Normed Fit Index (NFI)	0.818	≥ 0.80 (Acceptable model fit)

Source: SmartPLS Output, 2025.

Table 4 presents the evaluation results of the structural model, confirming the absence of multicollinearity among the independent variables, as all inner VIF values (for Risk Identification: 2.816, Risk Assessment: 3.741, Risk Mitigation Strategies: 4.164, and Risk Monitoring & Control: 3.314) fall well below the conservative threshold of 5.0. This confirms that the parameters are stable and reliable for analysis.The Coefficient of Determination (R^2) for Performance of NLNG Company is 0.761, indicating that 76.1% of the variance in NLNG's performance (encompassing both operational and financial metrics) is explained by the four dimensions of Supply Chain Risk Management (SCRM). This strong predictive power underlines the strategic importance of effective SCRM in improving NLNG's performance.The effect size (f^2) values reveal that Risk Identification has a Medium effect ($f^2 = 0.160$), whereas Risk Monitoring & Control, Risk Mitigation Strategies, and Risk Assessment show Small effects (f^2 values ranging from 0.026 to 0.080). These results emphasize the varying degrees of influence each dimension has on NLNG's performance.The Model Fit Indices confirm the model's adequacy. The SRMR value of 0.064 is below the recommended threshold of 0.08, and the Normed Fit Index (NFI) of 0.818 exceeds the minimum acceptable value of 0.80, demonstrating that the model is statistically sound and well-suited for hypothesis testing.

TABLE 5: Path Coefficients and Hypothesis Testing Results

Path (Hypothesis)	Original Sample (O)	Sample Mean (M)	STDEV	T Statistics	P Values	Decision
RISI → PNLN	0.328	0.333	0.058	5.681	0.003	Rejected (significant effect)
RISA → PNLN	0.154	0.153	0.062	2.489	0.013	Rejected (significant effect)
RSMS → PNLN	0.226	0.23	0.08	2.843	0.005	Rejected (significant effect)
RSMC → PNLN	0.252	0.243	0.07	3.604	0.034	Rejected (significant effect)

Source: SmartPLS 3 Output, 2025.

Key Findings

i. Risk Identification significantly and positively affects the performance of NLNG Company.

ii. Risk Assessment significantly and positively affects the performance of NLNG Company.

iii. Risk Mitigation Strategies significantly and positively affect the performance of NLNG Company.

iv. Risk Monitoring & Control significantly and positively affects the performance of NLNG Company.

DISCUSSION OF FINDINGS

H_{01}: Risk Identification (RISI) has no significant effect on the Performance of NLNG Company

The hypothesis was rejected, as the path coefficient of 0.328 with a t-value of 5.681 and p-value of 0.003 indicated a significant positive effect.This result implies that the systematic and proactive identification of

potential threats (e.g., shipping risks, supply failures) is the single most critical factor driving NLNG's performance (on-time delivery, cost efficiency).

This finding is strongly supported by the energy-specific study of Ankhi (2017), which emphasized that comprehensive risk identification is foundational in the LNG industry, and by Kiarie et al. (2017), who found identification strategies significantly influenced supply chain outcomes.

H_{02}: Risk Assessment has no significant effect on the Performance of NLNG Company

The hypothesis was rejected, with a path coefficient of 0.154, a t-value of 2.489, and a p-value of 0.013, indicating a positive significant effect. This result implies that risk assessment provides a necessary data-driven basis for prioritizing threats, ensuring operational continuity, and enhancing performance at NLNG.

This finding is in line with James & Renjith (2020), who demonstrated that effective risk assessments improve operational safety and mitigate potential disruptions in LNG operations. Similarly, Onoh et al. (2025), who demonstrated that risk assessment positively affects performance in Nigerian manufacturing firms. Furthermore, Mburu et al. (2015) found that risk assessment led to more informed decision-making in the manufacturing industry, similarly enhancing performance.

H_{03}: Risk Mitigation Strategies have no significant effect on the Performance of NLNG Company.

The hypothesis was rejected, with a path coefficient of 0.226, a t-value of 2.843, and a p-value of 0.005, indicating that risk mitigation strategies, such as dual sourcing and business continuity plans, are crucial for mitigating disruptions and improving performance.This finding corroborates Aliu-Ogbaini (2025), who found that risk management strategies like technology integration and third-party logistics significantly enhance the operational efficiency of oil and gas companies. Kiarie et al. (2017) also supported that risk mitigation strategies had a positive effect on supply chain performance. Furthermore, Ali et al. (2023), found that mitigation strategies minimized risk and enhanced firm performance.In the Nigerian context, these strategies act as a "vital shield" against the macroeconomic suppressors identified by Okegbemi (2024), such as record-high inflation and exchange rate volatility. By implementing dual-sourcing and contractual risk transfers, NLNG buffers itself against national instability, maintaining a "micro-environment of stability" that safeguards its operational efficiency and revenue despite a volatile domestic economy.

H_{04}: Risk Monitoring & Control has no significant effect on the Performance of NLNG Company.

The hypothesis was rejected, with a path coefficient of 0.252, a t-value of 3.604, and a p-value of 0.034, confirming that risk monitoring and control practices are essential in enhancing performance, particularly in mitigating unexpected disruptions in the LNG supply chain.This effectposition suggested that continuous oversight, tracking KRIs, conducting periodic audits, and implementing corrective actionsis highly crucial for sustaining stable operations and meeting delivery reliability.

This outcome supports Shad and Lai (2019), who found that the monitoring component of ERM positively predicted financial performance in the oil and gas industry, and Obondi (2021), who emphasized the necessity of continuous monitoring practices for project success. Similarly, Munir et al. (2020) suggested that the effectiveness of supply chain integration and risk monitoring is vital for ensuring long-term operational success. Furthermore, Asikhia et al. (2022) showed that risk monitoring improves overall business performance in the oil and gas industry.

CONCLUSION

In conclusion, this study found that all four dimensions of Supply Chain Risk Management (Risk Identification, Risk Assessment, Risk Mitigation Strategies, and Risk Monitoring & Control) significantly affect the

performance of NLNG Company. These results underscore the importance of a comprehensive and integrated approach to supply chain risk management in ensuring both operational and financial stability for NLNG. Collectively, SCRM is a substantial driver of NLNG's performance, explaining 76.1% of its variance.

RECOMMENDATIONS

Based on the strength of the tested relationships, the following recommendations are put forward to further enhance operational resilience, cost efficiency, and shipment reliability:

i. Given that Risk Identification is the most critical factor driving NLNG's performance, it is recommended that NLNG invests in advanced risk detection technologies, such as AI and predictive analytics, to improve the early identification of potential disruptions (e.g., geopolitical risks, supply chain delays). Implementing a more robust risk identification framework will help anticipate and address emerging threats promptly, ensuring consistent operational efficiency and performance.

ii. Since Risk Assessment plays a key role in prioritizing threats and ensuring operational continuity, it is recommended that NLNG integrates more advanced risk assessment tools, including scenario planning and probabilistic models, to provide deeper insights into potential risks. Regularly updating the risk register with real-time data from across the LNG supply chain can help optimize decision-making and improve response strategies, ultimately enhancing performance metrics like on-time delivery and cost efficiency.

iii. Considering the positive effect of Risk Mitigation Strategies, NLNG should expand its use of risk mitigation tools such as dual sourcing, diversified transportation options, and flexible contract negotiations. Moreover, business continuity plans should be continually updated to address evolving market dynamics and operational challenges. Integrating advanced technologies like blockchain for supply chain transparency and automation could further reduce disruptions and enhance cost-efficiency.

iv. As Risk Monitoring and Control are essential for maintaining stable operations, NLNG should implement a more dynamic risk monitoring system. This could include real-time tracking of Key Risk Indicators (KRIs), setting up automated alerts for potential disruptions, and conducting periodic audits. Furthermore, fostering a culture of continuous improvement through regular risk management training and simulations will help ensure that risk monitoring efforts are proactive and responsive to unforeseen challenges, thus supporting long-term performance sustainability.

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