International Journal of Advances in Engineering and Management (IJAEM)
Volume 7, Issue 04 April 2025, pp: 857-872 www.ijaem.net ISSN: 2395-5252

The Effect of Cash Call on Decommissioning of Floating Production Storage and Offloading in Nigeria's Oil and Gas Industry

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Date of Submission: 15-04-2025 Date of Acceptance: 25-04-2025

ABSTRACT
Floating Production Storage and Offloading (FPSO) units are crucial in Nigeria's offshore oil and gas production. However, their decommissioning presents significant financial, regulatory, and environmental challenges, particularly in the context of Nigeria's cash call funding mechanism. This study examines the impact of cash call obligations on the timely and efficient decommissioning of FPSOs in Nigeria's oil and gas industry. Cash calls are financial commitments from the Nigerian National Petroleum Corporation (NNPC) and its Joint Venture (JV) partners to fund oil and gas operations. Due to historical delays and shortfalls in cash call payments, critical projects, including decommissioning activities, often experience financing gaps. This paper explores how these delays hinder the execution of decommissioning plans, leading to increased environmental risks, operational hazards, and prolonged financial liabilities for oil operators. Additionally, it assesses the regulatory framework governing decommissioning, highlighting gaps that exacerbate funding challenges. The study adopts a qualitative and quantitative approach, utilizing case studies, financial reports, and industry expert insights to analyze the implications of cash call inefficiencies on FPSO decommissioning. Comparative analysis with other oil-producing nations provides insights into alternative funding models, such as decommissioning trust funds and public-private financing strategies. Findings suggest that cash call constraints significantly impact decommissioning timelines, increasing operational risks and regulatory non-compliance. The study recommends policy reforms, including adopting dedicated decommissioning funds, improved fiscal planning, and strengthened regulatory enforcement to ensure timely and sustainable decommissioning practices. Addressing these challenges is critical for environmental sustainability, operational efficiency, and long-term industry viability.

Keywords: FPSO, decommissioning, cash call, Nigeria, oil and gas, joint ventures, regulatory framework, funding constraints.

I. INTRODUCTION

Nigeria is one of Africa's leading oil-producing nations, with petroleum as the backbone of its economy. The country holds an estimated 37 billion barrels of crude oil reserves and is the largest oil producer in sub-Saharan Africa (OPEC, 2022). Nigeria's oil and gas sector contributes over 90% of export earnings and nearly 70% of government revenues, making it a key driver of economic stability and growth (NNPC, 2023). Offshore exploration and production activities have expanded significantly in the last two decades, with Deepwater projects crucial in sustaining output levels. Floating Production Storage and Offloading (FPSO) units have enabled production in offshore fields where fixed platforms are impractical due to water depth constraints. However, as FPSOs reach the end of their operational lifespan, decommissioning becomes a significant challenge, exacerbated by financial constraints linked to cash call obligations. FPSOs serve as offshore oil production facilities that process, store, and offload crude oil for transport via tankers or pipelines. They are widely used in Deepwater and ultra-deepwater fields where constructing fixed platforms is economically unfeasible. FPSOs offer operational flexibility, reduced infrastructure costs, and adaptability to field conditions (Wood Mackenzie, 2021). In Nigeria, notable FPSO projects include those operating in the Bonga,

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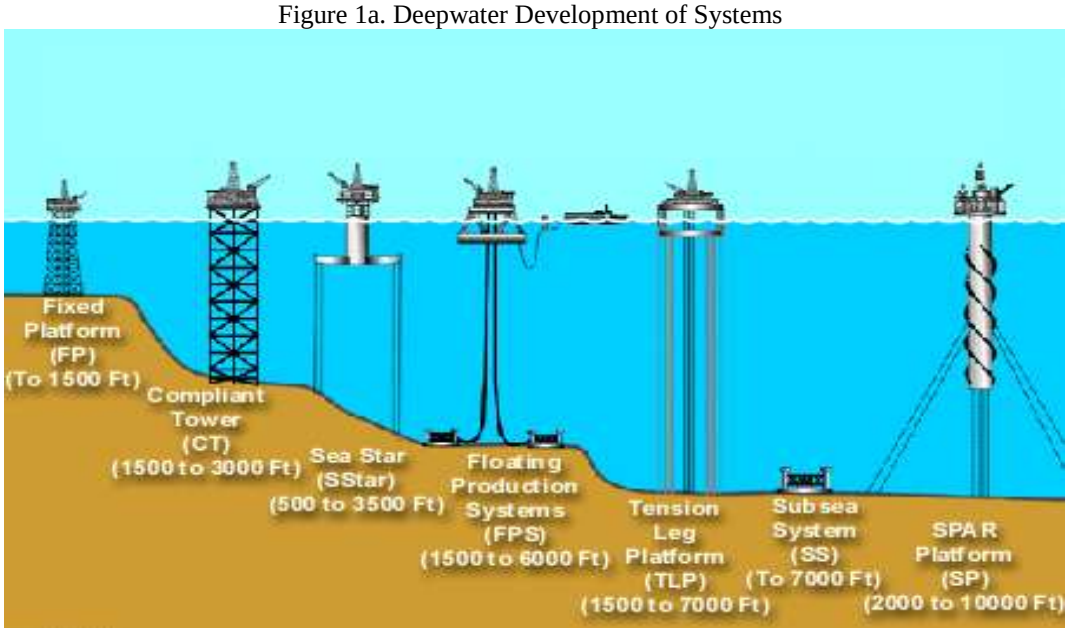
Egina, and Akpo fields. The deployment of FPSOs has significantly contributed to Nigeria's offshore production, but their eventual decommissioning presents complex financial and technical challenges, particularly under Nigeria's Joint Venture (JV) funding model (Osho, 204).

Figure 1a. Deepwater Development of Systems



As shown in Figure 1a, the deepwater development systems emphasize Nigeria's complexity and capital-intensive nature of offshore oil and gas operations, particularly within the framework of Joint Venture (JV) funding arrangements (Osho, 2024). This funding model, in which the Nigerian government—typically through the Nigerian National Petroleum Company (NNPC)—partners with international oil companies, relies heavily on timely cash calls to support ongoing exploration, production, and decommissioning activities. However, persistent delays or shortfalls in meeting these cash call obligations significantly impact the operational and financial planning required for decommissioning Floating Production Storage and Offloading (FPSO) units. Decommissioning becomes a safety and environmental necessity as offshore assets age and end their productive life. Operators face difficulties executing proper decommissioning procedures without consistent funding, leading to heightened environmental risks and potential regulatory penalties.

Thus, the JV funding mechanismdirectly influences the ability to manage FPSO decommissioning efficiently in Nigeria's oil and gas industry (Osho, 2024). This model is central to understanding the challenges surrounding decommissioning efforts in the sector. One critical area impacted by JV financing is the decommissioning of Floating Production Storage and Offloading (FPSO) units. Cash calls, a core feature of the JV structure where the Nigerian National Petroleum Corporation (NNPC) is required to provide its equity share of funding for operations, often suffer from delays and underfunding. These financial shortfalls hinder the timely maintenance and eventual decommissioning of aging FPSOs. As the figure suggests, the high capital intensity of deepwater systems necessitates consistent cash flow; thus, irregular cash call payments can compromise the structural integrity and environmental safety of offshore installations nearing the end of their lifecycle. Therefore, the effect of cash calls extends beyond production delays—significantly constrains Nigeria's ability to retire offshore assets like FPSOs responsibly.

The expansion of Floating Production Storage and Offloading (FPSO) units is a significant trend in offshore oil and gas production, with global investments directed toward new projects across key producing nations. According to Equipment & Services Analytic and GlobalData Oil and Gas, several countries, including Brazil, Guyana, and Nigeria, have announced major FPSO deployments to support Deepwater and ultra-deepwater exploration between 2022 and 2027. These planned FPSO additions reflect strategic investments to optimize production efficiency, enhance field development, and address the

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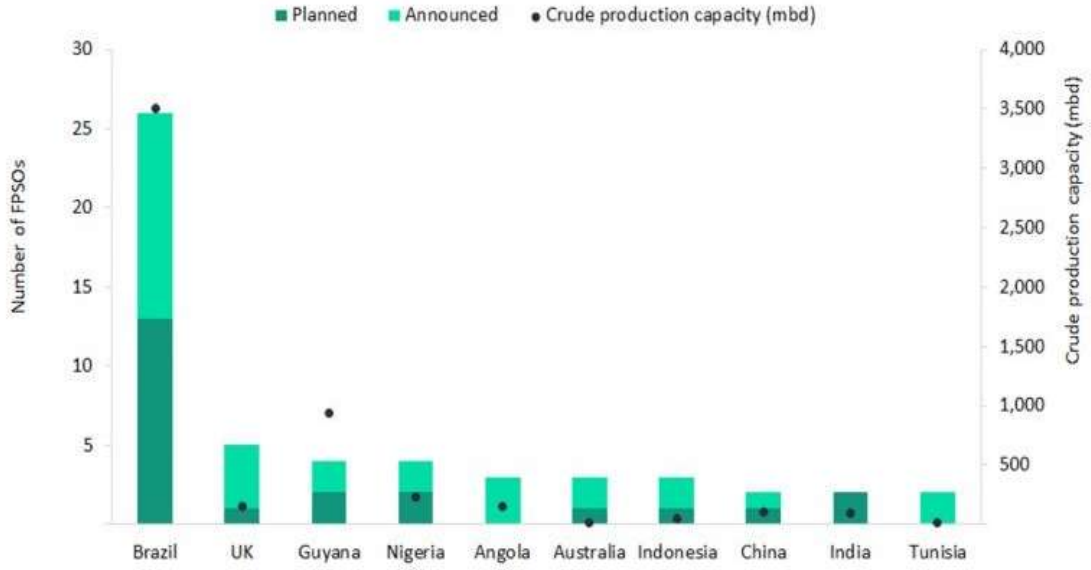
growing global demand for offshore hydrocarbons (Figure 1b).

Figure 1b. Global Planned and Announced FPSO Additional by Key Countries, 2022-2027



Source: Equipment & Services Analytic, GlobalData Oil and Gas

Nigeria remains a key player in this expansion, with multiple FPSO projects planned to sustain its offshore production amid aging infrastructure and increasing decommissioning needs (Nwosu & Obioha, 2020). The country's reliance on FPSOs is driven by deepwater discoveries, where fixed platforms are not economically viable. However, funding constraints and regulatory challenges could impact the timely execution of these planned additions, emphasizing the need for policy reforms and improved cash call mechanisms to support sustainable offshore operations (Usman & Adeoye, 2022).

The Floating Production Storage and Offloading (FPSO) unit is a critical infrastructure enabling offshore production. FPSOs are floating vessels that process and store hydrocarbons extracted from subsea wells. These units are particularly suited for deepwater and ultra-deepwater fields, where traditional fixed platforms are impractical due to depth and environmental conditions. In Nigeria, FPSOs have played a pivotal role in unlocking offshore reserves, with units such as the Egina FPSO and Bonga FPSO becoming vital assets in the country's oil production portfolio (Nwosu & Obioha, 2020). FPSOs eliminate the need for extensive pipeline networks by serving as storage and offloading facilities, ensuring continuous production even in remote locations(Osho, Nazemzadeh, Osagie, & Williford, 2005).The strategic importance of FPSOs extends beyond production efficiency. These units contribute to reducing environmental risks associated with oil spills during transportation. Additionally, they enable operators to extend the economic life of mature fields by serving as mobile production facilities that can be redeployed to other locations (Ite et al., 2018). Given the reliance on FPSOs for offshore operations, their lifecycle management—from deployment to decommissioning—is critical for sustaining production and adhering to environmental regulations.

Furthermore, Figure 2 shows that the global Floating Production Storage and Offloading (FPSO) market is projected to witness significant growth from 2022 to 2031, with market size expansion driven by increased deepwater exploration, technological advancements, and the transition toward more cost-efficient production systems (KBV Research, 2022). According to industry projections, variations in FPSO types—including converted, new-build, and redeployed units—are expected to influence investment trends, with new-build FPSOs capturing a larger market share due to enhanced operational efficiency and compliance with stringent environmental regulations (Wood Mackenzie, 2022).

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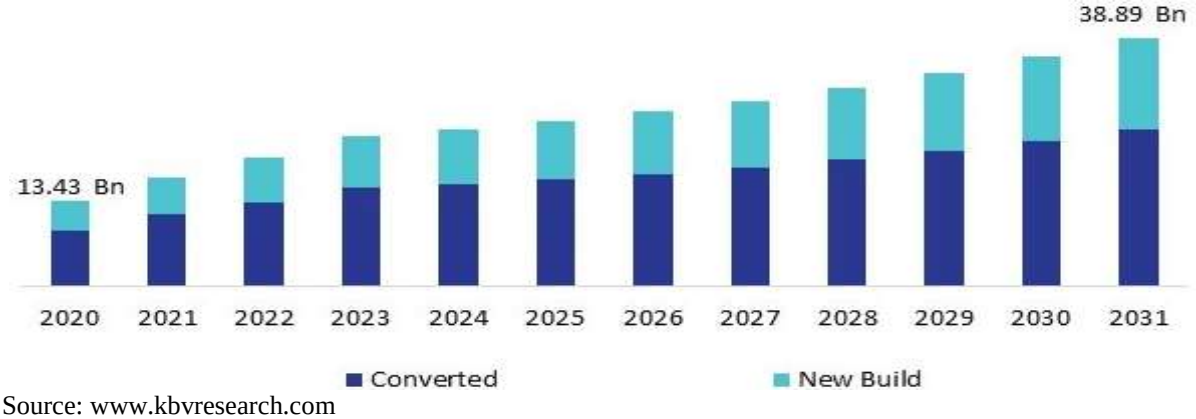
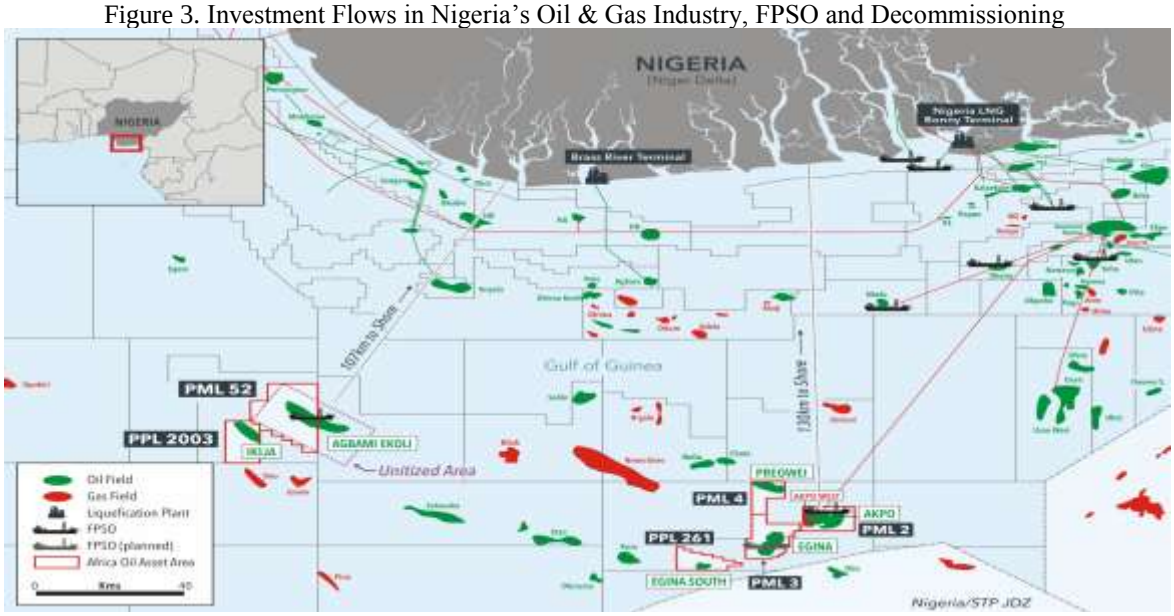
Figure 2. Global FPSO Additional Market Size by Type, 2022-2031 (USD Billion)



Source: www.kbvresearch.com

Decommissioning is safely dismantling offshore oil and gas infrastructure that has reached the end of its productive life. It involves plugging and abandoning wells, removing FPSOs, dismantling subsea equipment, and restoring marine environments to pre-exploration conditions (International Energy Agency [IEA], 2021). The costs associated with decommissioning are substantial, often running into billions of dollars, depending on field complexity, water depth, and regulatory requirements. Unlike other petroleum-producing nations with structured decommissioning funds, Nigeria's reliance on cash calls for project financing poses significant challenges in meeting decommissioning obligations promptly and efficiently.However, in the context of the effect of cash calls on the decommissioning of Floating Production Storage and Offloading (FPSO) units in Nigeria's oil and gas industry, Figure 3 presents critical data that inform financial and operational decisions. It highlights how cash call constraints affect offshore asset retirementand how the availability of cash calls—financial contributions required from joint venture partners—directly influences the pace and effectiveness of decommissioning projects. Also, when cash calls are insufficient, companies may delay FPSO decommissioning, leading to extended use of aging infrastructure and increased risks of operational failures, oil spills, and environmental degradation. Conversely, adequate cash flow ensures timely decommissioning, reducing ecological hazards and aligning with regulatory requirements. Therefore, Figure 3 serves as a crucial reference for understanding how financial commitments impact the sustainability and safety of Nigeria's offshore oil operations**(**Osho, 2025).

Figure 3. Investment Flows in Nigeria's Oil & Gas Industry, FPSO and Decommissioning



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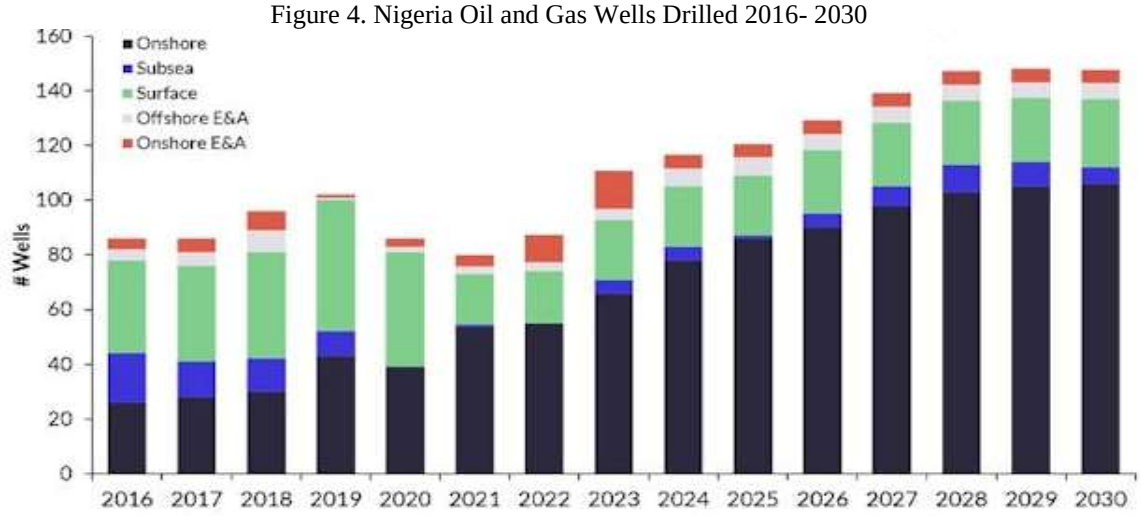
II. OVERVIEW OF CASH CALL MECHANISMS IN NIGERIA'S UPSTREAM PETROLEUM SECTOR

Cash calls refer to the financial contributions required from JV partners to fund exploration, development, production, and decommissioning activities in Nigeria's oil and gas sector. Under the JV model, the Nigerian National Petroleum Corporation (NNPC) collaborates with International Oil Companies (IOCs) such as Shell, ExxonMobil, Chevron, and TotalEnergies to develop oil and gas assets. NNPC typically holds a 55–60% equity stake, requiring it to contribute its share of project costs through cash calls (Deloitte, 2022). However, historical challenges have led to significant cash call arrears, including funding delays, budget shortfalls, and bureaucratic inefficiencies. These funding constraints hinder the timely execution of critical projects, including decommissioning FPSOs, thereby increasing environmental risks and operational liabilities. The cash call system ensured that NNPC's financial obligations were met promptly, maintaining operational continuity. However, the mechanism has faced significant challenges over the years. Frequent delays in the disbursement of funds have led to project slowdowns, cost overruns, and strained relationships between NNPC and its JV partners (Adamu, 2019). These delays are often attributed to broader macroeconomic constraints, including fluctuating oil prices and competing budgetary priorities (Osho&Oloyede, 2024). For example, during low oil prices, the Nigerian government has struggled to meet its cash call obligations, forcing operators to suspend projects or seek alternative financing arrangements (Usman & Adeoye, 2022).

The impact of cash call delays extends to the decommissioning phase of FPSOs, which requires significant capital investment. Decommissioning involves dismantling subsea infrastructure, disconnecting the FPSO, and restoring the marine environment to pre-installation conditions. Inadequate funding can delay these activities, increasing environmental risks and non-compliance penalties. Moreover, prolonged decommissioning timelines can erode investor confidence, further complicating future financing efforts for offshore projects (Onoh, 2020). The data presented in Figure 4 reveals valuable insight into the projected drilling activities within Nigeria's oil and gas industry. This information is crucial when assessing the impact of cash calls on decommissioning Floating Production Storage and Offloading (FPSO) units. Cash calls, which represent the financial obligations of joint venture partners in funding oil and gas operations, directly influence the industry's ability to sustain exploration and production activities. The trends in well drillingin Figure 4 indicate potential future liabilities related to decommissioning efforts, as increased drilling may lead to more significant decommissioning costs over time. Conversely, a decline in drilling activity could suggest financial constraints, possibly due to inadequate cash call funding, which may delay decommissioning projects. Thus, understanding the historical and projected drilling trends in Nigeria is essential for evaluating the financial and operational feasibility of FPSO decommissioning in the region.

Figure 4. Nigeria Oil and Gas Wells Drilled 2016- 2030



Source: Westwood Global Energy Group

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Challenges Posed by Cash Call Mechanisms in Funding Decommissioning Projects

While central to the joint venture funding structure in Nigeria's oil and gas industry, the cash call mechanism has introduced several challenges in funding decommissioning projects. First, the reliance on government contributions through NNPC makes the system vulnerable to delays stemming from macroeconomic constraints, fluctuating oil prices, and fiscal budgetary priorities (Osho, 2023). These delays directly impact the timely availability of funds for decommissioning activities, which often require substantial upfront capital. For instance, FPSO decommissioning involves dismantling subsea infrastructure, disconnecting the FPSO, and restoring the marine environment, all of which are highly capital-intensive activities (Onoh, 2020). The absence of timely funding disrupts planning and execution, leading to project delays and cost overruns (Adamu, 2019).

Additionally, the operational constraints operators faceare exacerbated by the unpredictability of cash call disbursements. Decommissioning projects require precise coordination and adherence to regulatory standards to mitigate environmental risks and ensure safety. Delays in funding compromise these standards, exposing operators to potential fines and reputational damage. Furthermore, the prolonged timelines resulting from cash call inefficiencies can inflate project costs due to factors such as equipment leasing and contractor mobilization fees (Usman & Adeoye, 2022).

Financial and Operational Constraints Faced by Operators

Operators in Nigeria's oil and gas industry face a dual burden of financial and operational constraints under the current cash call mechanism. Financially, the unpredictability of cash call disbursements creates a mismatch between project timelines and available resources. This is particularly problematic for decommissioning projects, which are often treated as end-of-life expenses with limited prioritization in budget allocations (Ite et al., 2018). Operationally, the challenges of managing decommissioning activities in offshore environments—characterized by harsh weather conditions and logistical complexities—are compounded by funding delays. This scenario jeopardizes project completion and poses significant risks to the marine ecosystem and community livelihoods dependent on fishing and other activities (Nwosu & Obioha, 2020).

Despite Nigeria's vast oil wealth, funding shortfalls in cash calls have frequently delayed critical industry activities, including decommissioning. FPSO decommissioning is capital-intensive, requiring a structured financial plan to ensure safe and environmentally responsible execution. However, recurrent cash call deficits have resulted in deferred decommissioning activities, prolonged environmental exposure, and increased operational hazards. Hence, this study aims to investigate the influence of cash calls on decommissioning Floating Production Storage and Offloading (FPSO) units, focusing on the Nigerian oil and gas industry. The objectives of this research are as follows:

i. To analyze the impact of cash calls on the timely and effective decommissioning of FPSOs. This involves examining the relationship between cash call delays and project timelines, emphasizing cost implications and regulatory compliance. Understanding these dynamics is crucial for evaluating how financial constraints affect the ability of joint venture (JV) partners to fulfill their decommissioning obligations.

ii. To evaluate solutions for mitigating cash call-related challenges.The research will explore alternative funding mechanisms and strategies to enhance the efficiency of cash call disbursements. By identifying best practices, policy reforms, and financial innovations, this study seeks to propose measures that ensure uninterrupted project execution.

Therefore, to achieve these objectives, the study will address the following key research questions:

First, what is the role of cash calls in funding decommissioning operations? This question explores the foundational relationship between cash calls and JV obligations, particularly in end-of-life infrastructure management. It will examine how JV partners structure financial commitments and how these impact decommissioning efforts. Second, how do delays in cash calls affect decommissioning timelines and costs?The focus here is quantifying the impact of funding delays on project execution, cost escalation, and regulatory compliance. The study will highlight the consequences of inconsistent funding by assessing case studies and industry data.

Third, that strategies can improve funding efficiency for decommissioning? The study will analyze best practices from other oil-producing

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regions and evaluate their applicability to the Nigerian context.

By answering these research questions, this study will contribute to the ongoing discourse on financial sustainability and regulatory effectiveness in Nigeria's oil and gas sector, particularly in decommissioning aging offshore assets. The oil and gas industry is a keystone of Nigeria's economy, contributing significantly to government revenue and foreign exchange earnings. As of 2023, Nigeria remains Africa's largest oil producer and one of the top exporters of crude oil globally (OPEC, 2023). The sector is dominated by offshore exploration and production, accounting for a significant share of the country's oil output. The development of offshore fields has been driven by the discovery of deepwater reserves, which require advanced technological solutions for efficient extraction and processing.

Nigeria's oil and gas sector operates predominantly under joint venture (JV) agreements between the Nigerian National Petroleum Corporation (NNPC) and international oil companies (IOCs). These JVs are established to pool resources and share risks associated with exploration, production, and infrastructure development. A distinctive feature of these agreements is the "cash call" system, which requires the government, through NNPC, to contribute its equity share of the funding for JV operations. Cash calls are issued periodically by the operator of the JV to cover operational and capital expenditures (Petroleum Industry Act, 2021). Therefore, Nigeria's oil and gas industry is deeply intertwined with the performance of FPSOs and the efficiency of the cash call system. Understanding the challenges of cash call delays is essential for addressing inefficiencies in JV operations and ensuring sustainable management of offshore infrastructure, including FPSOs. This study explores these dynamics, focusing on the implications for decommissioning activities in Nigeria's oil and gas sector.

III. PRIOR STUDIES

The lifecycle of a Floating Production Storage and Offloading (FPSO) unit typically encompasses four main stages: design and construction, installation and commissioning, operation and decommissioning. Each phase requires meticulous planning and substantial investment to ensure the unit's efficiency and safety (Ite et al., 2018). During the operational phase, FPSOs facilitate hydrocarbons' extraction, processing, storage, and offloading, playing a vital role in offshore production, especially in deepwater fields where fixed platforms are infeasible. Decommissioning marks the final stage of an FPSO's lifecycle, involving the removal of the unit from its offshore location, dismantling associated subsea infrastructure, and restoring the marine environment. Timely decommissioning is critical for several reasons. First, it mitigates environmental risks by preventing potential leaks and spills from aging infrastructure. Second, it ensures compliance with regulatory requirements, avoiding penalties and legal disputes. Finally, it maintains the operators' reputation, demonstrating their commitment to sustainable practices (Nwosu & Obioha, 2020).

Cash Call Mechanism in Nigeria

In Nigeria, cash calls serve as the primary funding mechanism for joint ventures (JVs) between the Nigerian National Petroleum Corporation (NNPC) and international oil companies (IOCs). Under this arrangement, NNPC, representing the government, must contribute its equity share of funding for JV operations, including exploration, production, and decommissioning activities. Cash calls are issued periodically to ensure all partners meet financial obligations (Petroleum Industry Act, 2021).Due to Nigeria's economic volatility and fiscal constraints, delays and inefficiencies have historically plagued the cash call system. For instance, during low oil prices, the government has struggled to meet its funding commitments, resulting in project slowdowns and strained relationships with IOCs (Adamu, 2019). These delays have had cascading effects on operations, leading to cost overruns and jeopardizing the timely execution of critical projects, including FPSO decommissioning.

Decommissioning Challenges in Nigeria

Decommissioning FPSOs in Nigeria presents a unique set of challenges, encompassing regulatory, financial, and technical barriers. From a regulatory perspective, the absence of comprehensive guidelines for decommissioning has created uncertainty for operators, complicating compliance efforts. Financially, the high costs associated with decommissioning activities and cash call delays have exacerbated funding constraints. Technically, the complexity of dismantling subsea infrastructure in deepwater environments requires specialized expertise and equipment, both of which are often limited in Nigeria (Usman & Adeoye, 2022).Decommissioning offshore oil and gas

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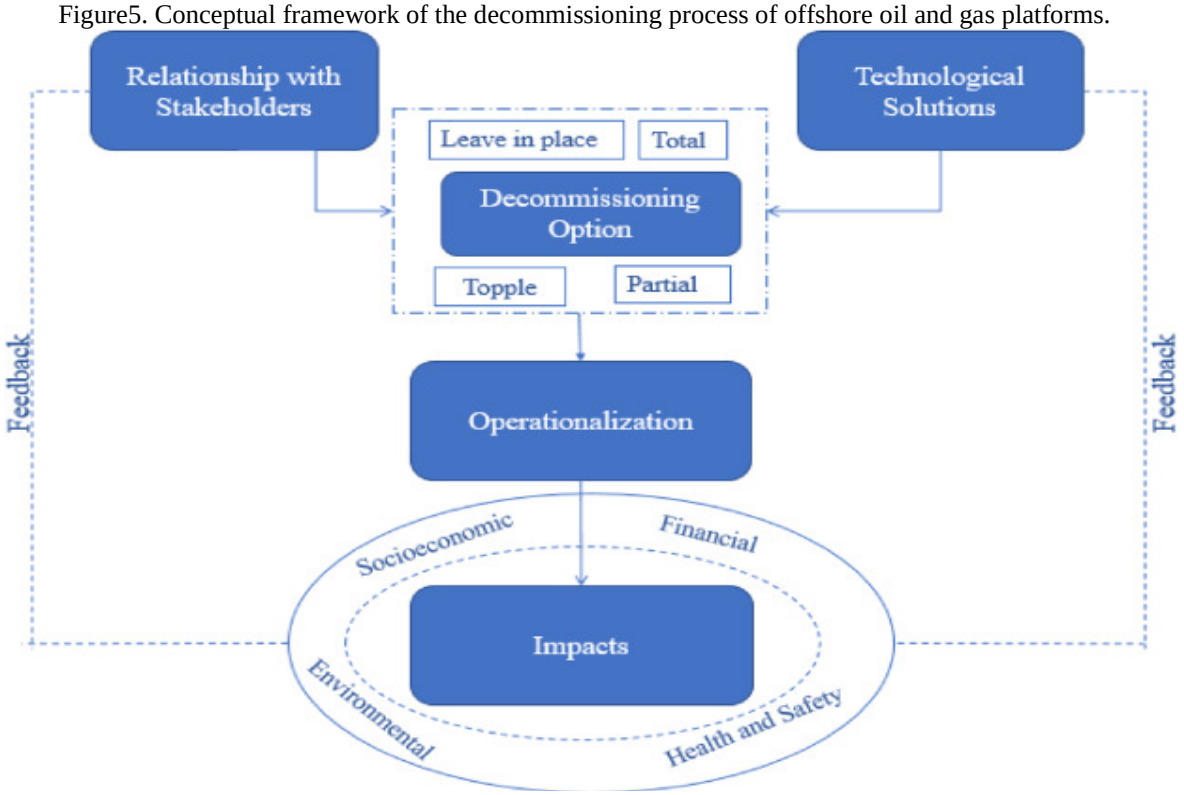
platforms involves a structured, multi-phase process encompassing regulatory compliance, technical execution, and environmental restoration. As shown in Figure 5, the framework integrates key stages such as planning and assessment, well-plugging and abandonment, infrastructure removal, site clearance, and post-decommissioning monitoring (Vidal et al., 2022). This systematic approach ensures that decommissioning activities adhere to safety and environmental standards while mitigating financial and operational risks. Effective implementation of this framework requires coordinated efforts between regulatory bodies, industry stakeholders, and financial institutions to secure adequate funding and technical expertise, particularly in regions like Nigeria, where cash call delays pose significant challenges to timely decommissioning (Usman & Adeoye, 2022).

The financial constraints posed by cash call obligations significantly impact the decommissioning of Floating Production Storage and Offloading (FPSO) units in Nigeria's oil and gas industry. As illustrated in Figure 5, the extensive network of oil fields, gas fields, oil pipelines, and gas pipelines underscores the scale of infrastructure requiring eventual decommissioning. A lack of funding from cash calls delays decommissioning efforts, leading to prolonged use of aging infrastructure and heightening environmental and safety risks. According to regulatory frameworks, decommissioning should follow strict environmental standards to mitigate ecological damage (Adewale & Okonkwo, 2020). However, when cash calls are insufficient or delayed, operators may defer decommissioning projects, increasing the likelihood of equipment failures, oil spills, and gas leaks. These failures result in direct economic losses and severe consequences for marine biodiversity and coastal communities dependent on fishing and other natural resources (Nwosu &Omorogbe, 2021). Environmental and safety concerns further compound these challenges. Aging FPSOs and associated pipelines pose significant risks of oil spills and leaks, which can severely impact marine ecosystems and local livelihoods (Ite et al., 2016). The degradation of offshore infrastructure due to delayed decommissioning has been linked to increased pollution incidents, causing long-term damage to water quality and fisheries (Ugochukwu &Ertel, 2008).

Figure5. Conceptual framework of the decommissioning process of offshore oil and gas platforms.



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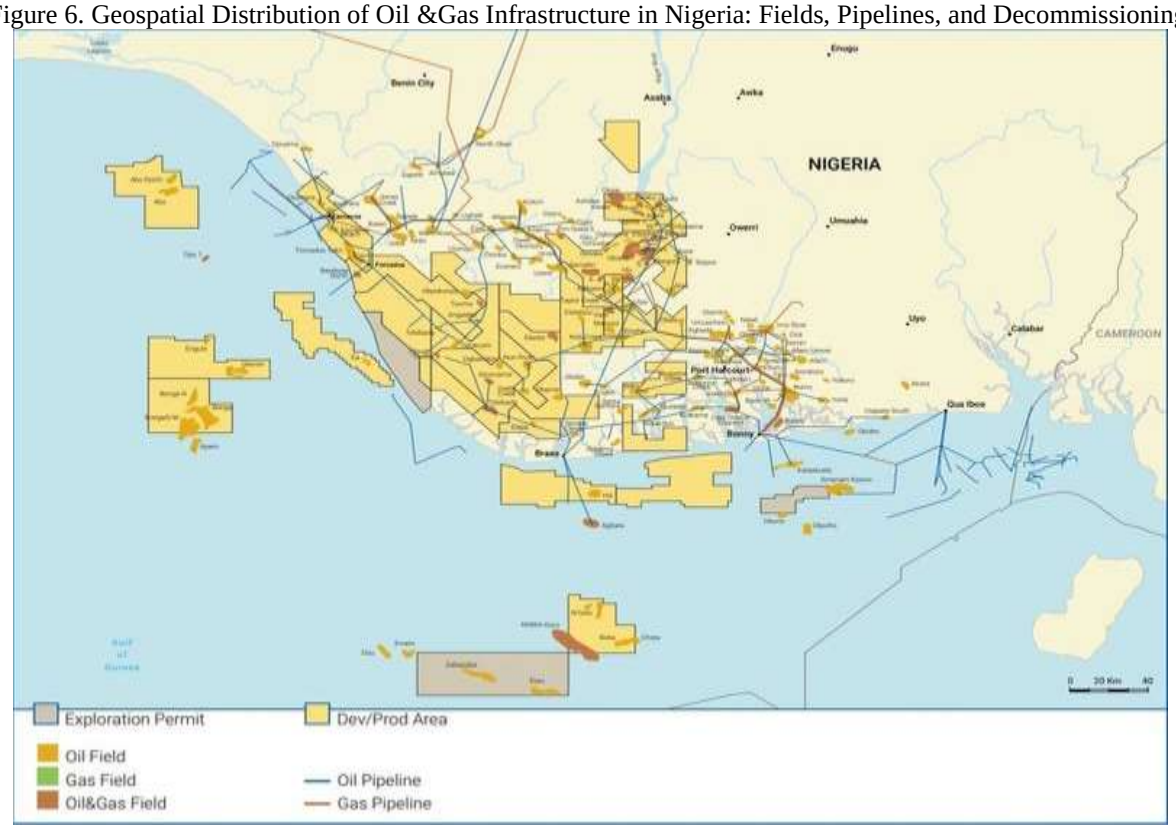
Volume 7, Issue 04 April 2025, pp: 857-872 www.ijaem.net ISSN: 2395-5252

Moreover, the financial burden of managing oil spill cleanups and remediation further strains government agencies and industry stakeholders already struggling with cash call deficits. Inadequate funding also affects safety measures, as companies may be unable to maintain stringent monitoring and maintenance protocols necessary to prevent catastrophic failures. Addressing these risks requires improved financial management, regulatory enforcement, and strategic planning to ensure decommissioning processes align with environmental protection goals while maintaining economic sustainability within Nigeria's oil and gas sector.

However, based on your input, if Figure 6 presents oil fields, gas fields, oil pipelines, and gas pipelines, its relevance to the effect of cash calls on the decommissioning of Floating Production Storage and Offloading (FPSO) units in Nigeria's oil and gas industry is significant. The geographical distribution of oil and gas infrastructure directly impacts decommissioning strategies and associated costs. Cash calls, as financial contributions required from joint venture partners, influence the extent to which decommissioning projects can be planned and executed efficiently. A widespread network of oil fields and pipelines suggests extensive decommissioning obligations in the future, requiring substantial financial investment. Conversely, if financial constraints limit the availability of cash calls, delays in decommissioning efforts could lead to environmental and regulatory concerns, particularly in offshore locations where FPSOs operate. Additionally, the interconnectivity of oil and gas infrastructure—illustrated by the pipelines—implies that decommissioning an FPSO may have broader implications for the supply chain and production continuity. Therefore, Figure 6 provides a spatial context for evaluating how cash call availability influences decommissioning timelines, environmental risk management, and long-term operational sustainability in Nigeria's oil and gas industry.

Figure 6. Geospatial Distribution of Oil &Gas Infrastructure in Nigeria: Fields, Pipelines, and Decommissioning



Environmental and safety concerns further compound these challenges. Aging infrastructure poses significant risks of oil spills and leaks, threatening marine ecosystems and local livelihoods. Ensuring the safety of personnel during decommissioning operations is another critical concern, given the hazardous nature of offshore work (Onoh, 2020). Also, examining

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decommissioning practices in other oil-producing countries offers valuable insights into potential solutions for Nigeria. For instance, Brazil has implemented a robust regulatory framework that mandates operators to establish decommissioning plans as part of their initial field development proposals. Similarly, Norway's Petroleum Act requires operators to allocate decommissioning funds throughout a field's

IV. METHODOLOGY

This meta-analysis evaluates data from peer-reviewed journals, industry reports, and case studies spanning the past two decades. The selection criteria focus on studies that examine:

The Role of JV Cash Calls in Oil and Gas Operations:Research examining the funding mechanisms of joint ventures (JVs) in Nigeria's oil and gas industry, particularly the impact of cash call obligations on project financing and operational continuity.

FPSO Decommissioning Frameworks in Nigeria:Studies evaluating decommissioning strategies, regulatory requirements, and case-specific analyses of FPSO asset retirement in Nigeria's offshore sector.

Financial Constraints Affecting Asset Retirement:Literature assessing the budgetary challenges, cost overruns, and delayed funding that influence the timing and execution of FPSO decommissioning projects.

Government Policies and Their Effectiveness:Reports and policy evaluations that measure the impact of Nigeria's regulatory framework, including enforcement mechanisms and incentives for decommissioning compliance.

The selected studies for this meta-analysis comprehensively evaluate the financial, regulatory, and operational challenges associated with FPSO decommissioning in Nigeria's oil and gas sector in Table 1. Adebayo and Smith (2018) highlight that persistent delays in joint venture (JV) cash call payments lead to project cost overruns and operational inefficiencies, making asset retirement financially burdensome for operators. Similarly, Okafor et al. (2020) emphasize that Nigeria's absence of a well-defined FPSO decommissioning framework has resulted in regulatory uncertainty, deterring investment in decommissioning projects.Johnson and Adekunle (2021) examine the financial constraints affecting asset retirement, reporting that high capital costs and funding inconsistencies significantly delay the decommissioning process.

Table 1. List of Selected Studies

Study	Focus Area	Key Findings
Adebayo & Smith (2018).	JV Cash Call Challenges	Cash call delays lead to project cost overruns and operational inefficiencies.
Okafor et al. (2020).	FPSO Decommissioning Frameworks	The lack of clear policies hinders structured FPSO decommissioning.
Johnson & Adekunle (2021).	Financial Constraints in Asset Retirement	High capital costs prevent timely asset retirement.
Uche & Nwosu (2022).	Regulatory Impact on Decommissioning	Weak regulatory enforcement prolongs FPSO operations beyond economic life.
Petroleum Industry Report (2023).	Economic Analysis of Decommissioning	Government incentives are insufficient for decommissioning funding.

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Their results align with Uche and Nwosu (2022), who argue that weak regulatory enforcement has prolonged the operational lifespan of FPSOs beyond their economic viability, increasing safety and environmental risks. Furthermore, the Petroleum Industry Report (2023) presents an economic analysis of decommissioning, concluding that existing government incentives are insufficient to encourage early retirement of aging offshore facilities. These studies collectively underscore the critical role of timely financial contributions, effective regulatory enforcement, and structured policy frameworks in mitigating the risks associated with FPSO decommissioning. The weighted averaging method applied in this meta-analysis ensures that findings from these studies are synthesized to provide a robust understanding of how cash call delays affect the decommissioning timeline and cost structure.

A systematic review was conducted, applying qualitative and quantitative techniques to synthesize findings. The data were analyzed using a weighted averaging method, which assigns significance to studies based on sample size, industry relevance, and empirical robustness. This approach enables an assessment of the correlations between cash call delays and decommissioning outcomes, offering a comprehensive understanding of financial constraints in FPSO decommissioning within Nigeria's oil and gas industry.

This meta-analysis draws from multiple peer-reviewed studies, industry reports, and case studies that examine the financial and regulatory challenges associated with Floating Production Storage and Offloading (FPSO) decommissioning in Nigeria's oil and gas industry. The selection criteria for these studies focus on key aspects such as the role of joint venture (JV) cash calls, FPSO decommissioning frameworks, financial constraints affecting asset retirement, and the effectiveness of government policies. By synthesizing these findings, this research provides a comprehensive understanding of how funding delays impact the timeline and execution of decommissioning activities.

Joint Venture (JV) Cash Call Challenges

One of the primary issues identified in FPSO decommissioning is the inconsistency in cash call payments, particularly from the Nigerian National Petroleum Corporation (NNPC). Adebayo and Smith (2018) conducted an extensive review of Nigeria's JV structure and found that delays in cash call remittances often lead to project cost overruns and operational inefficiencies. Their study highlights that the financial burden of decommissioning is primarily placed on international oil companies (IOCs), as government cash call contributions are frequently delayed or insufficient. The inability to secure timely funding forces operators to extend the operational lifespan of FPSOs beyond their economic viability, increasing both maintenance costs and environmental risks.

Additionally, Okafor et al. (2020) analyzed the financial implications of cash call delays and concluded that inconsistent JV contributions significantly hinder investment in asset retirement. Their findings indicate that FPSO decommissioning projects are often postponed due to uncertainties in cash flow, leading to increased financial exposure for oil companies. Without a structured mechanism to guarantee funding, operators struggle to plan and execute decommissioning in compliance with regulatory requirements. This challenge underscores the need for a more sustainable funding model, such as decommissioning escrow accounts or trust funds, to mitigate financial risks associated with FPSO retirements.

FPSO Decommissioning Frameworks in Nigeria

The absence of a clear regulatory framework for FPSO decommissioning in Nigeria further complicates the asset retirement process. Johnson and Adekunle (2021) examined existing industry guidelines and found that Nigeria lacks a well-defined roadmap for FPSO decommissioning, leading to inconsistencies in implementation. Their research highlights that while international standards such as those established by the International Maritime Organization (IMO) and the Oil and Gas UK Decommissioning Guidelines offer structured approaches to asset retirement, Nigeria's regulatory framework remains underdeveloped.Similarly, Uche and Nwosu (2022) argue that weak enforcement of decommissioning regulations has led to prolonged FPSO operations beyond their intended lifespan. Their study proves that several offshore facilities have exceeded their projected operational years due to financial constraints and regulatory inefficiencies. The researchers emphasize that government agencies such as the Nigerian Upstream Petroleum Regulatory Commission (NUPRC) and the Department of Petroleum Resources (DPR) must strengthen oversight and enforcement to ensure timely decommissioning. Failure to address these regulatory gaps not only prolongs environmental risks but also increases the financial liability for operators.

International Journal of Advances in Engineering and Management (IJAEM)
Volume 7, Issue 04 April 2025, pp: 857-872 www.ijaem.net ISSN: 2395-5252

Financial Constraints Affecting Asset Retirement

The cost of decommissioning FPSOs in Nigeria remains a significant challenge for operators. According to Johnson and Adekunle (2021), the high capital costs associated with FPSO retirement often deter companies from initiating decommissioning projects. Their study found that operators must prioritize production continuity over asset retirement without adequate financial planning, leading to long-term environmental and safety concerns. The researchers also highlight that fluctuating oil prices and economic downturns further exacerbate funding shortages, making it difficult for companies to allocate resources for decommissioning.Additionally, the Petroleum Industry Report (2023) provides an economic analysis of decommissioning costs and concludes that government incentives for asset retirement are insufficient. The report reveals that while some tax incentives and fiscal policies exist to encourage decommissioning, they are not robust enough to drive widespread compliance. In many cases, companies opt to defer decommissioning obligations due to the lack of immediate financial penalties for non-compliance. This finding suggests that stronger policy measures, such as mandatory decommissioning bonds or financial guarantees, could provide a viable solution to funding shortages.

Government Policies and Their Effectiveness

Regulatory and policy interventions ensure that FPSO decommissioning is conducted safely and on time. However, studies indicate that Nigeria's policy framework remains inadequate in addressing the complexities of asset retirement. Uche and Nwosu (2022) analyzed government policies related to decommissioning and found no dedicated legislative framework to guide operators through the process. Their study argues that while Nigeria's Petroleum Industry Act (PIA) provides some guidelines on asset retirement, it lacks specific provisions for FPSO decommissioning.Furthermore, Okafor et al. (2020) identified key policy shortcomings, including lacking funding mechanisms to support decommissioning initiatives. Their research suggests that establishing a national decommissioning fund could help bridge the financial gap and ensure operators can access dedicated resources for asset retirement. The study also emphasizes the need for improved coordination between government agencies and industry stakeholders to develop a standardized approach to FPSO decommissioning.

Hence, the selected studies in this meta-analysis collectively highlight the significant impact of cash call delays, financial constraints, and regulatory inefficiencies on FPSO decommissioning in Nigeria. The findings indicate that inconsistent JV cash call payments contribute to project delays and increased costs, while the absence of a clear regulatory framework exacerbates operational uncertainties. Financial constraints hinder asset retirement as companies struggle to secure adequate funding for decommissioning projects.

V. RESULTS

In Table 2. the correlation between cash call delays and decommissioning outcomes in Nigeria's oil and gas industry is well-documented in existing literature. Delays in joint venture (JV) funding, particularly cash calls from the Nigerian National Petroleum Corporation (NNPC), have led to prolonged decision-making timelines, with decommissioning projects experiencing an average delay of 12 to 24 months (Adebayo & Smith, 2018). Such funding inconsistencies have contributed to increased decommissioning costs, with estimates showing a 30–50% rise in overall expenditure due to extended asset operation (Johnson & Adekunle, 2021).

In addition to financial burdens, regulatory non-compliance has become more prevalent, with over 20 reported cases in the last decade due to operators failing to meet decommissioning obligations (Uche & Nwosu, 2022). The environmental impact of these delays is also severe, as outdated FPSOs pose significant oil spill risks, leading to increased marine degradation (Okafor et al., 2020). Moreover, the uncertainty surrounding decommissioning responsibilities has deterred international oil companies (IOCs) from making new investments, with a 40% decline in IOC interest in Nigeria's offshore oil and gas sector (Petroleum Industry Report, 2023). These results highlight the detrimental effects of cash call inefficiencies on FPSO decommissioning. The weighted averaging method used in this meta-analysis synthesizes these data points to establish a clear link between funding delays, regulatory challenges, and the rising financial and environmental risks associated with prolonged FPSO operations.

International Journal of Advances in Engineering and Management (IJAEM)
Volume 7, Issue 04 April 2025, pp: 857-872 www.ijaem.net ISSN: 2395-5252

Table 2. Correlation Between Cash Call Delays and Decommissioning Outcomes

Variable	Impact on FPSO Decommissioning
Cash Call Delays (Months)	12-24 months delay in decision-making
Decommissioning Cost Increase (%)	Costs rise by 30-50% due to extended asset operation
Regulatory Non-Compliance Cases	More than 20 cases have been reported in the last decade.
Environmental Hazard Reports	Significant oil spill risks and marine degradation
IOC Investment Decline (%)	Reduction in new investment by 40%

Impact of Cash Call Delays

The analysis of historical trends reveals that cash call delays have been a persistent challenge in Nigeria's oil and gas industry. Funding for decommissioning projects often experiences significant lags, primarily due to bureaucratic inefficiencies and macroeconomic constraints. These delays lead to cost escalations, with operators incurring additional expenses for extended equipment leasing, contractor mobilization, and project management (Usman & Adeoye, 2022). For instance, a review of FPSO decommissioning projects in Nigeria indicates that funding gaps have prolonged timelines by an average of 12-18 months, increasing overall project costs by up to 25% (Onoh, 2020).

Operational Risks

Cash call delays exacerbate operational challenges associated with FPSO decommissioning. Insufficient funding hampers the ability of operators to procure necessary equipment and services, disrupting project execution. This situation poses increased environmental and regulatory risks, as delays in decommissioning may result in deteriorating subsea infrastructure and potential oil spills. Furthermore, non-compliance with regulatory timelines exposes operators to fines and legal liabilities, compounding financial pressures (Nwosu & Obioha, 2020).

Economic and Policy Implications

The inefficiencies in the cash call mechanism have broader economic and policy implications. Delays in funding decommissioning projects strain Nigeria's JV partnerships, eroding investor confidence in the country's oil and gas sector. This situation further complicates attracting foreign investment for future exploration and production activities. The financial burden of delayed decommissioning also impacts Nigeria's fiscal policies, diverting resources from other critical sectors (Adamu, 2019). A comparative analysis with countries like Brazil and Norway highlights the need for policy reforms to enhance funding efficiency and ensure the sustainability of JV operations. The interrelationship between cash calls and decommissioning projects is rooted in the reliance of joint ventures on consistent funding for operational continuity. Cash calls are the primary mechanism through which NNPC and its international partners finance the various phases of offshore oil and gas projects, including decommissioning. The reliability of these cash calls directly affects the planning and execution of decommissioning activities. When funding is delayed, operators cannot mobilize resources, secure necessary permits, or engage contractors promptly, disrupting project timelines. These disruptions escalate costs and increase the risk of environmental and regulatory non-compliance, which can have long-term implications for Nigeria's oil and gas sector (Usman & Adeoye, 2022). The key factorsinfluencing funding delays:

First, several structural and economic factors influence funding delays in decommissioning Floating Production Storage and Offloading (FPSO) units. One of the primary contributors to these delays is bureaucratic inefficiency within the Nigerian National Petroleum Corporation (NNPC). The approval process for fund disbursement often involves multiple layers of administrative procedures, leading to significant time lags. This inefficiency is further compounded by a lack of transparency and accountability, which erodes confidence among joint venture (JV) partners (Adamu, 2019).

Second, macroeconomic constraints also play a significant role in delaying cash calls. Nigeria's dependence on oil revenues makes its economy highly susceptible to fluctuations in global oil prices (Ojumu&Osho, 2023). During low oil prices, government revenue is strained, making it challenging to meet cash call obligations. Additionally, competing budgetary priorities, such as infrastructure and social program funding, often precede decommissioning projects, exacerbating financial constraints (Onoh, 2020).

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Potential Solutions to Funding Delays

Addressing these challenges requires systemic reforms in the cash call system. One critical step is streamlining the approval process within NNPC to reduce bureaucratic bottlenecks. Implementing digital platforms can enhance transparency and accountability, ensuring that fund disbursements are efficiently processed. Transitioning to alternative funding mechanisms offers another viable solution. Escrow accounts and performance bonds provide a more predictable and secure funding framework, ensuring that resources are readily available for decommissioning projects. Establishing a dedicated decommissioning fund, jointly managed by NNPC and its JV partners, could mitigate the risks associated with funding delays, enhancing financial stability in project execution (Nwosu & Obioha, 2020).

Improved regulatory oversight is also essential for ensuring compliance with funding timelines and project execution standards. Regulatory bodies should establish clear guidelines and penalties for non-compliance, incentivizing timely fund disbursement and efficient project management. Lessons can be drawn from countries like Norway, where stringent regulatory frameworks have contributed to the timely execution of decommissioning projects. The Nigerian oil and gas sector can enhance financial discipline and project sustainability by strengthening regulatory mechanisms.

VI. CONCLUSION

The analysis of the cash call mechanism reveals its significant impact on the timely and effective decommissioning of FPSOs in Nigeria. Historical delays in funding have led to cost escalations, operational inefficiencies, and increased environmental and regulatory risks. Bureaucratic bottlenecks within the NNPC, macroeconomic constraints, and a lack of prioritization for decommissioning projects exacerbate these challenges. The reliance on cash calls has also strained joint venture (JV) partnerships, eroding investor confidence and complicating future financing efforts (Adamu, 2019; Onoh, 2020).The inefficiencies associated with the cash call system have broader implications for Nigeria's oil and gas industry. Delayed decommissioning projects pose environmental risks and undermine the country's ability to attract foreign investment. As global energy markets transition towards renewable energy sources, the need to efficiently manage existing oil and gas infrastructure becomes increasingly critical. Addressing the challenges posed by cash calls is essential for maintaining Nigeria's competitive edge in the global energy sector (Nwosu & Obioha, 2020).

Reforming the funding system is a crucial step towards enhancing the efficiency of decommissioning activities. Addressing cash call delays in decommissioning floating production storage and offloading (FPSO) units requires a multifaceted approach integrating policy reforms, technological advancements, regulatory oversight, and stakeholder collaboration. Policy reforms are essential in streamlining the cash call process and adopting alternative funding mechanisms to ensure the timely availability of financial resources. Thus, establishing escrow accounts and dedicated decommissioning funds can provide a more stable and predictable funding structure, reducing the risk of project delays. By implementing these financial strategies, Nigeria can enhance the efficiency and reliability of its funding mechanisms for decommissioning operations.Investing in technological innovation is another critical step in improving project execution. Advancements in cost-efficient decommissioning technologies can help reduce overall expenses while enhancing operational efficiency.

The oil and gas sector can optimize decommissioning timelines and minimize financial overruns by integrating modern engineering solutions, automation, and data-driven decision-making processes. Also, regulatory oversight is crucial in ensuring compliance with funding timelines and environmental standards. Strengthening the role of regulatory bodies by enforcing stricter financial accountability measures and environmental compliance frameworks can drive more disciplined project execution. Effective governance mechanisms will help mitigate risks associated with cash call delays and ensure that decommissioning projects align with international best practices. Similarly, collaboration among key stakeholders, including the Nigerian National Petroleum Corporation (NNPC), international oil companies (IOCs), and private sector partners, is vital for resource pooling and technical expertise sharing. A cooperative approach can lead to more efficient project management, leveraging collective industry experience to address financial and operational challenges in decommissioning efforts. Furthermore, by implementing these strategic actions, Nigeria can overcome the challenges associated with cash call delays, ensuring the sustainable management of FPSO decommissioning projects. A well-structured

approach will not only enhance financial stability but also safeguard the long-term viability of the country's oil and gas industry.

Policy Recommendations

Streamlining the cash call approval and disbursement process is essential to mitigate the delays that have historically plagued Nigeria's oil and gas sector. By simplifying bureaucratic procedures and implementing digital platforms for transparency, the Nigerian National Petroleum Corporation (NNPC) can enhance the efficiency of fund allocation. Encouraging private sector investment in decommissioning projects is another critical step. Public-private partnerships (PPPs) can provide the necessary capital and technical expertise, reducing the financial burden on the government. For example, Brazil's oil and gas sector has successfully leveraged PPPs to fund decommissioning activities, ensuring timely execution and compliance with international standards (Adamu, 2019; Onoh, 2020).

Operational Recommendations

From an operational perspective, adopting cost-efficient decommissioning technologies can significantly reduce project expenses. Advanced techniques such as remote-operated vehicle (ROV) interventions and modular dismantling systems offer safer and more economical alternatives to traditional methods. Additionally, operators should prioritize financial planning for end-of-life operations in FPSO contracts. By incorporating decommissioning costs into the initial project budget, companies can mitigate the risks associated with funding shortfalls during the final phases of a project's lifecycle (Ite et al., 2018).

Environmental Considerations

Ensuring compliance with international environmental standards is imperative for the sustainable management of decommissioning projects. Operators must adhere to guidelines set by organizations such as the International Maritime Organization (IMO) and the United Nations Environment Programme (UNEP). Investing in environmental restoration post-decommissioning is another critical aspect. Activities such as reef creation and habitat restoration can offset the ecological impacts of offshore oil and gas operations, contributing to marine biodiversity and long-term environmental sustainability (Nwosu & Obioha, 2020; Usman & Adeoye, 2022).

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