

Evaluating the Current Level of Safety and Health Practices in the Upstream Sector of the Nigerian Oil and Gas Industry-A Review

Zannah Alhaji Ali¹, Mohd Saidin Misnan²

^{1,2}Department of Quantity Surveying, Faculty of Built Environment and Surveying, University Technology Malaysia, 81310 Johor Bahru, Johor, Malaysia

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ABSTRACT

This study investigates the current state of safety and health practices in the Nigerian oil and gas industry, with a particular focus on the Niger Delta region. Recognized for its hazardous operations and significant economic contributions, the sector faces persistent risks such as oil spills, gas leaks, and equipment failures. The study aimed to evaluate the prevalence and severity of these risks and examine the effectiveness of risk-based safety strategies employed by companies to mitigate accidents and enhance worker safety. By addressing critical gaps in safety practices, this research contributes to the growing discourse on occupational health and safety in high-risk industries. A quantitative research design was employed, utilizing structured questionnaires to gather data from 300 industry professionals, including workers and stakeholders with direct experience in risk assessment. The study adopted purposive sampling to ensure respondents had sufficient expertise, and data were analyzed using descriptive statistics, including frequency tables, means, and standard deviations. Risk matrices further classified hazards based on their likelihood and severity, providing a systematic prioritization of safety concerns. The findings reveal a high prevalence of risks such as oil spills, gas leaks, and structural failures, exacerbated by aging infrastructure and inadequate maintenance practices. Despite efforts to implement risk-based safety strategies, inconsistencies persist in areas such as environmental risk consideration and emergency preparedness. While many organizations adhere to safety standards, gaps in compliance and enforcement remain significant challenges. The study highlights the importance of adopting advanced safety monitoring systems, enhancing employee training, and fostering stronger leadership involvement to address these issues.

Keywords: Safety Practices, Risk Assessment, Occupational Health, Oil and Gas Industry, Emergency Preparedness

INTRODUCTION

Ensuring a strong safety culture within the oil and gas sector is essential to maintaining operational security while also protecting human beings and the environment (Sugiono et al., 2020; Almazrouei et al., 2020; Glebova et al., 2023). This concept represents the collective perceptions, beliefs, attitudes, and standards of employees regarding safety inside their organization (Reason, 2016). Safety culture highlights the organization-wide dedication to safety, influencing the actions and decisions taken to prevent accidents and uphold a safe workplace (Goncalves Filho and Waterson, 2018). Its comprehensive adoption within organizational practices is critical, forming a fundamental element of the broader Health, Safety, and Environment (HSE) practices (Emetumah, 2016). A lack of robust safety culture can lead to severe consequences, including injuries and accidents amongst oil and gas personnel. Consequently, implementing strong accident prevention strategies is of utmost importance for this high-risk industry (Ehiaguina et al., 2024; Gao et al., 2019; Iqbal et al., 2019). The oil and gas industry faces numerous risks that significantly affect construction developments and day-to-day functions (Kassem et al., 2020). Despite its vital economic role, the sector is fraught with safety challenges that pose serious threats to workers, the surrounding environment, and local communities. In Nigeria alone, around 2018 to 2022, roughly 412 lives were lost due to industry-related incidents (Jeremiah, 2023). This period has seen multiple safety-related mishaps leading to fatalities, widespread environmental destruction, and substantial financial losses. The industry is further burdened by occupational hazards, including equipment failures, fires, oil spills, pipeline sabotage, and explosions, each contributing to devastating outcomes. Addressing these issues requires immediate attention through the implementation of advanced risk management frameworks, such as risk-based intervention

strategies and predictive modeling. Improving safety standards is essential to saving lives, mitigating environmental damage, and fostering sustainable development within the sector.

Numerous studies offer critical insights into methods and elements that can enhance safety standards in the oil and gas sector. For instance, Okezie et al. (2023) explored how organizational dynamics affect safety performance within oil and gas operations in Nigeria's Niger Delta region, identifying key internal factors influencing safety outcomes. Similarly, Ajmal et al. (2022) underscored the pivotal role of adhering to safety regulations in mitigating occupational risks and reducing workplace incidents, emphasizing the need for strong safety management systems. Additionally, Van Thuyet et al. (2007) delved into risk management practices in oil and gas industry, presenting adaptable strategies to boost safety measures in the sector. Complementing this, Khalilzadeh et al. (2020) stressed the significance of robust risk management techniques in enhancing project outcomes, which are indispensable for improving protection in oil and gas activities. These studies collectively illustrate the profound consequences of inadequate safety measures. Weak safety performance not only leads to financial losses but also tarnishes organizational reputation, triggers legal consequences, and exposes management to liability (Safety bank, 2019). Organizations working in regions like the Niger Delta face heightened risks due to safety lapses, which can result in severe legal and financial implications alongside adverse publicity. This underscores the critical need for prioritizing safety culture and implementing comprehensive strategies to mitigate these risks effectively.

The field of occupational health and safety (OHS) is undergoing a significant transformation. This change, which began around seventeen years ago, emerged as experts noticed that the decline in serious injuries and fatalities (SIFs) had plateaued, even in establishments with top-tier OHS systems (Walaski, 2016). Recent analyses by large organizations have identified critical shortcomings in conventional OH programs. Traditional, compliance-focused methods often fail to distinguish high-risk incidents from minor ones, treating all incidents uniformly and overlooking those with potentially severe outcomes. Additionally, reliance on Heinrich's injury hierarchy (the idea that reducing minor incidents would proportionally reduce severe ones) has been questioned for its validity in addressing high-severity risks. These programs also heavily depend on reactive measures, such as post-incident enquiries as well as lagging indicators, rather than proactive strategies designed to prevent future occurrences (Walaski, 2016). Another issue identified is the reliance on low-tier controls like personal protective equipment (PPE), operational procedures, and training programs. These controls often shift the responsibility onto workers while addressing critical hazards with insufficient preventive measures. As a result, many organizations have recognized the limitations of these approaches and are advocating for a paradigm shift in OHS strategies (Walaski, 2016). The focus is now on moving away from compliance-centric models toward systems that prioritize risk assessment and management. This shift aims to develop comprehensive safety management procedures that emphasize proactive strategies, higher-order controls, and the prevention of high-severity incidents, marking a significant evolution in workplace safety practices.

The oil and gas sector, characterized by its high-risk operations, has experienced several of the most catastrophic accidents in history, such as the Piper Alpha mishap in the North Sea and the Macondo blowout in the Gulf of Mexico. All these incidents resulted in significant loss of life, massive property destruction, and extensive legal disputes (Mandal & Agarwal, 2023). Basically, risk is defined as the combination of the likelihood of an undesired event and the severity of its potential consequences (Aalabaf-Sabaghi, 2023). In the offshore sector of oil and gas, insufficient risk management has always been a critical factor contributing to several high-profile accidents. These occurrences have led to the forfeiture of hundreds of lives, severe environmental degradation, and immense financial losses (Hosseinian Davatgar et al., 2021). Risk-based approaches aim to simultaneously reduce the probability of adverse events and minimize their severity when they occur. This method involves a proactive and systematic approach to identifying, evaluating, and controlling risks to avert accidents and enhance safety (Naji et al., 2021). It requires a detailed analysis of potential hazards, an assessment of their possibility and potential impacts, and the implementation of suitable mitigation measures. Given the inherent dangers connected with the production, exploration, and transportation processes in the oil and gas sector, adopting a risk-based approach is essential. Organizational dynamics significantly influence the industry's safety performance, underlining the importance of integrating these strategies at all levels of operation (Okezie et al., 2023). Risk-based security assessments focus on understanding and managing the possible risks linked to accidents, including damage to assets and environmental contamination (Paik & Paik, 2020). These assessments hold companies accountable for ensuring employee safety and reducing the chances of catastrophic incidents.

By employing risk-based safety measures, companies can effectively filter and address potential hazards, ultimately leading to enhanced safety performance and a lower likelihood of severe accidents (Stefana et al., 2022).

The oil and gas sector faces critical challenges in ensuring safety and mitigating risks despite its economic importance. Catastrophic incidents, such as the Piper Alpha disaster and the Macondo blowout, highlight the severe consequences of inadequate safety and risk management, including loss of life, environmental damage, and financial setbacks (Mandal & Agarwal, 2023; Hosseinnia Davatgar et al., 2021). As earlier identified in Nigeria, over 412 lives were lost between 2018 and 2022 due to safety lapses, emphasizing the urgent need for enhanced safety measures (Jeremiah, 2023). Current compliance-focused occupational health and safety (OHS) practices have proven insufficient, often neglecting proactive strategies and higher-order controls necessary for addressing high-severity risks (Walaski, 2016). This necessitates a transition toward risk-based safety strategies that prioritize systematic risk evaluation and prevention to improve safety outcomes and reduce operational hazards across the industry. This study aims to evaluate the effectiveness of risk-based safety strategies in improving safety performance and mitigating risks in the oil and gas industry, with a focus on addressing high-severity incidents. The objectives of the study is to:

1. To analyze evaluate the level of safety and health risks experienced within the oil and gas sector in the Niger Delta region in Nigeria
2. To examine the risk-based safety strategies adopted by companies in an effort towards reducing the frequency and severity of accidents in oil and gas operations.

LITERATURE REVIEW

Safety Climate in the Oil and Gas Industry

Oil was first detected in Nigeria at Oloibiri in 1956, and since then, it has become the country's leading export commodity. Nigeria holds the distinction of being Africa's leading exporter of crude oil. Prominent companies such as Chevron Nigeria, Total Upstream Nigeria, and Mobil Producing Nigeria are major players in the country's oil exploration activities. However, these operations frequently expose workers and nearby communities to various hazards and risks (Christou and Konstantinidou, 2012). According to Asikhia and Emenike (2013), despite governmental regulations aimed at promoting occupational safety and health in the oil and gas sector, significant dangers still persist for both workers and communities. Biological hazards, including viruses, toxins, fungi, and other bioactive agents, pose considerable health risks to those exposed (International Labor Organization, 2017). Women, particularly pregnant women, are especially vulnerable to these hazards, as exposure to certain substances can harm fetal health, potentially leading to congenital disabilities or higher infant casualty rates (Guiffrida et al., 2001). The health risks associated with the oil and gas sector are substantial. Around 2014 to 2015, Africa reported the greatest number of industry-related fatalities globally, according to the International Association of Oil and Gas Producers (International Labor Organization, 2017). The fatality rate in this sector is reported to be 2.5 times higher than in the construction industry and seven times higher than in general industry (Witter et al., 2014). Offshore production and exploration come with their own unique set of challenges, including physical injuries, psychological stress from long-distance travel over water, and ailments caused by extreme environmental conditions. Employees on offshore drilling platforms often face mental health issues due to isolation and prolonged work schedules in remote locations (International Labor Organization, 2017).

Activities on offshore rigs have frequently led to severe accidents with catastrophic consequences for employees' health, environmental safety, and economic stability. Such incidents emphasize the need for comprehensive data gathering and reporting to address these risks effectively (Christou and Konstantinidou, 2012). Effective risk management is critical, as it significantly influences the industry's financial stability, quality of operations, and overall execution. Proper management is integral to decision-making processes, yet recent studies to assess the occupational health risks for Nigerian refinery and petrochemical personnel remain scarce (Osabutey et al., 2013). Moreover, Aliyu and Saidu (2011) highlight the importance of follow-up research to identify specific risk factors and mitigate health hazards in the industry. The process of transforming crude oil into various energy products, such as gasoline, natural gas liquids, diesel, and other derivatives, is known as downstream operations. This sector is primarily in charge of producing goods like lubricants, liquefied natural gas, heating oil, fertilizers,

synthetic rubber, plastics, and pesticides (Investopedia, 2024). According to Akinlo (2012), the Nigerian government plays a dominant role in both regulatory and commercial aspects of downstream activities, including the distribution and transportation of petroleum products. Due to the lack of local water transport and the collapse of the railway system, petroleum products in Nigeria are predominantly transported through trucks and pipelines. Similar to other countries, Nigeria's pipeline systems for liquid petroleum manufactured goods traverse open land instead of secure industrial zones. This increases the likelihood of third-party interference, compromising the pipelines' integrity. The fusion of the pipeline routes and external interference also exposes nearby communities to significant risks in the event of pipeline failures (Ambituuni, 2016).

Research on risk and safety management within the downstream sector has been limited, and a universally accepted framework for assessing and moderating safety and environmental hazards in Nigeria's petroleum industry remains undeveloped. Accidents in downstream operations often result in severe economic losses and adverse environmental and safety impacts (Ambituuni, 2016). Regulatory compliance and effective safety administration practices are critical in enhancing safety performance, minimizing occupational injuries, and reducing accidents in the oil and gas sector (Ajmal et al., 2022). As noted by Mgbowaji et al. (2023), addressing challenges like oil spills, valve and seal failures, infrastructure deficiencies, and security concerns is essential to improving safety outcomes in this industry.

Regulatory Frameworks and Safety Practices

The regulatory landscape in the Nigerian oil and gas sector has evolved over the years, with frameworks such as the Environmental Guidelines and Standards for the Petroleum Industry in Nigeria (EGASPIN) and the Petroleum Industry Act (PIA) of 2021 aiming to enhance health and safety standards. EGASPIN, for instance, sets out comprehensive safety protocols across exploration, production, and decommissioning phases. However, studies show that the enforcement of these regulations is inconsistent, often due to capacity constraints within regulatory bodies such as the Department of Petroleum Resources (DPR) (Babalola et al., 2022). The PIA has introduced provisions for enhanced safety measures and stricter penalties for non-compliance, signaling a shift toward greater accountability in the sector. Yet, challenges persist, including a lack of trained personnel to monitor compliance effectively and financial limitations faced by smaller operators. Research by Okoro et al. (2021) highlights the disparity in compliance levels between multinational corporations and indigenous firms, with the former often subject to stricter scrutiny due to their international stakeholders.

Technology adoption is another critical area where the Nigerian oil and gas industry lags behind global peers. Real-time monitoring systems, for example, have been instrumental in improving safety practices in countries like Norway and Qatar but remain underutilized in Nigeria. The limited uptake of such technologies can be attributed to cost concerns and a lack of technical expertise (Ajibade et al., 2020). Strengthening regulatory frameworks through increased funding and capacity building could address these gaps, ensuring more consistent application of safety standards across the sector.

Occupational Health Risks in the Oil and Gas Sector

Occupational health risks in the Nigerian oil and gas industry are multifaceted, encompassing physical, chemical, and biological hazards. Workers are frequently exposed to toxic substances such as hydrogen sulfide and volatile organic compounds, leading to chronic respiratory issues and other long-term health conditions (Adebiyi et al., 2022). The prevalence of ergonomic stressors, such as heavy lifting and repetitive tasks, also contributes to musculoskeletal disorders, further exacerbating health challenges in the industry (Ayoade et al., 2021). Health surveillance systems, which are critical for early detection and prevention of work-related illnesses, are often underdeveloped in Nigeria. While multinational corporations typically implement robust health monitoring programs, local operators frequently lack the resources to provide similar services (Elenwo & Akankali, 2020). Additionally, the high incidence of oil spills and gas flaring in the Niger Delta has led to significant environmental degradation, indirectly impacting the health of workers and nearby communities (Ezeh et al., 2023). Efforts to mitigate these risks include the mandatory use of personal protective equipment (PPE) and periodic health assessments. However, compliance remains a challenge, particularly among smaller firms that prioritize cost-cutting over safety investments. Partnerships with international organizations, such as the International Labour Organization (ILO), could help bridge these gaps by providing technical assistance and funding for capacity-building initiatives (Olawuyi et al., 2021). The implementation of targeted training

programs tailored to the unique challenges of the Nigerian oil and gas industry could also enhance worker safety and health outcomes.

Empirical Review

The oil and gas industry in Nigeria is a cornerstone of the national economy, but it operates under conditions that pose significant risks to workers' safety and health. This sector's unique challenges, including hazardous operations, environmental concerns, and a high dependency on regulatory compliance, demand a comprehensive examination of safety and health practices. Research indicates that while efforts have been made to strengthen occupational health and safety (OHS) frameworks, systemic issues persist, affecting the effectiveness of these measures. Studies on the perception of safety climates within the industry have highlighted critical issues related to organizational transitions and their impact on safety practices. Research by Djunaidi et al. (2024) demonstrated that ownership changes in oil and gas companies often lead to a decline in safety climate perceptions among employees. This is particularly relevant in the Nigerian oil and gas sector, where ownership and operational changes frequently occur, especially in the downstream sector. The research underscores the importance of sustained management commitment and transparent communication in maintaining a consistent safety culture, particularly during periods of change. Without these, disruptions can erode employee confidence in safety systems, increasing the likelihood of accidents and non-compliance.

An empirical review of safety practices in Nigeria's oil and gas sector underscores significant variability in the implementation and effectiveness of safety measures. Obiorah et al. (2019) reported that while safety policies and management commitment are integral to the sector, these are often undermined by inconsistent enforcement. Although many organizations have formal safety policies, these are not always supported by sufficient training programs or financial resources. The study further highlights that educational attainment among employees significantly affects adherence to safety protocols. Workers with higher education levels tend to comply more with safety measures, emphasizing the need for targeted capacity-building programs to address gaps in knowledge and practice among less-educated employees.

Risk assessment and management remain another critical area of concern in Nigeria's oil and gas sector. Maduabuchi et al. (2023) identified several barriers to effective risk management, including limited access to real-time equipment data, insufficient expertise in advanced risk assessment techniques, and the absence of predictive tools for process safety. These limitations hinder the ability of organizations to anticipate and mitigate risks, particularly in infrastructure maintenance. The prevalence of aging pipelines and inadequate valve systems in the Nigerian oil sector exacerbates these challenges, increasing the likelihood of spills and other hazardous incidents. The study suggests that adopting digital technologies, such as predictive analytics and IoT-enabled monitoring systems, could significantly improve risk management outcomes. The relationship between employees' knowledge, attitudes, and compliance with safety protocols has also been a focus of research in similar industries across Africa. A study by Quaigrain et al. (2022) in Ghana's oil and gas sector found high levels of safety knowledge and generally positive attitudes among workers but noted gaps in translating this awareness into consistent compliance. These gaps were attributed to insufficient enforcement of safety rules and cultural tendencies to prioritize task completion over adherence to protocols. The findings have parallels in Nigeria, where similar challenges exist, underscoring the importance of strengthening enforcement mechanisms and fostering a culture that prioritizes safety over productivity shortcuts.

Efforts to identify and mitigate hazards in Nigeria's oil and gas industry have yielded valuable insights into the unique risks associated with this industry. Zacchaeus et al. (2023) developed a hazard checklist tailored to the Nigerian context, identifying issues such as outdated infrastructure, frequent equipment failures, and pervasive oil spills. The study emphasized the necessity for alignment with international standards like ISO 45001 to enhance the effectiveness of hazard mitigation strategies. Given the sector's susceptibility to catastrophic events, such as pipeline explosions and environmental contamination, adopting globally recognized safety standards is critical to safeguarding both human lives and the ecosystem. Leadership practices within the industry also significantly influence OHS outcomes. Vik-Benibo et al. (2024) explored the role of leadership in shaping safety cultures in Nigeria's oil and gas industry, finding that deficiencies in collaborative practices, feedback mechanisms, and worker engagement hinder safety performance. Managers often fail to incorporate input from frontline workers during safety planning, resulting in strategies that lack practical applicability. The study

recommends behavioral safety training for leaders and the establishment of 360-degree feedback systems to improve accountability and foster collaborative safety planning.

Comparative studies have highlighted disparities between the oil and gas sector and other industries in Nigeria regarding safety culture and practices. Olaniran and Akinbile (2023) compared OHS practices in the oil and gas and construction sectors, finding that the former exhibits better adherence to safety standards due to higher regulatory scrutiny and global pressure. However, both sectors face challenges related to inadequate enforcement of safety policies and limited investment in safety initiatives. These findings underscore the need for a more robust regulatory framework and increased financial commitment to safety improvements across high-risk industries. The integration of Human Factors Engineering (HFE) into workplace safety strategies has emerged as a promising approach to enhancing safety outcomes. Thomas et al. (2024) examined the impact of HFE on safety performance in Nigeria's oil construction sector, revealing that poor ergonomic design and inadequate consideration of human-system interactions contribute to workplace accidents. Incorporating HFE principles during the design phase of facilities can ensure that safety considerations are embedded from the outset, reducing the likelihood of accidents caused by design flaws or operational inefficiencies.

Policy alignment and prioritization of safety culture components are essential for driving improvements in safety outcomes. Rahim et al. (2024) used the Analytic Hierarchy Process (AHP) as a scale to rank safety culture components in Malaysia's oil and gas industry, identifying management commitment, safety rules and procedures, and regular training programs as the most critical factors. While the Nigerian context presents unique challenges, these findings provide a useful framework for prioritizing safety initiatives, emphasizing the importance of leadership, policy adherence, and continuous training.

Literature Gap

A notable gap in the current literature is the limited empirical research assessing the effectiveness of risk-based safety strategies in the Nigerian oil and gas sector, specifically within the context of the Niger Delta region. While several studies have identified the significant occupational health risks, regulatory challenges, and safety issues in the industry, there is a lack of in-depth evaluation of the actual risk management frameworks implemented by companies in the region. Although some research touches on safety climate perceptions, compliance, and environmental hazards, studies focusing on how specific risk-based strategies are adopted and their direct impact on reducing accidents and fatalities are scarce. Moreover, the influence of local factors, such as infrastructure deficiencies, security concerns, and cultural attitudes towards safety, on the implementation and success of these strategies remains underexplored. Given the unique operational environment in the Niger Delta, further research is needed to analyze the specific strategies used by both multinational and indigenous firms, and how these strategies compare to international best practices in terms of effectiveness, sustainability, and adaptability in mitigating the risks inherent to the sector.

METHODOLOGY

The study employed a robust and systematic methodology to investigate safety and health risks within the oil and gas sector of the Niger Delta region, using a quantitative research design approach.

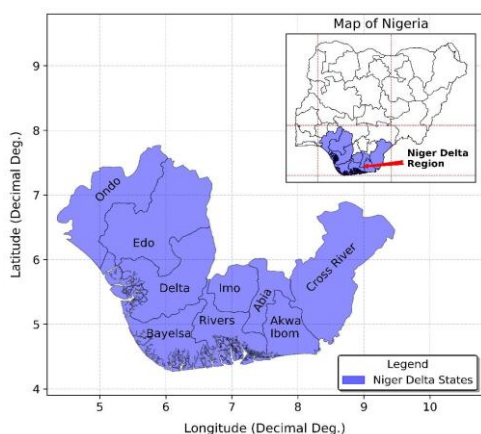


Figure 1: Study Area (Ikhumetse et al. 2022)

The study adopted a structured questionnaires to evaluate the landscape of safety and health risks and also identify the safety and health measures adopted in oil and gas companies. The structured questionnaire targeted industry experts, workers, and stakeholders with direct experience in risk assessment. Questions were designed to elicit respondents' perceptions of the likelihood and severity of various safety and health risks and also rate the level of adoption of safety and health measures in their organizations, utilizing a Likert scale model. Participants were purposively selected to ensure relevance and depth of responses, with a focus on individuals who had at least six months of experience in the industry and prior involvement in risk assessment. Exclusions included interns and National Youth Service Corps members. To achieve a robust dataset, 300 questionnaires were distributed physically and online, with a 10% allowance added to account for potential non-responses, resulting in a minimum sample size of 330 participants meeting the inclusion criteria.

Data analysis employed descriptive statistics, including means and standard deviations, to evaluate the responses. Frequency tables were particularly useful in assessing the extent to which safety and health measures were adopted within organizations, as perceived by the respondents. This approach enabled a complex understanding of variations in safety and health risk mitigation methods across different job roles and risk categories. The means and standard deviations were computed to assess the average perception of employees on the severity of safety and health risks/challenges and also to assess their likelihood of occurrence. The use of risk matrices further classified risks into levels (low, moderate, high, and critical) facilitating a visual and systematic prioritization of areas requiring immediate intervention.

FINDINGS

Safety and Health Risks in Oil and Gas Industry in Niger Delta

Table 1: Demographics

Demographics Criteria	Distribution	Frequency	Percent (%)	Cumulative Percent (%)
Gender	Male	188	62.7	62.7
	Female	112	37.3	100
Age Group	18 to 30 years	81	27	27
	31 to 40 years	113	37.7	64.7
	41 to 50 years	66	22	86.7
	51 to 60 years	19	6.3	93
	Above 60	21	7	100
Highest Educational Qualification	Secondary School	44	14.7	14.7
	Diploma	146	48.7	63.3
	Bachelor's Degree	94	31.3	94.7
	Postgraduate Degree	16	5.3	100

The demographic distribution of respondents provides critical insights into the composition of the study's participants, reflecting a diverse group in terms of gender, age, and educational qualifications. Out of the total

300 participants, the majority were male (62.7%), while females constituted 37.3%. This gender disparity highlights the male-dominated nature of the oil and gas sector in the Niger Delta region, a trend consistent with the industry's global workforce distribution. The cumulative percentage confirms that all genders were accounted for in the study, ensuring a comprehensive analysis of perceptions across the gender spectrum.

In terms of age distribution, the largest group of respondents (37.7%) were aged between 31 to 40 years, followed by the 18 to 30 years age group (27%) and the 41 to 50 years group (22%). The smallest representation came from individuals aged 51 to 60 years (6.3%) and those above 60 years (7%). This age distribution indicates a predominantly middle-aged workforce actively engaged in the industry, which aligns with the technical and physically demanding nature of roles in the sector. The cumulative percentages confirm that younger and older demographics were proportionally included, ensuring diverse insights into safety and health risk perceptions. Regarding educational qualifications, the data reveal a workforce with varying levels of formal education. Nearly half of the participants (48.7%) held a diploma, indicating a preference for technical qualifications in the oil and gas sector. Bachelor's degree holders constituted 31.3% of the sample, while participants with secondary school education accounted for 14.7%. Those with postgraduate degrees formed the smallest group at 5.3%. This distribution reflects the emphasis on technical expertise in the industry, with a significant proportion of workers attaining diploma-level education to meet operational requirements. The inclusion of respondents across all educational levels supports the reliability of findings, as perspectives from individuals with different educational backgrounds enhance the study's depth and validity.

Table 2: Occurrence of Hazardous Events in the Oil and Gas Sector

Hazardous Event	Percentage
Environmental and Weather Hazards	90%
Oil Spills	95%
Gas Leak	85%
Fire/Explosion	80%
Structural Failures	70%
Valve Failure	45%
Seal Failure	42%
Metal Deterioration	75%
Blowouts or Loss of Control	76%
Gas Accumulation in Confined Spaces	38%
Hot Work Hazards	55%
Electrical System Failures	60%
Security Threats (e.g., Vandalism, Piracy)	84%
Fatigue and Human Errors	75%

The results on Table 2 above indicate a high prevalence of various safety and health risks in the oil and gas sector within the Niger Delta region, underscoring the industry's inherently hazardous nature. Oil spills were reported as the most frequently occurring hazardous event, with 95% of respondents acknowledging their occurrence.

This aligns with the region's history of frequent spills, often resulting from pipeline ruptures, equipment failures, or vandalism. Environmental and weather hazards also ranked highly, with a 90% occurrence rate, reflecting the vulnerability of the industry to the Niger Delta's challenging environmental conditions, including heavy rainfall, flooding, and coastal erosion.

Gas leaks were identified by 85% of respondents as a significant hazard, emphasizing the sector's susceptibility to equipment failures and operational lapses that can result in catastrophic incidents. Fire and explosions were reported by 80% of respondents, further highlighting the flammable and volatile nature of hydrocarbons handled in the industry. Structural failures and metal deterioration also emerged as major risks, cited by 70% and 75% of participants respectively, likely attributable to aging infrastructure and insufficient maintenance practices.

While valve and seal failures were noted by 45% and 42% of respondents respectively, these events were less frequent compared to other hazards, possibly due to stricter monitoring and maintenance protocols for critical components. Similarly, gas accumulation in confined spaces, which can lead to asphyxiation or explosions, was acknowledged by 38% of respondents, suggesting a need for better ventilation and safety measures in enclosed operational areas. Human factors also play a crucial role in the occurrence of hazardous events. Fatigue and human errors were reported by 75% of respondents, underscoring the importance of addressing workforce management issues, including extended work hours and inadequate training. Hot work hazards, such as welding and cutting, were cited by 55% of respondents, while electrical system failures were identified by 60%, both pointing to risks associated with operational activities and the need for stringent adherence to safety protocols.

Security threats, including vandalism and piracy, were reported by 84% of respondents, reflecting the region's socio-political instability and its impact on oil and gas operations. This highlights the intersection of external security challenges with operational safety, emphasizing the need for robust security measures alongside technical safeguards. These findings collectively illustrate a complex safety landscape, necessitating comprehensive risk management strategies to mitigate these persistent challenges in the oil and gas sector.

Table 3: Mean Responses on Likelihood of Safety and Health Issues

Index	Likelihood of Issues	Mean	Std. Deviation	Rank
L1	Poor Design or Construction	2.89	1.178	4
L2	Excessive Vibration	3.15	1.01	2
L3	Substandard Materials Used	3.17	0.82	1
L4	Overloading of Platform	2.69	1.15	7
L5	Improper Storage of Inflammable Substances	2.40	1.18	9
L6	Poor Electrical Design or Connection	2.86	1.14	5
L7	Corroded Equipment and Pipelines	3.15	0.90	2
L8	Improper Maintenance Practices	2.50	1.20	8
L9	Inadequate Emergency Preparedness	2.95	1.17	3
L10	Inadequate Risk Assessments	2.77	1.03	6

The study assessed the likelihood of various safety and health issues within the oil and gas sector, as reflected in the responses from industry participants. The results on Table 3 show a diverse range of perceived risks, with varying degrees of likelihood. The most frequently identified issue was the use of substandard materials (mean = 3.17, std. dev = 0.82), which was ranked first. This suggests that respondents view poor-quality materials as a

significant concern, likely due to their potential to cause equipment failures, structural weaknesses, or operational inefficiencies. Following closely, excessive vibration (mean = 3.15, std. dev = 1.01) and corroded equipment and pipelines (mean = 3.15, std. dev = 0.90) were also highlighted as highly likely issues. These problems, particularly corrosion, are critical in the oil and gas industry due to their direct link to pipeline and equipment integrity, which can result in hazardous spills or failures. Poor design or construction (mean = 2.89, std. dev = 1.178) emerged as the fourth most likely issue. Inadequate planning or errors during the design phase can lead to operational inefficiencies and safety risks, such as structural weaknesses or equipment malfunction. The likelihood of overloading platforms (mean = 2.69, std. dev = 1.15) was ranked seventh, indicating concerns about operational capacity and the potential for accidents caused by exceeding safety thresholds. Improper storage of inflammable substances (mean = 2.40, std. dev = 1.18) was ranked the lowest, reflecting the relatively lower likelihood of this issue in the respondents' perception, though it remains a notable concern given the hazardous nature of the substances involved. Other issues, such as poor electrical design or connection (mean = 2.86, std. dev = 1.14) and inadequate emergency preparedness (mean = 2.95, std. dev = 1.17), were also significant, with participants perceiving these as likely as but somewhat less so than other factors like substandard materials and corrosion.

Table 4: Mean Responses on Severity of Safety and Health Risks

Index	Severity of Issues	Mean	Std. Deviation
L1	Poor Design or Construction	3.11	0.73641
L2	Excessive Vibration	3.20	0.84481
L3	Substandard Materials Used	2.62	1.21369
L4	Overloading of Platform	2.94	1.16532
L5	Improper Storage of Inflammable Substances	3.13	0.90555
L6	Poor Electrical Design or Connection	2.5567	1.17675
L7	Corroded Equipment and Pipelines	2.8167	1.04244
L8	Improper Maintenance Practices	3.2233	0.96431
L9	Inadequate Emergency Preparedness	3.0067	1.15081
L10	Inadequate Risk Assessments	2.76	1.15478

The study evaluated the severity of impacts associated with various safety and health issues in the oil and gas sector. The findings on Table 4 highlight notable concerns across several key areas, with some issues perceived as having particularly severe consequences. Improper maintenance practices were identified as the issue with the most severe impact (mean = 3.22, std. dev = 0.96). This underscores the critical importance of regular and effective maintenance in mitigating risks and ensuring operational safety. Excessive vibration (mean = 3.20, std. dev = 0.84) also ranked highly in terms of severity, likely due to its potential to cause structural failures, equipment damage, and operational downtime. Improper storage of inflammable substances (mean = 3.13, std. dev = 0.91) and poor design or construction (mean = 3.11, std. dev = 0.74) were also perceived as significant concerns. The high severity associated with these issues reflects their capacity to escalate into catastrophic events, such as fires or structural collapses. Similarly, overloading of platforms (mean = 2.94, std. dev = 1.17) and inadequate emergency preparedness (mean = 3.01, std. dev = 1.15) highlight operational vulnerabilities that could amplify the consequences of safety incidents. Substandard materials (mean = 2.62, std. dev = 1.21) and corroded equipment or pipelines (mean = 2.82, std. dev = 1.04) were perceived to have moderately severe impacts. These findings indicate concerns about material integrity and equipment durability, both of which are essential to maintaining safe operations. On the lower end of the spectrum, poor electrical design or connections (mean = 2.56, std. dev = 1.18) and inadequate risk assessments (mean = 2.76, std. dev = 1.15) were rated as less

severe but remain relevant given their potential to compound other risks.

Table 5: Risk Analysis of Severity of Safety and Health Challenges

Index		Likelihood	Severity	Risk Score	Risk Rating
L1	Poor Design or Construction	2.89	3.11	8.99	High
L2	Excessive Vibration	3.15	3.20	10.08	Very High
L3	Substandard Materials Used	3.17	2.62	8.32	High
L4	Overloading of Platform	2.69	2.94	7.93	High
L5	Improper Storage of Inflammable Substances	2.40	3.13	7.50	High
L6	Poor Electrical Design or Connection	2.86	2.56	7.32	High
L7	Corroded Equipment and Pipelines	3.15	2.82	8.86	High
L8	Improper Maintenance Practices	2.50	3.22	8.07	High
L9	Inadequate Emergency Preparedness	2.95	3.01	8.87	High
L10	Inadequate Risk Assessments	2.77	2.76	7.64	High

Risk Score = likelihood x severity

The risk analysis of safety and health challenges in the oil and gas sector provides valuable insights into the potential impact and likelihood of various issues. The findings on the Table 5 indicate that Excessive Vibration poses the most significant risk (risk score = 10.08, rated as Very High). This suggests that vibration-related hazards, which can affect structural integrity and equipment performance, are a critical concern requiring immediate attention. Other challenges, including Poor Design or Construction (risk score = 8.99, High), Corroded Equipment and Pipelines (risk score = 8.86, High), and Inadequate Emergency Preparedness (risk score = 8.87, High), were also identified as substantial risks. These findings highlight the need for robust design practices, material integrity, and effective emergency response mechanisms to mitigate operational vulnerabilities. Substandard Materials Used (risk score = 8.32, High), Improper Maintenance Practices (risk score = 8.07, High), and Overloading of Platform (risk score = 7.93, High) further underline the importance of quality assurance in materials and ongoing maintenance protocols. These risks reflect potential long-term threats to operational efficiency and worker safety. While Improper Storage of Inflammable Substances (risk score = 7.50, High) and Inadequate Risk Assessments (risk score = 7.64, High) were slightly lower in their risk scores, they remain significant concerns. Both issues emphasize the importance of proper storage procedures and comprehensive risk evaluations to prevent compounding other hazards. Poor Electrical Design or Connection (risk score = 7.32, High) represents a critical area for improvement. This result underscores the need for rigorous electrical safety standards and inspections to prevent potential electrical fires or system failures.

Consequences		Minor Damage	Damage	Severe	Catastrophic
Likelihood	Very Likely				
	Likely			L1, L2,L3, L4, L6, L7, L9, L10	
	Unlikely			L5, L8	

	Very Unlikely				
	Risk Rating				
	Low	Moderate	High	Very High	

Figure 2: Risk matrix on Safety and Health Risks

From the Figure, the majority of the risks identified in the oil and gas sector are classified under Likely in terms of their likelihood of occurrence and Severe in terms of their consequences. These include Poor Design or Construction (L1), Excessive Vibration (L2), Substandard Materials Used (L3), Overloading of Platform (L4), Poor Electrical Design or Connection (L6), Corroded Equipment and Pipelines (L7), Inadequate Emergency Preparedness (L9), and Inadequate Risk Assessments (L10). The fact that these risks are likely to occur and have severe consequences indicates that they are among the most critical hazards that organizations in the sector face regularly. For example, Poor Design or Construction (L1) could lead to significant structural failures if not addressed properly, while Excessive Vibration (L2) could result in machinery damage or safety risks for workers. Similarly, Substandard Materials Used (L3) could undermine the safety integrity of the entire system, making it susceptible to failure under stress. Addressing these risks requires proactive measures, including improving the design process, ensuring high-quality materials, and conducting frequent risk assessments and safety audits. Additionally, Improper Storage of Inflammable Substances (L5) and Improper Maintenance Practices (L8) are classified as Unlikely to occur but Severe in terms of consequences. Although these issues are not as common, their potential impact could be catastrophic if they do occur. Improper Storage of Inflammable Substances (L5) can lead to fires or explosions, which could result in significant loss of life and property damage, making it critical for companies to enforce stringent storage guidelines and safety protocols. Similarly, Improper Maintenance Practices (L8) could cause equipment failures or safety incidents, especially if vital systems are not properly maintained or repaired. These issues highlight the importance of developing a safety culture that emphasizes routine inspections, maintenance checks, and staff training to mitigate such risks.

Safety and health Practices/Measures adopted by Oil and Gas Firms

Table 6: Safety Practices Design and Construction

		Frequency	Percent	Cumulative Percent
The organization's infrastructure meets national and international safety standards.	Strongly Disagree	45	15	15
	Disagree	60	20	35
	Neutral	47	15.7	50.7
	Agree	80	26.7	77.3
	Strongly Agree	68	22.7	100
Only certified and durable materials are used in platform and pipeline construction.	Strongly Disagree	14	4.7	4.7

	Disagree	39	13	17.7
	Neutral	63	21	38.7
	Agree	102	34	72.7
	Strongly Agree	82	27.3	100
Risk assessments are conducted before construction begins.	Strongly Disagree	38	12.7	12.7
	Disagree	28	9.3	22
	Neutral	79	26.3	48.3
	Agree	109	36.3	84.7
	Strongly Agree	46	15.3	100
Design procedures consider environmental risks (e.g., earthquakes, extreme weather).	Strongly Disagree	69	23	23
	Disagree	28	9.3	32.3
	Neutral	41	13.7	46
	Agree	87	29	75
	Strongly Agree	75	25	100

The results from the Table 6 above on safety practices in the design and construction of oil and gas infrastructure reveal a varied range of responses across several key areas. These practices are essential in ensuring that the infrastructure is safe and meets both national and international standards. When asked whether the organization's infrastructure meets national and international safety standards, responses were spread across the spectrum. A significant portion of respondents, 22.7%, strongly agreed, and 26.7% agreed that the infrastructure meets safety standards. This indicates that, in general, there is a recognition of adherence to safety protocols within the organization. However, 20% disagreed and 15% strongly disagreed, suggesting that there are still concerns among some stakeholders regarding compliance with safety standards. These responses highlight the need for continuous monitoring and possible improvements in the consistency of meeting safety standards across projects.

Regarding the use of certified and durable materials in platform and pipeline construction, the responses showed a more positive trend. 34% agreed and 27.3% strongly agreed that only certified materials are used, reflecting a strong commitment to ensuring quality and safety in construction. However, 13% disagreed and 4.7% strongly disagreed, indicating a small proportion of respondents believe that substandard materials may still be used in certain cases. These concerns emphasize the importance of strict material certification and verification processes during construction. The practice of conducting risk assessments before construction was rated as moderately positive. 36.3% agreed and 15.3% strongly agreed that risk assessments are conducted before construction begins, suggesting that the majority of projects do implement safety risk evaluations. However, 12.7% strongly disagreed, and 9.3% disagreed, which highlights a gap in the implementation of comprehensive risk assessments across all projects. The 26.3% who were neutral further reflect uncertainty or inconsistencies in the application of risk assessments in some parts of the organization. Ensuring that risk assessments are a routine part of every construction project is critical in minimizing the likelihood of safety incidents. Regarding the consideration of

environmental risks (e.g., earthquakes, extreme weather) in the design process, responses were more varied. A combined 54% (23% strongly disagree, 9.3% disagree, and 13.7% neutral) expressed some level of dissatisfaction or uncertainty about environmental risks being adequately considered in the design procedures. On the other hand, 29% agreed and 25% strongly agreed that environmental risks are considered, indicating a general understanding of their importance. This result highlights the need for further integration of environmental risk considerations into the design phase to ensure the long-term safety and resilience of oil and gas infrastructure, particularly in areas prone to natural disasters.

Table 7: Operational Safety Practices

		Frequency	Percent	Cumulative Percent
Routine vibration checks are conducted to prevent structural failures.	Strongly Disagree	44	14.7	14.7
	Disagree	47	15.7	30.3
	Neutral	59	19.7	50
	Agree	91	30.3	80.3
	Strongly Agree	59	19.7	100
Machinery and equipment are regularly inspected and maintained.	Strongly Disagree	61	20.3	20.3
	Disagree	38	12.7	33
	Neutral	41	13.7	46.7
	Agree	90	30	76.7
	Strongly Agree	70	23.3	100
Employees are trained to identify and mitigate operational hazards.	Strongly Disagree	37	12.3	12.3
	Disagree	58	19.3	31.7
	Neutral	62	20.7	52.3
	Agree	90	30	82.3
	Strongly Agree	53	17.7	100
Maintenance logs are diligently updated and reviewed.	Strongly Disagree	29	9.7	9.7
	Disagree	55	18.3	28
	Neutral	61	20.3	48.3
	Agree	97	32.3	80.7
	Strongly Agree	58	19.3	100

The Table 7 above on operational safety practices highlight key aspects of operational procedures that directly impact safety in the oil and gas sector. Regarding routine vibration checks to prevent structural failures, the responses were moderately positive. 30.3% agreed and 19.7% strongly agreed that vibration checks are conducted regularly, demonstrating that many respondents recognize the importance of these checks in maintaining the integrity of structures. However, a notable 14.7% strongly disagreed, and 15.7% disagreed, which suggests that there are gaps in the consistent implementation of vibration checks. The 19.7% neutral responses further indicate uncertainty or inconsistency in how frequently these checks are carried out across different operations. Ensuring more uniform implementation of vibration checks could contribute to preventing potential structural failures, especially in equipment prone to wear and tear. The result also revealed that machinery and equipment maintenance practices are generally seen as satisfactory. 30% agreed and 23.3% strongly agreed that machinery and equipment are regularly inspected and maintained, indicating that a solid proportion of respondents recognize the importance of these practices in ensuring operational safety. However, 20.3% strongly disagreed and 12.7% disagreed, which points to a group of respondents who are concerned about the regularity or effectiveness of machinery inspections. The 13.7% neutral responses indicate that there may be some uncertainty or inconsistency in the enforcement of these practices. Regular and thorough inspections are vital in identifying potential issues before they escalate into larger safety concerns, and the organization should focus on improving consistency in inspection procedures. When asked about the training of employees to identify and mitigate operational hazards, the results showed a strong recognition of the importance of training. A combined 30% agreed and 17.7% strongly agreed, signaling a positive response regarding employee preparedness to handle operational hazards. However, 12.3% strongly disagreed, and 19.3% disagreed, which suggests that there are still employees who may not receive sufficient training or are unaware of hazard mitigation procedures. The 20.7% neutral responses could reflect variability in training across different teams or departments. Improving and standardizing hazard identification and mitigation training for all employees would contribute to reducing operational risks and ensuring a safer working environment. The results on the maintenance of logs and their diligent review were relatively positive, but some concerns remain. 32.3% agreed and 19.3% strongly agreed that maintenance logs are carefully updated and reviewed, indicating that a majority of respondents appreciate the importance of proper documentation in tracking equipment performance and maintenance history. However, 9.7% strongly disagreed, and 18.3% disagreed, which suggests that some operations may be lacking in proper documentation practices or fail to consistently update maintenance logs. The 20.3% neutral responses further highlight the inconsistency in how maintenance logs are managed across operations. Ensuring thorough documentation and regular reviews of maintenance logs is essential for identifying patterns that could signal potential equipment failures or safety risks.

Table 8: Emergency Preparedness

		Frequency	Percent	Cumulative Percent
Emergency response plans are clearly communicated to all employees.	Strongly Disagree	53	17.7	17.7
	Disagree	42	14	31.7
	Neutral	44	14.7	46.3
	Agree	110	36.7	83
	Strongly Agree	51	17	100
Regular drills are conducted for scenarios such as fire, gas leaks, and structural collapse.	Strongly Disagree	46	15.3	15.3
	Disagree	44	14.7	30

	Neutral	52	17.3	47.3
	Agree	91	30.3	77.7
	Strongly Agree	67	22.3	100
Emergency response equipment is accessible and functional at all times.	Strongly Disagree	48	16	16
	Disagree	39	13	29
	Neutral	35	11.7	40.7
	Agree	91	30.3	71
	Strongly Agree	87	29	100
Employees receive formal training on emergency management procedures.	Strongly Disagree	24	8	8
	Disagree	21	7	15
	Neutral	45	15	30
	Agree	109	36.3	66.3
	Strongly Agree	101	33.7	100

The results on Table 8 above regarding emergency preparedness reveal critical insights into the effectiveness of the emergency response plans and the overall preparedness of employees in the face of potential hazards. The communication of emergency response plans to employees received mixed feedback. 36.7% agreed and 17% strongly agreed that emergency response plans are clearly communicated to all employees, indicating that a significant portion of the workforce feels informed about these plans. However, 17.7% strongly disagreed and 14% disagreed, suggesting that there are gaps in how well these plans are communicated to all staff members. The 14.7% neutral responses further highlight the uncertainty or inconsistency in the communication of emergency procedures. To improve emergency preparedness, the organization should ensure that all employees are fully aware of the emergency response plans, possibly through more consistent and widespread communication channels. The results on the conduct of regular drills for various emergency scenarios such as fire, gas leaks, and structural collapse show that the organization is actively engaged in training staff for emergency situations. 30.3% agreed and 22.3% strongly agreed that regular drills are conducted. While this is a positive outcome, the 15.3% strongly disagreed and 14.7% disagreed, indicating that there is still a segment of the workforce that either perceives a lack of drills or is unaware of such activities. Additionally, 17.3% neutral responses further suggest that the frequency or relevance of these drills may not be consistent across all departments or locations. Regular emergency drills are essential to ensure that employees are prepared for any crisis, and further standardizing these drills could enhance overall preparedness. The availability and functionality of emergency response equipment were viewed favorably by respondents. 30.3% agreed and 29% strongly agreed that emergency response equipment is accessible and functional at all times. This reflects a generally positive perception of the readiness of the organization to respond to emergencies. However, 16% strongly disagreed and 13% disagreed, indicating that a small group of employees may have concerns regarding the reliability or accessibility of emergency equipment. The 11.7% neutral responses suggest that there may be some ambiguity in certain areas about the accessibility or functionality of emergency response tools. Ensuring that all emergency response equipment is not only readily accessible but also properly maintained and regularly checked is crucial in maintaining high standards of preparedness. Formal training on emergency management

procedures received strong support, with 36.3% agreeing and 33.7% strongly agreeing that employees receive formal training. This indicates that a majority of employees feel well-prepared and knowledgeable about emergency protocols. However, 8% strongly disagreed and 7% disagreed, suggesting that there is a small portion of the workforce that either lacks formal training or has not received adequate instruction on emergency management procedures. The 15% neutral responses reflect that some employees may be uncertain about the adequacy of their training. To further improve emergency preparedness, it is essential to ensure that all employees receive comprehensive and ongoing emergency management training.

Table 9: Monitoring and Evaluation

		Frequency	Percent	Cumulative percent
Safety monitoring equipment is functional and regularly calibrated.	Strongly Disagree	37	12.3	12.3
	Disagree	32	10.7	23
	Neutral	55	18.3	41.3
	Agree	110	36.7	78
	Strongly Agree	66	22	100
Corrective actions are implemented promptly for identified safety gaps.	Strongly Disagree	58	19.3	19.3
	Disagree	34	11.3	30.7
	Neutral	46	15.3	46
	Agree	104	34.7	80.7
	Strongly Agree	58	19.3	100
Feedback from safety reviews is communicated to all relevant departments.	Strongly Disagree	42	14	14
	Disagree	38	12.7	26.7
	Neutral	52	17.3	44
	Agree	98	32.7	76.7
	Strongly Agree	70	23.3	100
Safety policies are reviewed periodically to address emerging risks.	Strongly Disagree	61	20.3	20.3
	Disagree	41	13.7	34
	Neutral	62	20.7	54.7
	Agree	76	25.3	80
	Strongly Agree	60	20	100

The results on Table 9 related to monitoring and evaluation of safety practices offer valuable insights into how effectively safety measures are being tracked, evaluated, and improved within the organization. The results regarding the functionality and calibration of safety monitoring equipment suggest that the organization is generally effective in maintaining these systems. 36.7% agreed and 22% strongly agreed that safety monitoring equipment is functional and regularly calibrated, indicating a positive view of the equipment's operational effectiveness. However, 12.3% strongly disagreed and 10.7% disagreed, signaling that some employees perceive issues with the equipment's functionality or calibration. Additionally, 18.3% neutral responses suggest uncertainty, possibly due to inconsistent experiences across departments or sites. To ensure ongoing safety, it is critical that the organization regularly assesses and calibrates safety monitoring equipment and ensures it is in optimal condition to prevent potential hazards. The results on the implementation of corrective actions indicate a mixed but generally positive response. 34.7% agreed and 19.3% strongly agreed that corrective actions are promptly implemented for identified safety gaps. This shows that a significant portion of employees perceives that the organization is proactive in addressing safety issues. However, 19.3% strongly disagreed and 11.3% disagreed, suggesting that some employees feel that corrective actions are not implemented in a timely or effective manner. Furthermore, 15.3% neutral responses may reflect a lack of visibility into how quickly safety gaps are addressed. To improve safety outcomes, the organization should focus on ensuring that corrective actions are consistently implemented without delay and are clearly communicated to all employees.

The communication of feedback from safety reviews was seen positively, with 32.7% agreeing and 23.3% strongly agreeing that feedback from safety reviews is communicated to all relevant departments. This indicates that safety feedback is likely disseminated effectively across most areas of the organization. However, 14% strongly disagreed and 12.7% disagreed, highlighting that there may be some gaps in the communication process, or that certain departments may not be receiving the feedback in a timely manner. Additionally, 17.3% neutral responses suggest that some employees are unsure about the effectiveness of communication regarding safety feedback. Improving the transparency and consistency of communication channels could further enhance safety culture within the organization. The review of safety policies to address emerging risks is an area where the organization shows room for improvement. 25.3% agreed and 20% strongly agreed that safety policies are reviewed periodically to address emerging risks, suggesting that some level of ongoing policy evaluation is taking place. However, 20.3% strongly disagreed and 13.7% disagreed, indicating that a portion of the workforce perceives that safety policies are not regularly reviewed to adapt to new or evolving risks. Additionally, 20.7% neutral responses further highlight the uncertainty about the effectiveness and frequency of policy reviews. To address this issue, it is essential for the organization to establish a clear, systematic approach to periodically review and update safety policies, ensuring they are aligned with emerging risks and best practices.

Table 10: Leadership and Culture

		Frequency	Percent	Cumulative Percent
Are senior leaders actively involved in promoting and monitoring safety initiatives?	Strongly Disagree	64	21.3	21.3
	Disagree	46	15.3	36.7
	Neutral	34	11.3	48
	Agree	101	33.7	81.7
	Strongly Agree	55	18.3	100
Are contractors and third-party vendors held to the same safety standards as employees?	Strongly Disagree	38	12.7	12.7

	Disagree	54	18	30.7
	Neutral	51	17	47.7
	Agree	88	29.3	77
	Strongly Agree	69	23	100

The Table 10 above regarding leadership and organizational culture reveal important insights into how safety is managed and promoted by senior leaders, as well as the extent to which safety standards are applied to contractors and third-party vendors. The results indicate that there is a mixed perception regarding the level of involvement by senior leaders in promoting and monitoring safety initiatives within the organization. 33.7% agreed and 18.3% strongly agreed that senior leaders are actively involved in safety initiatives, which suggests that a portion of the workforce believes that leadership plays an active role in promoting and overseeing safety. However, 21.3% strongly disagreed and 15.3% disagreed, highlighting that a significant number of respondents feel that senior leaders are not sufficiently engaged in safety matters. Additionally, 11.3% neutral responses suggest some uncertainty about the extent of leadership involvement. This suggests that while some employees perceive senior leaders as proactive in safety management, others may feel that leadership could do more to visibly support safety initiatives. To address this, senior leaders should consider increasing their direct engagement with safety initiatives, ensuring that their involvement is more visible to all employees.

The responses regarding contractors and third-party vendors show a generally positive perception of the organization’s approach to ensuring that external parties adhere to the same safety standards as employees. 29.3% agreed and 23% strongly agreed that contractors and third-party vendors are held to the same safety standards as employees, indicating that the organization is making efforts to ensure consistency in safety protocols across both internal and external parties. However, 12.7% strongly disagreed and 18% disagreed, suggesting that some respondents believe contractors and third-party vendors may not be sufficiently held accountable to the same safety standards. 17% neutral responses further reflect uncertainty or lack of clarity about the organization’s safety policies for external parties. To improve in this area, the organization could enhance its monitoring and enforcement mechanisms to ensure that contractors and vendors consistently adhere to the same safety standards as employees, thus reinforcing a culture of safety across the entire organization.

DISCUSSION

Objective One: To analyze evaluate the level of safety and health risks experienced within the oil and gas sector in the Niger Delta region in Nigeria

The findings from this study reveal a high prevalence of safety and health risks within the Nigerian oil and gas sector, particularly in the Niger Delta region, an area historically plagued by operational hazards. The results largely align with existing literature, which highlights the sector’s hazardous nature and the multitude of risks that workers face. This section will compare the findings with literature on the prevalence and severity of safety and health risks in the oil and gas industry in Nigeria and provide an interpretation of the results in relation to the broader understanding of these risks. The study found that oil spills were the most frequently occurring hazard, acknowledged by 95% of respondents. This is consistent with the work of Akintoye et al. (2013), who emphasize that the Niger Delta has been the site of numerous oil spills, often due to pipeline ruptures, equipment failures, and environmental factors. These spills are not only an environmental disaster but also a significant health hazard to both workers and local communities (Akintoye et al., 2013). Furthermore, the high rate of environmental and weather-related hazards (90%) also corresponds with the findings of Nwachukwu et al. (2015), who identified heavy rainfall, flooding, and coastal erosion as major environmental challenges that exacerbate operational risks in the oil and gas sector. Gas leaks (85%) and fire/explosions (80%) were also identified as significant hazards in this study, which is in line with the findings of Olamide (2016), who noted that gas leaks and the flammable nature of hydrocarbons contribute to the high number of accidents in the Nigerian oil industry. Fire and explosions, in particular, have been frequent causes of fatalities and operational disruptions in the region (Olamide, 2016). These risks are compounded by aging infrastructure and inadequate

maintenance practices, both of which were noted as key factors contributing to structural failures and metal deterioration, with 75% and 70% of respondents citing these as major concerns, respectively. The occurrence of human errors and fatigue, reported by 75% of participants, further echoes the concerns raised by Akinwale et al. (2018), who found that extended working hours, inadequate training, and insufficient safety measures often lead to mistakes that can escalate into catastrophic events. Additionally, the perception of security threats, such as vandalism and piracy (84%), aligns with the work of Egbe (2019), who describes the socio-political instability in the Niger Delta and how it contributes to operational disruptions, including theft, vandalism, and even violent attacks on workers.

The likelihood of risks, as shown in Table 3, provides valuable insights into what industry professionals consider to be the most pressing concerns. The study identified substandard materials (mean = 3.17), excessive vibration (mean = 3.15), and corroded equipment and pipelines (mean = 3.15) as the most likely hazards. These findings correspond with the concerns raised in the literature about the use of low-quality materials and the deterioration of equipment due to poor maintenance and the harsh environmental conditions in the Niger Delta (Olamide, 2016; Nwachukwu et al., 2015). Substandard materials, in particular, were cited as a critical concern due to their impact on the structural integrity of pipelines and equipment, which are vital to maintaining safe operations in the sector.

Similarly, the high likelihood of excessive vibration and corroded equipment aligns with the findings of Egbe (2019), who highlighted the risks posed by mechanical and structural issues in oil rigs and pipelines. Vibration, often a result of heavy machinery and high-pressure operations, can lead to the failure of critical equipment if not properly managed, while corrosion weakens structural components, increasing the risk of accidents such as gas leaks and spills. The study also noted concerns about poor design or construction (mean = 2.89), which resonates with Olamide's (2016) assertion that errors in design and construction contribute significantly to the high incidence of accidents and operational inefficiencies in the sector.

When evaluating the severity of these risks, improper maintenance practices were identified as having the most severe impact (mean = 3.22), further corroborating the findings of Nwachukwu et al. (2015), who argue that inadequate maintenance is a major contributor to catastrophic events in the industry. The failure to maintain equipment and infrastructure regularly can lead to leaks, explosions, and other severe incidents that result in significant losses, both financially and in terms of human life. The second most severe risk in the study, excessive vibration (mean = 3.20), also underlines the importance of regular checks on machinery to prevent structural failures, as noted by Olamide (2016). The importance of proper equipment maintenance and safety inspections is further emphasized by the high severity scores for improper storage of inflammable substances (mean = 3.13) and poor design or construction (mean = 3.11). Both issues have the potential to escalate into major safety hazards, as highlighted by Akintoye et al. (2013), who argue that improper storage of hazardous materials can lead to catastrophic fires and explosions if not adequately controlled.

The risk analysis conducted in this study, as shown in Table 5, identifies excessive vibration as the most significant risk (risk score = 10.08), followed by poor design or construction (risk score = 8.99) and corroded equipment (risk score = 8.86). These results align with the literature, which consistently points to the risks posed by structural failures, inadequate equipment maintenance, and poor design practices in the Nigerian oil and gas industry (Nwachukwu et al., 2015; Olamide, 2016). The high-risk scores reflect the need for immediate attention to these issues to prevent potentially disastrous consequences.

The study also highlights concerns about inadequate emergency preparedness (risk score = 8.87), which has been a recurring theme in the literature on safety in the Nigerian oil sector. The failure to prepare adequately for emergencies, such as oil spills or gas leaks, can lead to slower response times and greater damage in the event of an accident (Akintoye et al., 2013). This highlights the need for comprehensive emergency response plans, regular drills, and the proper training of personnel. While some risks, such as improper storage of inflammable substances (risk score = 7.50) and inadequate risk assessments (risk score = 7.64), were ranked lower in terms of likelihood, their potential impact remains severe. The literature supports this view, with Egbe (2019) pointing out that these issues may not be as frequent but can have devastating consequences when they occur. This reinforces the importance of ongoing vigilance and risk management strategies to mitigate these less frequent but high-impact risks.

Research Objective Two: To examine the risk-based safety strategies adopted by companies in an effort towards reducing the frequency and severity of accidents in oil and gas operations.

The findings of this study provide valuable insights into the risk-based safety strategies adopted by companies in oil and gas operations, with a focus on reducing the frequency and severity of accidents. The responses regarding infrastructure meeting national and international safety standards reveal a mixed perception, with 49.4% of respondents indicating agreement that the organization's infrastructure complies with these safety standards. However, a significant proportion (35%) expressed concerns, suggesting that there is room for improvement in ensuring consistent compliance across all projects. These findings resonate with the literature on the importance of adhering to national and international safety standards in construction. As described by Hallowell and Gambatese (2010), the construction of oil and gas infrastructure requires strict compliance with safety standards to mitigate risks associated with structural failures. While the findings indicate that there is some adherence, the concerns raised by a portion of respondents underscore the need for continuous monitoring and perhaps stricter enforcement of compliance procedures.

The use of certified and durable materials in platform and pipeline construction received a generally positive response, with 61.3% agreeing that certified materials are used. However, 17.7% disagreed, which aligns with previous studies suggesting that despite safety policies, material quality remains a critical concern in the oil and gas industry (Goh, 2012). The literature emphasizes the need for robust material certification processes to reduce construction-related accidents. The results in this study suggest that while there is a commitment to using quality materials, the organization could benefit from enhancing its material certification and verification processes to ensure that substandard materials are not inadvertently used. Risk assessments before construction, while rated moderately positive (51.6% in agreement), still reveal notable gaps, with 22% expressing disagreement or neutrality. This finding aligns with research by Kletz (2009), who asserts that effective risk assessments are critical to identifying and mitigating potential hazards in oil and gas operations. The results suggest that while risk assessments are conducted in many cases, they may not be consistently applied across all projects. A standardized approach to risk evaluation, as recommended in the literature, would help in reducing safety incidents by ensuring that potential risks are thoroughly evaluated and addressed before construction begins.

The consideration of environmental risks, such as earthquakes and extreme weather, in the design process showed a divided response, with 54% expressing dissatisfaction or uncertainty about environmental risks being adequately considered. This is consistent with the findings of Preene (2005), who emphasized that environmental risk management is often inadequately integrated into the design phase of infrastructure projects. The literature highlights the importance of addressing environmental risks to ensure the long-term resilience of infrastructure, particularly in regions vulnerable to natural disasters. The study's results suggest that there is a need for further integration of environmental considerations into the design process to enhance the safety and sustainability of oil and gas infrastructure. The operational safety practices examined, such as routine vibration checks and machinery maintenance, indicate mixed levels of effectiveness. While 49.6% of respondents agreed that vibration checks are regularly conducted, 30.4% disagreed or were neutral. Similarly, machinery and equipment maintenance received a favorable response, but concerns about consistency in inspection practices were noted. These findings align with research by Mazzuchi and Sarkani (2016), who argue that regular maintenance and inspection of machinery are essential for preventing operational failures. The literature emphasizes that inconsistent maintenance practices are a significant risk factor in oil and gas operations, and the findings of this study highlight the need for more consistent and systematic maintenance procedures across the organization. Emergency preparedness is a critical area of focus in the oil and gas sector, and the results on communication of emergency response plans and regular drills show a varied response. While the majority of respondents agree that emergency plans are communicated, a substantial minority expressed dissatisfaction, indicating that the dissemination of emergency procedures may not be fully effective. This is consistent with the findings of Sayed et al. (2014), who noted that the effectiveness of emergency preparedness largely depends on clear communication and regular training drills. The study's results suggest that enhancing communication channels and standardizing emergency drills across all departments could improve overall emergency preparedness and response.

The findings related to the monitoring and evaluation of safety practices indicate that safety monitoring equipment is generally functional, but concerns about the calibration and effectiveness of these systems remain.

A similar concern is raised in the literature by Leveson (2011), who emphasizes the importance of regular calibration and maintenance of safety monitoring systems to ensure their reliability in detecting and preventing safety hazards. The results of this study suggest that while monitoring equipment is largely effective, further attention is needed to ensure that all systems are regularly calibrated and fully functional to prevent potential risks. The results on leadership involvement in safety initiatives show a mixed perception. While 52% of respondents agreed that senior leaders actively support safety initiatives, 36.6% felt that leadership could do more, to visibly engage with safety practices. This finding reflects the concerns raised by Frick et al. (2000), who argue that effective safety leadership requires visible and active involvement from senior management. The study suggests that increasing the visibility and engagement of leadership in safety initiatives could help foster a stronger safety culture within the organization.

CONCLUSION AND RECOMMENDATIONS

Conclusion

The study underscores the critical importance of addressing safety and health challenges in the Nigerian oil and gas sector, particularly in the Niger Delta region. The prevalence of hazards such as oil spills, gas leaks, and structural failures, compounded by human factors like fatigue, highlights the high-risk nature of operations in this industry. These findings align with previous studies emphasizing the severe consequences of inadequate safety measures, including environmental degradation, financial losses, and human casualties. The analysis further reveals that while some organizations strive to meet national and international safety standards, inconsistencies in their implementation persist. This indicates the need for a more robust and uniformly applied framework to mitigate risks effectively. An evaluation of risk-based safety strategies highlights their potential to reduce accidents and enhance operational safety. Positive trends, such as the use of certified materials and routine vibration checks, demonstrate progress. However, gaps in practices like environmental risk consideration and comprehensive emergency preparedness reveal areas requiring urgent attention. Despite advancements, critical risks (such as inadequate maintenance practices and poor emergency response systems) remain significant barriers to achieving an optimal safety culture. The mixed perceptions of leadership involvement further underscore the necessity of a more engaged and proactive management approach to foster safety awareness across all organizational levels. The study's methodology, involving structured questionnaires targeting diverse industry stakeholders, provides valuable insights into the sector's challenges and opportunities for improvement. The data reveal that perceptions of safety vary based on demographic and organizational factors, emphasizing the need for tailored interventions. For instance, employees with lower educational qualifications displayed less awareness of safety protocols, suggesting that targeted training programs could bridge these knowledge gaps. Additionally, the research confirms the critical role of monitoring and evaluation in maintaining safety standards, with findings pointing to the necessity for regular calibration of safety equipment and prompt corrective actions for identified safety gaps.

Future safety improvements in Nigeria's oil and gas sector depend on comprehensive policy reforms, technological advancements, and an enhanced safety culture. Strengthening regulatory compliance, integrating advanced monitoring systems, and fostering collaborations with international organizations could help address persistent challenges. By prioritizing risk-based approaches and proactive strategies, the industry can not only safeguard its workforce but also enhance operational efficiency and sustainability. This study, therefore, serves as a foundational step in identifying and addressing the sector's safety shortcomings, offering a pathway for stakeholders to implement effective solutions.

Recommendations

1. **Policy Enforcement and Compliance:** Regulatory agencies should strengthen the enforcement of safety standards across all oil and gas operations, ensuring consistency between multinational corporations and local operators. Regular audits and severe penalties for non-compliance are critical.
2. **Capacity Building and Training:** Implement targeted training programs focused on hazard identification and emergency preparedness. Special attention should be given to less-educated employees to promote uniform safety awareness.

3. Technology Integration: Invest in advanced safety monitoring technologies, such as IoT-enabled systems and predictive analytics, to enhance the detection and mitigation of potential hazards in real time.
4. Future Research: Conduct longitudinal studies to assess the long-term impact of risk-based safety strategies on accident rates and operational efficiency. This could involve exploring the integration of emerging technologies like artificial intelligence in predictive risk management.

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