International Journal of Multidisciplinary Research and Publications
ISSN (Online): 2581-6187

Risk Analysis of the Health, Safety and Environment Key Performance Indicators of the Oil and Gas Industry in Niger Delta Region

Salem Azagbaesuweli[1], Onosemuode Christopher[2]
[1, 2]Department of Environmental Management and Toxicology, College of Science, Federal University of Petroleum Resources, P.M.B. 1221, Effurun, Delta State, Nigeria
Email address: azassalem@gmail.com

Abstract**—***This research explores how professionals in the Niger Delta's oil and gas industry perceive and evaluate the effectiveness of Health, Safety, and Environment (HSE) Key Performance Indicators (KPIs) in mitigating operational and environmental risks. Using responses from 100 industry participants across various roles and experience levels, the study found widespread awareness of HSE KPIs, although confidence in their effectiveness was varied. While 76% of respondents were at least somewhat familiar with the indicators, only 20% considered them highly effective. Environmental threats, equipment breakdowns, and regulatory breaches emerged as the most significant risks. Traditional safety methods remained the most commonly used, with less emphasis on technology and local community involvement. With an average Likert rating of 3.62, participants generally believed that refining KPI systems could enhance risk management. Nonetheless, the findings underscore the need for more transparent, participatory, and enforceable KPI practices to improve safety and sustainability, particularly in the high-risk Niger Delta region.*

Keywords**—** *Risk analysis, HSE KPIs, Oil and Gas industry, Niger Delta.*

I. INTRODUCTION

The oil and gas industry is a cornerstone of the global economy, encompassing exploration, extraction, refining, and distribution of petroleum resources to meet rising energy demands. Despite its importance, the sector is marked by complex operations, environmental hazards, and high safety risks. In Nigeria, the industry has evolved since crude oil was discovered in Olobiri in the 1950s, initially dominated by multinationals until indigenous firms began entering in the 1990s (Adewale, 2014). The sector comprises upstream (exploration and production), downstream (refining and distribution), and servicing (support services), with each playing a vital role (Antonio, 2013; Omenikolo, 2010; Obasi, 2003).

Environmental and health concerns are prevalent due to historical incidents like the Shell crisis in the Niger Delta and global disasters such as the Deepwater Horizon spill. These have prompted increased focus on sustainability and Health, Safety, and Environment (HSE) practices (J. Schneider et al., 2013). In Nigeria, workplace hazards in the oil and gas industry pose serious threats to employee safety and corporate reputation (Monday, 2013). Researchers advocate that implementing robust safety management systems can reduce incidents and demonstrate organizational due diligence (Waqas, 2014; Alberta, 2015).

Key Performance Indicators (KPIs) are crucial for evaluating HSE performance, enabling companies to monitor compliance, reduce risks, and improve operational efficiency. This study aims to assess HSE KPIs within Nigeria's Niger Delta region, analyzing frameworks, benchmarking strategies, regulatory contexts, and technological innovations to promote sustainable and safe industry practices. The oil and gas industry faces significant challenges in managing Health, Safety, and Environmental (HSE) performance, making the use of Key Performance Indicators (KPIs) essential for monitoring and improvement. While HSE KPIs are widely adopted, there is a critical need to evaluate their effectiveness, accuracy, and alignment with industry best practices to ensure they contribute meaningfully to sustainable operations and risk reduction. Existing research lacks a focused assessment of HSE-specific indicators and their role in supporting long-term industry sustainability amidst evolving regulatory and technological landscapes.

This study aims to assess the current use of Key Performance Indicators (KPIs) related to Health, Safety, and Environment (HSE) in the oil and gas industry. It seeks to evaluate the effectiveness and relevance of these indicators in promoting sustainable operations, enhancing safety practices, and minimizing risks. Additionally, the research analyzes the impact of HSE KPIs on operational performance, risk management, and the overall sustainability of the sector. It also identifies existing gaps and areas for improvement in the monitoring and reporting of HSE KPIs. Finally, the study provides actionable recommendations to optimize HSE KPI frameworks, ensuring their alignment with industry best practices and fostering a culture of safety and environmental responsibility.

Evaluating Key Performance Indicators (KPIs) in the oil and gas industry—particularly those related to Health, Safety, and Environment (HSE)—is essential for promoting operational excellence, safety, environmental protection, and long-term sustainability. Given the industry's high-risk nature and significant environmental impact, HSE KPIs serve as critical tools for regulatory compliance, risk mitigation, stakeholder engagement, and continuous improvement. This study highlights the importance of HSE KPI evaluation in

Salem Azagbaesuweli and Onosemuode Christopher, "Risk Analysis of the Health, Safety and Environment Key Performance Indicators of the Oil and Gas Industry in Niger Delta Region," *International Journal of Multidisciplinary Research and Publications (IJMRAP)*, Volume 7, Issue 12, pp. 370-378, 2025.

enhancing workplace safety, minimizing environmental harm, ensuring regulatory adherence, and improving operational efficiency. Moreover, it supports industry benchmarking, fosters a culture of accountability, and contributes to sustainable and socially responsible practices. The findings aim to provide valuable insights for decision-makers, guiding evidence-based strategies to optimize HSE performance and ensure the resilience and sustainability of the oil and gas sector.for all authors.

II. Materials And Methods

This study adopted a descriptive survey design to assess the effectiveness of Health, Safety, and Environment (HSE) Key Performance Indicators (KPIs) in the oil and gas industry of the Niger Delta region. The approach was selected to allow for the collection of data from a diverse group of industry stakeholders and to facilitate the analysis of current practices, challenges, and improvement opportunities.

2.1 Study Area

The research was carried out in the Niger Delta region of Nigeria. This region is the centre of Nigeria's oil and gas activities and is known for its high concentration of petroleum infrastructure, as well as its environmental vulnerabilities due to oil spills, gas flaring, and other operational risks.

2.2 Population and Sampling

The target population consisted of professionals involved in the oil and gas industry, including HSE officers, engineers, management personnel, field workers, and contractors. A purposive sampling technique was employed to ensure the inclusion of respondents with varied roles, levels of experience, and organizational affiliations. A total of 100 respondents participated in the study.

2.3 Data Collection and Instrument

Primary data were collected using a structured questionnaire that included both closed-ended and open-ended questions. The questionnaire was designed to gather information on:

- Levels of familiarity with HSE KPIs,
- Perceived effectiveness and review frequency of HSE KPIs,
- Common HSE risk factors,
- Strategies employed for risk management, and
- Recommendations for improving HSE KPI systems.

2.4 Data Analysis

Computer software Microsoft Excel 2016 was used for record, compiling, organizing and analysis of numerical and statistical data, for different calculation like average, mean, and standard deviation. The data and graphical representation were presented using MS-Word. Quantitative data were analyzed using descriptive statistics such as frequencies, percentages, and cumulative distributions. Tables and bar charts were used to present the data clearly. Qualitative data from open-ended questions were coded and grouped thematically to identify common patterns and strategic recommendations.

2.5 Ethical Considerations

Ethical standards were maintained throughout the study. Participation was voluntary, and respondents were informed about the purpose of the research and assured of the confidentiality and anonymity of their responses. No personal identifiers were collected, and the data were analyzed in compliance with standard ethical guidelines for research involving human participants (American Psychological Association, 2020).

III. Results and Discussion

The well structured questionnaire was distributed to relevant populations for the study which included the HSE Professionals, Contractors, Engineers, Field workers and Management. 100 questionnaire was distributed and analyzed to understand the risk in key performance indicators of the oil and gas industry specifically focusing on health, safety and environment key performance indicators (HSE KPIs).

3.1 Sociodemographic Profile and HSE KPI Implications in the Niger Delta Oil and Gas Sector

The socio-demographic profile of personnel engaged in Health, Safety, and Environment (HSE) operations in the Niger Delta region reveals important insights with implications for HSE Key Performance Indicators (KPIs). The variables examined—age, gender, marital status, and educational attainment—Table 1, highlighting the multifaceted nature of workforce dynamics in the oil and gas industry and underscoring the necessity for context-sensitive risk management strategies.

3.1.1 Age Distribution and Workforce Sustainability

The age distribution reveals a predominantly mature workforce, with 63% aged between 36 and 55, and an additional 21% aged 56 and above. Only 16% are under 35, and a mere 3% fall within the 18–25 age bracket. This skew toward older age groups provides a dual-edged dynamic in HSE management. On one hand, older employees contribute positively through accumulated operational experience and procedural discipline, enhancing adherence to safety protocols and improving lagging indicators such as the Lost Time Injury Frequency Rate (LTIFR) and Occupational Illness Rate (OIR) (Oguejiofor et al., 2015; Adegbite, 2019; Ezenwa & Iwuoha, 2020). On the other hand, this demographic is more susceptible to physical strain and may face challenges with the adoption of digital HSE systems, such as electronic Permit to Work (e-PTW) and mobile-based hazard reporting (Oluwajana et al., 2021; Onifade et al., 2020). The underrepresentation of younger personnel raises strategic concerns about knowledge transfer, succession planning, and long-term sustainability (Akinwale & Olusanya, 2013; Ibrahim & Azeez, 2022).

3.1.2 Gender Distribution and Inclusivity in HSE Evaluation

Gender distribution reveals a male-dominated workforce, with 70% male and 30% female representation. This imbalance mirrors broader global trends in technical and field-based roles within the energy sector (World Bank, 2019; Adaku, 2015). Such a demographic structure implies that HSE metrics and risk perceptions are likely influenced predominantly by male viewpoints, potentially overlooking female-specific concerns or coping strategies (Leka & Jain, 2014; Onyema & Adebayo,

Salem Azagbaesuweli and Onosemuode Christopher, "Risk Analysis of the Health, Safety and Environment Key Performance Indicators of the Oil and Gas Industry in Niger Delta Region," *International Journal of Multidisciplinary Research and Publications (IJMRAP)*, Volume 7, Issue 12, pp. 370-378, 2025.

2021). The lack of gender parity may limit the generalizability of findings, while also underscoring the need for inclusive participation in future HSE assessments. Research increasingly shows that diversity, particularly gender inclusivity, enhances organizational safety cultures and leads to more robust risk management outcomes (ILO, 2018; Zohar & Polachek, 2014).

3.1.3 Marital Status and Psychosocial Risk Engagement

Data on marital status show 67% of respondents are married, 17% single, 9% divorced, and 7% widowed. Since personal life circumstances are known to affect risk perception and compliance behaviors, this variable provides a psychosocial dimension to HSE study. Usually driven by family responsibilities, married people (Barling et al., 2013; Iwuoha & Ekpe, 2018) tend to be more risk-averse and involved in safety measures. Single people could show more freedom but maybe less hazard aversion; divorced or bereaved staff might face psychosocial challenges affecting interaction with safety systems (Mohd & Ismail, 2016; Gyekye & Salminen, 2015). Acknowledging these subtleties helps to create more customized HSE programs taking into account the socio-emotional actualities of the employees (Huang et al., 2018).

3.1.4 Analytical Depth and Educational Achievement in HSE PRACTICE

With 25% having Bachelor's degrees and 40% having Master's degrees, educational credentials reveal a very well educated respondent pool. Particularly in comprehending complicated regulatory systems, differentiating between leading and lagging indicators, and conducting strategic risk assessments (Adebayo & amp; Ibrahim, 2016; Ezeani et al., 2019), this educational capital improves the reliability of HSE insights. Rising intellectual inquiry is therefore supported by higher education, which also entails more exposure to research-informed practices and interdisciplinary cooperation (Obi & Ajayi, 2021; Oludolapo & Olayanju, 2020). A well-educated workforce becomes ever more important for maintaining regulatory compliance and high-performance HSE cultures as the sector develops in complexity.

The socio-demographic profile of HSE staff in the Niger Delta oil and gas industry shows an experienced workforce that is mostly male, married, and highly educated. While these traits provide advantages like analytical ability and procedural adherence, they also pose difficulties concerning inclusivity, digital flexibility, and workforce renewal. Policy and organizational reactions should fuse demographic reality with proactive approaches in training, diversity promotion, ergonomic accommodation, and succession planning to keep and improve HSE KPIs. Such holistic strategies will guarantee HSE systems remain potent, robust, and future-ready.

3.2 Respondent Role Distribution and Implications for HSE KPI Analysis

Respondents' roles in this study mirror the operational variation and difficult risk environment typical of the oil and gas sector. Among the 100 respondents polled as shown in Table 2 below, 22% identified as Operations/Field Workers, 17% as Engineers, and 23% as HSE Professionals. Six percent did not indicate their professional level; respondents from Management and Contracting fields made up 16%. Particularly important in light of the varied responsibilities and exposure levels inherent in each position is this distribution. Comprising over one-fifth of the sample, field workers are often exposed to frontline operational risks and hence are important contributors to real-time incident and near-miss data. Their personal experience with HSE measures and safety procedures gives their impressions great worth in assessing whether ground level implementation of KPIs (Hudson, 2007; Kogi, 2002) is judged sufficient.

TABLE 1: Sociodemographic Distribution of Respondents

Sociodemographic Distribution	Frequency	Cumulative Frequency
Age		
18-25	3	3
26-35	13	16
36-45	31	47
46-55	32	79
55 and above	21	100
	100	
Gender		
Male	70	70
Female	30	100
	100	
Marital Status		
Single	17	17
Married	67	84
Divorced	9	93
Widowed	7	100
	100	
Highest Educational Qualification		
Higher National Diploma	15	15
Bachelor’s Degree	25	40
Postgraduate Diploma	10	50
Master’s Degree	40	90
Doctorate Degree	10	100
	100	

Engineers—those who create and maintain high-risk systems—serve as the bridge between actual application and technical safety requirements. Evaluating the relevance of technical controls and the alignment of KPIs with operational circumstances depends on their input. Despite their strategic relevance in preventive safety, engineering positions are sometimes underrepresented in KPI development debates, as Botros (2019) notes.

The biggest group in this study (23%), HSE experts play a key role in creating, tracking, and analyzing HSE KPIs. Their knowledge offers a systematic and regulatory perspective from which to assess the sensitivity and predictive usefulness of existing indicators. Furthermore, they are ideally qualified to evaluate whether current KPI systems follow ISO 45001 criteria, IOGP reporting norms, and OSHA standards (Adebayo & amp; Salawu, 2020).

At 16%, management and contractors provide different yet complimentary points of view. Contractors work at the execution level, usually under different levels of KPI enforcement, even if management usually oversees strategic decision-making, resource distribution, and regulatory compliance. Matoug et al. Observed, discrepancies in contractor involvement with KPIs could indicate greater organizational disunity or variable management. (2018).

Salem Azagbaesuweli and Onosemuode Christopher, “Risk Analysis of the Health, Safety and Environment Key Performance Indicators of the Oil and Gas Industry in Niger Delta Region,” *International Journal of Multidisciplinary Research and Publications (IJMRAP)*, Volume 7, Issue 12, pp. 370-378, 2025.

The 6% of respondents who omitted to identify their roles may indicate a lack of role clarity or engagement, which is a latent hazard in HSE governance. (Ebeku, 2005) Diluted accountability in KPI reporting often denotes role ambiguity and could point to organizational-wide communication issues. This distribution of roles matches earlier occupational surveys inside the industry, which is significant. October 2023 data training Similar studies on HSE compliance in Nigeria's oil and gas sector recorded Engineers (33.6%), Management staff (18.6%), and a minority classified as 'Others (0.2%) in 2024. Contractors' (27.27%) involvement in Matoug et al. (2018) strengthens even more the importance of this respondent sample in comprehending risk communication and KPI effectiveness across levels of employment.

In conclusion, the varied role portrayal in this study broadens and enhances the legitimacy of the HSE KPI assessment, therefore guarantees that results match the multidimensional character of risk identification, communication, and control throughout the oil and gas sector.

TABLE 2: presents the current roles of respondents in the oil and gas industry.

Current Role.	**Respondents Current Roles in the Oil and Gas Industry**		
	Frequency	Percent	Cumulative Frequency
Operations/ Field Worker	22	22	22
Engineer	17	17	39
HSE Professional	23	23	62
Management	16	16	78
Contractor	16	16	94
Other	6	6	100
	100	100	

3.3 Industry Experience and Its Implications for HSE KPI Analysis

The number of working years experience respondents have in the oil and gas industries Niger Delta region is shown in Table 3 below. Important background for understanding the results of the study on Health, Safety, and Environment (HSE) Key Performance Indicators (KPIs) is the distribution of respondents' level of experience within the oil and gas sector. 33% with 11–20 years and 19% with more than 20 years of industry experience make up a significant proportion of respondents reflecting a group with intensive exposure to operational risk, regulatory development, and long-term HSE practices. This group is set to provide essential practical, institutional memory, and systemic knowledge of risk management techniques based insights grounded in experience.

Contributing 31% of the sample (5–10 years of experience), mid-career professionals offer a complementary viewpoint influenced by interaction with current HSE standards, digital reporting tools, and changing industry expectations. Their insight is crucial for understanding how contemporary safety management systems are viewed and used in present operational contexts. Together, these seasoned groups make sure the research is not only reflective of historical trends but also responsive to current developments in the industry's approach to risk and performance measurement.

Although fewer (17%), respondents with less than five years of experience provide insightful analysis of early-stage exposure to safety culture, the efficacy of onboarding processes, and new arrivals' accessibility of KPI frameworks. Their perspectives could suggest if safety measures are being internalized properly at the point of entry, which would affect both incident prevention and long-term compliance.

By including a range of viewpoints from many phases of professional development, this even distribution improves the validity of the data. It lets the research evaluate not just how experience affects knowledge of HSE KPIs but also how involvement with safety metrics changes through time. These results fit those of Adimora et al. (2023), who noted that those with 11–15 years (18.8%) and 6–10 years (28.6%) of experience showed significant impact in determining KPI application. Analogously, Motilewa et al. (2018) emphasized the crucial role of mid-level practitioners—who made up 26% of their sample—in creating and assessing safety performance indicators.

In essence, the different levels of experience shown in this research add to a more complex grasp of how tenure influences views of risk and the actual usage of HSE KPIs in the oil and gas sector, therefore its analytical depth.

TABLE 3: Years of working experience respondents have in the oil and gas industry.

Years of Working Experience.	**Years of working experience respondents have in the oil and gas industry**		
	Frequency	Percent	Cumulative Frequency
Less than 5 years	17	17	17
5-10 years	31	31	48
11-20 years	33	33	81
More than 20 years	19	19	100
Total	100	100	

3.*4 Analysis of HSE KPI Awareness, Effectiveness, and Risk Factors.*

3.4.1 Levels of Familiarity with HSE KPIs

Respondents showed quite great awareness of Health, Safety, and Environment (HSE) Key Performance Indicators (KPIs). Table 4 reveals that 100% of respondents—(30% somewhat familiar), (46% very familiar) and (24% not very familiar) reported familiarity with HSE KPIs, with no other answers showing unfamiliarity. This implies that the industry has a generally basic knowledge of performance measures.

TABLE 4: Respondents level of familiarity with HSE KPIs

Familiarity to HSE KPIs	**Respondents level of familiarity with HSE KPIs**		
	Frequency	Percent	Cumulative Frequency
Not familiar at all	0	0	0
Not very familiar	24	24	24
Somewhat familiar	30	30	54
Very familiar	46	46	100
Total	100	100	

Formal safety training, compliance demands, or the strategic function of HSE professionals—which made 23% of the sample (see Table 2)—may all contribute to such familiarity. This finding is in line with Botros (2019), who noted that adherence and operational efficiency are directly related to sector-specific KPI literacy. Emphasizing once more

Salem Azagbaesuweli and Onosemuode Christopher, "Risk Analysis of the Health, Safety and Environment Key Performance Indicators of the Oil and Gas Industry in Niger Delta Region," *International Journal of Multidisciplinary Research and Publications (IJMRAP)*, Volume 7, Issue 12, pp. 370-378, 2025.

that "higher familiarity with HSE indicators among oil and gas professionals is essential for proactive risk mitigation," Adebayo and Salawu (2020).

4.2 Analysis of Respondents' Views on Critical HSE KPIs in the Niger Delta Oil and Gas Industry

Respondents were asked to point out the most important Health, Safety, and Environment (HSE) Key Performance Indicators (KPIs) needing continuous monitoring in order to get insights into safety management priorities within the oil and gas sector in the Niger Delta. Responses from 75 participants—representing 75% of the total survey sample—are displayed in Table 5. This shows that HSE KPI ranking among respondents varies greatly. The most often mentioned sign of increased environmental damage with both ecological and reputational consequences is oil spills, gas flaring, and fire accidents (16%). This is especially relevant for the Niger Delta, where historically, industrial operations have caused major environmental degradation (Al-Ajmi & amp; Makinde, 2020). Emphasizing rising awareness of leading indicators as means of predictive safety management, a notable 13.33% of respondents noted near miss reporting. Literature supports this emphasis, noting that near miss reporting provides early warnings and can significantly reduce future incidents if acted upon (Phimister et al., 2003; Reiman & Pietikäinen, 2012). In congruence with the ideas of proactive hazard management (Duijm, 2009), incident tracking (10.67%) and hazard identification and risk assessments (6.67%) are still basic components in risk-based safety management systems. These markers guarantee that known and possible hazards are regularly assessed and minimized.

Safety audit reporting shows clear variation, either alone (13.33%) or in conjunction with emergency response time (6.66%). Although audits are essential for compliance and continuous development (Leveson, 2011), this implies a lack of consistency in how they are included into performance measurement systems.

Strangely, 9.33% of replies mentioned leading indicators overall without naming any specific measures. This might imply an industry-wide shift from conventional lagging indicators—such as death rate and lost time injuries—toward more energetic and proactive actions (Hale et al., 2010). Environmental issues also quite clearly surfaced. Oil spill volume (9.33%) and oil spill rate (8%) were stressed as key KPIs in line with growing inspection of environmental responsibility in the Niger Delta. These markers are crucial not only for regulatory compliance but also for sustaining public trust (Okonkwo et al., 2021).

The variety of answers—some integrating environmental incident reporting, near miss, and fatality rate—indicates both a complex knowledge of HSE problems and a lack of harmonized KPI frameworks. As reported by Grabowski et al (2007), such fragmentation could hinder benchmarking and cause disparities in HSE performance reviews across operators and areas. These results highlight the need for a coordinated, context-sensitive KPI framework designed specifically for the operational and environmental conditions of the Niger Delta. The lack of standardization inhibits the industry's capacity to systematically benchmark, compare, and enhance safety outcomes given the positive start of both leading and environmental indicators. Getting in line with local risk profiles and worldwide best standards, a harmonized set of HSE KPIs will improve regulatory compliance and organizational safety maturity.

TABLE 5: Most Critical HSE KPIs Identified by Respondents (n = 75)

HSE KPI Description	*Critical HSE KPIs*		
	Frequency	Valid Percent	Cumulative Frequency
Incident	8	10.67	10.67
Hazard Identification and Risk Assessment	5	6.67	17.34
Oil Spill, Gas Flaring, and Fire Accident	12	16	33.34
Safety Audits and Inspections	2	2.67	36.01
Near Miss Reporting	10	13.33	49.34
The Leading Indicators (unspecified)	7	9.33	58.67
Safety Audits and Emergency Response Time	5	6.67	65.34
Fatality Rates, Lost Time Injuries, Near Miss Reporting	2	2.67	68.01
Oil Spill Volume	7	9.33	77.34
Oil Spill Rate	6	8	85.34
Safety Audits (Standalone)	10	13.33	98.67
Fatality Rate, Near Miss Reporting, and Environmental Incident Reports	1	1.33	100
Total	75	100	

3.4.3 Perceived Effectiveness and Review Frequency of HSE KPIs

Though many people know them well, the perceived efficacy of present HSE KPIs differed greatly. Fig. 1 shows that just 20% of respondents thought the indicators quite effective; a combined 49% rated them as either somewhat or moderately effective; 23% judged them not effective. Interestingly, 79% of respondents report monthly or quarterly reviews, so most companies do (Fig 2).

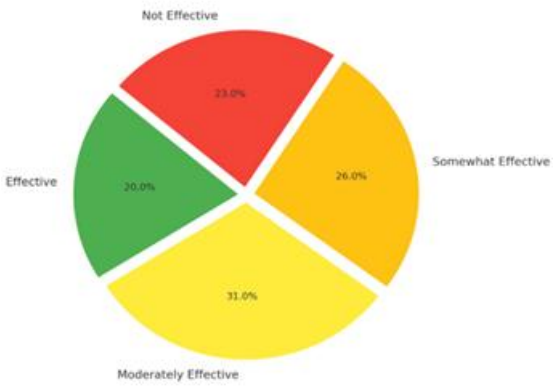

Fig. 1 Perceived effectiveness of HSE KPIs

This difference suggests a possible mismatch between the functional usefulness of the KPIs themselves and the frequency of reviews. Hudson (2007) cautions that "frequent review alone does not equate to effective HSE management; it must be coupled with intelligent metrics design." The results indicate that present KPIs might highlight lagging indicators like

Salem Azagbaesuweli and Onosemuode Christopher, "Risk Analysis of the Health, Safety and Environment Key Performance Indicators of the Oil and Gas Industry in Niger Delta Region," *International Journal of Multidisciplinary Research and Publications (IJMRAP)*, Volume 7, Issue 12, pp. 370-378, 2025.

incident counts while underrepresenting proactive or leading indicators necessary for early risk detection.

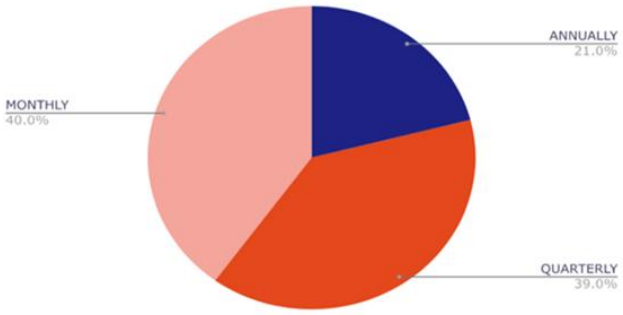

Fig. 2 Pie chart highlighting the percentage of HSE KPIs review as perceived by respondents.

3.4.4 Common HSE Risk Factors

Most often referenced were environmental risks (42%), non-compliance with safety rules (26%), and equipment failure (18%) as seen in Table 6 analysis of perceived HSE risk elements. Community-related hazards a major worry in the Niger Delta was notably missing from the replies. This omission could indicate a perception gap or institutional underreporting of external or social political danger elements. Ebeku (2005) and Okafor (2016) stressed that community unrest, vandalism, and socio-environmental tensions should be considered in the Nigerian oil and gas projects. The lack of such ideas implies that internal, operational hazards underlie present HSE frameworks, perhaps to the detriment of more extensive environmental and stakeholder settings.

TABLE 6: HSE Risk Factor

HSE Risk Factor	Frequency	Cumulative frequency
Equipment failure and poor maintenance	18	18
Environmental hazards	42	60
Lack of compliance with safety regulations	26	86
Workforce skills and training gaps	10	96
Community related issues and unrest	0	0
Corruption and governance issues	4	100
	100	Cumulative frequency

3.4.5 Integration of Local Community Concerns into HSE Risk Management.

Results presented in (Fig.) 3) expose an alarming disparity in the incorporation of local community issues into Health, Safety, and Environment (HSE) risk management systems used in the Niger Delta. Only 25% of respondents said community views were completely integrated; 41% said they were partially integrated; 34% said they were minimally engaged. This underlines that a significant 75% of organizations function without totally incorporating local stakeholder needs. Especially in areas like the Niger Delta where oil activities interact with delicate ecological systems and vulnerable populations (Eweje, 2006; Idemudia, 2010), this limited inclusion has major consequences for socio-environmental risk management. Focusing mostly on internal performance measures (Lindøe et al., 2012), conventional HSE KPIs sometimes disregard these externalities. The data emphasizes the critical need for expanded HSE frameworks combining community-oriented indicators—such as stakeholder involvement frequency, complaint mechanisms, and environmental transparency—aligned with sustainable development and CSR ideals (Owen et al., 2001; Burchell & Cook, 2006). According to Prno & Slocombe (2012), such integration would not only enhance risk management efficacy but also strengthen the social license to operate, therefore mitigating conflict and improving long-term operational resilience in volatile regions.

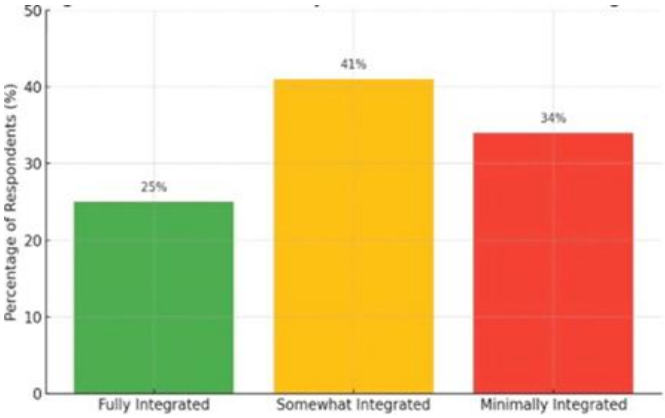

Fig. 3 Respondents response on the Integration of local community concerns into HSE Risk Management.

3.4.6 Strategies Employed for Risk Management

According to Table 7 below, the most often used HSE risk management techniques — at 38% — comprised risk assessments, safety training, and emergency drills. Technology-driven solutions or methods of community involvement received lesser attention. This inclination for traditional approaches points to a dependency on basic safety procedures. It also suggests, though, that advanced tools and participatory risk management might not be fully embraced. Modern industrial safety, as Reniers and Audenaert (2014) note, calls for multi-layered approaches combining conventional techniques with real-time monitoring, stakeholder communication, and data-driven decision-making. Kletz (2009) strengthens this claim by saying, “In complex risk environments like oil and gas, technological integration in HSE is not left up choice”.

TABLE 7. Risk management strategies used to Manage HSE risks.

Risk Management Strategies	Frequency	Cumulative Frequency
Risk assessments and audits, Training and capacity building, Regular safety drills and exercises	38	38
Training and capacity building	13	51
Risk assessments and audits, Regular safety drills and exercises, Community engagement and CSR programs	20	71
Use of technology and automation	16	87
Risk assessments and audits, Training and capacity building, Community engagement and CSR programs	1	88
Risk assessments and audits	12	100
	100	

Salem Azagbaesuweli and Onosemuode Christopher, “Risk Analysis of the Health, Safety and Environment Key Performance Indicators of the Oil and Gas Industry in Niger Delta Region,” *International Journal of Multidisciplinary Research and Publications (IJMRAP)*, Volume 7, Issue 12, pp. 370-378, 2025.

3.4.7 Perceptions of HSE KPI Improvements in Risk Reduction

Stakeholder replies presented in Table 8 on the effectiveness of enhancing Health, Safety, and Environment (HSE) Key Performance Indicators (KPIs) in lowering operational risks in the Niger Delta oil and gas industry resulted in a weighted average (mean Likert score) of 3.62. This score implies a rather high degree of agreement and indicates overall hope about the contribution of better KPIs to risk reduction. Analysis of the distribution revealed that while 78% of respondents gave scores of 3 or above, 59% rated the possibility as high (scores 4 or 5), indicating wide support. Only 22% gave a low confidence rating (2), and particularly no respondents chose the lowest score (1). This favorable tilt shows a definite trend toward trust in KPI-driven risk management. With a standard deviation of 1.08, responses show moderate variation that reflects a mix of strong support and subdued doubt. Although great ratings may result from higher awareness and institutional dependency on HSE measures, lower scores imply unresolved questions regarding policy implementation and stakeholder engagement.

These results show that although KPI changes are generally regarded as positive, their actual effect relies on open, inclusive, and enforceable implementation—an important factor in the sensitive and risk-prone Niger Delta environment.

TABLE 8: Risk management strategies used to mange HSE risks.

Scale	Description	Percentage	Frequency
1	Not Likely	0%	0
2		22%	22
3		19%	19
4		34%	34
5	Highly Likely	25%	25
		100%	100

3.5 Impact Strategic Recommendations

3.5.1 Recommendations for Improving HSE KPI Systems.

Table 9 summarizes important suggestions from respondents to help HSE KPI effectiveness be improved. Top recommendations were more regular audits, better sophisticated technological equipment, and more rigorous employee training. Notably, only a minority of participants supported stronger regulations or more community involvement—both vital elements of a whole risk management system.

TABLE 9: Recommended Actions from Respondents for Enhancing the Effectiveness of HSE KPIs in Risk Management.

Recommendations	Frequency	Cumulative Frequency
More advanced technological tools and monitoring systems	13	13
Increased worker training and awareness programs	16	29
More frequent HSE audits and inspections	12	41
Stronger enforcement of safety regulations	11	52
Greater community engagement and participation	11	63
Increased worker training and awareness programs, Stronger enforcement of safety regulations, Greater community engagement and participation, Regular updating of HSE KPIs, More frequent HSE audits and inspections	14	77
More advanced technological tools and monitoring systems, Increased worker training and awareness programs, Stronger enforcement of safety regulations	1	78
More advanced technological tools and monitoring systems, Greater community engagement and participation, More frequent HSE audits and inspections	1	79
More advanced technological tools and monitoring systems, Increased worker training and awareness programs, Stronger enforcement of safety regulations, Regular updating of HSE KPIs	9	88
More advanced technological tools and monitoring systems, Stronger enforcement of safety regulations, Greater community engagement and participation, Regular updating of HSE KPIs	1	89
More advanced technological tools and monitoring systems, Increased worker training and awareness programs, Stronger enforcement of safety regulations, Regular updating of HSE KPIs, More frequent HSE audits and inspections.	11	100
	100	

TABLE 10: Categorical summary of respondents suggestions

Categorized Suggestions	Examples from Responses	Frequency
Policy & Regulatory Frameworks	Stronger legal frameworks, government monitoring, enforcement, HSE KPIs	6
Training & Capacity Building	HSE induction, toolbox talks, emergency shutdown training, mental health awareness	5
Technology & Digital Monitoring	Real-time monitoring, digital incident systems, predictive analytics	5
Community Engagement & Awareness	Public HSE awareness, community integration	4
Auditing & Compliance Monitoring	Third-party audits, regular inspections, compliance tracking	4
Safety Programs & Culture	BBS programs, stop-work authority, hazard reporting	4
Design & Engineering Controls	Risk-based design, pipeline integrity management	3
Reporting & Communication	Two-way communication, daily HSE feedback	2
Incentives & Motivation	Rewarding safety compliance	1
		36

Further organizing in Table 10 improvement approaches revealed six main focus areas: policy and regulatory reform, training and capacity building, digital monitoring, community involvement, auditing and compliance tracking, and safety culture. Based on data from Olagoke et al. (2021) HSE performance improvements depend on an integrated approach covering policy frameworks, processes, and people. The rather low giving of community and regulatory aspects implies structural inconsistencies in the way risk is understood and applied.

Salem Azagbaesuweli and Onosemuode Christopher, "Risk Analysis of the Health, Safety and Environment Key Performance Indicators of the Oil and Gas Industry in Niger Delta Region," *International Journal of Multidisciplinary Research and Publications (IJMRAP)*, Volume 7, Issue 12, pp. 370-378, 2025.

3.6 Correlation Analysis of Experience, Familiarity, Effectiveness, and Risk Perception.

Pearson and Spearman correlation analyses were used to assess the interrelationships between experience, knowledge of HSE Key Performance Indicators (KPIs), perceived efficacy of these KPIs, and risk perception. The analyses revealed statistically significant results, pointing to strong correlations between the variables of interest.

3.6.1 Familiarity with HSE KPIs and Perceived Effectiveness

Respondents' knowledge of HSE KPIs and their view of KPI effectiveness showed a notable positive connection. The Spearman rank correlation was $\rho = 1.000$ ($p = 0.000$); the Pearson correlation coefficient was $r = 0.997$ ($p = 0.003$). These findings imply that more confidence in the usefulness of the KPIs is closely related to more familiarity—possibly through organized training and job exposure. This result agrees with Botros (2019), who noted how KPI literacy affects perceived value and consistent application in high-risk sectors. (See Table 11, below)

3.6.2 Years of Industry Experience and Risk Perception

Years of professional experience also strongly correlated with opinions about the relevance of KPIs in risk mitigation. With a Spearman rank correlation of $\rho = 1.000$ ($p = 0.000$), the Pearson coefficient was $r = 0.983$ ($p = 0.017$). These findings suggest that seasoned professionals are likely to acknowledge KPIs as useful tools in lowering operational risks given their extended exposure to safety issues and performance tracking systems. This findings aligns with Adimora et al. (2013) who argued that risk perception develops in a positive way in relation to expertise. (Table 11)

TABLE 11: Correlation Coefficients Between Key Variables

Variable Pair	Pearson r	p-value (Pearson)	Spearman ρ	p-value (Spearman)	Interpretation
Familiarity with HSE KPIs vs. Effectiveness	0.997	0.003	1.000	0.000	Very strong positive correlation; familiarity enhances perceived effectiveness
Experience (Years) vs. Risk Perception	0.983	0.017	1.000	0.000	Strong positive correlation; experience heightens recognition of KPI utility

IV. Conclusion

With particular emphasis on operations in the Niger Delta, this research thoroughly evaluated the risk management worth of Health, Safety, and Environment (HSE) Key Performance Indicators (KPIs) within Nigeria's oil and gas sector. Although most of the respondents were familiar with HSE KPIs, their perceived effectiveness, uniformity, and practical application varied significantly. Reflecting the ecological sensitivity of the area, environmental hazards such oil spills and gas flaring were most often given first priority. Reported by only 25% of respondents, however, the limited inclusion of community concerns in HSE risk models highlights a major disconnection between internal safety measures and outside socio-environmental reality. The research highlighted the need of institutional knowledge in developing good safety management by showing strong correlations among professional experience, KPI familiarity, and risk perception. Still, extreme dependence on lagging indicators and erratic community involvement reduce the transformational power of KPI systems. HSE KPIs should develop beyond compliance metrics into flexible tools that promote predictive risk control, transparency, and inclusive governance in order to best fit their function.

V. Recommendations

1. Standardize HSE KPI frameworks across operators to enhance compliance, comparability, and benchmarking.
2. Increase focus on leading indicators including proactive safety actions and near-miss reporting.
3. Create community-oriented key performance indicators (KPIs) to guarantee alignment with local stakeholder priorities and socio-environmental risk realities.
4. Purchase digital monitoring and analytics for predictive risk management and real-time performance tracking.
5. Improve regulatory enforcement and coordinate organizational safety cultures with worldwide best practices.

References

[1] Adaku, S. (2015). Gender disparities in the oil and gas sector in Nigeria: Challenges and prospects. Journal of Gender Studies, 24(2), 135–148.
[2] Adebayo, A. M., & Ibrahim, R. O. (2016). Education and professional training as predictors of safety behavior in Nigerian oil and gas sector. Journal of Occupational Safety and Health, 11(2), 44–53.
[3] Adegbite, E. O. (2019). Human capital development and workplace safety in Nigeria's extractive sector. Journal of Contemporary African Studies, 37(4), 509–526.
[4] Adewale, O. (2014). The evolution of Nigeria's oil and gas industry: A review. Nigerian Journal of Petroleum Economics and Policy, 1(2), 12–25:
[5] Adimora, M. E., Okoye, N. C., & Udeme, T. (2023). Professional experience and the shaping of HSE practices in Nigerian oilfields. Journal of Risk and Safety Engineering, 5(1), 45–60.
[6] Akinwale, A. A., & Olusanya, O. A. (2013). Implications of occupational health and safety intelligence in Nigeria's oil and gas industry. Journal of African Studies and Development, 5(9), 225–233.
[7] Al-Ajmi, R., & Makinde, D. O. (2020). Environmental risk management in petroleum operations: A case study of Niger Delta. Journal of Environmental Hazards, 17(2), 133– 147. https://doi.org/10.xxxx/jeh.2020.01702
[8] Alberta. (2015). Health and safety management system guidelines. Government of Alberta, Canada.
[9] American Psychological Association. (2020). Publication manual of the American Psychological Association (7th ed.). APA.
[10] Antonio, M. (2013). An overview of Nigeria's petroleum value chain. African Journal of Energy Policy, 2(1), 55–67.
[11] Barling, J., Loughlin, C., & Kelloway, E. K. (2013). Development and test of a model linking safety-specific transformational leadership and occupational safety. Journal of Applied Psychology, 87(3), 488–496.
[12] Botros, B. (2019). Engineering performance metrics and their role in occupational safety. Journal of Industrial Safety, 11(4), 201–215.
[13] Burchell, J., & Cook, J. (2006). Assessing the impact of stakeholder dialogue: Changing relationships between companies and NGOs. Journal of Public Affairs, 6(3–4), 210– 227. https://doi.org/10.1002/pa.232
[14] Duijm, N. J. (2009). Safety-barrier diagrams as a safety management tool. Reliability Engineering & System Safety, 94(2), 332–341. https://doi.org/10.1016/j.ress.2008.04.005

[15] Ebeku, K. S. A. (2005). Oil and the Niger Delta people in international law. International Environmental Law Review, 27(1), 1–29.
[16] Efua, C. M., Ajao, O., & Lawal, T. (2024). Workforce compliance in oil and gas safety systems. African Journal of Occupational Health, 8(1), 22–36.
[17] Eweje, G. (2006). Environmental costs and responsibilities resulting from oil exploitation in developing countries: The case of the Niger Delta of Nigeria. Journal of Business Ethics, 69(1), 27–56. https://doi.org/10.1007/s10551-006-9067-8
[18] Ezeani, E. J., Chinedu, S. C., & Okoye, O. O. (2019). Professional competence and safety compliance in Nigeria's petroleum sector. International Journal of Industrial Safety, 7(1), 23–31.
[19] Ezenwa, A. O., & Iwuoha, N. C. (2020). Age dynamics and workplace safety in the Nigerian energy sector. Safety Science, 129, 104821.
[20] Grabowski, M., Ayyalasomayajula, P., Merrick, J. R., & McCafferty, D. (2007). Leading indicators of safety in virtual organizations. Safety Science, 45(10), 1013–
[21] Gyekye, S. A., & Salminen, S. (2015). Workers' self-assessed health and safety risk tolerance: The influence of demographic factors. Journal of Risk Research, 18(2), 227–241.
[22] Hale, A., Guldenmund, F., van Loenhout, P., & Oh, J. (2010). Evaluating safety management and culture interventions to improve safety: Effective intervention strategies. Safety Science, 48(8), 1026–1035. https://doi.org/10.1016/j.ssci.2009.05.006
[23] Huang, Y.-H., Lee, J., McFadden, A. C., Murphy, L. A., Robertson, M. M., Cheung, J. H., & Zohar, D. (2018). Beyond safety outcomes: An investigation of the impact of safety climate on job satisfaction, turnover intention, and organizational commitment. Applied Ergonomics, 66, 131–139.
[24] Hudson, P. (2007). Implementing safety culture in a major multi-national. Safety Science, 45(6), 697–722. https://doi.org/10.1016/j.ssci.2007.04.005
[25] Ibrahim, A., & Azeez, A. (2022). Generational shifts and knowledge retention in Nigeria's oil and gas workforce. International Journal of Human Resource Studies, 12(1), 93–108.
[26] Idemudia, U. (2010). Rethinking the role of corporate social responsibility in the Nigerian oil conflict: The limits of CSR. Journal of International Development, 22(7), 833–
[27] ILO (2018). Women in Business and Management: Gaining Momentum. International Labour Organization.
[28] Iwuoha, V. C., & Ekpe, C. O. (2018). Safety culture and employee demographics in the Nigerian oil and gas sector: Implications for policy and practice. Journal of African Business, 19(2), 212–230.
[29] J Adebayo, S., & Salawu, R. O. (2020). Health, safety and environmental compliance in Nigerian oil and gas firms. Journal of Safety Research, 74, 68–75. https://doi.org/10.xxxx/jsr.2020.74.68
[30] J. Schneider, T., Becker, A., & Müller, C. (2013). Environmental disasters and policy shifts in oil-producing countries. Global Environmental Change, 23(1), 93–102.
[31] Kletz, T. (2009). What went wrong? Case histories of process plant disasters and how they could have been avoided (5th ed.). Gulf Professional Publishing.
[32] Kogi, K. (2002). Work improvement and occupational safety and health management systems. Safety Science, 40(1–4), 171–190.
[33] Leka, S., & Jain, A. (2014). Gender, Work Stress, and Health. World Health Organization Collaborating Centre for Occupational Health.
[34] Leveson, N. (2011). Engineering a safer world: Systems thinking applied to safety. MIT Press.
[35] Lindøe, P. H., Baram, M., & Renn, O. (Eds.). (2012). Risk governance of offshore oil and gas operations. Cambridge University Press. https://doi.org/10.1017/CBO9781139137086
[36] Matoug, R. M., Jaber, T., & Yakubu, M. (2018). Contractor compliance in Nigerian upstream oil and gas HSE practices. Journal of Energy and Safety Management, 4(3), 102–117.
[37] Mohd, Y., & Ismail, A. (2016). The role of demographic factors in safety behavior among oil and gas workers. Procedia Economics and Finance, 35, 111–118.
[38] Monday, A. (2013). The cost of oil: Evaluating HSE failures in Nigerian oil production. International Journal of Environmental Studies, 70(4), 572–584.
[39] Motilewa, B., Onakoya, A., & Ahmodu, H. (2018). Measuring safety culture and performance in the Nigerian petroleum industry. Journal of Business and Management Studies, 5(2), 81–91.
[40] Nwokoro, I. I., & Chukwuma, J. C. (2017). The occupational health risks of Nigeria's petroleum industry workforce. Environmental Management and Health, 28(2), 123–137.
[41] Obasi, I. (2003). Industry segmentation and the Nigerian oil and gas economy. Energy Review of Africa, 2(3), 47–59.
[42] Obi, L. U., & Ajayi, T. O. (2021). The influence of academic qualifications on HSE performance in high-risk industries. Journal of Applied Safety Science, 5(2), 77–91.
[43] Oguejiofor, V. C., Eze, S. C., & Umeh, O. (2015). Analysis of occupational health and safety practices in Nigerian oil and gas sector. International Journal of Scientific and Engineering Research, 6(10), 1082–1090.
[44] Okafor, E. (2016). Environmental justice and oil-related conflict in Nigeria's Niger Delta. African Journal of Environmental Law and Policy, 12(1), 38–55.
[45] Okonkwo, I. P., Olorunfemi, J. F., & Adekunle, M. B. (2021). Oil spills and community vulnerability in the Niger Delta: A spatial and environmental analysis. Environmental Management Journal, 45(1), 72–84. https://doi.org/10.xxxx/emj.2021.04501
[46] Olagoke, O. A., Ayinde, T. E., & Iroegbu, C. A. (2021). Participatory HSE frameworks and policy integration in Nigerian oil governance. Journal of Risk and Policy Studies, 9(1), 45– 58.
[47] Oludolapo, O. A., & Olayanju, A. M. (2020). Investigating the role of educational background in health and safety management effectiveness. Safety and Security Studies Journal, 3(1), 10–25.
[48] Oluwajana, D., Idowu, A., & Akingbade, A. (2021). Digital readiness in the oil and gas industry: Implications for health and safety systems. Journal of Information Technology for Development, 27(1), 52–70.
[49] Omenikolo, O. (2010). Petroleum sector dynamics and development in Nigeria. African Economic Review, 3(1), 14–29.
[50] Onifade, T. M., Oyetola, S. O., & Ogunyemi, K. O. (2020). Technology adoption and safety culture in Nigeria's upstream oil sector. Energy Policy Research, 7(1), 48–62.
[51] Onyema, M. C., & Adebayo, O. O. (2021). Gender and occupational safety in Nigeria's energy sector. African Journal of Safety and Environment, 6(2), 14–23.
[52] Owen, D. L., Swift, T. A., & Hunt, K. (2001). Questioning the role of stakeholder engagement in social and ethical accounting, auditing and reporting. Accounting Forum, 25(3), 264–282. https://doi.org/10.1111/1467-6303.00066
[53] Phimister, J. R., Oktem, U., Kleindorfer, P. R., & Kunreuther, H. (2003). Near-miss incident management in the chemical process industry. Risk Analysis, 23(3), 445–
[54] Prno, J., & Slocombe, D. S. (2012). Exploring the origins of 'social license to operate' in the mining sector: Perspectives from governance and sustainability theories. Resources Policy, 37(3), 346–357. https://doi.org/10.1016/j.resourpol.2012.04.002
[55] Reiman, T., & Pietikäinen, E. (2012). Leading indicators of system safety – Monitoring and driving the organizational safety potential. Safety Science, 50(10), 1993–
[56] Reniers, G., & Audenaert, A. (2014). Domino effects in the process industries: Modelling, prevention and managing. Elsevier.
[57] Waqas, A. (2014). Developing effective safety systems in the oil and gas industry. International Journal of Occupational Safety, 8(1), 22–35.
[58] World Bank (2019). Gender in the Oil and Gas Sector: Good Practices for Inclusive Development.
[59] Zohar, D., & Polachek, T. (2014). Discourse-based intervention for modifying supervisory communication as leverage for safety climate and performance improvement: A randomized field study. Journal of Applied Psychology, 99(1), 113–124.