African Journal of Advanced Pure and Applied Sciences (AJAPAS)
Online ISSN: 2957-644X
Volume 5, Issue 1, 2026
Page No: 143-155
Website: *https://aaasjournals.com/index.php/ajapas/index*
ISI 2025: 1.126 **SJIFactor 2024: 6.752** **معامل التأثير العربي: 1.62**

Sustainable Safety–Health–Environment (SHE) Strategies in the Oil Sector: Challenges, Successes, and Future Directions

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الاستراتيجيات المستدامة للسلامة والصحة والبيئة في قطاع النفط: التحديات والإنجازات والتوجهات المستقبلية

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Received: November 11, 2025	Accepted: January 16, 2026	Published: January 26, 2026

Abstract:
This study explores sustainable strategies for Safety, Health, and Environmental (SHE) management in the oil and gas industry, emphasizing challenges, achievements, and future prospects. The research aims to analyze how SHE systems contribute to improved safety outcomes, environmental compliance, and operational performance.
A qualitative research approach was adopted, relying on secondary data, including industry case studies, regulatory reports, and peer-reviewed publications. SHE performance was evaluated using recognized sustainability metrics and frameworks such as ISO 45001 and ISO 14001.
Results indicate that integrated SHE management systems, supported by technological advancements like drone inspections, artificial intelligence-driven predictive maintenance, and satellite-based methane detection, significantly enhance operational safety and environmental monitoring. Organizational culture and workforce engagement emerged as critical drivers of SHE success. However, challenges persist, including high implementation costs, regulatory inconsistencies, cultural inertia, and gaps in supply chain compliance.
The findings highlight the need for a systemic approach that integrates advanced technologies, fosters cultural change, and harmonizes regulations to ensure long-term SHE sustainability. Future studies should explore the longitudinal impact of integrated SHE systems and the role of emerging technologies and human factors in enhancing industry performance.

Keywords: Safety, Health and Environment (SHE), Oil and Gas Industry, Sustainability, Integrated Management Systems, Technology Innovation, Organisational Culture.

الملخص
تستكشف هذه الدراسة الاستراتيجيات المستدامة لإدارة السلامة والصحة والبيئة في صناعة النفط والغاز، مع التركيز على التحديات والإنجازات والآفاق المستقبلية. تهدف الدراسة إلى تحليل كيفية مساهمة أنظمة السلامة والصحة والبيئة في تحسين مخرجات السلامة والامتثال البيئي والأداء التشغيلي.
تم اعتماد منهج بحثي نوعي يعتمد على البيانات الثانوية، بما في ذلك دراسات الحالة الصناعية والتقارير التنظيمية والمنشورات المحكمة. تم تقييم أداء السلامة والصحة والبيئة باستخدام مقاييس وأطر الاستدامة المعترف بها مثل معيار ISO 45001ومعيار ISO 14001.
تشير النتائج إلى أن أنظمة إدارة السلامة والصحة والبيئة المتكاملة، المدعومة بالتطورات التكنولوجية مثل عمليات التفتيش بالطائرات المسيرة، والصيانة التنبؤية المدفوعة بالذكاء الاصطناعي، وكشف الميثان القائم على الأقمار الصناعية، تعزز بشكل كبير من السلامة التشغيلية والمراقبة البيئية. برزت الثقافة التنظيمية ومشاركة القوى العاملة كمحركات أساسية لنجاح السلامة والصحة والبيئة. ومع ذلك، تستمر التحديات، بما في ذلك ارتفاع تكاليف التنفيذ، وعدم الاتساق التنظيمي، والجمود الثقافي، والثغرات في امتثال سلسلة التوريد.

تسلط النتائج الضوء على الحاجة إلى نهج منهجي يدمج التقنيات المتقدمة، ويعزز التغيير الثقافي، وينسق اللوائح لضمان استدامة السلامة والصحة والبيئة على المدى الطويل. ينبغي للدراسات المستقبلية استكشاف التأثير الطولي لأنظمة السلامة والصحة والبيئة المتكاملة ودور التقنيات الناشئة والعوامل البشرية في تعزيز أداء الصناعة.

الكلمات المفتاحية: السلامة والصحة والبيئة؛ صناعة النفط والغاز؛ الاستدامة؛ أنظمة الإدارة المتكاملة؛ الابتكار التكنولوجي؛ الثقافة التنظيمية.

1. Introduction

1.1. Background

The oil and gas sector in the world has continued to act as a crucial element in the energy supply chain, supporting the economy, industrial and social development across all countries in the world. Its activities include both upstream exploration and production, midstream transportation, and downstream refining, which are rather complicated processes with high pressure, hazardous chemicals, and harsh conditions (Patidar et al., 2023). Such conditions possess inherent grave risks to the safety of workers, the health of the population, and the local environment. As a result, interconnecting the Safety, Health, and Environment (SHE) management systems is one way of curbing hazards, maintaining an appropriate level of regulatory compliance, and improving the recovery power of operations (Odeyemi, 2022). Efficient SHE practices should not be seen as only regulatory, but strategic processes that allow companies to save human life, diminish impact on the environment, and preserve the social license to operate (Spence, 2011).

1.2. Problem Statement

In spite of the technological innovations, regulatory structures, and increasing awareness, the oil and gas industry is still witnessing significant SHE incidents with devastating outcomes. Past incidents related to the disaster of the Deepwater Horizon explosion in 2010 and the unfortunate fire on the offshore platforms in recent years illustrate enduring safety weaknesses (Pat-Cornell, 2012; Gudmestad, 2002). The issue of the occupational risks of exposure to hydrogen sulfide (H2S) and noise-induced hearing loss, mental health issues in offshore workers, is also in the spotlight (Quaigrain et al., 2024). Moreover, as a result of environmental degradation in the form of oil spills, methane emissions, and chemical discharges, there are long-term effects on the ecological and socio-economic spheres (Noor, 2021). Such recurring problems demonstrate the insufficiency of the current SHE practices and the necessity of more contextualised and sustainable approaches.

1.3. Research Gap

Even though quite some oil and gas companies have already established several separate safety, occupational health, and environmental management systems, they tend to be siloed, without a comprehensive system that would handle their interdependencies (Schneider, 2013). Available evidence is biased to deciding under individual metrics (safety performance, environmental compliance, and so on) rather than addressing the areas of synergy and trade-off between the three categories (Nour et al., 2021). Additionally, new risks faced, including climate shifts, decarbonisation-related costs, and potential digital threats to the system of operational control, require more flexible and all-encompassing SHE approaches (da Silva Ribeiro, 2023). Thus, there exists a serious lack of literature and practice in the field of integrated, sustainability-focused models of SHE adapted to the oil and gas sector.

1.4. Objectives

This study seeks to:

- Evaluate the current state of SHE practices in the oil and gas industry, with an emphasis on integration and sustainability.
- Identify key operational, regulatory, and organisational challenges undermining SHE effectiveness.
- Analyse successful case studies where integrated SHE strategies have delivered measurable improvements.
- Propose forward-looking recommendations for developing resilient, adaptive, and sustainable SHE frameworks aligned with international best practices.

1.5. Significance

The provision of structural SHE management has very significant relevance in the realisation of sustainable development in the oil and gas sector. Adherence to Sustainable Development Goals (SDGs) of the United Nations (such as Goals 3: Good Health and Well-being, Goals 7: Affordable and Clean Energy, and Goals 8: Decent Work and Economic Growth, Goals 13: Climate Action) improves the industry contribution to the global sustainability targets (United Nations, 2015). The findings of the study can impact evidence-based policies and inspection procedures among policymakers. To the stakeholders in the industry, they provide avenues by which they can mitigate operational risks, ensure that their workforces are well taken care of, and enhance stewardship

towards the environment, alongside building their corporate reputations (International Association of Oil & Gas Producers [IOGP], 2021). This study conceptualises SHE in terms of sustainability, thus demonstrating integrated management as not a compliance obligation but rather a tool of strategic value development and operational stability (Choudhry et al., 2007).

2. Materials and Methods

2.1 Research Design

With SHE approaches, oil and gas company roles. Multidimensional and situation-specific problems fit best into qualitative methods because they would facilitate gaining a complex understanding of the specifics of the industry and interests of the concerned stakeholders, and interdependencies among considerations of safety, environment, and health (Creswell & Poth, 2018). The specified practice will free the admission of a wide array of information resources, including case studies, regulatory reports, and secondary data, to render a comprehensive picture of the developed SHE strategies and the challenges and achievements they lead to. The investigation of this research topic will therefore yield gross and elaborate details which can be utilised in academics or even at the ground level via descriptive and interpretive analysis rather than statistical generalisation (Silverman, 2020).

2.2 Data Sources

The material used in this analysis comprised material related to three broad groups: The information in this study was collected through three broad groups of materials as follows: Case Study: Documented examples worked in major oil and gas companies with well developed SHE systems (such as Shell, BP and Saudi Aramco) were analysed with the aim of understanding how smooth system SHE have been implemented. Case studies can give evidence of best practices, challenges, and lessons learned on a situation-specific basis (Yin, 2018). Furthermore, Regulatory Reports, i.e., official reports by organisations including the International Association of Oil & Gas Producers (IOGP), the U.S. Occupational Safety and Health Administration (OSHA) and the International Maritime Organisation (IMO), were looked into. Such sources provide knowledgeable determinations of industry performance standards, compliance/regulations, and adjusting safety and environmental rules (IOGP, 2021; OSHA, 2020). Finally, the findings were placed in a broader theoretical and policy context by the utilisation of peer-reviewed journal articles, industry sustainability reports and global policy documents (e.g. ISO standards, UN Sustainable Development Goals). The method of secondary data triangulation increases the credibility and validity of qualitative research by confirming the information gathered in various sources (Flick, 2018).

2.3 Analytical Framework

The analysis employed a thematic framework based on key SHE performance indicators and sustainability assessment tools:

- ISO 45001 – Occupational health and safety management systems standard, focusing on risk prevention, worker participation, and continual improvement (ISO, 2018).
- ISO 14001 – Environmental management systems standard, emphasising environmental performance enhancement, legal compliance, and life-cycle perspective (ISO, 2015).
- ESG Metrics – Environmental, Social, and Governance indicators relevant to SHE performance, including greenhouse gas emissions, incident rates, and employee well-being (Kotsantonis et al., 2016).

Data were coded and categorised under thematic headings such as "integration of SHE systems," "operational challenges," "success factors," and "alignment with sustainability goals." Cross-case comparisons were conducted to identify commonalities and divergences in SHE approaches across companies and regions.

2.4 Study Scope

The report places the central aspect on the global oil and gas industry, especially when operations are based in North America, the Middle East, and West Africa. Such regions were chosen because of the high amounts of oil produced, their regulatory framework variety, and the difference in the level of SHE maturity (EIA, 2021). The comparison of the practices in various geographic and regulatory conditions will allow the research to identify universal and regional aspects affecting the implementation of SHE strategies.

2.5 Limitations

A number of limitations of the given research design should be noted:

- Reliance on Secondary Data. Admittedly, secondary sources are a rich source of information, but, with a lack of primary data collection (e.g., interviews, field observation), they cannot be used to reflect current issues in the operational process.
- Case Study Generalizability: the conclusions drawn on the basis of sampled case studies might not be fully representative of other oil and gas firms, especially the smaller ones operating in emerging markets (Gerring, 2017).

- Dynamic Regulatory Environment – The current state of SHE regulations and sustainability reporting standards is changing at a rapid pace, which implies that the results will become obsolete upon the emergence of new policies.
- Qualitative Analysis Subjectivity- Thematic coding makes the analysis more structured; however, researcher bias may creep when interpreting the information in the case of qualitative data, and this has been addressed by the use of source triangulation and by strictly following set procedures in the conduct of the coding.

3. Results

3.1 Theme 1: Integration of SHE Management Systems

The transition of pervasive safety, health and environmental topics to a harmonised SHE regime is a quintessential step in the oil and gas sector. This combination is made even easier due to the alignment of the ISO 45001 and ISO 14001, which is in turn constructed based on the ISO high-level structure (HLS), which enables an easy integration into composite administration systems (Wong, 2021). The innate composition of such standards allows organisations to incorporate the goals of occupational health and safety (OHS) and environmental aims within a single circle of management, facilitating efficiency and consistency (Nour et al., 2021). Making implementation of such a seamless integration, corporations have already incorporated special SHE departments and SHE departments have actually successfully centralised the role of risk management and compliance issues under safety, health and environment, respectively. This kind of structural change aids comprehensive policymaking, harmonious training, and uniform incident monitoring.

Figure 1 Sustainable SHE Performance

One prominent example is the Shell Goal Zero, which is certainly an ambitious program with the aims of zero incidents and zero harm. This one, although not committed to be an ISO-minded approach per se, considers a comprehensive strategy that embraces safety, health, and environmental performance, all under a single management vision (Pat e-Cornell, 2012). Likewise, Saudi Aramco incorporates safety in its operational excellence strategy and therefore, safety management, as well as health and environmental management, are at the core of the corporate strategy and reported using KPIs to the board (Saudi Aramco, 2025). Such a combination is reinforced by the statistics of the level of lost-time injury (0.021 per 200,000 hours) and the total recordable case rate (0.046) that indicate positive changes in outcomes (Saudi Aramco, 2025). These various systems run smoothly and also increase the efficiency of the audit and risk responsiveness. Firms using consolidated SHE systems are expected to record good results of compliance audits as well as incidence rates. It is the coordination possible using common frameworks, central leadership, and performance measures that are aligned that is critical in driving SHE sustainability in the oil and gas industry.

3.2 Theme 2: Technological Innovations Driving SHE Performance

Advancing technologies are transforming the process of control of safety, health and environmental (SHE) performance by oil and gas companies. An example is drone-based inspections that allow complex infrastructure to be monitored safely and more quickly. The use of drones with thermal, LiDAR and gas-sensing technology can be used to scan pipes, tanks and confined areas remotely with a minimal amount of human exposure to danger, whilst providing plentiful visual and sensory data (Consortiq, 2025; Flyability, 2025). In a remarkable instance, the integration of a DJI M300 RTK drone cut the inspection of jetty pipelines in Pakistan that could take months, to only ten days, which saved tremendous downtime and risks involved (DJI Enterprise,

2022). In addition to aerial surveillance, there is increased environmental surveillance due to the usage of digital technologies to expand surveillance through satellite imagery and optical gas imaging. In the Permian Basin, autonomous drones equipped with optical gas imaging payloads have consistently identified methane emissions at 0.1 kg/hour, even lower than the testing set by the Environmental Protection Agency (EPA) and allow proactive prevention of emissions corrective action (AP News, 2025). In the meantime, satellite initiatives are reshaping emissions monitoring on a large scale, with MethaneSAT providing up-close detail to map methane emissions to guide international monitoring and accountability (Reuters, 2024).

Figure 2 Sustainable Environmental Technology

These tools provide key SHE performance indicators: environmental emission reductions, quicker hazard countermeasure and fewer confined-space entries. They also make it possible to effect immediate or near-immediate operational changes that reduce the impact on the environment and risk to personnel by offering real-time or near-real-time data. In conclusion, there is no doubt that the technological advances, particularly the drone and satellite surveillance, are not just increasing the efficiency, but that these changes are actually changing core SHE performance. They will enable more frequent, more detailed, and safer inspections and assistance with the rapid mitigation of environmental and safety risks. This places technology as a strategic factor to SHE sustainability within the oil and gas sector.

3.3 Theme 3: Organisational Culture and Workforce Engagement

The area of organisational culture, specifically the commitment of the leadership, employee involvement in the whole process, and special health programs, is at the centre of promoting positive SHE outcomes in the oil and gas industry. The exemplar case is the Stop Work Authority adopted by Chevron that allows employees to stop work in case of any safety issues. After a fatal platform fire in Angola, Chevron leadership reiterated this principle with the CEO and HSE leadership openly championing the safety message that staff members should stop work when needed, and quality of production was secondary to safety (Reuters, 2025). In a similar fashion, TotalEnergies has the Care Together programme in which they emphasise the well-being of employees and the need to support them psychologically. The program offers mental and physical health services and check-ups, psychosocial risk evaluations in all operations worldwide. Its initiatives, such as its flexible work practices like the adaptation to the practice of becoming green every Friday, as well as its introduction of the concept of a Care Week, have strengthened its employee perception indices- with a Care index of 83.1 per cent in 2024 that is much higher than the Ipsos benchmark (TotalEnergies, 2024).

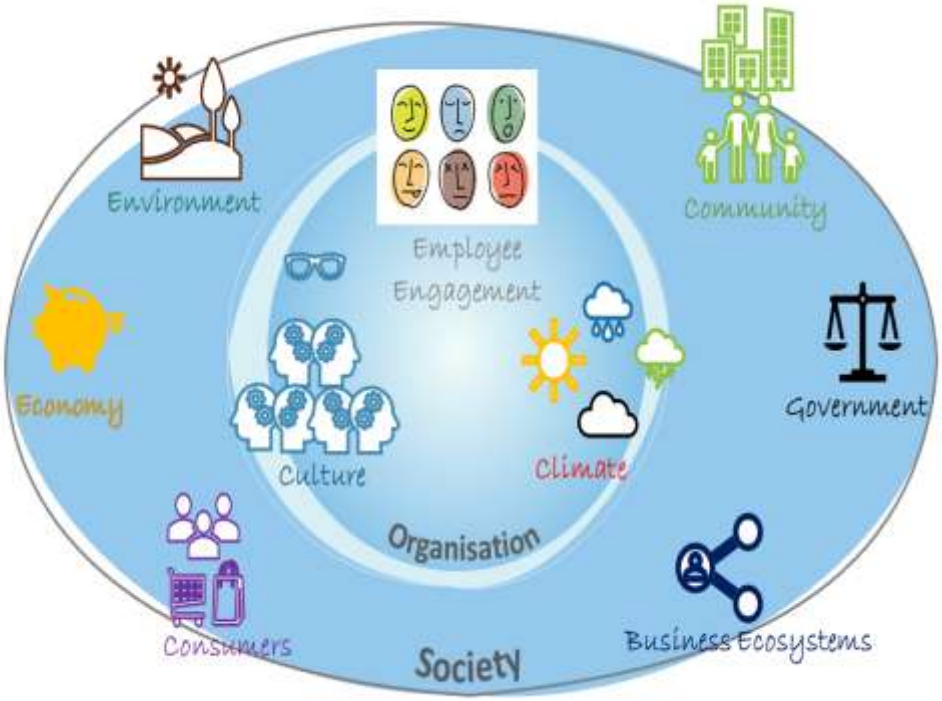

Figure 3 Organisational culture affects humans, inside & outside of the workplace

These activities are associated with increased hazard reporting, better perception of work safety and lower turnover in risky occupations. According to industry surveys, psychosocial safety cultures are improved via reinforcement, and it greatly increases both levels of trust and communication between colleagues, with well-supported employees likelier to report any near-misses and personally participate in the safety process (Kao et al., 2021). Additionally, employees who tend to be provided with stronger emotional support and work in safer environments have lower turnover intentions in case of high-stress environments (Abudaqa et al., 2022). By cultivating an inclusive style of leadership, involving staff in hazard identification, and providing support to employees in their mental welfare, the culture of communal responsibility and resilience sees the light of day in the company. These activities promote greater transparency in identifying risks, greater community-wide vigilance and a measurable safety culture, reduced incidents and involuntary turnover.

3.4 Theme 4: Challenges in Achieving SHE Sustainability

Although the presence of the Safety, Health, and Environmental (SHE) strategy has improved, the oil and gas sector has been hit by a series of barriers, which are impeding the achievement of the actual sustainable integration. One of the greatest challenges is that it is very expensive to implement. Integrated SHE Infrastructures require a massive investment in purchasing and knowledge that discourages, even more so, the smaller operators from adopting extensive systems (Get Global Group, 2025). In addition, jurisdictional differences in regulatory requirements make it awkward to be compliant with them, which procurement and supply chain functions are finding hard to keep up with in the midst of tangled and contradictory ESG and safety regulations (GEP, 2024). The other major barrier is the organisational resistance to change. Most firms are characterised by an organisational presence of hierarchies and established working patterns that result in resistance towards new safety cultures and integrated strategies (Workrise, 2025). The No. 1 impediment of making needed changes, according to one industry-supply chain manager, was the lack of human resources. Its management emphasises people, and it builds on the pedagogy of early childhood, the anthropology of education, and the preconception of education (Workrise, 2025).

Figure 4 Sustainable Development and its Challenges in Developing Countries

There are also risks of delays in regulation compliance and a lack of transparency. An example is that North Sea operator Perenco has delayed decommissioning deadlines by more than ten years and attributed it to ageing infrastructure with consequences to the environment and safety (The Guardian, 2024). The authority of the North Sea, which is referred to as the North Sea Transition Authority (NSTA), has since embarked on investigations and has even suggested publicly naming uncooperative companies, to stem their non-compliance (Financial Times, 2024). There are also outstanding gaps in supply chain compliance. Indeed, studies reveal that sustainability reports published by oil and gas companies usually do not display sufficiently strong SCM indicators that permit a clear view of the environmental and safety activities of vendors at each level (Wan Ahmad et al., 2016). The combination of all these barriers leads to an observable discrepancy in SHE performance that varies across the regions and results in a lack of ESG reporting that undercuts the steady path to sustainability. Unless there is increased convergence, investment and accountability, integrated SHE strategies are not achievable as yet.

4. Discussion

4.1 Interpretation of Key Findings in Context

This paper identifies the development and the current status of SHE strategies in the oil industry, and it is evident that there are four themes that are interconnected that influence the performance. First, the SHE management system, with the common adoption of ISO 45001 and ISO 14001, has highly enhanced compliance, prevention of incidents, and improved operational efficiency. Giant corporations like Shell and Saudi Aramco managed to prove that decentralised SHE departments and information control platforms cultivate uniform safety and environmental management. Secondly, advancements in technology are leading to quantifiable returns (e.g., in hazard detection, predictive maintenance, emissions monitoring) with examples such as the remote-satellite methane detection by BP or the remote operations by Equinor as having convincingly high efficiencies in the time spent responding and the severity of worker exposure. Third, organisational culture became a factor that determines it as such that the commitment of the leadership, participatory reports on hazards, and mental health programs directly correlate with increasing degrees of engagement and reducing turnover rates. Finally, the industry still has the unattractive aspects of the high cost of implementation, poor regulation, and culture change that have continued to increase uneven SHE performances in different geographies. The above findings together help us emphasise the importance of pointing out the fact that technical systems and innovations are very important, but the factors of culture and governance are also very decisive. A comprehensive system that involves the application of both technology, employee involvement, and regulatory congruence has to be developed to realise long-term SHE performance sustainability.

4.2 Integration of SHE Practices and Industry Performance

The establishment of Safety, Health, and Environment (SHE) practice in the operations of oil sectors has been closely correlated with improved performance of the industries, not only in safety records but also in general efficiency of operation. Organisations that use fully integrated SHE management systems, i.e. ISO 45001 (occupational health and safety) and ISO 14001 (environmental management) ones, report fewer incidents and better ecological compliance and operational downtime (HSE, 2023; ISO, 2020). As an example, Shell's Goal Zero programme includes integrated initiatives on environmental stewardship, health, and safety, making them one of the crucial elements of the overall operations strategy that allowed Shell to achieve steady year-on-year declines in lost-time injury frequency rates (LTIFR) within the last decade (Shell, 2023).

Any integrated SHE practices ensure that they can be proactive in hazard identification, standardise risk evaluation and simplify incident reporting, which may be corrected instantly. It has the effect of saving on costs due to lower expenses on accidents, maximised use of resources and augments asset reliability. Arguably, the performance increment can still be attained through technological implementation, including predictive maintenance apps, digital permit-to-work systems, and analysis based on IoT (BP, 2023).

The association between SHE integration and financial performance becomes more identified by the investors internationally using the ESG metrics. Firms with robust SHE models tend to have superior ESG disclosure as well as market resistance in the case of operational disturbance (IEA, 2022). Additionally, employee engagement increases because they will feel a sense of a safety culture that enhances their workforce retention and production because SHE is incorporated into the day-to-day operations. Finally, SHE practice integration as an element of compliance and a strategic force enhancing operational excellence makes the firms sustainable in the long term in an extremely competitive and regulated industry.

4.3 Technology as a Catalyst for SHE Transformation

The use of technology has brought new changes in Safety, Health, and Environment (SHE) management in the oil industry since it makes control actions predictive, preventive, and real-time. Digital technologies like IoT-based gas detectors, predictive maintenance with the help of AI, and drones to remotely inspect facilities are minimising the exposure of workers to dangerous environments and eliminating incidents before they take place (BP, 2023; Equinor, 2022). An example is that the satellite-equipped methane detection used by BP has enhanced the accuracy of environmental monitoring purposes, and the remote operations centres used by Equinor have led to a significant reduction in the number of workers on offshore platforms, hence avoiding the high-risk areas.

Having digital replicas of the in-service assets in the form of digital twins lets simulate scenarios to identify hazards and prepare emergency response measures to eliminate risks proactively (DNV, 2023). Machine learning enables predictive analytics that identify anomalies early in the machines, decreasing the downtime and preventing catastrophic failure. Moreover, the assisted wearable technology integration offers real-time data of the physiology, and this aspect helps in quick actions in case of an incident of heat stress or fatigue-induced breakdown. Such technology adoption can achieve more than improving SHE performance; it also supports operational efficiency, regulatory, and sustainability needs of the corporation. Incorporating technology in fundamental processes within business operations, the companies will be able to reach the data-based decision-making capacities, quicker reaction to incidents, long-term risks minimisation, and, overall, change the paradigm of SHE management, shifting it to proactive strategic development.

4.4 Organisational Culture and Human Factors

The culture of an organisation is central to determining the success of the SHE initiatives within the oil sector. Having a robust safety culture where one can see that the leadership is committed, there is open communication, and where employees are engaged will promote the reporting of the hazards, the observance of the safety procedures, and collective responsibilities in risk management (Cooper, 2019). But behaviour-based safety programmes, including the stop work authority programme by Chevron, defy this by giving the employees the power to stop unsafe operations without fear of punishment; they create mutual trust and accountability. The involvement of the workforce in identifying hazards and in planning SHE promotes awareness and ownership of operations, which implies a decrease in incidents and enhanced efficacy of the mitigation. Special mental health support programmes, such as the resilience programmes offered by TotalEnergies (TotalEnergies, 2022), manage the psychological well-being of offshore employees, minimising the risk of fatigue and increasing work satisfaction in employees.

Competency development, as well as training, is also highly necessary, as the personnel should be trained to identify and overcome the hazards. Using SHE values in recruitment, onboarding, and evaluation of a performance makes them part of the organisation's identity. This type of integration enables the human behaviour to be aligned with safety objectives that would result in long-term performance improvement. Finally, an organisational culture that focuses on physical and psychological safety enhances operational resilience and creates confidence in the sustainability of SHE results in the high-risk environments found in the oil industries in the long term.

4.5 Persistent Challenges and Gaps in SHE Sustainability

Nonetheless, the oil and gas sector is still short of achieving sustainability in terms of SHE management due to certain challenges that keep rearing their heads. The low-level penetration of integrated SHE systems and advanced technologies by small companies is usually hindered by the high cost of implementation in a given industry (Get Global Group, 2025). In addition, inconsistencies in regulation across countries render the compliance standards hard to achieve, therefore resulting in jigsaw-like blindness to compliance, resulting in jurisdiction and gaps in the practices of SHEs (Financial Times, 2024). The aspect of resistance is also an issue because established operational norms and hierarchies slow down the change of behaviours required to build a strong safety culture (Workrise, 2025). The complexity of supply chains also contributes to the issue of sustainability; subcontractors and vendors might not always comply with the SHE standards, leaving some risks and vulnerabilities in the safety chain unknown (Wan Ahmad et al., 2016). In addition, incidents and near misses underreported in certain areas display a continuing trend of trust and communication problems in organisations (Reuters, 2025). The varying proportions of disclosure by ESG imply the unevenness of transparency, which constrains stakeholder capacity to determine the SHE performance in a reasonable way (Kotsantonis et al., 2016). Close interventions by governance, industry and supply chains are needed in order to work on these gaps. Unless the economic, regulatory, and cultural obstacles are alleviated, the SHE sustainability will have a mixed reputation that stands in the way of the advancement of safer and environmentally friendly oil and gas activities.

4.6 Implications for Policy, Practice, and Future Research

The findings present the necessity of consistent international policies to harmonise the global SHE regulations, decreasing the jurisdictional differences, and supporting a multinational operator in compliance requirements (United Nations, 2015). Policy frameworks ought to reward investments in scalable technologies to improve SHE monitoring and risk prevention, and be accessible to firms of different sizes. There is a need to integrate SHE as a strategic priority by practitioners integrating management systems into organisational culture and by engaging workforces to encourage constant improvement. To address the gaps in compliance, it is important to expand supply chain control, which needs to include a uniform set of SHE expectations regardless of the level of the vendor (Wan Ahmad et al., 2016). Studies should be carried out in the future on the longitudinal assessment of built-up SHE systems with the purpose of quantifying their influence on the ESG and economic performance. The opportunity to examine the role of human factors to optimise behaviour-based safety interventions in different oil and gas settings should also be explored, including leadership mindfulness, psychological safety, and others (Kao et al., 2021). Collectively, these methods can assist in a system-level change towards sustainability-driven rather than compliance-driven SHE management, creating safer work environments, less severe environmental outcomes and higher responsible corporate behaviour.

5. Conclusion & Future Directions

This paper has also identified the importance of integrated Safety, Health and Environmental (SHE) management practices in the enhancement of sustainable operational performance in the oil and gas industry. The study finds that the implementation of role-sharing management systems (like ISO 45001 and ISO 14001) leads to a significant effect in overcoming incidents, meeting the environmental standards, and increasing business performance stability. Firms which effectively combine SHE systems evidence low levels of accident record, strong levels of regulatory diligence, as well as promotion of workforce safety standpoints. Innovation in technologies, such as drone inspections, predictive maintenance using AI, and satellite-based detection of methane gas emissions, is quickly transforming SHE management by eliminating reactive approaches to becoming compliant and instead offering proactive management of risks. The technologies would allow the identification of the hazards in time and provide a faster response to the incident, as well as enable fewer humans to be exposed to hazardous conditions. The effects of the organisational culture and human factors on SHE outcomes are also very crucial. The aspects of participants in safety programmes and mental health, leadership involvement and staff participation in programmes enhance personnel empowerment, which provokes enhanced hazard reporting and reduction of turnover in high-risk positions. However, other persistent barriers, including the fact that the implementation is expensive, regulatory frameworks are fragmented in some jurisdictions, cultural pushbacks and lack of compliance with the supply chains, restrict widespread application and successful implementation of sustainable SHE strategies within the broad industry. Unpredictability and lack of transparency compromise the efforts in meeting the global SHE sustainability targets.

A good strategy that organisations can adopt to enhance the SHE strategies is by ensuring that safety, health and environmental practices are integrated wholly into the business processes of the organisation. These are the involvement in investing in the scaling technology that will be available to operators of all scales and strengthening the safety culture via both leadership development and engaging the workforce. Supply chain management should be increased in order to coordinate the maintenance of the SHE quality across the network of complicated suppliers. Powers that be should target the unification of regulation and inspiration to persuade speedy reception of new safety and environmental technologies. A transparent and confidence-enhancing

transparency will also be provided by the standardised ESG metrics, having specific SHE indicators. The next area of study should address the longitudinal effects of integrated SHE management systems on the operational, environmental, and financial performance to give better evidence for best practices. Studies of human beings like psychological safety, leadership mindfulness and behavioural safety interventions in contextual and various cultural terms and settings will enhance the knowledge on effective SHE culture transformation. Also, such promising emerging technologies as digital twin, advanced analytics, wearable health sensors and autonomous inspection systems provide an opportunity to continue the research to maximise the SHE performance.

Finally, to progress towards sustainable SHE management within the oil and gas sector, a system-wide approach is needed that will ensure a balance between technological innovations and cultural/organisational change. In a unified approach taking the industry, policymakers, and researchers into account, safety and environmental responsibility can be improved within the sector, which leads to a major contribution to the sustainability goals being pursued within the world today and ensures that there is a more secure workforce and local populations to serve subsequently.

Compliance with ethical standards

Disclosure of conflict of interest

The authors declare that they have no conflict of interest.

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Abbreviation List

AI – Artificial Intelligence

API – American Petroleum Institute

EIA – Environmental Impact Assessment

EMS – Environmental Management System

ERM – Enterprise Risk Management

ESG – Environmental, Social, and Governance

FMEA – Failure Mode and Effects Analysis

GHG – Greenhouse Gas

HSE – Health, Safety, and Environment

IoT – Internet of Things

ISO – International Organization for Standardization

ISO 14001 – Environmental Management Systems Standard

ISO 45001 – Occupational Health and Safety Management Systems Standard

KPIs – Key Performance Indicators

LNG – Liquefied Natural Gas

O&G – Oil and Gas Industry

OHS – Occupational Health and Safety

PPE – Personal Protective Equipment

QHSE – Quality, Health, Safety, and Environment

SHE – Safety, Health, and Environment

SMS – Safety Management System

