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Case Studies on Safety Management Practices at Offshore Platforms in Malaysia

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ABSTRACT

This paper presents a qualitative exploratory study to investigate safety management practices across multiple offshore platforms in Malaysian oil and gas sector. The study identifies unsafe acts and behaviours that contribute to offshore accidents and examines current approaches to safety management implementation. Data were collected through semi-structured interviews with 5 offshore personnel from different platforms comprising experienced technicians and supervisors with 5 to 25 years of service and certified to operate in offshore environments. All interviews were qualitatively analysed to extract recurring patterns related to behavioural safety and procedural compliance. Findings reveal that improper use of Personal Protective Equipment (PPE) remains the most common unsafe behaviour despite existing safety protocols, daily toolbox meetings, and routine risk assessment activities. This indicates persistent behavioural non-compliance and enforcement gaps within the current Safety Management System. Additionally, limited structured competency development and inconsistent monitoring were identified as constraints affecting overall safety performance. The findings provide oil and gas organizations with actionable insights to reinforce compliance culture, reduce operational risks, and support continuous improvement in safety management offshore.

Keywords*: offshore safety, safety management, oil and gas industry, case study, Malaysia*

1.0 INTRODUCTION

The offshore oil and gas industry is globally recognized as one of the most hazardous working environments due to its complex operations, remote locations, and constant exposure to high-risk conditions (Elden et al., 2019). Activities such as drilling, production, and maintenance involve elevated operational pressures, flammable materials, confined spaces, and dynamic weather conditions, all of which increase the potential for catastrophic accidents. When incidents occur offshore, their consequences are often severe, leading to fatalities, serious injuries, major asset loss, and long-term environmental damage (Brkić & Praks, 2021).

To manage the inherent risk, offshore platforms operate under structured Safety Management Systems (SMS) guided by international and national regulatory requirements. These systems typically include safety training, hazard communication, risk assessment, emergency response planning, and continuous monitoring of safety compliance. Despite these measures, accidents remain a critical issue. Numerous incident investigations globally have shown that a significant number of offshore accidents stem from preventable unsafe behaviours (Chen et. al, 2022). This indicates that while safety procedures are well established, their implementation and enforcement may still be insufficient to ensure consistent compliance at the workforce level.

In Malaysia, offshore operations contribute substantially to national economic growth, with extensive oil and gas infrastructure across the region (Otitolaiye & Aziz, 2025). However, reported incidents involving fires, gas leaks, equipment failures, and vessel collisions suggest ongoing challenges in maintaining high safety standards (Mujeeb-Ahmed et. al, 2018). Many of these events highlight human and organizational factors as underlying contributors, reinforcing the need to assess how workers perceive, adopt, and comply with safety requirements in real operational contexts. Understanding these behavioural aspects is essential to improving accident prevention efforts and supporting risk-mitigation strategies.

Previous research in offshore safety tends to emphasize regulatory structures, system audits, or organizational-level performance (Otitolaiye & Aziz, 2025). There is comparatively limited qualitative evidence exploring how workers adhere to safety procedures and what contributes to persistent behavioural non-compliance. Therefore, this study focuses specifically on identifying unsafe acts at the workforce level and examining the current approach to safety management implementation on offshore platforms.

1.1 Offshore Safety in Oil and Gas Industry

Offshore platforms involve continuous production activities that require the integration of multidiscipline workers, heavy machinery, and frequent maintenance routines. Workers often operate in confined spaces, elevated structures, and under strict time pressure, which increases physical and mental fatigue (Necci et al., 2019).The consequences of even minor errors in these settings can escalate rapidly into severe incidents due to the presence of hydrocarbons and high-pressure systems. Emergency response capabilities are also limited by distance from shore and weather-dependent evacuation, intensifying the urgency to prevent incidents before they occur (Brkić & Praks, 2021).

Globally, offshore industries have recorded severe accident histories including Piper Alpha (1988), Deepwater Horizon (2010), and Bohai Bay spill (2011), highlighting how catastrophic failures frequently stem from inadequate safety management and unsafe human actions (Chen et al., 2022). In Malaysia, offshore safety incidents also happened to occur, though detailed statistics may not always be publicly disclosed due to corporate confidentiality (Marchiori et al., 2017). Although engineering safeguards and regulatory compliance have significantly reduced technical failures, unsafe human behaviour remains a principal cause of offshore incidents (Cai et al., 2012). Studies indicate that up to 80–90% of offshore accidents are linked to unsafe acts or human error (Otitolaiye & Aziz, 2025).

Moreover, work schedules in offshore environments typically involve long shifts and rotational work arrangements (e.g., 14 days offshore), contributing to cumulative fatigue, reduced alertness, and behavioural lapses (Li et al., 2016). Therefore, human factors become a pivotal determinant of safety performance. Accordingly, Human Factors framework (HF) conceptualises accident causation beyond individual mistakes by considering 4 interrelated dimensions: individual, organisational, technological, and environmental factors such as shown in Figure 1.

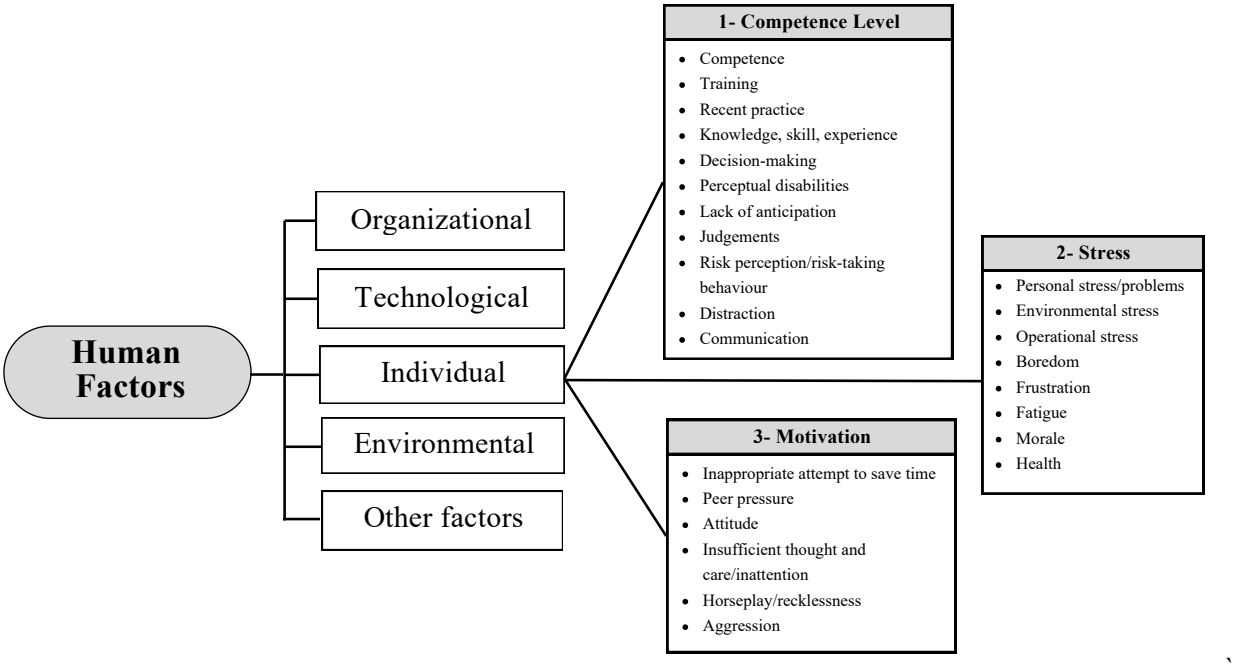

Figure 1. Individual Factors in HF theoretical framework (Franca & Hollnagel, 2020)

From an HF perspective, unsafe outcomes emerge not from isolated human error, but from the interaction between these system elements (Franca & Hollnagel, 2020). In this study, the HF framework is adopted to provide a theoretical anchor for examining offshore safety, with specific emphasis placed on the individual factors dimension, which consists of competence level, stress and motivation as element factors. This focus is aligned with the research objective to identify unsafe acts and behaviours that contribute to offshore accidents.

Other than framing unsafe acts within the Human Factors perspective, these behaviours can also be categorised according to the nature of the action (Aydinli, 2019) following a commonly used taxonomy: (1) unintended actions and (2) intended actions (Figure 2). In this study, the focus is placed on intended actions observed on Malaysian offshore platforms, as these behaviours are directly relevant to the research objective of identifying unsafe acts contributing to offshore accidents, which can later be systematically mapped to individual factors for analysis.

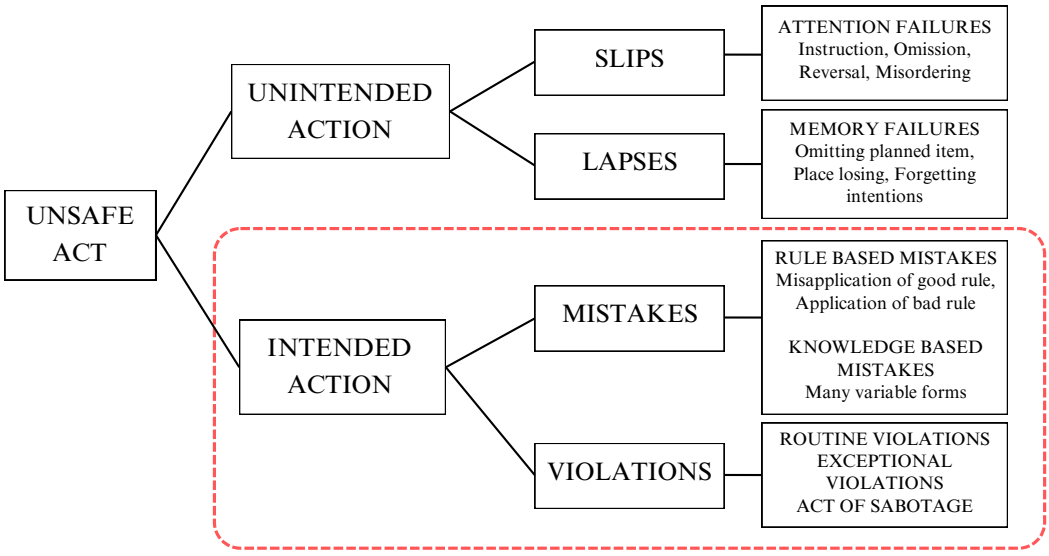

Figure 2. Reason's Taxonomy on Unsafe Acts (Aydinli, 2019)

1.2 Safety Management Systems in Offshore Platforms

Safety Management Systems (SMS) form the structured approach used by offshore operators to manage risk systematically. An SMS typically includes accident prevention strategies, performance monitoring, emergency preparedness, and continuous improvement mechanisms (Otitolaiye & Aziz, 2025). Well-established SMS frameworks are guided by regulatory requirements such as the Occupational Safety and Health Act (OSHA), international HSE standards, ISO 45001, and industry-specific guidelines enforced by authorities such as PETRONAS and DOSH in Malaysia (Guédé, 2019; Liu et al., 2021a). An effective SMS ensures that hazards are systematically identified and controlled through the following pillars:

- Safety policy & leadership commitment (Brkić & Praks, 2021).
- Risk assessment and hazard control (Chen et al., 2022).
- Operational procedures (PTW, lockout-tagout, confined space entry) (Otitolaiye & Aziz, 2025).
- Safety training & competency assurance (Otitolaiye & Aziz, 2025).
- Monitoring, audits & inspections (Guédé, 2019).
- Incident investigation & reporting (Liu et al., 2021a).
- Emergency response readiness (Li et al., 2016).

These elements aim to create safe working routines while maintaining regulatory compliance and ensuring readiness for abnormal conditions. Although SMS is widely implemented, the degree of effectiveness varies across different offshore platforms. Practical execution often faces real-world constraints such as:

- Supervisory gaps in safety enforcement (Christou & Konstantinidou, 2012).
- Insufficient worker engagement in safety processes (Otitolaiye & Aziz, 2025).
- Inconsistent communication between management and frontline personnel (Otitolaiye & Aziz, 2025).
- Perception that productivity is prioritized over safety (Elden et al., 2019).

As a result, workers may view safety procedures as formalities rather than essential safe operating practices. While systems and procedures exist, compliance behaviour determines their success. Therefore, continuous improvement must prioritize behavioural interventions rather than merely administrative expansion of SMS documentation.

2.0 METHODOLOGY

This study adopts a qualitative exploratory approach to investigate safety management practices at offshore platforms in the Malaysian oil and gas industry. This method allows an in-depth exploration of complex phenomena within their real-world context, specifically focusing on the behavioural and organizational dimensions of safety compliance (Tang et al., 2018).

Table 1. Respondents Profile

Respondent	Position	Years of Experience	Platform Location	Interview Mode
R1	Technician	Over 20 years	Terengganu	Google Meet
R2	Technician	5-10 years	Malay Basin	Face-to-face
R3	Technician	5-10 years	Terengganu	Face-to-Face
R4	Production Supervisor	Over 15 years	Kelantan	Google Meet
R5	Supervisor	5-10 years	Pahang	Google Meet

Participants were selected using a combination of purposive and snowball sampling, ensuring that respondents possessed relevant experience and knowledge to address the research objectives. Purposive sampling enabled the researcher to directly approach offshore personnel who had substantial experience and certification to work in oil and gas operations, while snowball sampling leveraged respondents' professional networks to identify additional suitable participants. A total of 5 participants from different offshore platforms were interviewed, comprising 3 technicians, 1 production supervisor, and 1 platform supervisor. Their offshore experience ranges from 5 to over 20 years, providing diverse perspectives on safety practices. The platforms

represented locations across Terengganu, the Malay Basin, Kelantan, and Pahang, reflecting a range of operational environments within Malaysia.

Data were collected through semi-structured interviews, conducted either in person or virtually via Google Meet, each lasting approximately one hour. An interview protocol was developed and reviewed by the researcher's supervisor prior to data collection to ensure relevance and clarity of questions. Participants were informed that the interviews were conducted for research purposes, and consent was obtained for audio recording. In addition to interviews, document analysis was conducted on safety-related materials provided by respondents. These documents provided contextual evidence to complement verbal accounts and allowed for triangulation of data. The documents include:

- Fire Extinguisher Inspection Tags
- Sling Safety Inspection Records
- Safety Layout Escape Routes
- Job Hazard Analysis Worksheets and Forms
- Emergency Response Plan (ERP) Contacts and Manuals
- Incoming Briefing Guides
- Permit-To-Work (PTW) Forms
- Safety Posters

The collected data were subjected to content and document analysis to identify recurring patterns, behaviours, and organizational practices related to safety management. Interview transcripts were manually transcribed and systematically coded to extract meaningful information aligned with the research objectives, unsafe acts and procedural compliance. Documents were reviewed to verify procedural adherence and safety system implementation, providing further validation of participants' accounts. The combination of interview and document analysis facilitated a robust understanding of both individual behaviour and organizational safety processes.

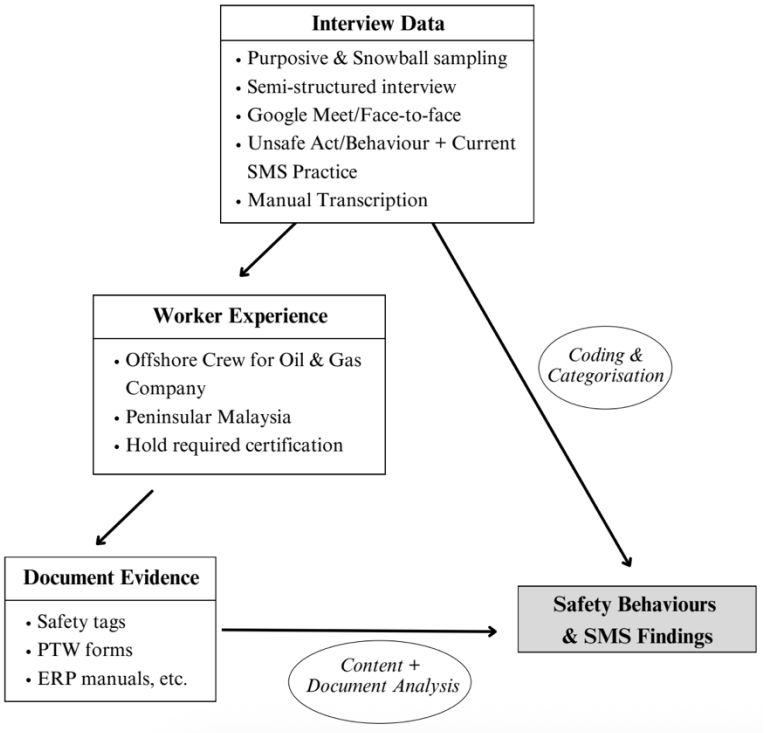

Figure 3. Data Triangulation

As shown in Figure 3, data triangulation was employed by comparing interview responses with documented safety records. Participants' anonymity was maintained by reporting only platform locations rather than company names. Participants were also fully informed of the research purpose and granted permission for recording and document sharing.

3.0 RESULT

The data analysis identified five dominant unsafe behaviours on offshore platforms. All interview transcripts were manually coded using the intended-action taxonomy, which distinguishes between mistakes (cognitive errors) and violations (deliberate procedural deviations). As shown in Table 2, each unsafe act was assigned a unique code (M1–M3 for mistakes, V1–V2 for violations) to enable systematic thematic analysis.

Table 2. Unsafe Acts and Behaviours That Contribute to Offshore Accidents

No	Unsafe Behaviour/Act	Intended Action Category		Respondent Frequency
1	PPE Non-Compliance	V1	Violation (Routine)	5/5
2	Procedural Shortcuts	V2	Violation (Routine)	3/5
3	Inadequate Job Assessment	M1	Mistake (Rule/Knowledge-based)	3/5
4	Human Bias & Complacency	M2	Mistake (Knowledge-based)	2/5
5	Faulty Equipment Usage	M3	Mistake (Knowledge-based / Rule-based)	1/5

All five respondents emphasized that improper or incomplete use of personal protective equipment (PPE) remained the most commonly observed unsafe behaviour. Despite strict company policies, some workers continued to neglect proper PPE usage due to discomfort, complacency, or perceived time pressure. One participant remarked: *"The PPE is there, but some workers still don't wear it properly. Sometimes they think the task is quick, so they just ignore it."* This behaviour was consistently reported across all platforms and was coded as V1: routine violation, reflecting a deliberate disregard for established safety procedures. The coding choice captures the intentional nature of this action, as workers knowingly bypass PPE requirements despite understanding the rules.

Procedural shortcuts were the second most frequently reported unsafe behaviour, noted by three respondents. Workers were described as bypassing established procedures to complete tasks more quickly, particularly when performing familiar operations or under production pressure. One participant stated: *"When they feel like they've done the job so many times, they skip steps. The focus becomes finishing faster, not safer."* This behaviour was coded as V2: routine violation, consistent with the intentional nature of violating safety rules. The coding reflects the conscious decision to deviate from standard procedures, which can increase vulnerability to incidents such as dropped objects, chemical exposure, or equipment failure.

Inadequate job assessment was identified by three respondents as another contributing unsafe behaviour. Pre-job evaluations were sometimes incomplete, with hazards not fully identified or briefing quality varying depending on the personnel in charge. As one respondent explained: *"Sometimes the briefing is rushed. People think they already know the work, so they don't pay much attention."* This behaviour was coded as M1: mistake (rule/knowledge-based), reflecting cognitive errors rather than deliberate violations. The coding rationale is based on the observation that workers unintentionally failed to follow proper planning or hazard recognition procedures, highlighting limitations in situational awareness and experience.

Human bias and complacency emerged as another key theme, mentioned by two respondents. Familiarity with routine tasks was reported to lead to overconfidence and underestimation of risks, resulting in lapses in following mandatory precautions. One participant noted: *"The more routine the job is, the more relaxed people become. They forget that even a small mistake can be fatal offshore."* This behaviour was coded as M2: knowledge-based mistake, as it reflects a cognitive limitation in risk perception and judgement rather than a conscious rule violation. The coding captures the pattern of errors that occur from normalization of risk over time, reinforcing the importance of addressing human perception in safety management.

Finally, unsafe practices involving faulty or worn-out equipment were reported by one respondent. Workers were observed to continue using defective tools due to perceived urgency or unavailability of replacements. This behaviour was coded as M3: knowledge-based / rule-based mistake, highlighting that errors in tool use often stem from gaps in training, knowledge, or understanding of operational procedures rather than purely technical failures. Although less frequently reported, this finding is still concerned because a single equipment-related mistake offshore can lead to major operational disruptions.

Table 3. Current Approaches to Safety Management Implementation

Safety Management Approach	Respondent Frequency	Supporting Document Evidence
Daily Safety Meetings	5/5	Yes
Risk Assessment / JHA	4/5	Yes
Emergency Response Preparedness	4/5	Yes
Training & Competency	2/5	Some
Auditing & Inspections	2/5	Yes

Next, Table 3 shows that offshore platforms implement safety management measures can be classified into five key approaches based on respondent perspectives and supporting documents. However, certain components appear to be less emphasized or unevenly practiced, which may contribute to ongoing behavioural non-compliance.

Firstly, all respondents confirmed the practice of routine daily safety meetings, including toolbox talks and shift briefing sessions. These meetings serve to communicate planned tasks, operational hazards, and lessons learned from past incidents. *"We start every day with a toolbox meeting. It helps remind the team what to look out for."* This aligns with industry expectations for continuous safety communication offshore (Yin et al., 2021).

Four respondents mentioned the systematic use of JHA or JSA documents before performing any operational task. These assessments outline hazards, risk controls, PPE requirements, and responsible personnel. Several related documents were reviewed, such as:

- Job Hazard Analysis (JHA) Worksheets
- JHA Forms
- Job Safety Analysis (JSA) System Records

However, despite the availability of these tools, the findings from first objective reveal gaps between procedural documentation and actual worker behaviour. Emergency preparedness measures were widely implemented, including ERP manuals, emergency contact lists, and escape route layouts displayed in strategic areas of the platform. Respondents reported regular drills and briefings to ensure workers remain prepared for critical events (Adedigba et al., 2018; Bhandari et al., 2015). Supporting documents received include:

- Emergency Response Plan (ERP) Manual
- Emergency Response Plan (ERP) Contact List
- Emergency Response Chart
- Safety Layout Escape Route Map

These demonstrate structured and established response mechanisms consistent with offshore legislative standards. Two respondents highlighted the importance of competency certificates and continuous training, especially for hazardous task roles such as lifting, confined space entry, electrical work, and crane operations. *"Everyone must have proper certification. If not, they are not allowed to perform the task."* Training is reinforced through orientations and awareness campaigns, supported by documents such as:

- Incoming Safety Briefing Guide
- Safety Awareness Posters

However, limited mention by respondents may indicate insufficient emphasis or inconsistent implementation across platforms. Regular safety inspections form another critical component of safety management systems offshore. The evidence reviewed includes:

- Fire Extinguisher Inspection Tags
- Sling Safety Inspection Records
- Permit-To-Work (PTW) Forms

These ensure that equipment safety and procedural control mechanisms are continuously monitored. Respondents stated that periodic audits are carried out either internally or by external parties to verify adherence to regulatory standards.

4.0 DISCUSSION

The findings of this study show that although offshore operations are governed by strict safety protocols, established industry standards, and comprehensive training requirements, incidents and risks remain prevalent due to the persistent gap between safety procedures and actual worker behaviour. The unsafe acts and behaviours reported by respondents across offshore platforms can be categorised using the Individual Factors dimension of the Human Factors (HF) framework such as shown in Table 4. This approach provides a structured lens to explain how individual-level determinants contribute to unsafe behaviours.

Table 4. Mapping identified unsafe behaviours to Individual Factors of the HF framework

Unsafe Behaviour / Act	Individual Factors	
PPE Non-Compliance – V1: Violation (Routine)	Motivation	• Inappropriate attempt to save time • Attitude • Insufficient thought and care
	Competence level	• Risk perception/risk-taking behaviour • Judgement
Procedural shortcuts – V2: Violation (Routine)	Motivation	• Attempt to save time • Attitude
	Competence level	• Judgement • Lack of anticipation
Inadequate job assessment – M1: Mistake (Rule/Knowledge-based)	Competence level	• Knowledge & experience • Decision-making • Lack of anticipation
Human bias & complacency – M2: Mistake (Knowledge-based)	Competence level	• Risk perception/risk-taking behaviour • Judgement
	Motivation	• Attitude • Inattention
Faulty equipment usage – M3: Mistake (Knowledge-based/Rule-based)	Competence level	• Training • Knowledge & skill

PPE Non-Compliance (V1: Violation, Routine), exemplifies both motivational and competence-related factors. Workers' habitual disregard for PPE, despite its mandatory nature, reflects motivational influences such as prioritising convenience, insufficient thought, and attitudes towards risk. At the same time, cognitive aspects of competence including risk perception and judgement, explain why individuals underestimate potential hazards and choose to bypass safety requirements. Prior studies similarly report that PPE misuse remains one of the leading contributors to injury rates in high-risk industries, showing that availability alone does not guarantee compliance (Liu et al., 2023). This indicates that offshore safety challenges are not merely technical but strongly influenced by perceptions, motivation, and monitoring.

Procedural Shortcuts (V2: Violation, Routine) were highlighted as behaviours occurring under time pressure or during routine tasks. These actions similarly map to motivation (e.g., attempt to save time, attitude) and competence (judgement, lack of anticipation). The findings suggest that workers' decision-making processes are influenced by both motivational drivers to complete tasks efficiently and cognitive limitations that reduce their ability to foresee consequences, reinforcing the value of integrating behavioural insights into offshore safety management. Previous research highlights that when employees believe management values efficiency over caution, they are more likely to compromise safety rules (Menteş & Helvacioglu, 2011). In offshore operations, where schedules are tight and delays may lead to major financial implications (Jaculli et al., 2019; Liu et al., 2021b), procedural shortcuts become an attractive option despite the risks involved. This reinforces the importance of strong safety culture indicators, where the organisation must visibly value safety over productivity to influence daily decision-making.

Inadequate Job Assessment (M1: Mistake, Rule/Knowledge-based) reflects superficial execution of Job Hazard Analysis (JHA) and insufficient hazard recognition, aligning with competence-level factors such as knowledge, experience, decision-making ability, and anticipation. Respondents noted that while JHA procedures are implemented, they are sometimes treated as a formality rather than a meaningful evaluation of

risks. This "paper compliance" approach, consistent with organisational safety literature (Nguyen et al., 2019), leaves workers unprepared for changing site conditions and increases the likelihood of procedural violations and exposure to unexpected hazards. These findings suggest that offshore platforms would benefit from stronger engagement strategies, where workers actively contribute to hazard identification instead of passively completing checklists.

Human Bias & Complacency (M2: Mistake, Knowledge-based), reflects overconfidence and desensitisation to routine hazards. This behaviour is strongly linked to both competence (risk perception, judgement) and motivation (attitude, inattention). Workers' cognitive biases result in misjudged risks, while motivational aspects such as underestimating the seriousness of repetitive tasks can further influence compliance.

Finally, the Faulty Equipment Usage (M3: Mistake, Knowledge-based / Rule-based), shows competence-related gaps in training, knowledge, and skill. Even where equipment may be technically functional, improper handling demonstrates how individual capability directly shapes unsafe outcomes.

5.0 CONCLUSION

This study identified five dominant unsafe behaviours occurring on offshore platforms, revealing that the safety challenges are behavioural in nature rather than due to an absence of safety systems. The persistence of PPE non-compliance, procedural shortcuts, inadequate job assessments, cognitive biases, and occasional use of faulty equipment indicates that workers understand safety expectations but do not consistently translate these into practice. At the same time, five key safety management strategies are already in place, which is daily safety meetings, risk assessments, emergency response readiness, competency training, and auditing processes, and this suggesting that offshore operations possess structurally sound systems on paper.

These findings matter because they show that the disconnection between available safety systems and real-world worker behaviour creates a critical safety culture gap. Production pressures, routine familiarity, limited hazard perception, and weak monitoring practices collectively reduce the effectiveness of offshore safety controls. Rather than introducing more procedures, what is required is strengthening behavioural regulation, supervisory leadership, and accountability mechanisms to ensure that existing systems are genuinely practiced.

Theoretically, this research contributes by linking specific unsafe acts to corresponding organizational safety practices, offering clearer insight into where behavioural breakdowns occur within an otherwise structured management system. Practically, the study underscores the need to reinforce behavioural safety interventions, including continuous coaching, competence evaluations, and more robust behavioural observation programs to improve consistency in safety compliance.

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