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The Influence of Occupational Health and Safety Cultural Factors on the Behavior of Well Intervention Drilling Rig Contractor Workers at Pertamina Hulu Rokan

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Abstract

This study aims to analyze the influence of occupational health and safety culture factors on the behavior of drilling well intervention rig contractor workers at Pertamina Hulu Rokan. The factors examined include safety awareness, safety knowledge, risk management, and safety training as exogenous variables, with safety culture as a mediating variable and safety behavior as an endogenous variable. The research employed a quantitative approach with a cross-sectional survey design. A sample of 100 rig contractor workers was selected using purposive sampling. Data were collected through a 5-point Likert scale questionnaire and analyzed using Structural Equation Modeling-Partial Least Squares (SEM-PLS) with SmartPLS 4. The results showed that out of nine proposed hypotheses, seven hypotheses were accepted and two were rejected. Safety training was the most dominant factor in shaping safety culture (t-statistic 3.075), followed by safety knowledge (2.924), risk management (2.415), and safety awareness (1.483) which was not significant. Safety culture was proven to have a significant influence on safety behavior (5.718) and acted as a full mediator for the influence of safety knowledge, risk management, and safety training on safety behavior. The R-Square values indicate that safety culture explains 33.8% of the variation in safety behavior, while safety behavior is explained by 62.3% through safety culture. These findings confirm that safety culture is formed through the interaction between personal factors (knowledge) and organizational factors (risk management and training), which require continuous reinforcement. The managerial implications suggest that companies need to allocate resources for contextual and sustainable safety training, integrate risk management into daily work routines, and build a non-punitive culture that is responsive to safety reports. Future research is recommended to expand the population scope and add variables such as safety leadership and safety climate.

INTRODUCTION

Globally, the International Labour Organization (ILO, 2025) reports that nearly three million workers die annually due to work-related accidents and illnesses. The oil and gas industry is considered a high-risk sector due to factors such as high pressure, flammable fluids, heavy equipment, and extreme environmental conditions. The IOGP (2025) also recorded 52 fatalities and 2,685 recordable injuries within the upstream oil and gas industry.

In Indonesia, the upstream oil and gas sector recorded seven fatalities in 2025, exceeding the maximum target of four incidents. PHR accounted for the highest number of fatalities, with three incidents (Directorate General of Oil and Gas, 2025). The IADC (2025) also recorded nine fatalities in global drilling operations, with "struck-by" incidents and slips/falls being the dominant causes.

At PHR's Rokan Zone, data from 2021–2025 indicate an increase in recordable incidents from two to five cases. This situation highlights the ongoing need for attention to safety issues, despite fluctuations in the total number of incidents. Well intervention drilling activities—such as wireline, coiled tubing, and workover operations—carry high risks due to the involvement of fluid

pressure, heavy equipment, and rig mechanical components (Billingham et al., 2024; Suhartina & Johan, 2024).

Investigations using the Systematic Cause Analysis Technique (SCAT) revealed that the 2025 incidents were primarily caused by unsafe actions (74.42%) and unsafe conditions (25.58%). The root causes stemmed mainly from organizational factors (66.21%) and personal factors (33.79%). These findings demonstrate that accidents are not solely linked to worker error but are also influenced by organizational systems and culture.

Theoretically, Jamil et al. (2025) explain—using the Swiss Cheese Model—that accidents result from the interaction between systemic failures (latent failures) and active errors made by workers (active failures). Meanwhile, Imandiya (2024), through the concept of Total Safety Culture, explains that safety culture emerges from the interaction of three aspects: behavior, personal/psychological factors, and the environment.

Edmondson & Bransby (2023) found that a weak safety culture fosters unsafe behavior and that the quality of safety management is linked to worker compliance and participation. Naji (2021) also found that safety culture significantly influences safety performance and interacts with psychosocial hazards. Thus, safety culture not only shapes worker behavior but also affects the psychological and organizational conditions that determine responses to hazards.

Regarding the personal aspect, Abidin (2023) found that safety awareness helps workers recognize hazards through training and work experience. Conversely, Alroomi (2021) found that psychological pressure and increased workloads can diminish situational awareness. Regarding safety knowledge, Basahel (2021) demonstrated that safety knowledge acts as a mediator between leadership and safety behavior, while Andrea et al. (2023) found that low safety knowledge increases the likelihood of engaging in unsafe actions.

From an organizational perspective, Ofori et al. (2023) found that hazard identification and risk assessment are strong factors in enhancing safety performance. Jamil et al. (2025) emphasized that risk management must be integrated into organizational culture to ensure it goes beyond mere procedural compliance. Nelson & Zega (2021) found that OHS culture and management commitment positively influence OHS performance, while Naji (2022) highlighted the importance of communication and supervisor support in translating training outcomes into actual work behavior.

Previous research has highlighted various critical factors within safety culture. Jannati & Prasetya (2026) found that safety leadership is the most dominant factor influencing safety behavior. Luthfiyah (2024) identified psychological, behavioral, and situational aspects as components of safety culture. Kristiawan (2025) discovered that safety culture acts as a mediator between management practices and safety performance, while Mogilski & Shackelford (2023) emphasized the importance of leadership, management commitment, training, and OHS communication. A research gap exists due to the limited number of studies specifically examining safety culture within onshore well intervention drilling contractor rig companies in Indonesia, particularly in the Rokan Zone. Prior research has largely focused on the offshore sector, production, downstream oil and gas operations, or contexts in other countries. Furthermore, some existing studies rely on descriptive or bivariate approaches, failing to explain the simultaneous influence of various safety culture factors on worker behavior. Therefore, this study aims to analyze the impact of leadership and management commitment, safety communication, training and competence, reporting systems, and worker involvement on safety behavior within oil and gas well intervention drilling contractor rig companies. This research is significant as it can practically help reduce unsafe behaviors and fatalities, theoretically enrich the study of OHS culture in Indonesia's oil and gas sector, and managerially provide a foundation for formulating more effective, evidence-based safety strategies (Y. Zhang et al., 2022). Based on the background above, this study aims to: (1) Analyze the influence of awareness on OHS culture among PHR DWI contractor rig workers; (2) Analyze the influence of knowledge on OHS culture among PHR DWI contractor rig workers; (3) Analyze the influence of risk management on OHS culture among PHR

DWI contractor rig workers; and (4) Analyze the influence of OHS training on OHS culture among PHR DWI contractor rig workers. (5) To analyze the influence of OHS culture on the safe behavior of rig workers employed by DWI PHR contractors. (6) To analyze the mediating role of OHS culture in the relationship between occupational safety awareness and the safe behavior of rig workers employed by DWI PHR contractors. (7) To analyze the mediating role of OHS culture in the relationship between occupational safety knowledge and the safe behavior of rig workers employed by DWI PHR contractors. (8) To analyze the mediating role of OHS culture in the relationship between risk management and the safe behavior of rig workers employed by DWI PHR contractors. (9) To analyze the mediating role of OHS culture in the relationship between OHS training and the safe behavior of rig workers employed by DWI PHR contractors.

Research Hypotheses

H1: OHS awareness (X1) is hypothesized to have a positive and significant effect on OHS culture (Z). This hypothesis is supported by findings revealing that workers' social values and collective awareness help shape safety culture patterns in the Indonesian oil and gas industry; thus, it is emphasized that "social and psychological dimensions need to be considered in quantitative research models."

H2: OHS knowledge (X2) is hypothesized to have a positive and significant effect on OHS culture (Z). Herawati (2026) found that workers' understanding of the safety climate contributes to effective OHS implementation across all management levels in oil and gas contractor companies—a finding that reinforces the argument that knowledge serves as the cognitive foundation of an organization's safety culture.

H3: Risk management (X3) is hypothesized to have a positive and significant effect on OHS culture (Z). This aligns with Lyu & Hon (2018), who demonstrated that the absence of risk control policies is significantly associated with the emergence of risky behaviors among oil and gas workers; it is further supported by evidence of a significant relationship between safety management and worker compliance and participation.

H4: OHS training (X4) is hypothesized to have a positive and significant effect on OHS culture (Z). Kumala (2022) empirically demonstrated that socialization and training interventions can drive a drastic surge in compliance with personal protective equipment usage; consequently, training is considered a means of instilling safety values into the workers' collective culture.

H5: OHS culture (Z) is hypothesized to have a positive and significant effect on Safe Behavior (Y). PLS-SEM analysis indicates that safety culture fully mediates the relationship with safe work behavior; this is supported by Irawan et al. (2025), who demonstrated that OHS culture significantly influences safe work behavior in oil and gas contracting companies.

H6: OHS culture (Z) is hypothesized to positively and significantly mediate the relationship between OHS Awareness (X1) and Safe Behavior (Y). Hu (2020) showed that safety culture significantly impacts safety behavior; thus, it is posited that workers' safety awareness can be reinforced through OHS culture to foster safe behavior.

H7: OHS culture (Z) is hypothesized to positively and significantly mediate the relationship between OHS Knowledge (X2) and Safe Behavior (Y). Putra et al. (2022) found that safety knowledge influences safety performance through safety behavior, while Prayoga et al. (2024) demonstrated that safety knowledge and safety culture are factors associated with safety performance.

H8: OHS culture (Z) is hypothesized to positively and significantly mediate the relationship between Risk Management (X3) and Safe Behavior (Y). Eze et al. (2024) showed that safety management practices are significantly linked to workers' safety compliance and participation, emphasizing the importance of safety culture in enhancing safety performance.

H9: OHS culture (Z) is hypothesized to positively and significantly mediate the relationship between OHS Training (X4) and Safe Behavior (Y). Oktaviani et al. (2026) found that safety

training has a positive effect on safety culture and that safety culture mediates the relationship between safety training and safety performance.

METHOD

This study employs a quantitative approach within a positivist paradigm to examine the causal relationships between OHS (Occupational Health and Safety) awareness, OHS knowledge, risk management, and OHS training regarding OHS culture, as well as the influence of OHS culture on safe behavior. The theoretical framework is grounded in Heinrich's Domino Theory and Skinner's Activator-Behavior-Consequences (ABC) model. A cross-sectional survey was conducted among rig workers employed by well intervention drilling contractors at Pertamina Hulu Rokan (Rokan Zone), utilizing Structural Equation Modeling-Partial Least Squares (SEM-PLS) for analysis. According to Hair (2022), SEM-PLS is suitable for complex models involving intervening variables and does not strictly require a normal data distribution.

The study population comprises rig operational personnel, including crews for drilling, well intervention, HSE, and transportation, as well as field supervisors. Based on a population assumption of 130 workers and Slovin's formula (Mukti, 2025), a sample size of 100 respondents was determined using a 5% margin of error. This figure exceeds the minimum requirement of 40 respondents for SEM-PLS—based on the "10 times the largest number of paths leading to a construct" rule of thumb proposed by Naji and Isha (2026). Sampling was conducted using purposive sampling and proportionate stratified random sampling, with criteria including active employment status, direct involvement at the worksite, a minimum tenure of six months, prior participation in safety induction, JSA, or HSE briefings, and willingness to participate as a respondent.

The research focuses on oil and gas rig contracting companies conducting well intervention drilling operations for Pertamina Hulu Rokan (Rokan Zone). Rahim et al. (2024) identify the oil and gas sector as a high-risk industry requiring a robust safety culture, while Jamil (2025) emphasizes the importance of sustainable safety practices and hazard management. The unit of analysis employs a bi-unit approach, covering both the individual level and the organizational/work-group level. Through the Safer Culture Framework, Kilcullen (2022) explains that safety culture is a multilevel construct formed by the interaction between individual perceptions and organizational practices.

The research data consist of both primary and secondary data. Primary data were collected using a closed-ended questionnaire with a five-point Likert scale, while secondary data were derived from safety SOPs, OHS audit reports, incident and near-miss records, and scientific literature. The study also engaged key informants—specifically the HSE Coordinator and field supervisors—following the approach of Nkrumah (2021). The instrument comprised 32 items for independent variables, 16 items for intervening variables, and 9 items for dependent variables.

Instrument quality was assessed via the outer model, covering convergent validity, discriminant validity, and reliability. Hair (2022) established outer loadings >0.7 and AVE >0.5 as criteria for convergent validity, while discriminant validity was assessed using HTMT <0.9, in accordance with Cheung et al. (2024). Reliability was evaluated using Cronbach's Alpha and Composite Reliability, with a threshold of >0.7, consistent with Tan et al. (2023).

SEM-PLS analysis was conducted using SmartPLS through the evaluation of both outer and inner models. The inner model was assessed using R^2 to determine the variables' explanatory power, Q^2 for predictive relevance, and f^2 to measure the magnitude of the effect of exogenous variables on endogenous variables. Hypothesis testing was performed via bootstrapping (5,000 iterations), applying criteria of t-statistic >1.96 and p-value <0.05 at a 5% significance level.

The structural relationships examined included the influence of OHS Awareness, OHS Knowledge, Risk Management, and OHS Training on OHS Culture, as well as the impact of OHS Culture on Safe Behavior. Beyond direct relationships, the study evaluated the role of OHS Culture as an intervening variable linking personal and organizational factors to Safe Behavior. Model fit

was assessed using SRMR. Overall, the research methodology was designed to elucidate the mechanisms underlying the formation of safety culture and worker safe behavior within the high-risk environment of the oil and gas industry.

RESULT AND DISCUSSION

Respondent Overview

The study involved 100 drilling well intervention (DWI) contractor workers at Pertamina Hulu Rokan (Rokan Zone), selected via purposive sampling. All respondents met the criteria of being active rig workers directly involved in field operations, having a minimum tenure of six months, having previously attended safety inductions, JSA sessions, or HSE briefings, and being willing to participate. All questionnaires were returned fully completed, resulting in a 100% response rate.

Regarding respondent characteristics, all respondents were male (100%). In terms of age, the majority were aged 28–37 (43%), followed by the 38–47 age group (38%); the 17–27 and 48–57 age groups each accounted for 9%, while the 58–67 age group represented only 1%.

Based on highest level of education, the majority of respondents were high school or vocational school (SMA/SMK) graduates (74%), followed by those with a bachelor's degree (S1) at 23% and a diploma (D3) at 3%. There were no respondents with only elementary (SD) or junior high (SMP) education.

Regarding tenure, the largest group had 6–10 years of experience (28%), followed by 11–15 years (26%) and over 15 years (25%). Respondents with 3–5 years of tenure accounted for 14%, while those with 0–2 years accounted for 7%. This composition indicates that the majority of respondents possessed relatively extensive work experience in rig operations.

In terms of job position, the largest group consisted of Floormen (16%), followed by HFOs (Holiday Floating Operators) at 12% and Derrickmen at 8%. Other positions included Vacuum Operators and Vacuum Swampers (7% each); Drillers, Roustabouts, Tandem Operators, and Tandem Swampers (6% each); Toolpushers, Rig Clerks, and Foco Swampers (5% each); and Assistant Drillers, Mechanics, Foco Operators, and Truck Pushers (4% each). Overall, the respondents' characteristics indicate that the sample was dominated by male workers of productive age (28–47 years old) with a high school or vocational school education and over six years of work experience, holding diverse roles within rig operations. This profile suggests that the respondents possessed sufficiently relevant experience to evaluate OHS (Occupational Health and Safety) culture and safe behavior regarding well intervention drilling activities.

Descriptive Analysis of Variables

Based on the descriptive analysis of 100 respondents—where all research variables were measured on a 1–5 scale and a range of 4.6–5.0 signified "strongly agree"—the results indicate that, in general, all variables received very high ratings.

The OHS Awareness variable (X1) comprised eight statements, yielding an average score of 4.87 ("strongly agree"). The highest score was recorded for the statement regarding working safely to ensure a safe return home (4.95), while the lowest score was for the ability to explain hazard warning signs (4.66). These findings demonstrate a very high level of worker safety awareness, particularly regarding personal motivation, although there is still room for improvement in the understanding of all safety signs.

Occupational Health and Safety (OHS) Knowledge (X2) comprises 9 statements with an average score of 4.82 (strongly agree). The highest score relates to the understanding that a Permit to Work (PTW) and lockout/tagout procedures must be executed prior to commencing work (4.90), while the lowest pertains to the ability to explain the hazards and risks associated with well intervention drilling operations (4.67). Overall, the workers' level of knowledge is classified as very high, serving as a crucial asset in supporting the safety culture.

Risk Management (X3) achieved an average score of 4.88 (strongly agree) across 12 statements. The highest score concerns the mandatory requirement to conduct a Job Safety Analysis (JSA) before starting work (4.95), while the lowest relates to using the likelihood of hazards as a basis for risk assessment (4.80). These results indicate that risk management implementation in the rig environment is rated very highly, including aspects such as near-miss reporting, audits, and the review of risk controls.

OHS Training (X4) consists of 9 statements, all of which fall into the "strongly agree" category. The highest score relates to the necessity of on-the-job training or field practice to ensure safe work performance (4.95), whereas the lowest score concerns the adequacy of training time and frequency (4.49). These findings demonstrate that the training is considered highly relevant and compliant with standards, supported by competent instructors, and effective in enhancing safe worker behavior.

OHS Culture (Z) achieved an average score of 4.79 (strongly agree). The highest score relates to the routine and high-quality communication of safety-related information to workers (4.89), while the lowest pertains to management's response to reports regarding safety issues (4.67). This implies that a robust safety culture has been established—particularly regarding communication—although management's response and follow-up actions still require strengthening.

Safe Behavior (Y) achieved an average score of 4.86 (strongly agree). The highest score relates to compliance with standard Personal Protective Equipment (PPE) usage (4.97), while the lowest pertains to reporting unsafe conditions and near-misses to supervisors (4.75). The results indicate that worker safety behavior is excellent, particularly regarding PPE compliance; however, there is still room for improvement in the consistency of reporting unsafe conditions.

Overall, Risk Management (4.88) received the highest descriptive rating, followed by OHS Awareness (4.87), Safety Behavior (4.86), OHS Knowledge (4.82), OHS Training, and OHS Culture (4.79). All variables fell into the "strongly agree" category, indicating that respondents generally hold a positive perception of OHS conditions and the implementation of safety behaviors within the operations of the well intervention drilling contractor's rig.

Summary of Average Research Variable Ratings

Presented below is a summary of the average ratings for all research variables, providing a concise overview of respondent perceptions regarding each variable studied:

Table 1. Summary of Average Research Variable Ratings

No.	Variable	**Mean**	Category
1	OHS Awareness (X1)	4,87	Strongly Agree
2	OHS Knowledge (X2)	4,82	Strongly Agree
3	Risk Management (X3)	4,88	Strongly Agree
4	OHS Training (X4)	4,79	Strongly Agree
5	OHS Culture (Z)	4,79	Strongly Agree
6	Safe Behavior (Y)	4,86	Strongly Agree
Average Total		**4,86**	

Source: Processed primary data (2026)

Based on Table 1, all research variables fall into the "Strongly Agree" category, with mean scores ranging from 4.79 to 4.88 and an overall mean of 4.84. Risk Management (X3) achieved the highest score at 4.88, primarily because workers recognized the importance of implementing Job Safety Analysis (JSA), hazard identification, Permit to Work (PTW) systems, and the reporting of incidents, near-misses, and unsafe conditions. This indicates that risk-based safety implementation is well-established and thoroughly understood.

Occupational Health and Safety (OHS) Awareness (X1) ranked second with a mean of 4.87, driven largely by the conviction that working safely ensures a safe return home and that safety is a fundamental right for every worker. Safe Behavior (Y) achieved a mean of 4.86, with adherence to standard Personal Protective Equipment (PPE) usage and support for colleagues serving as dominant indicators. OHS Knowledge (X2) had a mean of 4.82, particularly regarding the

understanding of PTW and lockout/tagout procedures, as well as the ability to make quick and prudent decisions during critical situations.

Meanwhile, OHS Training (X4) and OHS Culture (Z) both recorded a mean of 4.79. Regarding training, workers highly valued on-the-job training and field practice but felt that the duration and frequency of training were not yet fully adequate. Regarding OHS culture, communication concerning safety issues was rated positively, though management's response to safety reports requires improvement. Overall, worker perceptions of OHS aspects are excellent, serving as a vital asset for ensuring safe and productive rig operations. Improvements should focus primarily on increasing the duration and frequency of training and enhancing management responsiveness to safety reports.

Outer Model Analysis

Convergent Validity Test

Table 2. Convergent Validity

Variable	AVE	Composite Reliability (rho_a)	Composite Reliability (rho_c)	Cronbach Alpha
X1	0,638	0,951	0,955	0,948
X2	0,722	0,947	0,954	0,944
X3	0,659	0,955	0,959	0,953
X4	0,656	0,939	0,945	0,934
Z	0,628	0,931	0,938	0,926
Y	0,642	0,934	0,942	0,930

Source: Processed primary data (2026)

Based on the convergent validity test results table above, all variables in this study have met the required criteria. This is evidenced by Average Variance Extracted (AVE) values that are all above 0.5—ranging from 0.628 to 0.722—indicating that more than 50% of the variance in each construct can be explained by its constituent indicators. The highest AVE value is found in the OHS Knowledge variable (X2) at 0.722, while the lowest is in the OHS Culture variable (Z) at 0.628. Furthermore, all variables exhibit Composite Reliability values (rho_a and rho_c) and Cronbach's Alpha values above 0.7—ranging from 0.926 to 0.959—signifying that the research instrument possesses an excellent level of internal reliability. Thus, it can be concluded that all variables in this study meet the criteria for convergent validity and reliability, making them suitable for further analysis.

The table reveals that the AVE values for most variables fall below 0.5—specifically X1 (0.443), X2 (0.440), X3 (0.427), Z (0.484), and Y (0.473)—with only X4 (OHS Training) meeting the convergent validity requirement with a value of 0.536. Nevertheless, all variables show Composite Reliability values above 0.7 (ranging from 0.828 to 0.900) and Cronbach's Alpha values above 0.7 (ranging from 0.822 to 0.897), indicating that all constructs satisfy the required reliability criteria. Thus, although the AVE values for some variables remain below 0.5, the overall reliability of the research instrument is classified as excellent and suitable for proceeding to the hypothesis testing stage.

The results of the outer loading test using SmartPLS 4 are presented in Figure 1 below.

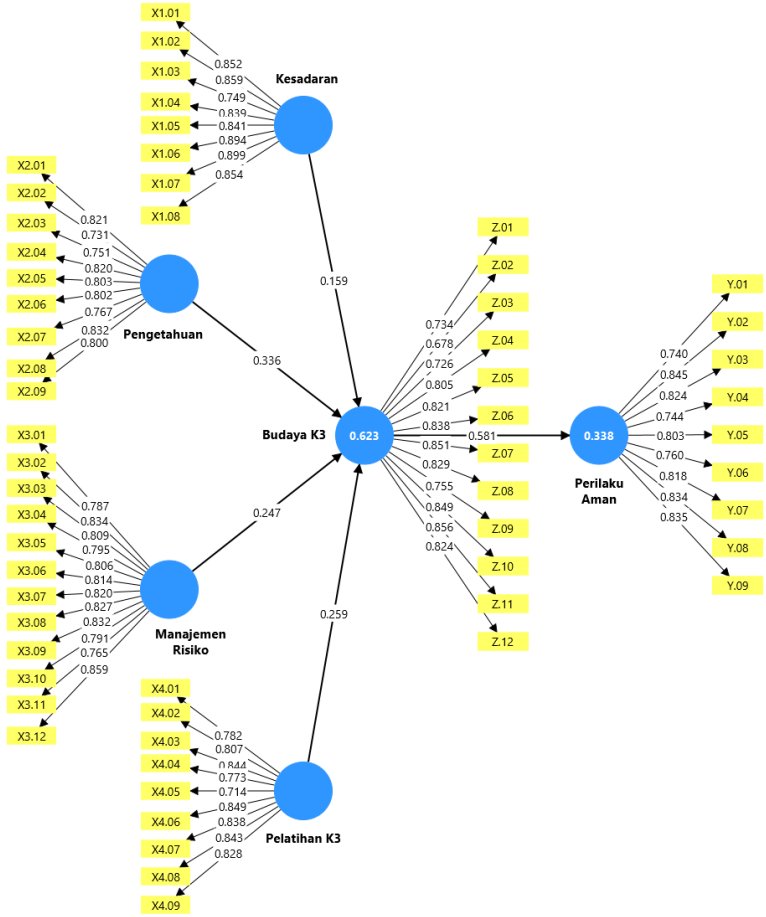


Figure 1. Outer Model Testing

Figure 1 above illustrates the testing of 50 indicators; all indicators met the requirement of having an outer loading value greater than 0.7 (McGinnis, 2011; Yim, 2019).

Based on the factor loading results, all indicators for the variables OHS Awareness (X1), OHS Knowledge (X2), Risk Management (X3), OHS Training (X4), and Safe Behavior (Y) yielded values above 0.70; thus, all indicators were deemed valid and retained in the measurement model. For OHS Awareness, loading values ranged from 0.749 to 0.899. The most dominant indicator was X1.7 (0.899), concerning safety as a universal right, followed by X1.6 (0.894), regarding the motivation to work safely to ensure a safe return home. The lowest value was observed for X1.3 (0.749), concerning the ability to explain hazard warning signs, though it still met the criteria.

Regarding OHS Knowledge (X2), loading values fell within the 0.731–0.832 range. The highest indicator was X2.8 (0.832), representing the ability to make quick and prudent decisions during critical conditions. This indicates that decision-making capability in emergency situations is the strongest aspect in shaping OHS knowledge. Meanwhile, X2.2 had the lowest value (0.731), concerning the ability to explain hazards and risks in well intervention drilling operations, yet it still satisfied validity criteria.

For Risk Management (X3), all loading values ranged from 0.765 to 0.859. Indicator X3.12 had the highest value (0.859), demonstrating that the reporting of incidents, near-misses, and unsafe conditions for follow-up action is the most dominant aspect in shaping risk management. Conversely, X3.11 recorded the lowest value at 0.765 regarding the review of risk control effectiveness. Despite having the lowest value, the indicator still met the criteria, allowing all Risk Management indicators to be retained.

For OHS Training (X4), loading values ranged from 0.714 to 0.849. Indicator X4.6 had the highest value at 0.849, indicating that instructor competence and experience were the most dominant aspects in shaping the quality of OHS training. Furthermore, X4.8 (0.843) demonstrated the training's ability to shift worker behavior toward safer practices. The lowest value was found

in X4.5 (0.714)—concerning the adequacy of training time and frequency—but it remained above the required threshold and was thus retained.

Regarding OHS Culture (Z), most indicators showed loading values above 0.70. The highest value was Z.11 (0.856), indicating that management's response to reported safety issues was the most dominant indicator. Additionally, Z.7 (0.851) highlighted the importance of worker involvement in safety planning and decision-making, while Z.10 (0.849) reflected the ease with which workers could report safety issues. However, one indicator—Z.2—had a loading value of 0.678, falling below the 0.70 mark. Consequently, the statement that all OHS Culture indicators exceeded 0.70 is not entirely consistent with the data in the table. Indicator Z.2 requires further attention or evaluation during validity testing, even though the source text indicates that the OHS Culture construct remains usable.

Meanwhile, the Safe Behavior variable (Y) exhibited loading values between 0.740 and 0.845. Indicator Y.2 had the highest value at 0.845, indicating that adherence to safe work SOPs was the most dominant indicator in shaping Safe Behavior. This was followed by Y.9 (0.835), regarding support for colleagues to work safely, and Y.8 (0.834), concerning the sharing of OHS experiences with colleagues. The lowest value was observed for Y.1 (0.740), related to the use of PPE in accordance with standards; however, it still met the validity criteria.

Overall, the factor loading results indicate that the indicators for OHS Awareness, OHS Knowledge, Risk Management, OHS Training, and Safe Behavior contribute strongly to their respective constructs. The most dominant indicators were: motivation and safety values (within OHS Awareness); decision-making under critical conditions (OHS Knowledge); incident and near-miss reporting (Risk Management); instructor competence (OHS Training); management response to safety reports (OHS Culture); and adherence to SOPs (Safe Behavior). However, indicator Z.2, with a loading of 0.678, was the only value falling below 0.70 and thus requires consideration during the outer model evaluation.

Discriminant Validity Test

Table 3. Cross-Loading Values

Code	X1	X2	X3	X4	Z	Y
X1.1	**0,852**	0,274	0,297	0,214	0,401	0,279
X1.2	**0,859**	0,361	0,334	0,352	0,393	0,292
X1.3	**0,749**	0,410	0,366	0,205	0,421	0,401
X1.4	**0,839**	0,288	0,323	0,224	0,381	0,321
X1.5	**0,841**	0,309	0,400	0,247	0,421	0,284
X1.6	**0,894**	0,311	0,348	0,247	0,407	0,260
X1.7	**0,899**	0,422	0,412	0,247	0,421	0,369
X1.8	**0,854**	0,499	0,544	0,383	0,502	0,436
X2.1	0,346	**0,821**	0,476	0,516	0,569	0,503
X2.2	0,190	**0,731**	0,359	0,397	0,401	0,304
X2.3	0,393	**0,751**	0,473	0,391	0,631	0,512
X2.4	0,358	**0,820**	0,515	0,514	0,555	0,513
X2.5	0,379	**0,803**	0,574	0,493	0,516	0,467
X2.6	0,266	**0,802**	0,464	0,465	0,550	0,515
X2.7	0,329	**0,767**	0,528	0,335	0,475	0,496
X2.8	0,388	**0,832**	0,537	0,462	0,666	0,552
X2.9	0,363	**0,800**	0,512	0,388	0,572	0,455
X3.1	0,398	0,417	**0,787**	0,220	0,474	0,439
X3.2	0,410	0,517	**0,834**	0,307	0,473	0,447
X3.3	0,470	0,655	**0,809**	0,342	0,608	0,577
X3.4	0,298	0,466	**0,795**	0,282	0,458	0,322
X3.5	0,321	0,546	**0,806**	0,384	0,524	0,344
X3.6	0,353	0,514	**0,814**	0,353	0,481	0,399

Code	X1	X2	X3	X4	Z	Y
X3.7	0,403	0,565	**0,820**	0,242	0,505	0,368
X3.8	0,295	0,472	**0,827**	0,288	0,467	0,397
X3.9	0,367	0,470	**0,832**	0,322	0,478	0,332
X3.10	0,338	0,431	**0,791**	0,215	0,531	0,355
X3.11	0,286	0,429	**0,765**	0,306	0,481	0,400
X3.12	0,427	0,561	**0,859**	0,408	0,582	0,418
X4.1	0,280	0,510	0,324	**0,782**	0,545	0,399
X4.2	0,194	0,447	0,320	**0,807**	0,500	0,359
X4.3	0,196	0,408	0,297	**0,844**	0,484	0,319
X4.4	0,229	0,374	0,207	**0,773**	0,370	0,306
X4.5	0,233	0,451	0,274	**0,714**	0,403	0,235
X4.6	0,274	0,399	0,297	**0,849**	0,442	0,225
X4.7	0,269	0,432	0,353	**0,838**	0,454	0,314
X4.8	0,333	0,505	0,356	**0,843**	0,557	0,422
X4.9	0,277	0,503	0,303	**0,828**	0,487	0,384
Z.1	0,185	0,547	0,368	0,619	0.574	0,383
Z.2	0,154	0,458	0,338	0,469	0.605	0,308
Z.3	0,285	0,511	0,444	0,429	0.567	0,428
Z.4	0,437	0,569	0,538	0,507	0.654	0,477
Z.5	0,414	0,556	0,521	0,423	**0,734**	0,544
Z.6	0,427	0,588	0,513	0,584	0,678	0,432
Z.7	0,471	0,605	0,573	0,462	**0,726**	0,501
Z.8	0,474	0,552	0,553	0,445	**0,805**	0,490
Z.9	0,394	0,554	0,544	0,412	**0,821**	0,425
Z.10	0,450	0,566	0,507	0,456	**0,838**	0,504
Z.11	0,524	0,626	0,571	0,443	**0,851**	0,535
Z.12	0,437	0,590	0,488	0,443	**0,829**	0,497
Y.1	0,432	0,473	0,431	0,249	0,396	**0,740**
Y.2	0,447	0,543	0,444	0,336	0,475	**0,845**
Y.3	0,353	0,560	0,406	0,311	0,468	**0,824**
Y.4	0,278	0,428	0,335	0,274	0,397	**0,744**
Y.5	0,215	0,526	0,335	0,365	0,491	**0,803**
Y.6	0,150	0,418	0,237	0,349	0,401	**0,760**
Y.7	0,313	0,531	0,456	0,381	0,514	**0,818**
Y.8	0,322	0,457	0,413	0,359	0,504	**0,834**
Y.9	0,329	0,476	0,495	0,342	0,515	**0,835**

Source: Processed primary data (2026).

Based on Table 3, all cross-loading values for each construct meet the minimum criterion of 0.70. Furthermore, the cross-loading value of each indicator on its intended construct is higher than its values on other constructs. Thus, it can be concluded that all indicators in this study accurately represent the constructs being measured; consequently, all items are deemed valid and satisfy the requirements for discriminant validity.

Composite Reliability Test

Table 4. Construct Reliability and Validity

1	Cronbach's Alpha	Composite Reliability (rho a)	Composite Reliability (rho c)	AVE
X1	0,638	0,951	0,955	0,948
X2	0,722	0,947	0,954	0,944
X3	0,659	0,955	0,959	0,953
X4	0,656	0,939	0,945	0,934

1	Cronbach's Alpha	Composite Reliability (rho a)	Composite Reliability (rho c)	AVE
Z	0,628	0,931	0,938	0,926
Y	0,642	0,934	0,942	0,930

Source: Processed primary data (2026).

Based on Table 4, all variables in this study met the required criteria. This is evidenced by the Composite Reliability (rho_a and rho_c) and Cronbach's Alpha values, all of which exceeded 0.7—ranging from 0.926 to 0.959—indicating that the research instruments possess an excellent level of internal reliability. The highest Composite Reliability value was observed for the Risk Management variable (X3) with a rho_c of 0.959, while the lowest was found for the OHS Culture variable (Z) with a rho_c of 0.938. Thus, it can be concluded that all variables in this study are reliable and consistent in measuring their respective constructs, making them suitable for further analysis.

Inner Model Analysis

R-Square (R2)

Table 5. R-Square Results

Variables	R-Square	R-Square Adjusted
(Y) Safe Behavior	0,623	0,607
(Z) OHS Culture	0,338	0,331

Source: Processed primary data (2026).

Based on the coefficient of determination (R-Square) in Table 5 above, the R-Square value for the OHS Culture variable (Z) is 0.338, falling into the "weak" category; this indicates that the variables OHS Awareness (X1), OHS Knowledge (X2), Risk Management (X3), and OHS Training (X4) simultaneously explain 33.8% of the variation in the OHS Culture variable, while the remaining 66.2% is explained by variables outside the research model. Meanwhile, the R-Square value for the Safe Behavior variable (Y) is 0.623, falling into the "moderate" category; this indicates that the OHS Culture variable (Z) explains 62.3% of the variation in the Safe Behavior variable, while the remaining 37.7% is explained by variables outside the research model. Thus, it can be concluded that the structural model in this study possesses weak predictive capability for the OHS Culture variable and moderate predictive capability for the Safe Behavior variable.

Hypothesis Testing

Table 6. T-Statistic Results

Variables	Original sample (O)	Sample mean (M)	Standard deviation (STDEV)	T statistics (|O/STDEV|)	P values
(X1) OHS Awareness -> (Y) Safe Behavior	0,092	0,089	0,061	1,516	0,130
(X1) OHS Awareness -> (Z) OHS Culture	0,159	0,158	0,107	1,483	0,138
(X2) OHS Knowledge -> (Y) Safe Behavior	0,195	0,196	0,084	2,316	0,021
(X2) OHS Knowledge -> (Z) OHS Culture	0,336	0,332	0,115	2,924	0,003
(X3) Risk Management -> (Y) Safe Behavior	0,144	0,142	0,066	2,170	0,030
(X3) Risk Management -> (Z) OHS Culture	0,247	0,244	0,102	2,415	0,016

(X4) OHS Training -> (Y) Safe Behavior	0,151	0,151	0,053	2,817	0,005
(X4) OHS Training -> (Z) OHS Culture	0,259	0,263	0,084	3,075	0,002
(Z) OHS Culture -> (Y) Safe Behavior	0,581	0,580	0,102	5,718	0,000

Source: Processed primary data (2026).

Based on the hypothesis testing results, out of the nine hypotheses proposed, seven were accepted and two were rejected. The testing criteria used were a t-statistic > 1.96 and a p-value < 0.05. Regarding the relationships with OHS Culture (Z), OHS Knowledge, Risk Management, and OHS Training were found to have a significant influence, whereas OHS Awareness was not significant. OHS Training emerged as the strongest factor influencing OHS Culture, with a t-statistic of 3.075 (p=0.002), followed by OHS Knowledge (t=2.924, p=0.003) and Risk Management (t=2.415, p=0.016). OHS Awareness yielded a t-statistic of 1.483 and p=0.138, thus failing to meet the significance criteria.

Regarding the relationship between OHS Culture and Safe Behavior, the results showed a highly significant influence, with a t-statistic of 5.718 and p=0.000. This implies that the stronger the implemented OHS Culture, the better the workers' Safe Behavior. Meanwhile, in the mediation analysis, OHS Culture did not mediate the influence of OHS Awareness on Safe Behavior, as the t-statistic was only 1.516 (p=0.130). Conversely, OHS Culture was proven to mediate the influence of OHS Knowledge on Safe Behavior (t=2.316, p=0.021), Risk Management on Safe Behavior (t=2.170, p=0.030), and OHS Training on Safe Behavior (t=2.817, p=0.005).

Thus, H1 and H6 were rejected, while H2, H3, H4, H5, H7, H8, and H9 were accepted. These results indicate that OHS knowledge, risk management, and—above all—OHS training are crucial factors in shaping OHS culture, which in turn plays a significant role in enhancing workers' safe behavior. OHS training emerges as the most dominant factor, both in the relationship with OHS culture and along the mediation pathway to safe behavior. Conversely, OHS awareness has not demonstrated a sufficiently strong influence, either on OHS culture directly or on safe behavior via OHS culture. Overall, the findings confirm that improving safe behavior cannot rely solely on individual awareness; rather, it requires strengthening knowledge, risk management, training, and—most importantly—OHS culture as a linking mechanism between personal and organizational factors and worker behavior.

Variable Influence

The Influence of Occupational Safety Awareness on OHS Culture

Occupational Health and Safety (OHS) awareness (X1) does not have a significant effect on OHS culture (Z), as indicated by a t-statistic of 1.483 (< 1.96) and a p-value of 0.138 (> 0.05); thus, H1 is rejected. This implies that a high level of individual worker awareness is insufficient to directly shape a safety culture.

These findings align with Khusaini (2023), who found that safety awareness does not significantly affect safety compliance, and with Tiawati and Faidal (2024), who demonstrated that safety awareness does not directly influence safety behavior but can exert an influence through safety culture. Rachman, Mees, and Fry (2016) also showed that structural and organizational cultural factors—such as hierarchy and a "can-do" culture—can hinder the formation of a safety culture, even when individual awareness is high.

Theoretically, these findings support James Reason's Swiss Cheese Model, illustrating that individual awareness does not automatically evolve into a collective culture without the support of organizational systems. Cooper (2018) explains that safety culture is formed through the interaction of psychological, behavioral, and situational aspects, while Biermann-Teuscher et al. (2024) emphasize that safety systems which are overly standardized and lack contextual relevance may overlook workers' practical competencies.

Consequently, the lack of significance regarding OHS awareness may stem from differing perceptions among workers and weak organizational reinforcement. ACSNI (1993) asserts that safety culture is shaped by the values, attitudes, perceptions, competencies, and behaviors of both individuals and groups. Therefore, awareness must be reinforced through safety communication, consistent reward and punishment mechanisms, leadership by example, responsive reporting systems, worker involvement, and management commitment to foster the development of a robust safety culture.

The Influence of Safety Knowledge on Safety Culture

Safety knowledge (X2) has a significant influence on safety culture (Z), with a t-statistic of 2.924 (> 1.96) and a p-value of 0.003 (< 0.05); thus, H2 is accepted.

This finding aligns with Carissa, Etikariena, and Admaja (2025), who demonstrated that safety knowledge is linked to safety compliance, both directly and through safety culture acting as a mediator. Research in the Malaysian oil and gas industry also indicates that safety knowledge is positively influenced by safety management, hazard identification, and safety communication.

Theoretically, these results support Notoatmodjo (2007), who stated that knowledge is a predisposing factor preceding the formation of attitudes and behaviors. Widespread safety knowledge can strengthen collective norms and shape safety culture (Prayoga et al., 2024). Bauzir and Agustina (2024) also highlighted the importance of safety knowledge in enhancing worker participation in safety.

The highest-scoring indicator is X2.8—the ability to make quick and prudent decisions in critical situations. This indicates that workers possess a solid understanding of emergency decision-making, which serves as the foundation for a responsive safety culture within the rig's operational environment.

The Influence of Risk Management on Safety Culture

Risk management (X3) has a significant influence on safety culture (Z), with a t-statistic of 2.415 (> 1.96) and a p-value of 0.016 (< 0.05); thus, H3 is accepted.

This finding aligns with Jamil et al. (2025), who stated that hazard identification and risk assessment (HIRA) form the foundation of sustainable safety and can strengthen a culture of vigilance and shared responsibility. Egila et al. (2025) also emphasized the importance of risk management and safety culture in building a highly reliable organization. Theoretically, these results support James Reason's Swiss Cheese Model, which positions risk management as a defensive layer designed to close hazard gaps before they escalate into incidents.

The highest-scoring indicator is X3.12—specifically, the reporting of and follow-up on incidents, near-misses, and unsafe conditions. This demonstrates that a participatory and continuous reporting system plays a crucial role in strengthening the OHS culture.

The Influence of OHS Training (Safety Training) on OHS Culture (Safety Culture)

OHS training (X4) has a positive and significant influence on OHS culture (Z), with a t-statistic of 3.075 (> 1.96) and a p-value of 0.002 (< 0.05). Thus, H4 is accepted, indicating that the better the OHS training, the stronger the OHS culture.

This finding aligns with Çil (2025), who found that safety training is positively and significantly associated with safety participation through enhanced safety information and awareness. Fakhri et al. (2026) also demonstrated that human-based safety training can improve workers' safety awareness and participation.

Theoretically, these results support Cooper (2018), who views OHS training as a structured learning process designed to shape the knowledge, skills, and attitudes necessary for workers to perform their duties safely. Effective training enhances not only cognitive aspects but also affective and behavioral dimensions, thereby facilitating changes in habits (Oktaviani et al., 2026).

The most dominant indicator is X4.6—specifically, the competence and experience of the training instructor. This indicates that instructor quality is a crucial aspect of OHS training effectiveness. This finding is consistent with the "behaviourally informed digital framework" approach in the BOSCA study, which identifies instructor competence and experience as vital components in shaping safety culture through training.

The Influence of OHS Culture (Safety Culture) on Safe Behavior (Safety Behavior)

OHS culture (Z) has a significant influence on safe behavior (Y), with a t-statistic of 5.718 (> 1.96) and a p-value of 0.000 (< 0.05); therefore, H5 is accepted. The original sample value of 0.623 indicates that OHS culture exerts a strong, positive influence on workers' safe behavior. These findings align with the study by Soebroto, Budiyanto, and Suwitho (2020), which found that safety culture has a positive and significant impact on the safety behavior of oil and gas industry workers in East Kalimantan. That study also demonstrated that safety culture acts as a full mediator between safety leadership and safety behavior. Similar findings among oil and gas workers in Nigeria indicate that a strong safety culture enhances worker compliance and participation in safety practices.

Theoretically, these results support B.F. Skinner's ABC Model, which explains that behavior is shaped by antecedents (activators), behaviors, and consequences. A positive OHS culture—fostered by support and recognition from supervisors and colleagues—serves as a consequence that consistently reinforces safe behavior.

The highest-scoring indicators of OHS culture were management's response to safety issue reports (Z.11) and the ease of reporting safety issues (Z.10). This indicates that the reporting system is functioning effectively and is supported by a non-punitive culture (a "just culture"). Such conditions reflect a maturing safety culture, consistent with the National Academies of Sciences (2024), which states that safety culture maturity is characterized by a high level of involvement from all organizational tiers in the safety management system.

The Mediating Role of OHS Culture (Safety Culture)

Based on the mediation analysis, OHS culture (Z) was found to act as a mediating variable in the relationship between OHS awareness, OHS knowledge, risk management, and OHS training regarding safe behavior. This implies that the influence of these factors on safe behavior occurs not only directly but also through the establishment and reinforcement of OHS culture.

These findings align with Jamil et al. (2025), who demonstrated that safety culture serves as a mediator between safety management practices and safety performance in the oil and gas industry. Riansyah (2024) also emphasized that the impact of safety communication is more effective when supported by trust and cultural alignment.

Conceptually, these results support the Swiss Cheese Model, wherein OHS culture functions as a collective layer of defense that integrates personal factors—namely awareness and knowledge—with organizational factors—namely risk management and training—to foster safe behavior (Hu, 2020).

The study results indicate that the most dominant factor in shaping OHS culture is OHS training (t-statistic of 3.075), followed by OHS knowledge (2.924), risk management (2.415), and OHS awareness (1.483). The National Academies of Sciences (2024) asserts that a safety-supportive culture reflects an organization's commitment to minimizing risk and prioritizing safety as a value equal to economic achievement.

Consequently, it is insufficient for companies to merely enhance awareness, knowledge, risk management, and training in isolation. These four factors must be integrated through the strengthening of OHS culture so that safety values, norms, and practices become ingrained in the organization, ultimately enhancing workers' safe behavior.

The Influence of Safety Awareness on Safety Behavior

Occupational Health and Safety (OHS) awareness (X1) shows a positive influence on safety behavior (Y) with a t-statistic of 1.516; however, as this value remains below 1.96, the influence is not yet statistically significant, despite indicating a trend toward a positive relationship.

This finding aligns with Khoirunnisa (2023), who found that workers with poor OHS awareness were more likely to exhibit poor safety behavior (71.8%), whereas only 25.0% of workers with good awareness did so. This relationship was significant (p-value = 0.000), and poor OHS awareness was associated with a 7.64 times greater likelihood of resulting in poor safety behavior.

Theoretically, Lu et al. (2025) state that safety awareness influences safety compliance behavior and can act as a mediator between safety commitment and safety participation. Low safety awareness can be a root cause of unsafe behavior. These findings also accord with the Stimulus-Organism-Response (SOR) theory, which explains that safety communication and regulations—acting as external factors—influence individual awareness, thereby fostering the development of safe behavior.

The Influence of Occupational Safety Knowledge on Safety Behavior

The analysis results indicate that Occupational Safety and Health (OSH) knowledge (X2) has a significant positive influence on safety behavior (Y), with a t-statistic of 2.316 and a p-value of 0.021. This finding aligns with research by Scheepers (2024), which found that acquired safety knowledge significantly promotes safety behavior—both directly and indirectly—through other individual human factors. That study also revealed that safety knowledge influences safety behavior via mediators such as safety behavior attitude and safety behavior intention. These findings are further supported by research in the South African manufacturing industry, which showed that 11 out of 17 hypotheses regarding the relationship between safety knowledge and safety behavior were empirically supported.

Theoretically, these results support the Theory of Planned Behavior—the foundation of Scheepers' (2024) study—wherein knowledge influences attitudes, intentions, and ultimately, safety behavior. Sound safety knowledge enables workers to understand not only what must be done but also why safety procedures are important, thereby fostering the internalization of safety values into daily work practices (Putra et al., 2022).

The Influence of Risk Management on Safety Behavior

Risk management (X3) has a significant positive influence on safety behavior (Y), with a t-statistic of 2.170 (> 1.96) and a p-value of 0.030 (< 0.05). This implies that the better the implementation of risk management, the better the workers' safety behavior.

This finding is consistent with research involving 188 organizations in Spain, which demonstrated that proactive risk management plays a crucial role in enhancing safety behavior through both safety compliance and safety participation. Risk management helps ensure that workers adhere to safety standards and procedures, thereby minimizing the risk of injury and material damage. Theoretically, these results support James Reason’s Swiss Cheese Model, which positions risk management as an organizational layer of defense designed to prevent unsafe acts and incidents. The consistent application of hazard identification, risk assessment, control measures, and monitoring can close risk gaps before they escalate into accidents. These findings are further reinforced by research indicating a significant relationship between safety management practices and safety behavior (p-value = 0.004).

The Influence of OHS Training on Safety Behavior

OHS training (X4) has a positive and significant influence on safety behavior (Y), with a t-statistic of 2.817 and a p-value of 0.005. These findings indicate that the more effective the OHS training, the better the workers' safety behavior. This result aligns with research conducted at an

Indonesian ferry company, which demonstrated that safety training shapes workers' mindsets and actions, thereby impacting safety behavior, accident risk, and performance. Research in the warehousing sector also identified a significant relationship between OHS training and unsafe actions ($p = 0.004$), while other studies have shown a strong positive correlation between OHS training and safety behavior ($r = 0.724$; $p < 0.01$).

Theoretically, these findings support the Behavior-Based Safety (BBS) approach, which positions training as an activator for shaping safe behavior. Effective training not only enhances knowledge but also shapes affective and behavioral aspects, thereby enabling habit transformation. Hamidah and Inayah (2025) assert that workers who have undergone OHS (Occupational Health and Safety) training tend to exhibit fewer unsafe behaviors due to their superior experience and understanding of safety.

Overall, OHS knowledge, risk management, and OHS training exert a positive and significant influence on safe behavior, while OHS awareness shows a positive influence bordering on statistical significance. Khoirunnisa (2023) demonstrated a link between OHS awareness, motivation, and safety behavior, while other studies have underscored the importance of safety knowledge, proactive risk management, and training in fostering safe behavior.

Consequently, efforts to enhance safe behavior must be implemented in an integrated manner, prioritizing OHS training, followed by OHS knowledge and risk management. Safe behavior emerges from the interaction between personal factors—specifically awareness and knowledge—and organizational factors, namely risk management and training.

Managerial Implications

Research findings indicate that building a safety culture within oil and gas contractor rig companies requires an integrated approach involving individual, organizational, and management system factors.

First, OHS training stands out as the most dominant factor in shaping safety culture. Therefore, companies must provide training that is contextual, continuous, and aligned with the specific risks of well intervention drilling; this should encompass not only theory but also on-the-job training and simulations. Utami et al. (2025) demonstrated that simulation-based training and safety inductions can improve safety behavior. Cooper (2018) emphasized that training should aim to transform habits rather than merely impart knowledge. Training programs need to be conducted regularly, led by competent instructors, updated in accordance with OHS standards, and evaluated for effectiveness.

Second, safety culture serves as a crucial link between safety programs and worker behavior. Investments in training will not yield optimal results if the organization lacks a supportive culture. Jamil et al. (2025) demonstrate that safety communication is more effective when supported by trust and cultural alignment. Therefore, management needs to actively participate in safety meetings and toolbox talks, acknowledge the reporting of unsafe conditions, and ensure that near-miss and incident reports are followed up on. Reason (2016) emphasizes that leadership consistency is key to establishing a mature safety culture.

Third, although safety awareness does not have a significant direct effect, enhancing it remains necessary. Individual awareness must be reinforced by organizational systems to evolve into a collective culture. Djunaidi et al. (2024) show that organizational changes can diminish perceptions of the safety climate, particularly regarding management commitment, communication, and safety priorities. Sembiring (2025) underscores the importance of consistent top-management commitment to ensure safety remains a priority despite production pressures or organizational changes.

Fourth, companies need to adopt a high-reliability management approach, emphasizing vigilance regarding potential failures, learning from incidents, and layered risk controls. Egila et al. (2025) and Ehiaguina et al. (2024) highlight the importance of management commitment and the involvement of various stakeholders. Rizky et al. (2025) also demonstrate a positive relationship

between safety climate, safety knowledge, and safety behavior. Near-miss reporting systems should be developed based on "just culture" principles, allowing workers to report errors without fear of punishment. Through the Safety-II concept, Hollnagel (2018) emphasizes that safety should also be understood in terms of workers' success in performing tasks safely.

Fifth, risk management must be integrated into daily work rather than remaining merely an administrative formality. Workers at all organizational levels need to be involved in hazard identification, risk assessment, and hazard control. Jamil et al. (2025) show that near-miss reporting and Behavior-Based Safety (BBS) can strengthen safety culture. Managers need to ensure that workers are involved in Job Safety Analysis (JSA), provide feedback on risk controls, and review risk assessments in accordance with changing field conditions. Ramli (2019b) emphasizes that effective risk management must be participatory.

Sixth, given that contractors account for 78% of fatalities in the global oil and gas industry (IOGP, 2023), contractor management must be strengthened through a Contractor Safety Management System (CSMS). Contractors must undergo pre-qualification covering OHS legal compliance, accident statistics, OHS programs, personnel competence, and the readiness of equipment and personal protective equipment (PPE). During operations, contractor performance requires monitoring via safety performance scores, safety audits, and firm action against violations (Lawson, 2026).

Seventh, companies need to periodically measure the maturity of their OHS culture. Sembiring (2025) emphasizes that the level of safety culture maturity can serve as an indicator of the OHS system's effectiveness. Safety culture perception surveys should be conducted at least annually to identify weaknesses and formulate improvement plans. The highest stage—the Generative Level—is achieved when safety becomes a value embedded in all aspects of the organization and worker behavior.

Overall, building a robust safety culture requires effective OHS training, participatory risk management, contractor management, incident reporting and learning systems, and consistent commitment from top management. Cooper (2018) asserts that a "one-size-fits-all" approach is ineffective because every organization and worker group possesses distinct cultural characteristics. Therefore, managers must act as agents of change—demonstrating leadership by example, fostering communication, ensuring active engagement, and positively reinforcing safe behaviors—to establish a sustainable safety culture.

CONCLUSION

The research results indicate that OHS awareness does not significantly influence OHS culture; thus, high individual awareness alone is insufficient to shape a collective safety culture without organizational system support. Conversely, OHS knowledge significantly influences OHS culture, primarily by enabling workers to make quick and accurate decisions during emergencies.

Risk management also significantly impacts OHS culture, with systems for reporting incidents, near-misses, and unsafe conditions serving as the most dominant indicators. This demonstrates that participatory and continuous risk management can strengthen safety culture. OHS training emerges as the most dominant factor influencing OHS culture, with instructor quality and competence acting as key indicators. Effective training not only enhances knowledge but also helps establish safe work habits.

Furthermore, OHS culture significantly influences safe behavior. Management's response to safety reports and the implementation of a "no-blame" culture are crucial factors in consistently fostering safe behavior. Regarding mediation, OHS culture does not mediate the effect of OHS awareness on safe behavior; however, it is proven to mediate the effects of OHS knowledge, risk management, and OHS training on safe behavior. This implies that knowledge, risk management, and training are more effective at generating safe behavior when safety values are internalized within the organizational culture.

Overall, seven out of nine hypotheses were accepted, while two were rejected. OHS culture proved to be a vital mechanism linking personal and organizational factors to safe behavior. Among the variables studied, OHS training was the most dominant factor, followed by OHS knowledge, risk management, and OHS awareness.

Consequently, improving workers' safe behavior requires continuously strengthening safety culture through quality training, knowledge enhancement, effective risk management, and organizational system support. These findings are limited to well-intervention drilling contractor rig workers at Pertamina Hulu Rokan (Rokan Zone) and cannot be directly generalized to all oil and gas contractor workers in other regions.

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