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Safety Behavior as a Mediator of Safety Leadership and Safety Climate in Oil and Gas Operation and Maintenance

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ABSTRACT
Occupational safety is a critical issue in high-risk industries, particularly in oil and gas Operation and Maintenance (O&M) companies, where workplace accidents frequently occur due to unsafe behaviors. Strengthening organizational factors such as safety leadership and safety climate is essential to improve employees' safety behavior and mitigate occupational accidents. This study aims to analyze the direct and indirect effects of safety leadership and safety climate on occupational accidents, positioning safety behavior as a mediating variable. A quantitative approach with a verificative design was employed, involving 110 employees from an O&M oil and gas company. Data were collected via questionnaires and analyzed using Partial Least Squares Structural Equation Modeling (PLS-SEM). The results indicate that safety leadership and safety climate significantly and directly reduce occupational accidents. Furthermore, safety behavior acts as a crucial mediating variable, successfully bridging the impact of safety leadership and safety climate on occupational accidents. Out-of-sample prediction using PLSpredict confirmed the model's high predictive relevance. These findings highlight that organizational safety practices are most effective when translated into individual safety behaviors. The study provides actionable managerial implications for HSE professionals to implement behavior-based safety observations and horizontal peer-to-peer safety communication to sustainably reduce workplace accidents in high-risk operational environments.

Keywords: Safety Behavior, Safety Climate, Safety Leadership, Occupational Accident.

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ABSTRAK
Keselamatan kerja merupakan isu yang sangat penting pada industri berisiko tinggi, khususnya pada perusahaan Operasi dan Pemeliharaan (Operation and Maintenance/O&M) di sektor minyak dan gas, di mana kecelakaan kerja sering terjadi akibat perilaku kerja yang tidak aman. Penguatan faktor-faktor organisasi seperti kepemimpinan keselamatan (safety leadership) dan iklim keselamatan (safety climate) menjadi aspek penting untuk meningkatkan perilaku keselamatan karyawan serta mengurangi terjadinya kecelakaan kerja. Penelitian ini bertujuan untuk menganalisis pengaruh langsung dan tidak langsung kepemimpinan keselamatan dan iklim keselamatan terhadap kecelakaan kerja, dengan menempatkan perilaku keselamatan (safety behavior) sebagai variabel mediasi. Penelitian ini menggunakan pendekatan kuantitatif dengan desain verifikatif yang melibatkan 110 karyawan dari sebuah perusahaan O&M di sektor minyak dan gas. Data dikumpulkan melalui kuesioner dan dianalisis menggunakan Partial Least Squares Structural Equation Modeling (PLS-SEM). Hasil penelitian menunjukkan bahwa kepemimpinan keselamatan dan iklim keselamatan secara langsung dan signifikan mampu menurunkan angka kecelakaan kerja. Selain itu, perilaku keselamatan berperan sebagai variabel mediasi yang penting dalam menjembatani pengaruh kepemimpinan keselamatan dan iklim keselamatan terhadap kecelakaan kerja. Prediksi di luar sampel (out-of-sample prediction) menggunakan PLSpredict mengonfirmasi bahwa model memiliki relevansi prediktif yang tinggi. Temuan ini menegaskan bahwa praktik keselamatan organisasi akan memberikan hasil yang paling efektif apabila diwujudkan dalam perilaku keselamatan individu. Penelitian ini juga memberikan implikasi manajerial yang aplikatif bagi para profesional Health, Safety, and Environment (HSE) untuk menerapkan observasi keselamatan berbasis perilaku (behavior-based safety observations) serta komunikasi keselamatan horizontal antarrekan kerja (peer-to-peer safety communication) guna mengurangi kecelakaan kerja secara berkelanjutan pada lingkungan operasional berisiko tinggi.

Kata Kunci: Perilaku Keselamatan, Iklim Keselamatan, Kepemimpinan Keselamatan, Kecelakaan Kerja.

INTRODUCTION

Occupational safety is one of the primary factors in every industry, particularly in high-risk sectors such as the oil and gas industry (Selamat, Carlo, & Utama, 2025). The risk of occupational accidents in the oil and gas operation and maintenance (O&M) sector is exceptionally high due to the nature of the work, which involves high pressure, flammable materials, and complex field activities (Arifin, et al., 2023). Despite the widespread implementation of occupational health and safety (OHS) policies, accident rates continue to exhibit a concerning upward trend. Globally, the International Labour Organization (ILO) reports millions of work-related casualties annually, a macro-trend reflected in Indonesia, where BPJS Ketenagakerjaan recorded a 127.33% surge in occupational accidents in 2022 (Putri, Kurniasih, & Rachman, 2022).

National data reported by BPJS Ketenagakerjaan indicate that workplace accidents in Indonesia have continued to increase in recent years, suggesting that existing safety management practices have not fully achieved the expected outcomes. This trend highlights that regulatory compliance alone may not be sufficient to prevent workplace accidents and underscores the importance of examining organizational and behavioral factors that contribute to accident prevention in high-risk work environments. This condition is also reflected in the O&M oil and gas company observed in this study, where occupational accidents increased from 67 incidents in 2022 to 81 incidents in 2023. This increase indicates that, despite existing regulations, challenges remain in ensuring effective implementation of safety procedures at the operational level.

Given that approximately 85% of workplace accidents are attributed to unsafe actions (Larasatie et al., 2022), identifying the mechanisms that encourage employees to consistently engage in safe work practices becomes paramount. In this context, organizational factors are considered crucial determinants of workplace safety performance. Previous studies have suggested that leadership commitment to safety and employees' perceptions of the organizational safety environment play an important role in shaping safety-related behaviors. Therefore, understanding how these organizational factors influence safety behavior is essential for developing effective strategies to reduce occupational accidents in high-risk operational environments

To address these unsafe actions, safety leadership and safety climate act as key determinants that have been proven to influence workers' safety behavior (Moon, 2024). Safety leadership reflects the extent to which leaders demonstrate commitment to safety through role modeling, effective communication, and consistency in implementing safety policies. Meanwhile, safety climate reflects workers' collective perceptions of the extent to which organizations prioritize safety (Putri, Kurniasih, & Rachman, 2022). These two factors interact in shaping the overall safety culture. However, existing literature presents inconsistent findings regarding the direct impact of these organizational factors on actual accident rates. This discrepancy suggests that leadership mandates and a positive climate alone cannot prevent accidents unless they are translated into individual actions on the ground.

Therefore, this study posits that safety behavior which includes strict compliance with safety procedures (safety compliance) and active participation in safety activities (safety participation) (Draghici et al., 2022) acts as the crucial theoretical mediator. While previous studies have explored the relationships among these variables, they often incorporate subjective psychological mediators, such as perceived risk (Ningtyas, 2024), which can limit operational generalizability due to individual psychological differences. The novelty of this study lies in its streamlined conceptual framework, which eliminates subjective psychological variables to focus strictly on observable safety behavior as the primary mediator connecting organizational safety factors to accident reduction in a high-risk operational setting.

Therefore, this study aims to analyze the direct effects of safety leadership and safety climate on occupational accidents in O&M oil and gas companies. Furthermore, it specifically seeks to examine the mediating role of safety behavior in the relationship between safety leadership, safety climate, and occupational accidents. The findings are expected to provide empirical contributions and actionable insights for developing more effective, behavior-driven safety management strategies in the O&M oil and gas industry.

RESEARCH METHODS

This study employed a quantitative research design using descriptive and verificative approaches. The descriptive approach was intended to describe the actual conditions of the research variables, whereas the verificative approach was applied to examine the causal relationships among variables through structural hypothesis testing. Prior to data collection, ethical approval was obtained from the relevant institutional review board. All participants provided informed consent before participating in the study, and the confidentiality of the collected data was strictly maintained throughout the research process.

The analytical framework of this study was based on path analysis to investigate the direct and indirect relationships between safety leadership and safety climate on occupational accidents, with safety behavior functioning as the mediating variable in an Operation and Maintenance (O&M) oil and gas company. Path analysis is an extension of multiple linear regression that is designed to analyze theoretically established cause-and-effect relationships among variables (Sugiyono, 2019). In the proposed structural model, safety leadership and safety climate were specified as exogenous variables, occupational accidents as the endogenous variable, and safety behavior as the mediating variable. This framework enabled the simultaneous examination of both direct and indirect effects among the research variables.

The development of the conceptual model was informed by previous studies. Ningtyas (2024), for example, developed a path analysis model involving safety leadership, safety climate, safety behavior, and perceived risk. The study demonstrated that safety leadership directly influences safety behavior and safety climate while also shaping workers' perceived risk, which subsequently affects safety behavior. Nevertheless, the inclusion of subjective variables such as perceived risk may reduce the generalizability of findings because individuals often differ in their perception and interpretation of workplace hazards. Building upon these findings, the present study adopts a more focused framework by positioning safety behavior as the sole mediating variable linking safety leadership and safety climate with occupational accidents. By excluding subjective psychological variables, the proposed model is expected to provide a more practical and operational explanation of how organizational safety factors contribute to reducing occupational accidents in O&M oil and gas companies. Furthermore, the use of path analysis allows simultaneous estimation of direct and indirect effects while providing a comprehensive understanding of the causal mechanisms underlying occupational accident prevention through improvements in safety behavior.

Based on the proposed conceptual framework, six hypotheses were formulated. The first hypothesis examined the direct effect of safety leadership on occupational accidents (H_0: safety leadership has no significant effect on occupational accidents; H_a: safety leadership has a significant effect on occupational accidents). The second hypothesis tested the direct effect of safety climate on occupational accidents (H_0: safety climate has no significant effect on occupational accidents; H_a: safety climate has a significant effect on occupational accidents). The third hypothesis investigated the indirect effect of safety leadership on occupational accidents through safety behavior (H_0: no indirect effect exists; H_a: an indirect effect exists). The fourth hypothesis examined the indirect effect of safety climate on occupational accidents through safety behavior (H_0: no indirect effect exists; H_a: an indirect effect exists). The fifth hypothesis evaluated the direct influence of safety leadership and safety climate on occupational accidents (H_0: no direct effect exists; H_a: a direct effect exists). Finally, the sixth hypothesis examined the simultaneous indirect effects of safety leadership and safety climate on occupational accidents through safety behavior (H_0: no indirect effect exists; H_a: an indirect effect exists).

The population of this study comprised all 152 employees working in the Operation and Maintenance (O&M) oil and gas company. The required sample size was determined using the Slovin formula, resulting in a minimum sample of 110 respondents. Participants were selected using a purposive sampling technique, whereby only employees directly exposed to operational risks in the field were included. To ensure methodological adequacy for structural equation modeling with mediation analysis, this study followed the widely accepted Partial Least Squares Structural Equation Modeling (PLS-SEM) guideline known as the "10-times rule". According to this guideline, the minimum sample size should be at least ten times the maximum number of

structural paths directed toward a latent construct. Since the maximum number of predictor paths directed to the endogenous construct in the proposed model was three, the minimum required sample size was only 30 respondents. Therefore, the final sample of 110 respondents substantially exceeded this requirement, indicating sufficient statistical power for estimating both the structural model and mediation effects.

The study utilized both primary and secondary data sources. Primary data were collected through structured questionnaires distributed directly to respondents and electronically via Google Forms. Secondary data were obtained from various supporting sources, including books, previous research, scientific journals, published articles, and internal company documents, such as occupational accident reports, occupational health and safety (OHS) evaluation reports, and administrative project records.

Several complementary data collection techniques were employed to enhance data validity. Direct observations were conducted to examine the implementation of safety procedures and interactions between safety leadership and employees during workplace operations. Structured questionnaires using a five-point Likert scale were administered to measure respondents' perceptions regarding safety leadership, safety climate, safety behavior, and occupational accidents. Documentation studies were performed by reviewing occupational accident reports and OHS evaluation records maintained by the company. In addition, semi-structured interviews were conducted with selected employees to obtain deeper insights into their experiences and perceptions concerning organizational safety leadership, safety climate, and safety behavior.

The overall research procedure followed the quantitative research stages proposed by Sugiyono (2019). The process began with identifying the research topic and objectives, followed by a preliminary survey to identify existing workplace safety issues. Subsequently, an extensive literature review was conducted to establish the theoretical foundation and identify research gaps. Based on the literature review, the research problems and hypotheses were formulated. Primary and secondary data were then collected, processed, and analyzed using SmartPLS software. The analytical results were interpreted and discussed in relation to previous empirical findings, leading to the formulation of conclusions and practical recommendations.

Following data collection, statistical analysis was performed using the Structural Equation Modeling (SEM) approach with the Partial Least Squares (PLS) method implemented in SmartPLS version 3. PLS-SEM was selected because it is suitable for predictive research models involving mediation relationships and does not require strict multivariate normality assumptions.

The measurement model (outer model) was first evaluated to assess the reliability and validity of the measurement instruments. The outer model describes the relationships between latent variables and their observed indicators. Exogenous variables represent constructs whose variation originates from outside the structural model, whereas endogenous variables are explained by the proposed structural relationships. The evaluation of the measurement model followed the procedures recommended by Sarstedt, Ringle, and Hair (2021).

Convergent validity was assessed by examining the outer loading values and the Average Variance Extracted (AVE). Convergent validity reflects the extent to which indicators of the same construct share a high proportion of variance (Hamid & Anwar, 2019). Indicators were considered valid when outer loading values were at least 0.70 and AVE values exceeded 0.50.

The reliability of the constructs was evaluated through internal consistency reliability using Cronbach's alpha and Composite Reliability (CR). These statistics measure the consistency and accuracy of the indicators in representing their respective constructs (Hamid & Anwar, 2019). Following the recommendations of Sarstedt, Ringle, and Hair (2021), values of 0.70 or higher for both Cronbach's alpha and Composite Reliability indicated satisfactory reliability.

Discriminant validity was subsequently examined to ensure that each construct was empirically distinct from the others. According to Hamid and Anwar (2019), discriminant validity indicates that indicators correlate more strongly with their own construct than with different constructs. This criterion was assessed using the Fornell–Larcker criterion by comparing the square root of the AVE for each construct with its correlations with other constructs.

After confirming the adequacy of the measurement model, the structural model (inner model) was evaluated to determine the predictive relationships among the latent variables. Structural model evaluation was primarily based on the coefficient of determination (R^2), which represents the proportion of variance in endogenous constructs explained by the exogenous constructs. According to Ghozali and Latan (2020), R^2 values of 0.67, 0.33, and 0.19 indicate substantial, moderate, and weak explanatory power, respectively.

Finally, hypothesis testing was conducted using the bootstrapping procedure in SmartPLS. The significance of the structural relationships was evaluated using t-statistics and p-values. A structural relationship was considered statistically significant when the t-statistic was at least 1.96 or the p-value was less than or equal to 0.05 (Sugiyono, 2019). In addition, mediation analysis was performed following the procedure proposed by Ghozali and Latan (2020) to determine whether safety behavior significantly mediated the effects of safety leadership and safety climate on occupational accidents. Mediation was confirmed when the indirect effect was statistically significant, as indicated by a t-statistic greater than 1.96.

RESULTS

Before conducting further analysis on the effects of each variable examined, it is necessary to first identify the characteristics of the respondents who constitute the subjects of this study. The characteristics analyzed include gender, age, highest level of education, job position, and length of service. The following table presents the distribution of respondents' characteristics.

Table 1. Responden Characteristic

Respondent Characteristics	Description	Frequency	Percentage (%)
Gender	Male	92	84
	Female	18	16
Age	20-25 years	12	11
	26-30 years	10	9
	31-35 years	30	27
	36-40 years	31	28
	> 40 years	27	25
Level of education	Associate's Degree	62	56
	Bachelor's Degree	44	40
	Master's Degree	4	4
Job title	Manager	2	2
	Supervisor	7	6
	Coordinator	12	11
	Operator/Tehnician	89	81
Length of employment	< 2 years	15	14
	2-5 years	17	15
	6-10 years	14	13
	> 10 years	64	58

The analysis of respondents' characteristic was conducted to provide an an overview of the demographic and professional backgrounds of the workforce involved in this study, as well as to contextualize the interpretation of the relationships between safety leadership, safety climate, and occupational accidents through the mediation of safety behavior in Operation and Maintenance (O&M) oil and gas companies. Understanding these characteristics is important to explain how individual factors and job positions may influence safety perceptions, safety behavior, and the level of occupational accidents in high-risk work environments. The characteristics analyzed include gender, age, educational background, job position, and length of service.

Based on the results, the majority of respondents were male, totaling 92 individuals (84%), while female respondents numbered 18 individuals (16%). This composition reflects the workforce structure in the O&M oil and gas sector, which is predominantly male, particularly in operational roles with high-risk exposure, where the effectiveness of safety leadership and safety

climate plays a crucial role in shaping workers' safety behavior. In terms of age, most respondents were within the productive age range of 31–40 years, indicating a relatively mature workforce with sufficient work experience in recognizing and managing occupational hazards.

Regarding educational background, most respondents held a Diploma (D3) degree, with 62 individuals (56%), followed by those with a Bachelor's degree (S1), totaling 44 individuals (40%). Only a small proportion of respondents held a Master's degree (S2), amounting to 4 individuals (4%). This educational profile suggests that the majority of workers possess adequate technical competence to understand occupational safety procedures, which may influence safety behavior in daily operational activities.

In terms of job position, the respondents were predominantly operators or technicians, accounting for 89 individuals (81%), who are directly exposed to workplace hazards in the field. Other positions included coordinators (11%), supervisors (6%), and managers (2%). The dominance of operational workers is highly relevant to the focus of this study, as occupational accidents and safety behavior are most prevalent at the operational level, making safety leadership and safety climate critical factors in influencing workers' safety behavior.

With respect to length of service, most respondents had more than 10 years of work experience, totaling 64 individuals (58%), indicating a workforce with substantial experience and a relatively strong understanding of workplace risks and safety procedures. Meanwhile, respondents with less than 10 years of experience provided additional variation, reflecting a diverse workforce in terms of experience. This diversity is important in analyzing the mediating role of safety behavior, as work experience can influence levels of compliance and participation in occupational safety practices.

Measurement Model Analysis (Outer Model)

a. Convergent validity test result

Convergent validity assesses the quality of measurement instruments used to represent latent variables. An instrument demonstrates adequate convergent validity when its indicators consistently measure the intended construct (Rahadi, 2023). Outer loading reflects the strength of the relationship between indicators and latent variables, where values above 0.70 are considered acceptable, indicating that a substantial proportion of indicator variance is explained by the latent construct (Setiabudi et al., 2025). Indicators with outer loading values below the recommended threshold may be excluded from the analysis to improve convergent validity (Rahadi, 2023).

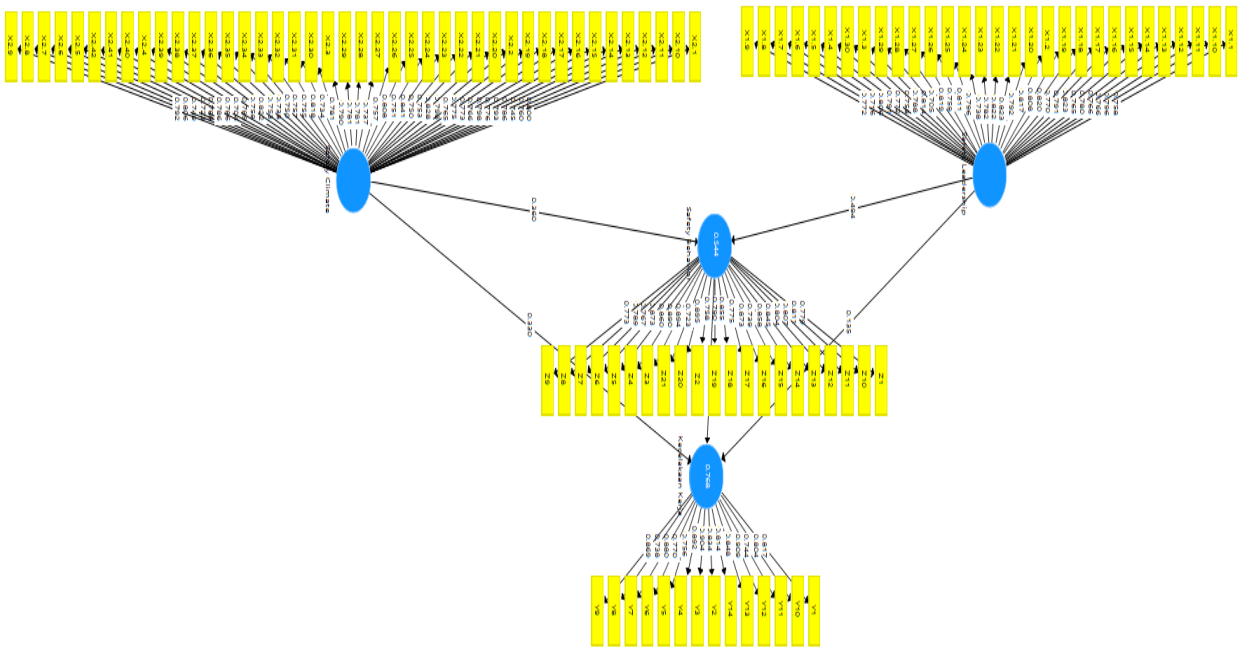

Figure 1. Path analysis by the research.

Based on the SmartPLS output shown in Figure 1, all indicators used to measure safety leadership, safety climate, safety knowledge, safety behavior, and occupational accidents exhibit outer loading values exceeding the minimum threshold of 0.70, indicating that the convergent validity criteria have been satisfied. Following the fulfillment of outer loading requirements, further assessment was conducted by examining the Average Variance Extracted (AVE), Cronbach's alpha, and Composite Reliability.

b. Internal consistency reliability test result

Internal consistency of indicators in representing the measured latent constructs. After the outer loading criteria were satisfied, reliability assessment was conducted by examining Cronbach's alpha and Composite Reliability as measures of construct reliability. The results of these analyses are presented in Table 2.

Table 2. Construct reliability

	Cronbach's alpha	rho_a	Composite Reliability
Occupational accident (Y)	0.965	0.968	0.968
Safety Behavior	0.975	0.976	0.977
Safety Climate	0.984	0.984	0.984
Safety Leadership	0.978	0.979	0.980

The reliability test results presented in Table 2 indicate that all research variables meet the criteria for excellent reliability, with Cronbach's alpha and Composite Reliability values exceeding the minimum threshold of 0.70. These findings demonstrate that the research instruments exhibit strong internal consistency in measuring each construct.

The variables safety leadership, safety climate, safety behavior, and occupational accidents show very high reliability values, reflecting the stability and consistency of the measurement instruments. The high reliability of safety behavior as a mediating variable further supports the overall adequacy of the research model and confirms its role in mediating the effects of the independent variables on occupational accidents.

Overall, these results confirm that the research instruments possess good measurement quality and are appropriate for further analysis of the relationships among safety leadership, safety climate, safety knowledge, safety behavior, and occupational accidents in oil and gas O&M companies.

c. Discriminant Validity test Result

Discriminant validity is achieved when the measurement model does not contain redundant indicators and each construct in the model can be clearly distinguished. One requirement for discriminant validity is that the correlation between latent constructs is lower than 0.85 (< 0.85). In addition, based on the Fornell–Larcker criterion, the square root of the Average Variance Extracted (AVE) for each construct must be greater than the correlations with other constructs (Rahadi, 2023).

Table 3. Discriminant validity

	Occupational accident (Y)	Safety Behavior (Z)	Safety Climate (X2)	Safety Leadership (X1)
Occupational accident (Y)	0.829			
Safety Behavior (Z)	0.825	0.819		
Safety Climate (X2)	0.715	0.596	0.774	
Safety Leadership (X1)	0.651	0.666	0.578	0.785

Based on Table 3, the results of the discriminant validity evaluation indicate that all constructs in the research model meet the Fornell–Larcker criterion, where the square root of the Average Variance Extracted (AVE) for each construct is higher than its correlations with other constructs. This finding demonstrates that each construct can be clearly distinguished and that

no measurement overlap occurs among constructs. The constructs safety leadership, safety climate, safety behavior, and occupational accidents each exhibit adequate measurement capability for their respective constructs. These results confirm that each construct represents a unique and distinct concept, while maintaining logical relationships within the research model

Thus, the fulfillment of the Fornell Larcker criterion confirms that the discriminant validity of the research model has been satisfactorily established, indicating that the model is valid and suitable for further structural analysis in oil and gas O&M companies.

Structural Model Analysis (Inner Model)

Structural model (inner model) analysis aims to evaluate the relationships among latent variables in the research model. This process is conducted by examining the R-square (R^2) values of each endogenous latent variable, which indicate the extent to which the independent variables explain the variance in the dependent variables (Setiabudi et al., 2025).

Table 4. R Square.

	R Square	R Square Adjusted
Occupational accident	0.768	0.761
Safety Behavior	0.544	0.535

Based on the analysis results, safety leadership and safety climate, with safety behavior as a mediating variable, influence occupational accidents. The R-square value for occupational accidents is 0.768, indicating that 76.8% of the variance in occupational accidents is explained by safety leadership and safety climate through safety behavior, while the remaining 23.2% is influenced by other factors outside the scope of this study. This result indicates that the structural model falls into the strong category. The Adjusted R-square value of 0.761 indicates that the model has been appropriately adjusted for the number of predictors used. The relatively small difference between the R-square and Adjusted R-square values suggests that the model is efficient and does not suffer from overfitting. Furthermore, the R-square value for the mediating variable safety behavior is 0.544, indicating that 54.4% of the variance in safety behavior is explained by safety leadership and safety climate. The Adjusted R-square value of 0.535 further confirms the stability and reliability of the model.

These findings confirm that safety behavior plays a key mediating role in the relationship between safety leadership, safety climate, and occupational accidents. The results suggest that behavioral safety improvements serve as the primary mechanism for reducing occupational accidents in oil and gas O&M companies, rather than relying solely on administrative safety policies.

Table 5. Path Coefficients

	Original Sample (O)	T Statistics	P-Values
Safety Leadership (X1) → Occupational accident (Y)	0.149	2.067	0.039
Safety Climate (X2) → Occupational accident (Y)	0.338	5.951	0.000

Based on the path coefficient results presented in Table 5, the relationships among variables in the tested structural model can be analyzed. The model evaluates the direct effects of safety leadership, safety climate, and safety behavior on occupational accidents, as well as the effects of safety leadership and safety climate on safety behavior. This analysis aims to explain how safety leadership and safety climate influence safety behavior, which subsequently acts as a mediating variable in reducing occupational accidents in oil and gas O&M companies.

1) Safety Leadership and Occupational Accidents

The relationship between safety leadership and the mitigation of occupational accidents is positive and significant (T=2.067, p=0.039). This positive statistical relationship indicates that as safety leadership improves, the organizational capacity to mitigate and prevent occupational accidents also increases. Therefore, the hypothesis stating that safety leadership influences occupational accident mitigation is accepted.

2) Safety Climate and Occupational Accidents

The relationship between safety climate and the mitigation of occupational accidents is also positive and significant, with a path coefficient of 0.338 (T=5.951, p=0.000). This finding indicates that an improvement in safety climate is strongly associated with a substantial increase in the organization's ability to mitigate occupational accidents, supporting the acceptance of the proposed hypothesis.

a. Mediation test Results

Mediation analysis was conducted to examine the role of safety behavior as a mediating variable in the relationships between safety leadership, safety climate, and safety knowledge and occupational accidents. This analysis aims to determine whether safety behavior mediates the effects of the independent variables on the dependent variable.

Table 6. Specifics indirect effects

	T Statistics	**P Values**
Safety Leadership (X1) → Safety Behavior (Z) → Occupational accident (Y)	3.196	0.001
Safety Climate (X2) → Safety Behavior (Z) → Occupational accident (Y)	3.645	0.000

The results of the indirect effect analysis, as presented in Table 6, indicate that all independent variables safety leadership and safety climate have a significant indirect effect on occupational accidents through the mediation of safety behavior. These findings support the underlying assumption of the research model that safety behavior plays a central mediating role in linking organizational and behavioral factors to occupational accident reduction.

1) Safety Leadership → Occupational Accidents through Safety Behavior

The indirect effect of safety leadership on occupational accident mitigation through safety behavior shows a positive and significant effect (T=3.196, p=0.001). Thus, safety leadership significantly enhances the capacity to mitigate occupational accidents through the mediation of safety behavior, highlighting its importance in risk-reduction efforts in oil and gas O&M companies.

2) Safety Climate → Occupational Accidents through Safety Behavior

The indirect effect of safety climate on occupational accident mitigation through safety behavior yields a positive and significant effect (T=3.645, p=0.000). These results indicate that a positive safety climate significantly drives better individual safety behavior, which subsequently acts as an active mechanism to successfully mitigate workplace accidents.

b. Total Effect

The total effects test in SmartPLS is conducted to identify the overall effects (both direct and indirect) between independent variables and the dependent variable through the mediating variable.

Table 7. Total effects.

	Original Sample (O)	Sample Mean (M)	Standard Deviation (STDEV)	T Statistics (O/STDEV)	P-Values
Safety Leadership (X1)→Workplace Accidents (Y)	0.281	0.282	0.061	4.600	0.000
Safety Climate (X2) →Workplace Accidents (Y)	0.432	0.432	0.059	7.311	0.000
Safety Behavior (Z)→ Workplace Accidents (Y)	0.370	0.366	0.076	4.881	0.000
Safety Leadership (X1)→Safety Behavior (Z)	0.357	0.356	0.062	5.777	0.000
Safety Climate (X2) →Safety Behavior (Z)	0.254	0.252	0.063	4.023	0.000

Based on the total effects analysis presented in Table 7, statistically significant relationships were identified among the variables, supporting the theoretical framework concerning the roles of safety leadership, safety climate, and safety behavior in influencing occupational accidents.

The effect of safety leadership on occupational accidents was obtained with an Original Sample (O) value of 0.281 and a p-value of 0.000. Similarly, the effect of safety climate on occupational accidents was obtained with an Original Sample (O) value of 0.281 and a p-value of 0.000, indicating a statistically significant relationship.

Furthermore, the effect of safety behavior on occupational accidents was obtained with an Original Sample (O) value of 0.370 and a p-value of 0.000. In addition, the effects of safety leadership and safety climate on safety behavior were obtained with Original Sample (O) values of 0.357 and 0.254, respectively, both with p-values of 0.000. These results support the role of safety behavior as a mediating variable in the structural model.

DISCUSSION

The Effect of Safety Leadership on Occupational Accident Mitigation

Based on the results of the study examining the effect of safety leadership on occupational accidents, the data analysis demonstrates that safety leadership has a direct and significant effect on the mitigation of occupational accidents in O&M oil and gas companies. This finding is supported by a t-statistic of 2.067 and a p-value of 0.039, confirming a statistically significant direct relationship between safety leadership and occupational accident mitigation. These results indicate that effective safety leadership plays a crucial role in reducing accident rates by strengthening employees' awareness of safety risks and encouraging preventive actions in the workplace. Accordingly, the hypothesis stating that safety leadership has a direct effect on occupational accident mitigation is accepted.

From a theoretical perspective, safety leadership represents leaders' commitment to prioritizing occupational safety through clear communication, consistent enforcement of safety policies, and visible role modeling of safe behavior. In high-risk industries such as O&M oil and gas companies, leadership involvement in safety management is particularly critical, as employees are frequently exposed to hazardous working conditions. Leaders who consistently emphasize safety values and provide clear guidance create an environment in which safety becomes an integral part of daily work practices.

The findings of this study are consistent with previous research (Rahman, Daryanto, & Aini, 2023), which reported that safety leadership directly influences the mitigation of occupational accidents. Similar evidence was also reported by Fortuna, Kurniasih, & Rachman (2025), who found that effective safety leadership significantly reduces accident rates through strong leadership commitment, clear safety policies, and continuous safety guidance. Furthermore,

studies by Ningtyas (2024), Satoto (2020), and Chen et al. (2025) highlight that strong safety leadership enhances employees' compliance with safety procedures and promotes positive safety norms within organizations.

Importantly, safety leadership not only directly mitigates occupational accidents but also indirectly contributes to accident prevention by shaping employees' safety behavior. When employees perceive consistent leadership support for safety, they are more likely to comply with safety regulations, use personal protective equipment appropriately, and proactively identify potential hazards. This alignment between leadership commitment and employee behavior reinforces a strong safety culture and lowers the likelihood of workplace accidents.

Therefore, strengthening safety leadership should be considered a strategic priority in occupational accident prevention efforts. Consistent leadership practices that emphasize safety values, support employee involvement, and promote safe behavior contribute to sustainable improvements in workplace safety performance, particularly in high-risk operational environments such as O&M oil and gas companies.

The Effect of Safety Climate on Occupational Accident Mitigation

Based on the results of the study examining the effect of safety climate on occupational accidents, the data analysis also indicates that safety climate has a direct and significant effect on the mitigation of occupational accidents in O&M oil and gas companies. This is evidenced by a t-statistic of 5.951 and a p-value of 0.000, confirming a statistically significant direct effect. A positive safety climate reflects employees' perceptions and attitudes toward occupational safety, which are manifested through safety policies, work procedures, and organizational safety culture. These findings indicate that the more positive the safety climate perceived by employees, the higher the organizational capacity to mitigate occupational accidents.

The results of this study are consistent with previous research conducted by Haki, Achmadi, & Vitasari (2025), which reported that safety climate explained 86.538% of the total variance in occupational safety and health (OSH), indicating a substantial contribution to workplace safety performance. These findings suggest that a strong safety climate has a significant impact on occupational safety and health and is effective in mitigating occupational accidents. This result is also in line with the study by Setiawan, Wijaya, & Chandra (2019), which found that safety climate has a significant effect on occupational accident mitigation among employees of PT Panca Wana Indonesia.

Organizations with a strong safety climate tend to create work environments that prioritize safety, thereby successfully mitigating the occurrence of occupational accidents. Employees' perceptions of occupational safety, as reflected in the safety climate, directly enhance accident mitigation efforts. A positive safety climate encourages employees to comply with safety procedures, remain vigilant while performing their tasks, and proactively identify potential hazards. These findings are consistent with previous studies by Ghofur, et al. (2024), and Najla, Safani, & Marniati (2025), which report that organizations with a strong safety climate tend to experience better occupational accident mitigation.

Thus, the findings of this study highlight the importance of developing a positive safety climate at all organizational levels. A strong safety climate not only enhances employees' compliance and discipline in following safe work practices but also strengthens their engagement in maintaining workplace safety, thereby contributing to a sustained mitigation of occupational accidents.

The Effect of Safety Leadership and Safety Climate on Occupational Accident Mitigation

Based on the total effects analysis presented in Table 7, this study demonstrates that safety leadership and safety climate have significant effects on the mitigation of occupational accidents in oil and gas O&M companies. The results indicate that both variables exhibit t-statistic values greater than the critical value (1.981) and p-values of 0.000, confirming the overall statistical significance of the research model.

The findings further reveal that safety leadership has a significant direct effect on occupational accident mitigation, indicating that leaders' commitment to safety, clear safety policies, and exemplary safe work practices play a crucial role in preventing accident

occurrences. Effective safety leadership encourages employees to be more attentive to safety aspects and to comply consistently with established safety procedures, thereby enhancing accident mitigation.

In addition, safety climate is found to have a significant influence on occupational accident mitigation. Safety climate reflects the extent to which safety is prioritized within the organization and how safety policies are implemented in daily work practices. A positive safety climate fosters employees' discipline and caution at work, leading to successful accident mitigation.

These findings are consistent with previous studies by Prayoga, Tranggono, & Islami (2024) and Fajrin (2024), which report that strong safety leadership and a positive safety climate contribute significantly to accident mitigation. Leadership that prioritizes safety strengthens the organizational safety climate, which in turn supports employees' compliance with safety procedures.

Overall, this study concludes that safety leadership and safety climate jointly play a critical role in mitigating occupational accidents in oil and gas O&M companies. Strengthening leadership commitment to safety and fostering a positive safety climate are therefore essential strategies for improving workplace safety performance and maximizing accident mitigation.

The Effect of Safety Leadership on Safety Behavior

Based on the results of the study examining the effect of safety leadership on occupational accidents, the analysis indicates that safety leadership has a significant indirect effect on the mitigation of occupational accidents through the mediation of safety behavior. This is evidenced by a t-statistic of 3.166 and a p-value of 0.002, which meet the criteria for statistical significance. These findings indicate that safety leadership influences occupational accident mitigation not only directly but also indirectly through improvements in employees' safety behavior. Conceptually, safety leadership reflects leaders' active roles in building a safety culture, clearly communicating safety policies, and serving as role models for safe work practices. Leadership commitment to safety creates a safer working environment and enhances employees' discipline in complying with safety procedures, which ultimately enhances accident mitigation through improved safety behavior.

These findings are consistent with previous studies by Ningtyas (2024), Doloksaribu, et al. (2025), and Millana, et al. (2024), which report that effective safety leadership positively influences employees' safety behavior. Leaders who consistently enforce safety policies and demonstrate safe work practices encourage employees to act more cautiously and comply with safety procedures. In the context of O&M oil and gas companies, safety leadership plays a critical role in shaping safety behavior, including compliance with standard operating procedures, proper use of personal protective equipment, and proactive actions to identify and control potential hazards. Employees working under safety-oriented leadership tend to exhibit stronger safety behavior, which directly contributes to mitigating occupational accidents.

Thus, safety behavior is proven to significantly mediate the relationship between safety leadership and occupational accident mitigation, indicating that the effect of safety leadership on mitigating occupational accidents is strengthened through improvements in employees' safety behavior.

The Effect of Safety Climate on Safety Behavior

Based on the results of the study examining the effect of safety climate on occupational accidents, the analysis indicates that safety climate has a significant indirect effect on the mitigation of occupational accidents through the mediation of safety behavior. This is evidenced by a t-statistic of 4.091 and a p-value of 0.000, which confirm statistical significance. These findings indicate that the more positive employees' perceptions of the safety climate, the higher the level of safety behavior demonstrated. A positive safety climate enhances employees' awareness of and compliance with occupational safety procedures established by the organization.

This finding is supported by previous research by Nosary & Adiati (2021), which involved 176 employees and reported a positive and significant relationship between safety climate and safety behavior among workers exposed to high accident risk. Similar results were also reported

by Brondino et al. (2025), who found that safety climate has both direct and indirect effects on safety behavior. Safety climate reflects employees' perceptions of organizational safety policies, procedures, and practices, while safety behavior refers to individual actions related to maintaining workplace safety. A poor safety climate may encourage unsafe work behavior, which ultimately compromises the mitigation of occupational accidents.

In this context, safety behavior serves as an important mechanism that mediates the relationship between safety climate and occupational accident mitigation. When employees perceive the safety climate positively, they are more likely to engage in safe work behaviors, such as complying with company regulations, properly using personal protective equipment, and actively participating in safety programs. These behaviors directly contribute to the successful mitigation of occupational accidents.

Safety climate also reflects the extent to which safety is prioritized in the workplace, as demonstrated through safety policies, effective safety communication, and management support. A work environment that prioritizes safety encourages employees to act more cautiously and consistently adhere to safety procedures, thereby strengthening safety behavior as a preventive measure to mitigate occupational accidents.

These findings are consistent with previous studies by Mezentseva et al. (2023) and Luo (2020), which report that a positive safety climate improves employees' safety behavior and indirectly enhances the mitigation of occupational accidents. Thus, safety behavior is proven to significantly mediate the relationship between safety climate and occupational accident mitigation. This finding indicates that the effect of safety climate on mitigating occupational accidents is strengthened through improvements in employees' safety behavior.

The Effect of Safety Leadership and Safety Climate on Occupational Accident Mitigation Mediated by Safety Behavior

As part of the structural model evaluation, a total effects analysis was conducted to examine the combined effects of safety leadership and safety climate on the mitigation of occupational accidents through safety behavior. Based on the total effects analysis presented in Table 7, safety leadership and safety climate were found to have significant effects on occupational accident mitigation through the mediation of safety behavior in oil and gas O&M companies. All relationships among the variables show t-statistic values greater than 1.981 and p-values of 0.000, confirming the overall statistical significance of the research model.

The results indicate that safety leadership, safety climate, and safety behavior each have a significant effect on occupational accident mitigation. In addition, safety leadership and safety climate significantly influence safety behavior, highlighting safety behavior as the primary mechanism linking leadership and the safety environment to the successful mitigation of occupational accidents.

Safety leadership plays a crucial role in shaping employees' safety behavior through leadership commitment to safety, clear communication of safety policies, and exemplary safe work practices. Consistent safety leadership encourages employees to act more cautiously, comply with safety procedures, and maintain discipline in their work activities. A positive safety climate reinforces this process by fostering the perception that safety is an organizational priority, thereby motivating employees to consistently demonstrate safe work behavior.

These findings are consistent with previous studies by Saputro & Situmorang (2025) and Dera, Adedokun, & Iyoila (2025), which emphasize that the effects of safety leadership and safety climate on occupational accident mitigation become stronger when mediated by safety behavior. Thus, the results suggest that efforts to mitigate occupational accidents in oil and gas O&M operations are more effective when focused on strengthening employees' safety behavior through effective safety leadership and a supportive safety climate.

CONCLUSION

This study concludes that safety leadership and safety climate significantly influence the mitigation of occupational accidents, both directly and indirectly through safety behavior in O&M oil and gas companies. The results indicate that safety leadership and safety climate have a direct and significant effect on occupational accident mitigation and safety behavior. In addition,

safety behavior itself has a significant direct effect on the mitigation of occupational accidents, confirming its critical role in accident prevention.

Furthermore, safety behavior acts as a significant mediating variable in the relationship between safety leadership and occupational accident mitigation, as well as between safety climate and occupational accident mitigation. These findings demonstrate that effective leadership and a positive safety climate enhance occupational accident mitigation primarily by shaping and strengthening employees' safety behavior. Overall, the results emphasize that improving safety behavior is a key mechanism through which organizational safety practices can successfully mitigate workplace accidents in the O&M oil and gas sector.

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