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The Effect of Safety Knowledge and Safety Climate, Mediated by Safety Behavior and Management Support on Safety Performance

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Abstract: The oil and gas industry is a sector with a high level of occupational safety risk, especially in marine operations involving various types of support vessels. The high potential for danger requires the implementation of an effective occupational safety and health (OSH) system, not only through policies and procedures, but also through the improvement of safety knowledge, safety climate, and safety behaviour of the crew. However, the occurrence of marine incidents shows that safety control efforts are not yet fully optimal. This study aims to analyse the influence of safety knowledge and safety climate on safety performance with safety behaviour as a mediating variable in marine operations management at Pertamina Subholding Upstream. This study uses a quantitative approach with a survey method targeting marine operation support ship crews. This study uses a quantitative approach with the Structural Equation Modelling–Partial Least Squares (SEM-PLS) method. Data was obtained through questionnaires distributed to crews involved in marine operations. The results of the study indicate that safety knowledge and safety climate have a positive effect on safety performance, with safety climate being the dominant factor. Safety knowledge and safety climate also have a positive effect on safety behaviour and management support. Furthermore, safety behaviour and management support are proven to act as mediating variables that strengthen the relationship between safety knowledge and safety climate on safety performance. These findings emphasize the importance of strengthening safety knowledge, creating a conducive safety climate, and consistent management commitment to continuously improve occupational safety performance in marine oil and gas operations.

Keyword: Safety Knowledge, Safety Climate, Safety Performance, Safety Behaviour, Management Support.

INTRODUCTION

The oil and gas industry is a strategic sector that plays a vital role in supporting Indonesia's national economic development and energy security. As energy demand rises and technology advances at an increasingly rapid pace, activities related to oil and gas exploration, production, and distribution continue to expand. Technological advancements and innovations

in the oil and gas industry have contributed to improved operational efficiency; however, they have also increased the complexity of work and the potential safety risks faced by workers (Soesanto et al., 2024). The oil and gas industry is known as a high-risk work environment because it involves various activities that can potentially lead to workplace accidents, such as fires, explosions, gas leaks, exposure to hazardous chemicals, lifting operations, and maritime transport operations (Prastiyo et al., 2022; Haki & Achmadi, 2024).

Unidentified or poorly controlled hazards generally cause workplace accidents in the oil and gas industry. Hazards are the primary factors that can lead to workplace accidents if appropriate preventive measures are not taken (Andita, 2013). These potential hazards may stem from operational activities, workplace conditions, or human factors involved in the performance of the work (Moniaga & Rompis, 2019). Therefore, the implementation of an occupational safety and health (OSH) management system is essential for companies to identify hazards, conduct risk assessments, and establish effective control measures to create a safe and productive work environment.

One factor believed to influence the success of workplace safety implementation is safety knowledge. Safety knowledge refers to workers' understanding of safety procedures, hazard identification, the use of personal protective equipment, and the actions required to prevent workplace accidents. Workers with a good level of safety knowledge tend to understand workplace risks better and are able to consistently follow safety procedures. Griffin dan Neal (2000) state that safety knowledge contributes to improved safety behavior and safety performance. However, research explaining how safety knowledge specifically influences safety behavior remains relatively limited, particularly in work environments characterized by high risk levels and high operational complexity, such as the oil and gas industry and marine operations (Noorliza & Isha, 2023).

In addition to safety knowledge, another key factor in improving workplace safety is the safety climate. The safety climate refers to the collective perception among workers regarding the extent to which the organization prioritizes safety in its operational activities. It reflects management's commitment to safety, the quality of safety communication, the implementation of training, and the consistent enforcement of safety policies in the workplace (Zohar, 1980). A positive safety climate can encourage workers to better comply with safety procedures and actively participate in the company's safety programs. Griffin dan Curcuruto (2016) explain that safety climate is an organizational factor that influences workers' safety behavior and safety performance. However, research that thoroughly examines the relationship between safety climate, safety behavior, and safety performance still requires further development.

Safety behavior refers to the concrete actions workers take to apply safety principles while performing their duties. Safety behavior includes adherence to safety procedures (safety compliance) as well as active participation in activities that support the improvement of workplace safety (safety participation) (Griffin & Neal, 2000). Safety behavior is a critical factor because it directly influences workplace safety levels and the success of occupational safety and health (OSH) programs within an organization. However, most previous studies have treated safety behavior as an outcome variable rather than as a variable that explains how safety knowledge and safety climate can translate into improved safety performance.

In addition to these individual and organizational factors, management support is also a critical element in the successful implementation of workplace safety. Management support reflects the extent to which organizational leaders provide attention, commitment, resources, training, supervision, and communication that support the implementation of workplace safety programs. Management with a strong commitment to safety will provide adequate resources, conduct regular evaluations, and foster a robust safety culture in the workplace. Conversely, a lack of management support can reduce the effectiveness of safety programs and increase the risk of unsafe work behavior. The importance of workplace safety is increasingly evident in

marine operations within the oil and gas industry. Pertamina Subholding Upstream, as a company engaged in oil and natural gas exploration and production activities, carries out various marine operations to support operational activities in offshore and swamp areas. These activities involve various types of support vessels, such as crew boats, platform supply vessels, anchor handling tug supply vessels, diving support vessels, and other support vessels operating under time charter arrangements. The dynamic and complex nature of marine operations makes these activities highly prone to accidents and operational incidents.

To manage these risks, Pertamina Subholding Upstream has implemented a Health, Safety, and Environment (HSE) Management System supported by marine operational guidelines, organizational procedures, and the application of continuous improvement principles through the Plan-Do-Check-Act (PDCA) cycle. However, various marine incidents still occur on vessels supporting operations. This situation indicates that the existence of sound safety systems and procedures has not yet been fully capable of ensuring the achievement of the zero-incident target. This phenomenon suggests a gap between the safety systems designed by the company and the safety behaviors demonstrated by the crew in their daily work. Previous research indicates that safety knowledge and safety climate have a positive influence on safety performance (Griffin & Neal, 2000; Zohar, 1980). However, most studies still focus on the direct relationships between variables and have not yet extensively examined the mechanisms explaining how these relationships manifest through safety behavior. Furthermore, research on occupational safety in marine operations within the oil and gas industry remains relatively limited compared to studies in the manufacturing, construction, and onshore oil and gas sectors. This situation indicates a research gap that needs to be addressed through the testing of a model that integrates safety knowledge, safety climate, safety behavior, management support, and safety performance within a single research framework.

Based on empirical findings, theoretical foundations, and existing research gaps, this study aims to analyze the influence of safety knowledge and safety climate on safety performance, with safety behavior and managerial support serving as mediating variables in marine operations at Pertamina Subholding Upstream. This study is expected to provide a theoretical contribution to the development of behavior-based safety models in high-risk industries and offer practical insights to help companies formulate more effective and sustainable strategies for improving workplace safety.

METHOD

This study employs a quantitative approach using a survey method to analyze the influence of safety knowledge and safety climate on safety performance through safety behavior and management support as mediating variables in marine operations management within the Pertamina Upstream Subholding. The quantitative approach was chosen because this study aims to test the causal relationships among variables formulated based on theory and prior research. Research data was obtained through the distribution of questionnaires to respondents who met the study criteria. The research was conducted from December 2025 to January 2026 within the Pertamina Upstream Subholding environment. Operationally, Pertamina's upstream business activities are managed by PT Pertamina Hulu Energi (PHE) as the Upstream Subholding, which is responsible for oil and natural gas exploration and production activities both within Indonesia and abroad. The research location focused on marine operations supporting oil and gas exploration and production activities, including the operations of support vessels used in logistics and maritime transportation.

The population in this study consisted of all crew members and employees involved in marine operations within the Pertamina Upstream Subholding, totaling 298 individuals. This population was selected because they are directly involved in operational activities related to the implementation of workplace safety. The sample size was determined using Hair's guidelines, which state that the minimum sample size for Structural Equation Modeling (SEM)

analysis is five to ten times the number of indicators used in the study. With 22 indicators, the sample size was set at 171 respondents. The sampling technique used was purposive sampling, which is a technique for determining the sample based on specific considerations tailored to the research objectives. The selected respondents were crew members and employees who had work experience in marine operations and understood the implementation of occupational safety and health within the Pertamina Subholding Upstream environment.

Data collection methods included observation, a literature review, and the distribution of questionnaires. Observations were conducted to gain an understanding of the current state of occupational safety implementation in marine operations. Literature review was used to obtain relevant theoretical and empirical foundations through scientific journals, books, company reports, and various other academic sources. Meanwhile, questionnaires were used as the primary research instrument to measure respondents' perceptions of the variables under study.

Table 1: Instrument Matrix

NO	VARIABLE	DIMENSION	STATEMENT
1	Safety Knowledge (Vinodkumar & Bhasi, 2010)	Knowledge of using safety equipment	I am able to operate safety equipment (e.g., fire extinguishers, life jackets) according to procedures
		Knowledge of types of occupational hazards	I can identify types of hazards that may occur in a marine operations work environment
		Knowledge of emergency response	I know the actions to take in the event of a fire in the work area
2	Safety Climate (Neal & Griffin, 2004)	Awareness of the importance of workplace safety training programs	I recognize that workplace safety training is essential for reducing the risk of accidents
		Awareness of attitude management that promotes workplace safety	I believe that safety-conscious behavior reflects professional conduct
		Awareness of the impact of workplace safety behavior on promotions	I recognize that safe work behavior can influence evaluations for promotions
		Awareness of workplace risk levels	I understand that my job involves high potential hazards if not performed according to procedures
		Awareness of the impact of work on workplace safety	I am responsible for the impact of my work on a safe work environment

		Awareness of the roles of safety officers	I know who the officers/staff responsible for workplace safety are in my unit
		Awareness of the impact of workplace safety behavior on social standing	I realize that safe behavior at work can enhance my personal image and reputation
		Awareness of the role of the safety committee	I believe that the safety committee helps create a safe and orderly work culture
3	Safety Performance (Wu et al., 2011)	Safety inspection	I feel that safety inspections help reduce potential hazards in the workplace
		Accident investigation	I have learned from the findings of accident investigations that have taken place in the workplace
		Safety training	The safety training I have received has improved my ability to handle emergency situations
4	Safety Behavior (Neal & Griffin, 2004)	Using safety equipment	I do not start work until I have ensured that all safety equipment is being used properly
		Following safety rules and procedures	I follow work instructions in accordance with safety operating standards
		Participating in safety programs	I actively participate in safety activities/programs organized by the company
		Assisting coworkers when working in hazardous conditions	I remind coworkers who do not follow safety procedures
		Providing information regarding safety issues	I offer suggestions for improving workplace safety in my environment
5	Manajemen Support (Griffin & Neal, 2000)	Consistent supervision	My manager or supervisor regularly monitors the implementation of safety procedures in the workplace

	Development of safety policies	Safety policies are designed to be easy for all employees to understand and implement
	Safety behavior modeling by managers	My managers' attitudes and actions encourage me to be more safety-conscious

Data analysis was conducted using the Partial Least Squares Structural Equation Modeling (PLS-SEM) approach with the assistance of SmartPLS 4 software. The PLS-SEM method was chosen because it can accommodate complex research models, does not strictly require a normal data distribution, and is suitable for predictive and exploratory research. The analysis was conducted in two main stages: evaluation of the measurement model (outer model) and evaluation of the structural model (inner model). The measurement model was evaluated to assess construct validity and reliability. Convergent validity was assessed using outer loadings and Average Variance Extracted (AVE), while discriminant validity was evaluated using the Fornell-Larcker criterion and cross-loadings. Construct reliability is assessed based on Cronbach's Alpha and Composite Reliability values, with a minimum threshold of 0.70. Furthermore, the structural model evaluation is conducted by analyzing the coefficient of determination (R-square), predictive relevance (Q-square), and path coefficients to test the relationships between variables in the research model.

Hypothesis testing was conducted using the bootstrapping procedure in SmartPLS by examining t-statistics and p-values. A hypothesis was accepted if the t-statistic was greater than 1.96 and the p-value was less than 0.05 at a 5% significance level. In addition to testing direct effects, this study also examined indirect effects to determine the mediating roles of safety behavior and management support in the relationship between safety knowledge, safety climate, and safety performance. The results of this analysis were subsequently used as a basis for addressing the research objectives and providing recommendations for improving safety performance in marine operations within the Pertamina Subholding Upstream environment.

RESULTS AND DISCUSSION

Respondent Characteristics

Table 2: Description of Gender Characteristics

Gender	Number	Precentage
Male	133	78%
Female	38	22%
Total	**171**	**100%**

Table 3: Description of Respondents' Age Characteristics

Respondents' Age	Number	Precentage
Under 30	67	39%
30 - 40	41	24%
41 - 50	32	19%
Over 50	31	18%
Total	**171**	**100%**

Table 4: Description of Respondents' Highest Level of Education

Highest Level of Education	Number	Precentage
High School or Equivalent	91	53%
Diploma	27	16%
Bachelor's Degree	43	25%
Master's Degree	10	6%
Total	**171**	**100%**

Table 5: Description of the Respondents' Job Characteristics

Position	Number	Persentase
Ship Crew	118	69%
Marine Operator	32	19%
Supervisor	21	12%
Total	171	100%

Variable Reliability Testing

The Cronbach's Alpha and Composite Reliability values for the variables Safety Knowledge, Safety Climate, Safety Behavior, Management Support, and Safety Performance are as follows:

Table 6: Reliability Test Results

Variable	Cronbach's alpha	Composite reliability (rho_c)
Safety Knowledge	0,744	0,854
Safety Climate	0,906	0,924
Safety Behavior	0,784	0,874
Management Support	0,833	0,899
Safety Performance	0,816	0,892

Source: SmartPLS Data Analysis Results, 2026

Based on the results of the reliability test shown in the table above, the Cronbach's Alpha values obtained for all constructs in this study—namely Safety Knowledge, Safety Climate, Safety Behavior, Management Support, and Safety Performance—are ≥ 0.70. Therefore, it can be concluded that the instrument used in this study is reliable.

Composite Reliability Test

Table 7: Results of Composite Reliability Testing

Variabel	Cronbach's Alpha	rho_A	Composite Reliability	Average Variance Extracted (AVE)
Safety Knowledge	0,744	0,747	0,854	0,661
Safety Climate	0,906	0,907	0,924	0,605
Safety Behavior	0,784	0,788	0,874	0,698
Management Support	0,833	0,845	0,899	0,899
Safety Performance	0,816	0,814	0,892	0,735

Source: SmartPLS Data Analysis Results, 2026

Based on the reliability test results shown in the table above, the composite reliability values of the five variables used in this study all exceed 0.70. Thus, it can be concluded that the instrument used in this study is reliable.

Coefficient of Determination

Table 8: Coefficient of Determination (R^2)

	R-square	R-square adjusted
Safety Behavior	0,555	0,550
Safety Performance	0,671	0,663
Management Support	0,449	0,442

Source: SmartPLS Data Analysis Results, 2026

Based on the table above, the Safety Behavior model yields a value of 0.550, or 55%, which falls into the moderate category. Meanwhile, the Adjusted R-Square value for the Safety Performance variable is 0.671, or 67.1%, which falls into the moderate category, and the Adjusted R-Square value for the Management Support variable is 0.449, or 44.9%, which also falls into the moderate category.

Goodness of Fit (GoF) Test

Table 9: GoF Test

Variable	Average variance extracted (AVE)	R- Square
Safety Knowledge	0,661	
Safety Climate	0,605	
Safety Behavior	0,698	0,555
Management Support	0,749	0,449
Safety Performance	0,735	0,671
Average	**0,690**	**0,558**

Source: SmartPLS Data Analysis Results, 2026

Using the GoF formula

$$GoF = \sqrt{\overline{AVE} \; x \overline{R2}}$$

The GoF value is **0,621**

Hypothesis Testing

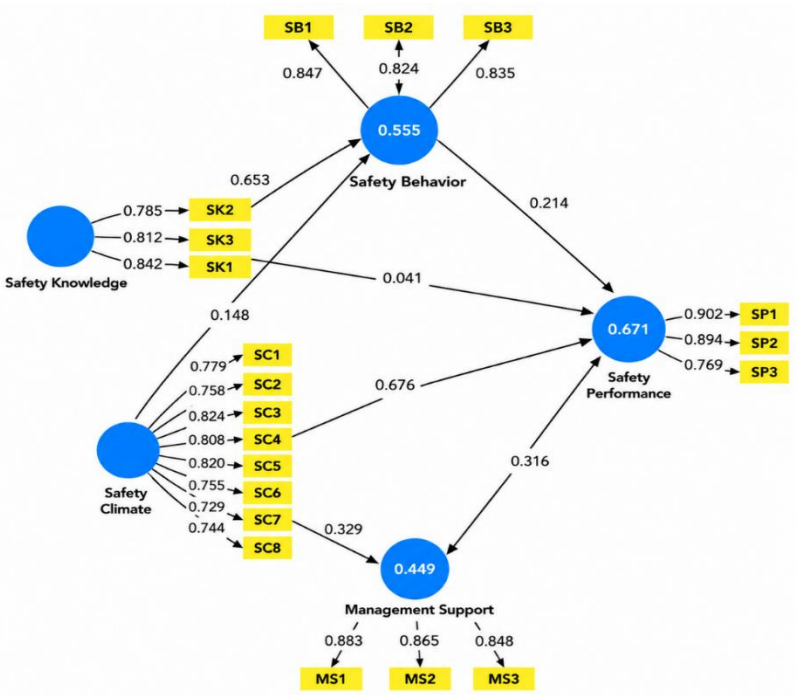

Figure 1: Results of the Partial Least Squares (PLS) analysis in the appendix

Table 10: Testing the Effect of Direct Output from Partial Least Squares

	Original Sample	Standard Deviation	T Statistics	Pvalues (One-Tailed)	Conclusion
Safety Knowledge -> Safety Performance **H1**	**0,171**	0,061	2,797	**0,005**	H1 Accepted/Supported
Safety Climate-> Safety Performance **H2**	**0,701**	0,053	13,107	**0,000**	H2 Accepted/Supported
Safety Knowledge -> Safety Behavior **H3**	**0,653**	0,065	10,038	**0,000**	H3 Accepted/Supported
Safety Knowledge -> Dukungan Manajemen **H4**	**0,429**	0,065	6,612	**0,000**	H4 Accepted/Supported
Safety Climate -> Safety Behavior **H5**	**0,148**	0,074	2,007	**0,045**	H5 Accepted/Supported
Safety Climate -> Dukungan Manajemen **H6**	**0,329**	0,072	4,558	**0,000**	H6 Accepted/Supported
Safety Behavior -> Safety Performance **H7**	**0,214**	0,096	2,236	**0,025**	H7 Accepted/Supported
Management Support -> Safety Performance **H8**	**0,316**	0,078	1,993	**0,021**	H8 Accepted/Supported
Safety Knowledge -> Safety Behavior -> Safety Performance **H9**	**0,140**	0,064	2,174	**0,030**	H9 Accepted/Supported
Safety Knowledge -> Management Support -> Safety Performance **H10**	**0,309**	0,073	2,270	**0,031**	H10 Accepted/Supported
Safety Climate -> Safety Behavior -> Safety Performance **H11**	**0,332**	0,053	1,975	**0,000**	H11 Accepted/Supported
Safety Climate -> Management Support -> Safety Performance **H12**	**0,270**	0,066	2,821	**0,038**	H12 Accepted/Supported

Hypothesis Test Results using regression with SmartPLS 4

The Impact of Safety Knowledge on Safety Performance

Research findings indicate that safety knowledge has a positive impact on safety performance in marine operations within the Pertamina Upstream Subholding. Safety knowledge is a fundamental factor that equips crews with an understanding of safety procedures, hazard identification, the use of personal protective equipment, and emergency response, thereby supporting safer work practices that comply with operational standards. Although its direct impact on safety performance is not always dominant, safety knowledge plays a crucial role as the foundation for the development of safety behavior and a positive perception of the occupational safety system. These findings confirm that improving Safety Performance requires strengthening Safety Knowledge, supported by positive Safety Behavior, consistent management support, and a conducive Safety Climate. These research results align with studies by Putra et al. (2022) and Wijaya and Brahmasari (2024), which state that Safety Knowledge has a significant influence on Safety Performance, both directly and through safety behavior (Safety Behavior).

The Impact of Safety Climate on Safety Performance

Research findings indicate that Safety Climate has a positive impact on Safety Performance in marine operations within the Pertamina Upstream Subholding. Safety Climate is a key factor that reflects workers' perceptions of management commitment, policies, and safety practices implemented within the organization. A positive safety climate fosters a work environment that supports safe behavior, enhances compliance with safety procedures, and reduces the risk of workplace accidents. These findings suggest that the better workers' perceptions of safety priorities within the organization, the higher the safety performance that can be achieved. Therefore, strengthening the Safety Climate is a critical aspect of efforts to improve Safety Performance sustainably. These research results align with Prinasti (2018), who found a relationship between Safety Climate and Safety Performance among crew members, as well as the study by Syed-Yahya et al. (2022), which demonstrated that Safety Climate has a positive and significant relationship with Safety Performance, including in improving worker safety compliance and safety participation.

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The Effect of Safety Knowledge on Management Support

The research results indicate that Safety Knowledge has a positive influence on Management Support in marine operations within the Pertamina Subholding Upstream environment. Safety Knowledge acts as an enabler that strengthens the relationship between workers and management in the implementation of occupational safety systems. Good safety knowledge enables workers to understand better the safety policies, procedures, and

commitments established by the organization, thereby fostering more effective communication regarding safety issues. Furthermore, increased levels of safety knowledge among workers provide positive feedback to management to enhance support through the provision of training, safety facilities, supervision, and various other safety programs. These findings indicate that the development of Safety Knowledge not only impacts individual aspects but also contributes to strengthening management's role and commitment in creating a safe work environment. These research results align with Kamilah et al. (2021), who state that safety management practices influence safety performance through increased safety knowledge, as well as Yani's (2025) research, which emphasizes the importance of management's role in ensuring the implementation of safety training to improve compliance with occupational safety standards.

The Influence of Safety Climate on Safety Behavior

Research findings indicate that Safety Climate has a positive influence on Safety Behavior in marine operations within the Pertamina Upstream Subholding environment. Safety Climate serves as an organizational contextual factor that shapes workers' perceptions of management commitment, the consistency of safety rule enforcement, and the effectiveness of safety communication and supervision in the workplace. A positive safety climate creates a work environment that supports safe behavior, increases compliance with safety procedures, and encourages workers to avoid risky actions. When safety is perceived as the organization's top priority, workers tend to demonstrate more consistent safety behavior in carrying out their daily operational activities. Thus, Safety Climate is a crucial element in building and strengthening Safety Behavior as part of efforts to achieve sustainable workplace safety improvements. These findings align with the research by Abdillah and Rumita (2007), which states that factors within the Safety Climate simultaneously influence Safety Behavior, as well as the research by Pradewa and Mahardayani (2023), which demonstrates that a positive perception of the safety climate has a positive and significant relationship with workers' safety behavior across various industrial settings.

The Impact of Safety Climate on Management Support

The research findings indicate that Safety Climate has a positive influence on Management Support in marine operations within the Pertamina Upstream Subholding environment. Safety Climate serves as an organizational factor that both reflects and reinforces management's commitment to workplace safety. A positive safety climate indicates alignment between management policies, practices, and actions in prioritizing safety as the organization's top priority. Positive worker perceptions of the safety climate encourage management to provide more tangible support through the provision of safety resources, the implementation of training, enhanced supervision, and the consistent enforcement of safety procedures. Thus, Safety Climate becomes a crucial element that strengthens the implementation of managerial support and fosters the creation of an effective and sustainable workplace safety system. These findings align with the research by Hertanto et al. (2023), which indicates that positive perceptions of the Safety Climate—including management's commitment to safety—are correlated with improved worker safety behavior. Furthermore, the study by Rahmadhan et al. (2021) also confirms that Safety Climate has a significant influence on safety behavior, reflecting the importance of management's role in building a safe work environment and supporting the optimal implementation of workplace safety.

The Impact of Safety Behavior on Safety Performance

Research findings indicate that safety behavior has a positive impact on safety performance in marine operations within the Pertamina Upstream Subholding. Safety behavior serves as a key operational factor that reflects the practical implementation of workplace safety in daily activities. Such safety behavior is manifested through workers' compliance with safety

procedures, the use of appropriate personal protective equipment, and caution in performing operational tasks. Workers who consistently practice safe work behavior tend to be able to reduce the potential for accidents, incidents, and unsafe conditions in the workplace. Thus, safety behavior serves as a crucial link between the safety policies established by the organization and the achievement of optimal safety performance.

These findings underscore that the success of a workplace safety system is determined not only by the existence of rules and procedures but also by the extent to which workers consistently apply safety behavior in the performance of their duties. The results of this study are consistent with research by Wijaya and Brahmasari (2024) showing that safety behavior, including safety compliance and safety participation, has a strong relationship with safety performance. Furthermore, the study by Hertanto et al. (2023) also found that safety behavior has a positive and significant effect on safety performance, wherein workers' safe behavior directly contributes to improved organizational safety performance.

The Impact of Management Support on Safety Performance

The research findings indicate that management support has a positive impact on safety performance in marine operations within the Pertamina Upstream Subholding. Management support serves as a strategic factor that reflects the organization's commitment to consistently providing policies, resources, training, oversight, and enforcement of safety regulations. Strong commitment from management can create a safe work environment, improve worker compliance with safety procedures, and encourage safer work behaviors. Thus, management support is a key driver in improving safety performance and ensuring the successful implementation of a sustainable occupational safety system. These findings align with the research by Zhang et al. (2022) and Saleem and Malik (2022), which states that management support and commitment significantly contribute to improved safety performance through the strengthening of safety culture and practices within the organization.

Pengaruh Safety Knowledge terhadap Safety Performance melalui Safety Behavior

The research findings indicate that Management Support has a positive effect on Safety Performance in marine operations within the Pertamina Subholding Upstream environment. Management support serves as a strategic factor reflecting the organization's commitment to consistently providing policies, resources, training, supervision, and enforcement of safety regulations. Strong commitment from management can create a safe work environment, increase worker compliance with safety procedures, and encourage the development of safer work behaviors. Thus, management support becomes the primary driver in improving safety performance and ensuring the successful implementation of a sustainable occupational safety system. These findings align with the research by Zhang et al. (2022) and Saleem and Malik (2022), which states that management support and commitment significantly contribute to improved safety performance by strengthening safety culture and practices within the organization.

The Effect of Safety Knowledge on Safety Performance through Management Support

The research findings indicate that safety knowledge influences safety performance through management support in marine operations within the Pertamina Upstream Subholding. These findings indicate that workers' safety knowledge not only enhances their understanding of safety procedures and standards but also fosters more effective management support in the implementation of occupational safety systems. Increased Safety Knowledge helps build collective awareness of the importance of safety, thereby encouraging management to provide more tangible support through the provision of training, resources, supervision, and enforcement of safety regulations. This strong management support subsequently contributes to improved Safety Performance. Thus, Management Support acts as a mediating variable

bridging the influence of Safety Knowledge on Safety Performance, meaning the effectiveness of safety knowledge in enhancing safety performance is highly dependent on the commitment and consistency of the support provided by management. This finding aligns with the research by Sandora et al. (2023) and Vinodkumar and Bhasi (2010), which demonstrates that safety management practices and support strengthen the influence of Safety Knowledge on Safety Performance through the provision of training, resources, and effective safety policies.

The Influence of Safety Climate on Safety Performance through Safety Behavior

The research findings indicate that Safety Climate influences Safety Performance through Safety Behavior in marine operations within the Pertamina Upstream Subholding. These findings indicate that a positive safety climate does not directly improve safety performance but first shapes workers' safety behavior. A Safety Climate that reflects management commitment, consistent enforcement of rules, and effective safety communication can encourage workers to demonstrate safer work behaviors, such as adhering to safety procedures, properly using personal protective equipment, and avoiding risky actions. Such safety behaviors then become the primary factors contributing to improved safety performance. Thus, safety behavior acts as a mediating mechanism explaining how positive perceptions of the safety climate can translate into better safety performance. These findings align with Zohar's (2002) research, which states that the influence of Safety Climate on Safety Performance is mediated by Safety Behavior, as well as the research by Putra et al. (2022), which found that Safety Behavior is a significant mediator in the relationship between Safety Climate and Safety Performance among operational workers.

The Influence of Safety Climate on Safety Performance through Management Support

The research results show that safety climate influences safety performance through management support in marine operations within the Pertamina Upstream Subholding. These findings indicate that a positive safety climate not only shapes workers' perceptions regarding the importance of workplace safety but also encourages management to provide stronger and more consistent support in the implementation of safety systems. A good Safety Climate is reflected in management commitment, clear safety policies, effective communication, and continuous monitoring. These conditions encourage management to provide adequate resources, training, and safety facilities, thereby supporting the creation of a safer work environment. Strong management support then directly contributes to improved safety performance. Thus, management support acts as a mediating variable that bridges the influence of safety climate on safety performance, meaning that the effectiveness of the safety climate in improving safety performance is highly dependent on management's commitment and active involvement. These findings are consistent with the research by Neal et al. (2000), which states that management values and practices are key components of the safety climate that influence safety performance, as well as the research by Zohar (2002), which emphasizes that management commitment to safety is the primary mechanism that translates perceptions of the safety climate into improved organizational safety performance.

The results of the study show that safety knowledge has a positive and significant effect on safety behavior. These findings indicate that the higher the crew's level of understanding of safety procedures, the use of safety equipment, and emergency response, the higher the level of safety behavior demonstrated while working. These research results align with a study conducted by Michael A. Griffin and Andrew Neal (2000), which states that safety knowledge is a key factor influencing workers' safety behavior. Additionally, safety climate was found to have a positive influence on safety behavior. This suggests that the crew's positive perception of the company's commitment to safety fosters compliance with safe work procedures and participation in safety programs. These findings support the theory proposed by Dov Zohar (1980), which explains that a positive safety climate fosters positive safety behavior.

This study also found that safety behavior has a significant impact on safety performance. Crew members who consistently adhere to safety procedures and actively participate in safety programs tend to have better safety performance. These results indicate that safety behavior is a key factor in reducing the potential for accidents and enhancing the effectiveness of a company's safety programs. Furthermore, management support has been shown to have a positive impact on safety performance. Management commitment, manifested through supervision, resource allocation, safety communication, and ongoing training, can improve safety performance in marine operations. Strong management support fosters a safer work environment and encourages workers to adopt safe work practices.

The results of the mediation analysis indicate that safety behavior mediates the relationship between safety knowledge and safety performance, as well as the relationship between safety climate and safety performance. These findings indicate that safety knowledge and safety climate do not directly improve safety performance, but rather first shape safety behavior, which then contributes to improved safety performance. Thus, safety behavior serves as a crucial mechanism that bridges the influence of individual and organizational factors on safety performance in marine operations within the Pertamina Subholding Upstream environment.

CONCLUSION

This study aims to analyze the influence of safety knowledge and safety climate on safety performance, with safety behavior and management support serving as mediating variables in marine operations management within the Pertamina Upstream Subholding. The results indicate that improvements in workplace safety performance are determined not only by workers' level of safety knowledge but also by the safety climate fostered by the organization, the safety behavior exhibited by workers, and consistent management support. The relationships among these variables form an integrated safety system that supports the achievement of better safety performance in marine operations.

The findings indicate that safety climate plays a crucial role in creating a work environment that supports the sustainable implementation of safety. Meanwhile, safety behavior and management support function as mechanisms that bridge the influence of individual and organizational factors on the achievement of safety performance. Thus, the success of a safety program is not sufficient through merely increasing workers' safety knowledge, but requires the establishment of a positive safety culture and climate, as well as active management involvement in all operational processes.

The contribution of this study lies in advancing our understanding of a multidimensional occupational safety model within the marine operations environment of the oil and gas industry. This study reinforces the view that safety performance is the result of the interaction between cognitive, organizational, behavioral, and managerial factors that operate simultaneously. These findings expand the scope of occupational safety research, which has traditionally focused more on direct relationships between variables, by highlighting the mediating roles of safety behavior and managerial support in explaining the formation of safety performance.

From a practical perspective, this study provides a foundation for companies to develop more comprehensive safety strategies by strengthening the safety climate, improving the quality of safety knowledge development programs, fostering safe work behaviors, and enhancing management commitment and support for workplace safety. This integrated approach is expected to support the achievement of operational excellence, reduce the risk of workplace accidents, and enhance the sustainability of safety performance in marine operations within the Pertamina Upstream Subholding as well as in the oil and gas industry in general.

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