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Analysis Of Factors Affecting Safety Satisfaction And Performance

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Abstract

This study aims to analyze the factors influencing safety/security satisfaction and safety performance in the SPAM WOSUSOKAS pipeline construction project. Specifically, it examines the effects of work equipment and environmental factors, human behavior, and organizational climate on safety/security satisfaction, as well as the effects of safety/security satisfaction and job satisfaction on safety performance. A quantitative approach with a causal research design was employed. Data were collected through a structured questionnaire using a census method involving 489 project workers. The data were analyzed using Partial Least Squares–Structural Equation Modeling (PLS-SEM) with SmartPLS software. The results indicate that work equipment and environmental factors, human behavior, and organizational climate have positive and significant effects on safety/security satisfaction. Furthermore, safety/security satisfaction and job satisfaction significantly and positively affect safety performance. These findings suggest that improving safety performance requires an integrated approach that emphasizes safe work equipment and environments, compliance with safety procedures, and a safety-oriented organizational climate. This study provides empirical evidence and practical implications for enhancing occupational safety management in high-risk infrastructure construction projects.

INTRODUCTION

Efforts to improve occupational health and safety (OHS) performance in the mining sector, which is widely recognized as one of the highest-risk working environments, have become a critical focus in creating safe, productive, and sustainable workplaces. A study by Milosevic et al. (2024) indicates that factors such as fatigue, harsh working conditions, and insufficient safety knowledge and motivation among workers significantly contribute to lower safety satisfaction and reduced worker performance. Furthermore, organizational support, safety training, and management commitment to OHS implementation have been shown to positively influence safety satisfaction and safety performance. These findings highlight the necessity of a holistic approach to improving workplace safety (Milosevic et al., 2024). In addition, the importance of safety climate within organizations as a determining factor influencing compliance with safety procedures has been emphasized by Zohar (1980).

Occupational health and safety (OHS) is a fundamental aspect of construction project implementation, including the development of water supply pipeline infrastructure under the Drinking Water Supply System (SPAM). In Indonesia, the high rate of occupational accidents, particularly in the construction sector, indicates that the implementation of OHS standards remains suboptimal. This condition poses significant risks to worker welfare, operational efficiency, and project sustainability (Oktaviani, 2025).

Over the past three years, monthly HSE (Health, Safety, and Environment) reports from the SPAM Wosusokas project recorded a total of 13 workplace accidents. These data demonstrate that the level of occupational accidents in the construction sector, particularly in drinking water pipeline infrastructure projects, remains relatively high (PT. Kogas Driyap Consultant, 2025). Despite various efforts to improve occupational health and safety, inadequate implementation of OHS standards continues to be a major concern. This situation results in substantial risks to

worker well-being, operational efficiency, and project continuity. According to monthly HSE reports in 2025, these accidents were caused by multiple factors, including insufficient use of personal protective equipment (PPE), non-compliance with safe work procedures, inadequate equipment conditions, and psychological factors such as fatigue and work-related stress. This phenomenon underscores the urgent need for more effective OHS implementation to create safer and more productive working environments in high-risk projects such as SPAM infrastructure development.

The conditions observed in the SPAM Wosusokas pipeline construction project indicate that although the project involves various risk factors such as the use of heavy equipment, exposure to open environments, and high work mobility across extensive areas the incidence of occupational accidents remains relatively high. Several recurring workplace accidents are influenced by factors such as improper use of personal protective equipment (PPE), non-compliance with safe work procedures, and unfit or poorly maintained equipment. Additionally, psychological factors such as fatigue and work-related stress further exacerbate safety conditions (Kartika, 2019).

These phenomena suggest that although management has made efforts to implement safety management systems, their effectiveness still requires improvement, particularly in relation to job satisfaction as an indicator of the success of OHS programs. This situation also indicates that effective leadership and the strengthening of safety culture at the operational level have not yet been optimally implemented. Therefore, this study aims to identify and analyze the factors influencing job satisfaction and safety performance in this project and to provide recommendations for improving occupational safety and creating a safer and more productive working environment (Hanif, 2024).

Furthermore, this study considers factors such as working environment conditions, individual behavior, organizational support, and safety climate within the company, which interact to influence workers' perceptions of safety, job satisfaction, and safety performance. Although numerous studies have examined occupational safety in the mining and manufacturing sectors, research specifically focuses on the construction sector particularly drinking water pipeline infrastructure projects mremains limited. The unique characteristics of SPAM projects, including geographically dispersed work locations, high worker mobility, and limited direct supervision, create conditions that require special attention in safety risk management (Kartika, 2019).

This study also seeks to address a gap in the literature by integrating job satisfaction as an additional variable influencing safety performance. This integration is based on the findings of Gatot and Sukwika (2021), who explain that high levels of job satisfaction encompassing organizational support, attention to safety, and responsive leadership can encourage workers to demonstrate safer work behaviors. Workers who are satisfied with their working conditions and perceive strong organizational support for safety tend to be more motivated to comply with safety procedures, maintain discipline, and minimize unsafe actions. As a result, job satisfaction not only affects productivity but also has a positive impact on improving safety performance (Gatot & Sukwika, 2021).

This research is not only relevant for advancing academic understanding of occupational safety but is also practically significant for organizations and policymakers. The findings are expected to support the development of safety management systems that are more adaptive to field conditions and responsive to workers' needs. Through a quantitative approach and empirical analysis of relevant variables, this study aims to provide data-driven recommendations for improving OHS policies in infrastructure projects, particularly the SPAM Wosusokas pipeline development, as part of sustainable national development efforts.

METHODS

This study adopts a quantitative approach with a causal explanatory research design to analyze the cause-and-effect relationships among work equipment and environmental factors, human behavior, organizational climate, safety satisfaction, job satisfaction, and safety performance. The

research was conducted in the Water Supply System (SPAM) WOSUSOKAS pipeline construction project covering the regions of Wonogiri, Sukoharjo, Surakarta, Karanganyar, and Sragen, with a total project length of approximately 80 km. The research population comprised all active workers involved in the project, including field workers, foremen, technical staff, contractors, and supervisory consultants. Given that the entire population was accessible, a census method was employed, resulting in a total of 489 respondents.

Data were collected using a structured questionnaire distributed online via Google Forms. The research instrument was developed based on variable indicators adapted from Milosevic et al. (2025) and Gatot and Sukwika (2021) and measured using a five-point Likert scale ranging from 1 (strongly disagree) to 5 (strongly agree). Prior to data analysis, the instrument was subjected to validity and reliability testing to ensure measurement accuracy and consistency. The questionnaire was designed to capture respondents' perceptions of occupational safety conditions, work environment, organizational support, and safety-related behaviors.

Data analysis was conducted using Structural Equation Modeling based on Partial Least Squares (PLS-SEM) with the assistance of SmartPLS 3 software. The analytical procedure involved evaluating the measurement model (outer model) through convergent validity, discriminant validity, and construct reliability tests, followed by the evaluation of the structural model (inner model) to examine the causal relationships among variables in accordance with the research hypotheses. PLS-SEM was selected due to its ability to analyze complex models with latent constructs and its flexibility regarding data distribution assumptions, making it suitable for large-scale construction project research with heterogeneous data characteristics.

RESULTS AND DISCUSSION

Validity Test

The instrument validity test in this study was conducted using Confirmatory Factor Analysis (CFA) to assess the ability of indicators to measure the research constructs. The results indicate that all indicators have outer loading values above 0.70 and Average Variance Extracted (AVE) values above 0.50, thus meeting the criteria for convergent validity. The variables of Work Equipment and Environmental Factors, Human Behavior Factors, and Organizational Climate Factors demonstrate very good validity with high AVE values, while Safety Performance, Safety Satisfaction, and Job Satisfaction are also considered valid as they clearly explain the variance of their indicators.

Discriminant validity was evaluated using three approaches: cross-loading, the Fornell–Larcker criterion, and the Heterotrait Monotrait Ratio (HTMT). The cross-loading results show that each indicator loads highest on its intended construct compared to other constructs. The Fornell Larcker test further indicates that the square root of AVE for each construct is greater than its correlations with other constructs, confirming adequate construct distinction. In addition, all HTMT values are below the threshold of 0.90, confirming discriminant validity. Therefore, all research instruments are deemed valid and suitable for further analysis.

Reliability Test

The reliability test was conducted to assess the internal consistency of the research instrument in measuring the constructs used in the study. Reliability was evaluated using Cronbach's Alpha and Composite Reliability (rho_c), with a threshold value of ≥ 0.70 indicating acceptable reliability. The results show that all research variables Work Equipment and Environmental Factors, Human Behavior Factors, Organizational Climate Factors, Safety Performance, Safety Satisfaction, and

Job Satisfaction have Cronbach's Alpha and Composite Reliability values exceeding the recommended minimum. These high reliability values indicate that all indicators within each construct demonstrate good internal consistency and are capable of measuring the research variables consistently. Therefore, the research instrument is considered reliable and suitable for further analysis in the research model.

Coefficient of Determination (R-Square Value)

Table 1 Results of Testing R Square

	R-square	R-square adjusted
Safety Satisfaction	0.451	0.447
Safety Performance	0.511	0.509

Source: Processed primary data, 2025

Based on the results of the structural model testing, the endogenous variables show a moderate level of explanatory power. Safety Satisfaction has an R-square value of 0.451 and an adjusted R-square of 0.447, indicating that 44.7% of its variance is explained by the exogenous constructs in the model. Meanwhile, Safety Performance has an R-square value of 0.511 and an adjusted R-square of 0.509, meaning that 50.9% of the variance in Safety Performance is explained by the exogenous variables. These findings suggest that the proposed model has a moderate ability to explain variations in the endogenous variables and provides a sufficient basis for further path analysis and hypothesis testing.

Path Analysis (Hypothesis Testing)

Table 2 Direct Hypothesis Testing

	Original sample (O)	Sample mean (M)	Standard deviation (STDEV)	T statistics (|O/STDEV|)	P values
Organizational Climate Factor → Safety and Security Satisfaction	0.298	0.297	0.062	4,779	0.000
Human Behavior Factors → Safety and Security Satisfaction	0.268	0.268	0.058	4,607	0.000
Safety and Security Satisfaction → Safety Performance	0.495	0.494	0.058	8,503	0.000
Job Satisfaction → Safety Performance	0.325	0.327	0.053	6,144	0.000
Work Equipment and Environmental Factors → Safety and Security Satisfaction	0.202	0.203	0.056	3,616	0.000

Source: Processed primary data, 2025

The following figure presents the structural model of the study, illustrating the relationships among the constructs analyzed in this research.

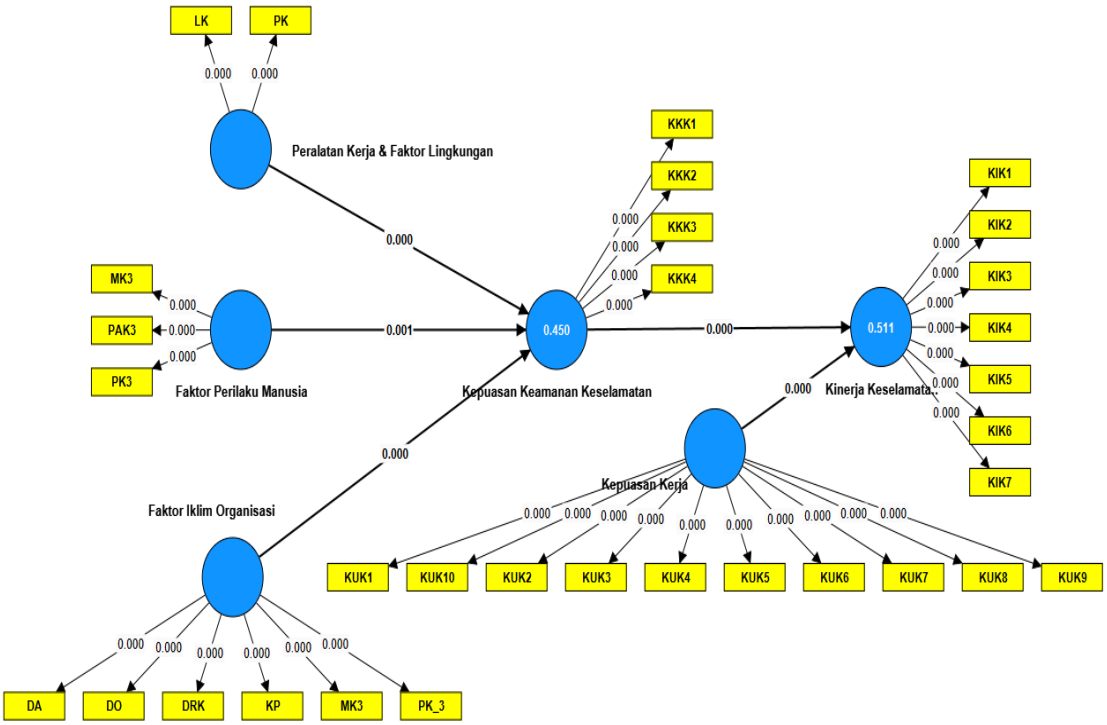

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Figure 4.1 Structural Model

Statistical testing of each hypothesized relationship using PLS was conducted through a simulation approach by applying the bootstrapping method to the sample. The significance of the effects among variables was evaluated based on the p-values and t-statistics. A p-value < 0.05 or a t-statistic > 1.97 indicates a significant effect between variables. Based on the analysis, the decisions for hypothesis testing are described as follows:

1. First hypothesis: Organizational Climate has a positive and significant effect on Safety and Security Satisfaction, as indicated by an original sample value of 0.298, a t-statistic of 4.779 > 1.97, and a p-value of 0.000 < 0.05. Therefore, the first hypothesis is supported.
2. Second hypothesis: Human Behavior has a positive and significant effect on Safety and Security Satisfaction, evidenced by an original sample value of 0.268, a t-statistic of 4.607 > 1.97, and a p-value of 0.000 < 0.05. Thus, the second hypothesis is supported.
3. Third hypothesis: Safety and Security Satisfaction has a positive and significant effect on Safety Performance, with an original sample value of 0.495, a t-statistic of 8.503 > 1.97, and a p-value of 0.000 < 0.05. According to, the third hypothesis is supported.
4. Fourth hypothesis: Job Satisfaction has a positive and significant effect on Safety Performance, as shown by an original sample value of 0.325, a t-statistic of 6.144 > 1.97, and a p-value of 0.000 < 0.05. Therefore, the fourth hypothesis is supported.
5. Fifth hypothesis: Work Equipment and Environmental Factors have a positive and significant effect on Safety and Security Satisfaction, indicated by an original sample value

of 0.202, a t-statistic of 3.616 > 1.97, and a p-value of 0.000 < 0.05. Hence, the fifth hypothesis is supported.

DISCUSSION.

1. **Work Equipment and Environmental Factors Have a Positive Effect on Safety/Security Satisfaction.**

The analysis results indicate that the first hypothesis (H1) is supported, meaning that work equipment and environmental factors have a positive effect on safety/security satisfaction. This is proven by an original sample value of 0.202 with a t-statistic of 3.616 (> 1.97) and a p-value of 0.000 (< 0.05), indicating a statistically significant effect. These findings are consistent with the concept that workers' perceptions of the adequacy, comfort, and safety of work equipment, as well as the physical conditions of the work environment, can enhance their sense of safety while performing their tasks. From a practical perspective, adequate work equipment such as the availability and comfort of personal protective equipment (PPE), appropriate machinery, and regularly inspected tools along with a supportive work environment including proper lighting, air quality, cleanliness, and safe working surfaces contributes to workers feeling more protected and comfortable. As a result, their level of satisfaction with safety and security increases. Conversely, conditions such as inadequate use of PPE, non-compliance with safety procedures, or poorly maintained equipment can worsen safety conditions and reduce workers' perception of safety in the workplace.

2. **Human Behavior Has a Positive Effect on Safety/Security Satisfaction.**

The analysis results indicate that the second hypothesis (H2) is supported, meaning that human behavior has a positive effect on safety/security satisfaction. This is demonstrated by an original sample value of 0.268 with a t-statistic of 4.607 (> 1.97) and a p-value of 0.000 (< 0.05), indicating a statistically significant relationship. This finding suggests that the higher the level of workers' compliance with safety procedures, the use of personal protective equipment (PPE), and the avoidance of risky behaviors, the greater their satisfaction with workplace safety and security conditions. From a theoretical perspective, consistently practiced safe behavior enhances workers' sense of control and self-protection during work activities, leading them to feel more secure and satisfied with the existing safety conditions. Conversely, non-compliant or unsafe behavior can reduce perceptions of safety and increase the likelihood of workplace accidents, which ultimately lowers safety satisfaction.

3. **Organizational Climate Has a Positive Effect on Safety/Security Satisfaction.**

The analysis results indicate that the third hypothesis (H3) is supported, meaning that organizational climate has a positive effect on safety/security satisfaction. This is proven by an original sample value of 0.298 with a t-statistic of 4.779 (> 1.97) and a p-value of 0.000 (< 0.05), indicating a statistically significant relationship. This suggests that stronger organizational commitment, management support, safety communication, and occupational safety and health (OSH) training are associated with higher levels of workers' satisfaction with safety and security conditions. From a theoretical perspective, tangible organizational support makes workers feel that safety is genuinely prioritized, thereby increasing their sense of security and safety satisfaction. Conversely, a weak organizational climate characterized by inadequate supervision, limited training, and low managerial attention can create uncertainty in the workplace and reduce perceptions of safety, ultimately leading to lower safety satisfaction

4. **Safety/Security Satisfaction Has a Positive Effect on Safety Performance**

The analysis results indicate that the fourth hypothesis (H4) is supported, meaning that safety/security satisfaction has a positive effect on safety performance. This is demonstrated by an original sample value of 0.495 with a t-statistic of 8.503 (> 1.97) and a p-value of 0.000 (< 0.05), indicating a statistically significant effect. This finding implies that higher levels of workers' satisfaction with safety facilities, procedures, and protective measures lead to better safety performance in their work activities. Theoretically, when workers perceive their work environment as safe and adequate, they tend to be more motivated to comply with safety procedures, consistently use personal protective equipment (PPE), and perform tasks in accordance with standard operating procedures, thereby enhancing safety performance. In contrast, low safety satisfaction may reduce motivation to follow safe work practices, increase the risk of unsafe behavior, and result in suboptimal safety performance.

5. Job Satisfaction Has a Positive Effect on Safety Performance

The analysis results indicate that the fifth hypothesis (H5) is supported, meaning that job satisfaction has a positive effect on safety performance. This is shown by an original sample value of 0.325 with a t-statistic of 6.144 (> 1.97) and a p-value of 0.000 (< 0.05), confirming a statistically significant relationship. This indicates that the more satisfied workers are with their jobs such as feeling supported, comfortable, and valued the better the safety performance demonstrated in their work activities. From a theoretical standpoint, high job satisfaction encourages discipline and intrinsic motivation to protect oneself and co-workers by complying with safety procedures and using PPE, thereby improving safety performance. Conversely, low job satisfaction can diminish motivation to adhere to safety standards, increase the likelihood of unsafe behavior, and hinder the achievement of optimal safety performance.

CONCLUSION

Based on the results of the research and discussion, it can be concluded that work equipment and environmental factors, human behavior, and organizational climate have a positive effect on safety/security satisfaction among employees involved in the SPAM WOSUSOKAS pipeline construction project. Adequate and safe work equipment, along with a conducive working environment, enhance employees' sense of security and satisfaction with occupational safety conditions. In addition, compliance with safe work procedures, proper use of personal protective equipment (PPE), and vigilance in performing work tasks contribute to higher safety/security satisfaction. Management support, effective safety communication, and consistent supervision also create a safety-oriented organizational climate that strengthens employees' safety/security satisfaction. Furthermore, safety/security satisfaction and job satisfaction are proven to have a positive effect on safety performance, as employees who feel safe, satisfied, and valued tend to demonstrate more disciplined, responsible, and compliant behavior with occupational safety standards.

The implications of this study emphasize that improving safety performance should be carried out in an integrated manner by ensuring safe work equipment and work environments, fostering safe work behaviors that comply with safety procedures, and strengthening an organizational climate oriented toward safety. Management support, effective safety

communication, and consistent supervision play a crucial role in enhancing safety satisfaction and job satisfaction, which in turn positively affects employees' safety performance. Therefore, the management of the SPAM WOSUSOKAS project is encouraged to continuously improve the quality of work equipment and the work environment, reinforce compliance with safety procedures, and place safety as a top organizational priority. Future studies are recommended to expand the research scope to other construction sectors, adopt a longitudinal approach, and incorporate additional variables such as safety leadership or safety culture to deepen the understanding of factors influencing safety performance.

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