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Analysis of the Implementation of the Occupational Safety and Health Management System (SMK3) among Automatic People Mover System (APMS) Personnel at Soekarno–Hatta International Airport

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Abstract: This study aims to analyze the influence of safety motivation and safety culture on operational performance, both directly and indirectly through the implementation of the Occupational Safety and Health Management System (SMK3) as an intervening variable. A quantitative approach was employed, with a population of 218 employees of PT Angkasa Pura II working as personnel of the Automatic People Mover System (APMS) at Soekarno-Hatta International Airport. The sample size was determined using the guideline suggested by Hair et al. (2014), which recommends five to ten times the number of indicators. Primary data were collected through an online questionnaire (Google Form), while secondary data were obtained from literature studies. Data analysis was conducted using the Structural Equation Modeling (SEM) method with the help of SmartPLS software. The results indicate that both safety motivation and safety culture have a positive effect on operational performance, both directly and indirectly through the implementation of SMK3. Safety motivation encourages more effective implementation of SMK3, which in turn enhances work efficiency and productivity. Similarly, a strong safety culture contributes to the successful implementation of SMK3 and fosters a safe, stable work environment that supports improved operational performance. The implications of this research highlight the importance of embedding safety as a core operational strategy in airport management and the need for systemic implementation of SMK3 to support sustainable operational effectiveness.

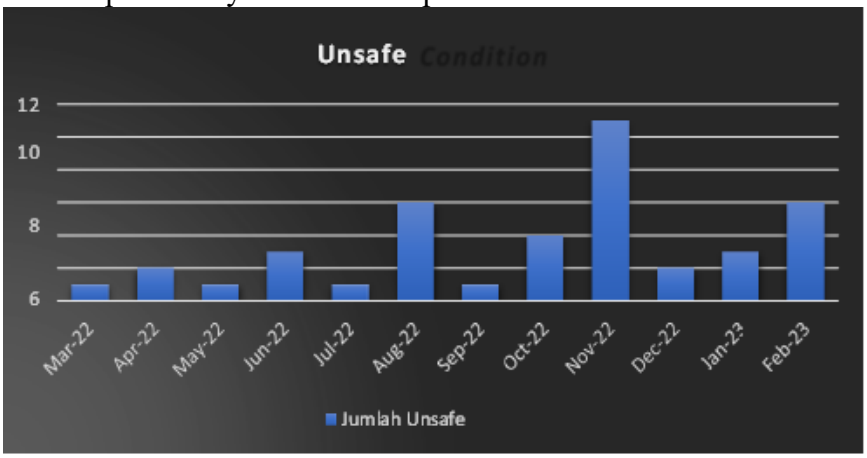
Keyword: Safety Motivation, Safety Culture, SMK3, Operational Performance, APMS, Soekarno-Hatta Airport.

INTRODUCTION

The aviation industry is a high-risk sector in which occupational safety and health play an essential role in ensuring operational continuity. Occupational safety is not limited to the prevention of accidents and injuries but also encompasses an organization's ability to identify and control various risks that may endanger workers. In this context, human resource competence is particularly important, as human factors remain one of the primary causes of accidents across various industrial activities (Li & Pilz, 2023).

Data on Occupational Accident Insurance claims indicate that the number of workplace accidents in Indonesia has continued to increase. The number of claims rose from 182,835 cases in 2019 to 297,725 cases in 2022. Between January and November 2023, the number of claims reached 360,635 cases, with most Occupational Accident Insurance claims occurring in companies and plantation sectors (Saputra, 2024). This condition indicates that the implementation of occupational safety and health systems must be further strengthened through effective supervision, increased worker awareness, proper equipment maintenance, and the consistent development of a strong safety culture.

The risk of occupational accidents and work-related illnesses is also present in the operation and maintenance activities of the Automatic People Mover System (APMS) at Soekarno–Hatta International Airport. APMS personnel are exposed to various potential hazards, including electric shock during inspections of power rails and point machines, falls from heights while maintaining signalling systems, trips during axle counter inspections, and being trapped or struck by objects when operating lifting equipment. Reports on APMS operation and maintenance activities for the 2022–2023 period also identified several unsafe conditions that could potentially result in occupational accidents and work-related illnesses.



Source: APMS (2024)

Figure 1. Unsafe Condition Report in 2022-2023

Unsafe conditions may result from damaged or poorly maintained equipment, hazardous workplace environments, inadequate protective measures, and weaknesses in organizational supervision and management. Although various control measures have been implemented, unsafe conditions may still arise due to the interaction of human, organizational, equipment, and environmental factors. Therefore, continuous commitment is required to improve personnel competence, maintain workers' health and adequate rest periods, conduct regular equipment maintenance, and strengthen the organization's safety culture.

The implementation of the Occupational Safety and Health Management System (SMK3) is an important measure for controlling these risks. The effectiveness of SMK3 implementation is influenced not only by safety procedures and facilities but also by the safety motivation and safety culture of individual personnel. Safety motivation reflects workers' willingness to perform their duties safely, whereas safety culture represents shared values, attitudes, perceptions, and behaviors that position safety as an organizational priority. Previous

studies have shown that worker safety may be influenced by safety culture (Yeboah et al., 2024) and safety motivation (Subramaniam et al., 2023), while the implementation of occupational safety and health practices may contribute to improved employee performance (Tong et al., 2020).

Based on these conditions, this study aims to analyze the effects of safety motivation and safety culture on the performance of APMS personnel, both directly and indirectly through SMK3 implementation as a mediating variable. The findings are expected to provide recommendations for the company to strengthen SMK3 implementation, reduce the potential occurrence of unsafe conditions, and improve the safety, health, and performance of APMS personnel at Soekarno–Hatta International Airport.

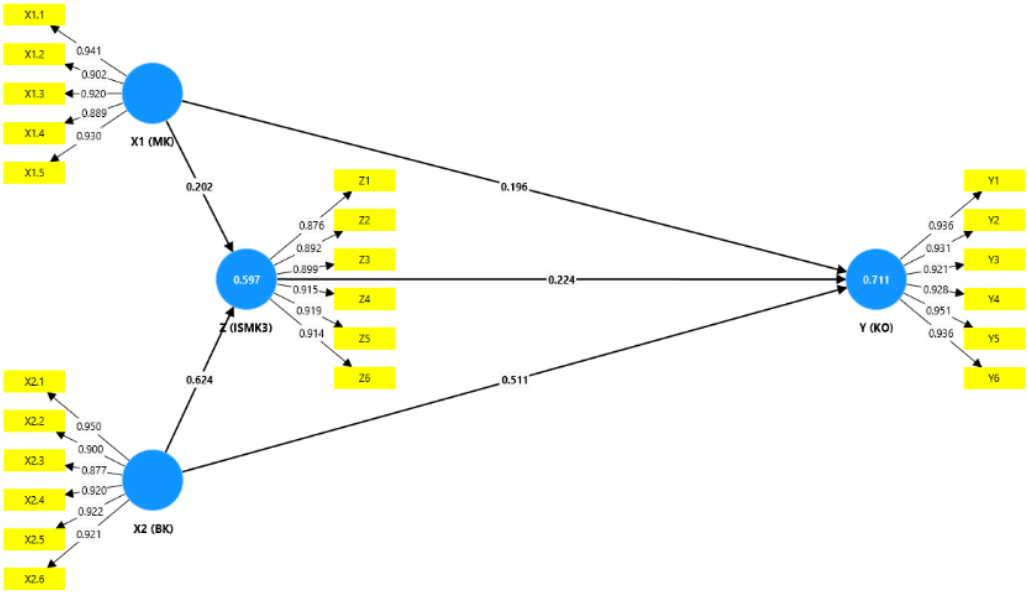
METHOD

This study employs a quantitative research method with a survey approach to examine the relationships between safety motivation, safety culture, Occupational Safety and Health Management System (SMK3) implementation, and operational performance among Automatic People Mover System (APMS) personnel at Soekarno–Hatta International Airport. The research was conducted from February to September 2024. The population of this study consists of 218 employees of Angkasa Pura II working as APMS personnel. Referring to Hair et al. (2014), the minimum sample size for research using PLS-SEM can be determined by multiplying the number of research indicators by five to ten. This study applies a multiplier of six to the 24 indicators used in the research instrument. Therefore, the minimum sample size required is 144 respondents. Primary data were collected through an online questionnaire using Google Forms, with responses measured using a five-point Likert scale ranging from “Strongly Disagree” to “Strongly Agree.”

The data analysis technique used in this research is Structural Equation Modeling (SEM) with the Partial Least Squares (PLS) approach, processed using SmartPLS version 4.1.1. PLS-SEM was selected because the research model examines both direct and indirect relationships among independent, mediating, and dependent variables. The analysis procedure consists of three main stages: evaluation of the measurement model (outer model) to assess convergent validity, discriminant validity, composite reliability, and Cronbach’s alpha; evaluation of the structural model (inner model) to assess the coefficient of determination (R^2), predictive relevance (Q^2), effect size, and model fit; and hypothesis testing using the bootstrapping procedure at a significance level of 5 percent. Through this method, the study aims to determine the influence of safety motivation and safety culture on operational performance through the implementation of SMK3 among APMS personnel at Soekarno–Hatta International Airport.

RESULTS AND DISCUSSION

The convergent validity test aims to assess the adequacy of the indicators used to measure each variable in this study. The analysis was conducted using Smart PLS 4 software in accordance with the Partial Least Squares (PLS) algorithm procedure. An indicator is considered valid when its loading factor value is ≥ 0.70. This threshold indicates that the indicator makes a strong contribution to representing the construct being measured. The following figure presents the measurement model (outer model) used to assess the loading factor values in this study.



Source: Research Results

Figure 2. Outer Model

Based on the findings of the validity analysis, the loading factor values illustrating the relationship between each variable and its corresponding indicators are presented as follows:

Table 2. Outer Loading

Variable	Indicator	Outer Loading	Indication
Safety Motivation	**X1.1**	0.941	VALID
	X1.2	0.902	
	X1.3	0.920	
	X1.4	0.889	
	X1.5	0.930	
	X1.6	0.927	
Safety Culture	**X2.1**	0.950	VALID
	X2.2	0.900	
	X2.3	0.877	
	X2.4	0.920	
	X2.5	0.922	
	X2.6	0.921	
Implementation Occupational Safety and Health Management System (SMK3)	**Z1**	0.876	VALID
	Z2	0.892	
	Z3	0.899	
	Z4	0.915	
	Z5	0.919	
	Z6	0.914	
Operational Performance	**Y1**	0.936	VALID
	Y2	0.931	
	Y3	0.921	
	Y4	0.928	
	Y5	0.951	
	Y6	0.936	

Source: Research data

The table above illustrates the factor loading results for each indicator across the examined constructs, indicating varying levels of contribution among the variables. As all factor loading values exceed the recommended threshold of 0.70, each indicator satisfies the criteria for validity. Beyond factor loadings, convergent validity is further evaluated using the Average Variance Extracted (AVE) as a complementary indicator. AVE represents the extent to which a construct explains the variance of its indicators relative to the variance arising from measurement error. A construct is considered to demonstrate adequate convergent validity when its AVE value surpasses 0.50. The AVE results for each variable are presented below:

Table 3. AVE (Average Variance Extracted)

Research Variable	Average variance extracted (AVE)	Indication
X1 (Safety Motivation)	0.840	VALID
X2 (Safety Culture)	0.838	VALID
Y(Operational Performance)	0.872	VALID
Z (Implementation Occupational Safety and Health Management System (SMK3)	0.815	VALID

Source: Research data

Ghozali & Latan, (2015) state that the Average Variance Extracted (AVE) is utilized to assess the convergent validity of constructs measured using reflective indicators. An AVE value of 0.50 or above signifies that a construct explains more than half of the variance in its observed indicators.

In addition, construct reliability is examined through Cronbach's Alpha and Composite Reliability (CR). A construct is regarded as having satisfactory internal consistency when both Cronbach's Alpha and Composite Reliability values exceed the threshold of 0.70, indicating that the indicators reliably and consistently represent the same latent concept.

Table 4. Cronbach Alpha and Composite Reliability

	Cronbach's alpha	Composite reliability (rho_c)	Indication
X1 (Safety Motivation)	0.952	0.963	Reliable
X2 (Safety Culture)	0.961	0.969	
Y(Operational Performance)	0.971	0.976	
Z (Implementation Occupational Safety and Health Management System (SMK3)	0.955	0.964	

Source: Research data

The findings indicate that all constructs exhibit Cronbach's Alpha values exceeding the acceptable thresholds (≥0.6 for exploratory research and ≥0.7 for confirmatory research), along with Composite Reliability values greater than 0.70. These results confirm that the research instruments possess strong internal consistency and reliability, making them appropriate for use. Consequently, the data obtained can be regarded as consistent and dependable for subsequent analytical procedures.

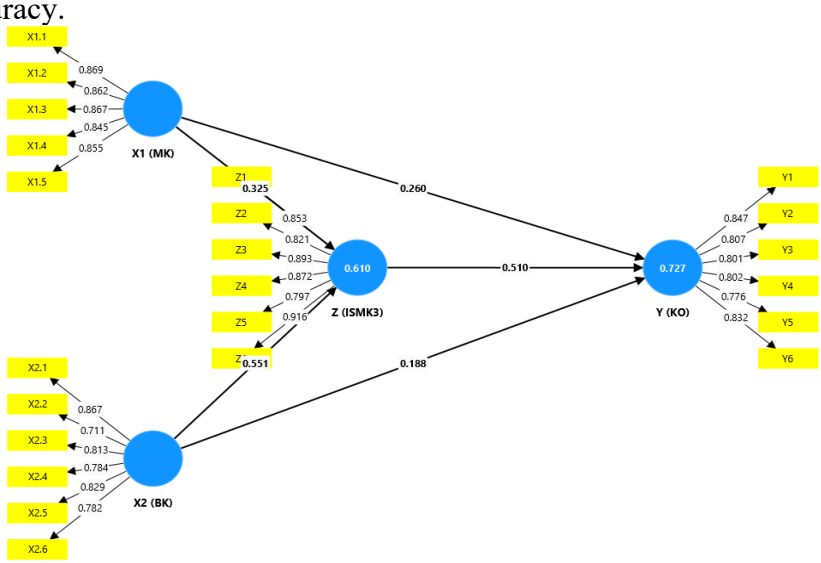
Table 5. The Coefficient of Determination (R^2)

	R-square	R-square adjusted
Y (Operational Performance)	0.711	0.705
Z (Implementation Occupational Safety and	0.597	0.592

Health Management System (SMK3)	

Source: Research data

Operational Performance model yields an R-square value of 0.711, or 71.1%, which falls into the strong category. The R-square value for the Implementation Occupational Safety and Health Management System (SMK3) variable is 0.597, or 59.7%, which is also classified as strong, while the Adjusted R-square value for the Operational Performance variable is 0.750, or 75.0%, likewise indicating a strong category. Therefore, it can be concluded that the proposed model demonstrates good performance, or in other words, exhibits satisfactory predictive accuracy.



Source: Research Results

Figure 3. Bootstraping Model

This stage focuses on hypothesis testing to evaluate the significance of the relationships among variables in the proposed research model, including the independent variables Service Safety Motivation (X1), and Safety Culture (X2), the mediating variable Implementation Occupational Safety and Health Management System (SMK3) (Z), and the dependent variable Operational Performance (Y). The analysis was performed using the bootstrapping procedure in Partial Least Squares–Structural Equation Modeling (PLS-SEM) with the assistance of SmartPLS software.

Hypothesis testing was conducted by examining the path coefficients, T-statistics, and P-values generated from the bootstrapping results. A hypothesis is considered supported when the P-value is less than 0.05, indicating a statistically significant relationship. Conversely, a hypothesis is not supported when these criteria are not met.

Table 6. Bootstrapping Result

Hypothesis	Path	Original sample (O)	Standard deviation (STDEV)	T statistics (|O/STDEV|)	P values
H1	Safety Motivation on Operational Performance	0.196	0.077	2.547	0.011
H2	Safety Motivation on Implementation of the Occupational Safety and Health Management System (SMK3)	0.202	0.083	2.419	0.016
H3	Safety Culture on Operational Performance	0.511	0.096	5.345	0.000

H4	Safety Culture on Implementation of the Occupational Safety and Health Management System (SMK3)	0.624	0.075	8.281	0.000
H5	Implementation of the Occupational Safety and Health Management System (SMK3) on Operational Performance	0.224	0.09	2.486	0.013
H6	Safety Motivation on Implementation of the Occupational Safety and Health Management System (SMK3) on Operational Performance	0.045	0.023	2.006	0.045
H7	Safety Culture on Implementation of the Occupational Safety and Health Management System (SMK3) on Operational Performance	0.14	0.064	2.195	0.028

Source: Research data

Hypothesis 1

Based on the hypothesis testing results, the path coefficient is 0.196, with a P-value of 0.011, which is lower than the significance level of α = 0.05. Therefore, Hypothesis H1 is accepted. This result indicates that Safety Motivation has a positive and significant effect on Operational Performance. Statistically, at a 95% confidence level, higher safety motivation among employees contributes to improved operational performance at Soekarno–Hatta Airport.

his finding is consistent with the study conducted by Sunarjo & Amin, (2024) in the construction sector, which concluded that safety motivation plays a significant role in improving project performance, particularly through risk reduction and enhanced work timeliness. Similarly, Bergman et al., (2023) , in their study of Ghana's oil and gas sector, found that safety motivation directly contributes to improved employee performance, both in terms of occupational safety and operational productivity.

Hypothesis 2

The hypothesis testing results show a path coefficient of 0.202 and a P-value of 0.016, which is lower than the significance level of α = 0.05. Accordingly, Hypothesis H2 is accepted. This finding indicates that Safety Motivation has a positive and significant effect on the Implementation of the Occupational Health and Safety Management System (SMK3). At a 95% confidence level, stronger safety motivation encourages employees to participate more actively in implementing occupational health and safety procedures.

This result is supported by Rahmi & Ramdhan (2021), who identified employee motivation as an important factor influencing the effectiveness of SMK3 implementation. Fernández-Muñiz et al., (2007) also emphasized that successful safety management system implementation depends on motivated employee participation in incident reporting, procedural compliance, and internal safety audits.

Hypothesis 3

Based on the statistical analysis, the path coefficient is 0.511, with a P-value of less than 0.001, which is below the significance level of α = 0.05. Therefore, Hypothesis H3 is accepted. This result confirms that Safety Culture has a positive and significant effect on Operational Performance at a 95% confidence level. A stronger safety culture promotes collective compliance, careful decision-making, effective risk management, and cooperation among operational units.

This finding is consistent with Huang et al (2006) ,who culture significantly improves both safety and operational performance, particularly when supported by a structured safety management system.

Hypothesis 4

The hypothesis testing results indicate a path coefficient of 0.624 and a P-value of 0.013, which is lower than the significance level of α = 0.05. Thus, Hypothesis H4 is accepted. This finding demonstrates that Safety Culture has a positive and significant effect on SMK3 Implementation. Statistically, a stronger organizational safety culture leads to more effective implementation of occupational health and safety policies, procedures, and risk-control practices.

This result is supported by Restuputri et al. (2021), who found that organizational safety culture significantly strengthens the effectiveness of safety management systems. A related Farhan & Ambarwati, (2025) also showed that safety culture developed through training, open communication, and safety leadership contributes directly to the successful implementation of workplace safety management systems.

Hypothesis 5

The results show a path coefficient of 0.224 and a P-value of 0.013, which is below the significance level of α = 0.05. Therefore, Hypothesis H5 is accepted. This result indicates that SMK3 Implementation has a positive and significant effect on Operational Performance at a 95% confidence level. Effective SMK3 implementation contributes to improved operational performance by reducing workplace accidents, minimizing operational disruptions, and increasing work efficiency.

This finding is consistent Fernández-Muñiz, B., Montes-Peón, J. M., & Vázquez-Ordás, C. J. (2009) , who demonstrated that comprehensive safety management system implementation improves operational reliability and reduces operational incidents. Rahmi & Ramdhan (2021), also found that management involvement, employee training, and structured safety-reporting systems collectively contribute to higher productivity and operational efficiency.

Hypothesis 6

Based on the indirect-effect testing results, the path coefficient is 0.045, with a P-value of 0.045, which is lower than the significance level of α = 0.05. Accordingly, Hypothesis H6 is accepted. This result indicates that Safety Motivation has a positive and significant indirect effect on Operational Performance through SMK3 Implementation. In other words, stronger safety motivation improves SMK3 implementation, which subsequently contributes to improved operational performance.

This finding is supported by (Yiu et al., 2019), who stated that employee motivation contributes to the successful implementation of safety management systems and indirectly improves organizational performance. Otitolaiye et al (2021) also emphasized that strong safety values and motivation support effective safety management practices, which ultimately enhance overall organizational performance.

Hypothesis 7

The hypothesis testing results show an indirect-effect coefficient of 0.014 and a P-value of 0.028, which is lower than the significance level of α = 0.05. Therefore, Hypothesis H7 is accepted. This finding confirms that Safety Culture has a positive and significant indirect effect on Operational Performance through SMK3 Implementation at a 95% confidence level. A strong safety culture must therefore be translated into structured safety management practices to generate measurable operational improvements.

This finding is consistent with Ogbeibu et al. (2021)who found that a positive safety culture improves organizational performance when mediated by an effectively implemented safety management system. A study published by Shabani et al (2023) similarly showed that safety values must be translated into concrete managerial safety practices to improve productivity and operational efficiency.

CONCLUSION

This study concludes that Safety Motivation and Safety Culture are important determinants of Operational Performance, both directly and indirectly through SMK3 Implementation. Strong safety motivation encourages greater commitment to safe work practices, while a well-established safety culture reinforces shared values, behavioral consistency, and organizational compliance with safety standards. These conditions facilitate more effective implementation of SMK3, which subsequently contributes to improved operational performance through reduced workplace risks, enhanced process reliability, and greater operational efficiency. Overall, the findings highlight the mediating role of SMK3 Implementation in translating individual and organizational safety-related factors into sustainable operational performance.

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