

Safety Risk Management and Management Information Systems on Aviation Security Performance at Kualanamu International Airport

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ABSTRACT

Purpose: The main focus of this study is to evaluate the extent to which the implementation of Safety Risk Management and Management Information System (MIS) affects the performance effectiveness of Avsec personnel at Kualanamu International Airport.

Research Method: This study employed a quantitative survey approach, with primary data obtained through questionnaires distributed to 100 active Avsec personnel. The data were subsequently processed using Multiple Linear Regression analysis assisted by the SPSS statistical application.

Results and Discussion: The results showed that Safety Risk Management and the Management Information System (MIS) had a significant positive effect on Avsec personnel's performance. These findings indicate that more optimal implementation of risk management and information systems leads to higher levels of personnel preparedness and effectiveness in maintaining aviation security.

Implications: This study implies that airport management should strengthen safety risk management practices and optimize the implementation of an integrated management information system to improve Aviation Security performance. These findings provide practical insights for developing risk-based security strategies, improving personnel preparedness, and supporting more effective decision-making in airport security operations.

Originality: The originality of this study lies in integrating Safety Risk Management and Management Information System as simultaneous determinants of Aviation Security Performance.

Keywords: management information system; risk management; aviation security; cybersecurity; airport operations; aviation security performance.

1. Introduction

Airports are critical nodes in the air transportation system, serving as gateways for economic activity and connecting regions both domestically and internationally. As national vital objects and strategic public facilities, airports bear significant responsibility for ensuring the safety and security of all passengers, cargo, and aviation personnel. In operational contexts, the performance of Aviation Security (Avsec) personnel serves as the frontline in protecting airport areas from various threats. Airport security performance not only affects passenger safety but also shapes public perceptions and levels of trust in the national aviation industry as a whole. Slow or indecisive security services may directly reduce



passengers' positive perceptions, whereas firm yet humane security measures can strengthen public trust (Datanabolon *et al.*, 2019).

Aviation safety and aviation security are two interrelated aspects of airport operations, although they address different sources of risk. Aviation safety focuses on operational hazards, failures, errors, and unintentional events, whereas aviation security is concerned with protecting civil aviation from acts of unlawful interference and deliberate threats. This distinction is reflected in the ICAO framework, which addresses safety management through Annex 19 and the Safety Management Manual (Doc 9859), while aviation security is regulated through Annex 17 (ICAO, 2018, 2022, 2025). Although the objects of risk differ, both areas require systematic processes for identifying risks, establishing controls, conducting monitoring, and strengthening organizational preparedness. Within this context, Safety Risk Management (SRM) is relevant to Aviation Security Performance through risk management practices that may strengthen risk awareness, consistency in procedural implementation, monitoring, and preparedness to respond to abnormal conditions, without equating safety hazards with security threats. The assessment of security threats specifically remains within the aviation security management framework, such as the Security Management System (SeMS), which encompasses threat identification, security risk assessment, reporting, communication, and security performance monitoring (IATA, 2026).

In carrying out duties in the field Aviation Security Performance also depends heavily on human factors, particularly the ability to maintain attention and make decisions consistently. Aviation Security Performance, as reflected in the ability to prevent prohibited items from entering restricted areas and responsiveness in handling emergency situations, can be influenced by working conditions as well as the quality of system support. Research involving airport security personnel indicates that work rhythms and working hours can affect processing speed during security screening, while errors in decision-support systems may increase the likelihood of prohibited items being missed (Riz à Porta *et al.*, 2024; Huegli *et al.*, 2025). These findings highlight the importance of vigilance, procedural clarity, communication, and accurate decision-making in maintaining the effectiveness of security duties. Human factor management is also an important element in supporting system performance and maintaining aviation operational safety (Teperi *et al.*, 2023).

The gap between ideal conditions and the actual performance of Avsec personnel was clearly illustrated by an incident at Kualanamu International Airport in 2023. In that incident, a woman was found dead inside an airport elevator after remaining undetected for several days. The incident attracted considerable public attention and raised critical questions about the level of vigilance, the speed of response, and the effectiveness of the surveillance system implemented by Avsec personnel (Author's Field Observation, 2024). This incident demonstrates a tangible weakness in operational monitoring performance in the field.

This condition highlights the importance of a risk management approach that is not merely reactive but also capable of identifying and controlling risks before they lead to operational disruptions. Safety Risk Management systematically identifies hazards, assesses the probability and impact of risks, establishes appropriate controls, and monitors the effectiveness of those controls. The implementation of structured risk management in aviation environments has been shown to support the proactive identification and control of operational hazards before undesirable events occur (Stolzer *et al.*, 2008). This approach is also consistent with the ICAO safety management framework, which places risk management, performance monitoring, and the use of information as important components of the safety management process (ICAO, 2018, 2025).

The relevance of SRM to Aviation Security Performance primarily lies in the capabilities developed through the process. Risk identification and assessment encourage personnel to become more sensitive to abnormal or deviant conditions, while control measures, monitoring, and post-incident evaluation support procedural consistency and organizational learning. In security operations, these capabilities can help personnel maintain vigilance, recognize situations requiring intervention, and coordinate responses more effectively. These similarities in process do not eliminate the distinction between safety and security; rather, both retain different objects of risk, while security management through SeMS specifically regulates threat identification, security risk assessment, reporting, communication, and security controls (IATA, 2026).

Previous studies have demonstrated varying findings regarding the relationship between risk management and organizational performance or outcomes. The literature review conducted by Asir *et al.*, (2023) indicates that the implementation of risk management plays a positive role in supporting corporate performance. In contrast, Kurniasih (2022), in the context of mining-sector companies, found that enterprise risk management had no significant effect on firm value. Although these studies differ in both context and outcome variables, the variation in their findings suggests that the benefits of risk management do not automatically emerge in every organizational context. This creates an opportunity to examine how SRM is associated with performance in a more specific operational environment, namely Avsec personnel.

In addition to risk management, the effectiveness of operational security depends heavily on the support of a reliable Management Information System (MIS). In airport environments, MIS is implemented through the integration of CCTV, incident reporting systems, biometric access control, and real-time data communication. These systems are designed to support data-driven decision-making, accelerate information flow, and minimize blind spots in airport surveillance (Tjahjanto *et al.*, 2025).

The role of MIS in Aviation Security Performance primarily stems from its ability to provide relevant information and support decision-making. Rapidly available and integrated information helps personnel understand operational conditions, identify anomalies, and determine appropriate responses. In airport security screening, decision-support systems can assist in the detection process; however, their benefits depend on system reliability and on how operators use the information (Huegli *et al.*, 2023; Huegli *et al.*, 2025). Therefore, MIS does not replace personnel judgment; rather, it serves as an information infrastructure that supports situational awareness and decision-making in the performance of security duties.

Nevertheless, previous research findings regarding the influence of information technology on performance remain varied. Mubin *et al.*, (2025) found that the reliability of Management Information System contributes significantly to performance optimization. In contrast, Fauzi and Musrifah (2025) demonstrated that the presence of advanced technological systems does not automatically improve performance effectiveness when it is not supported by the competence and readiness of human resources in the field. These findings indicate that the contribution of MIS to performance is determined not only by the availability of technology but also by personnel's ability to understand, use, and translate the information generated by the system into operational decisions and actions.

Based on the discussion, SRM and MIS can be understood as two aspects that operate through different mechanisms in supporting Aviation Security Performance. SRM establishes the risk management process through identification, assessment, control, and monitoring, whereas MIS provides the information support required to recognize operational conditions and make appropriate

decisions. Thus, SRM is more closely related to risk management capabilities, whereas MIS strengthens personnel's information processing and decision-making capacity.

The differences in previous research findings, the need to clarify the relationship between risk management and security performance, and the existence of operational problems at Kualanamu International Airport provide the basis for this study to examine the effects of Safety Risk Management (X1) and Management Information System (X2) on Aviation Security Performance (Y). The novelty of this research lies in examining these two factors, both individually and in combination, in the context of Avsec personnel performance following the incident at Kualanamu International Airport. Evaluating performance after an incident is particularly important for supporting organizational learning and long-term improvements in the aviation system (Tutkun *et al.*, 2025). This study is expected to provide a clearer understanding of the contribution of risk management processes and information support to the effectiveness of aviation security duties

2. Literature Review and Hypothesis Development

2.1 Aviation Security Performance

Aviation Security (Avsec) performance is a specific component of organizational performance that refers to the ability of Avsec units/personnel to carry out aviation security protection and surveillance duties, including passenger and baggage screening, restricted-area surveillance, implementation of security procedures, and response to threats (Elysia *et al.*, 2025). The assessment of Aviation Security Performance considers not only the quantity of tasks performed, such as the number of screenings conducted, but also the quality of procedural implementation, compliance with standards, and the effectiveness of airport security duties (Pratiwi & Awan, 2024). In general, the definition of performance in management emphasizes two main dimensions: behavior, which concerns what individuals do during the work process, and outcomes, which concern the achievement of objectives. Aguinis *et al.*, (2024) explain that performance encompasses observable work behaviors and results in achieving relevant objectives. This perspective provides a basis for understanding Aviation Security Performance not only in terms of the outcomes achieved but also in terms of the quality of task execution that contributes to achieving security objectives.

From a management perspective, performance is a continuous process involving planning, monitoring, evaluation, and development (Moko *et al.*, 2021). The importance of measurable indicators and feedback in improving the performance of airport security personnel is reflected in indicators such as screening time, anomaly detection rates, compliance with Standard Operating Procedures (SOPs), and airport user satisfaction. Overall performance improvement is supported by three main pillars: (1) innovation-based reward mechanisms, (2) a conducive work environment, and (3) improvements in job restructuring (Viantika *et al.*, 2023). Clear performance measurement within Avsec units also enables more objective monitoring of processes and the identification of training needs (Milbredt & Deutschmann, 2016). Several factors that determine performance include technical competence, work discipline, motivation, equipment availability, and organizational support. Competence and discipline significantly influence screening effectiveness and procedural compliance; therefore, training programs, task rotation, and workload management are recommended to improve performance (Pinem *et al.*, 2024).

In addition to internal factors, organizational aspects and performance measurement systems also determine the quality of Aviation Security Performance. Modern approaches to performance management recommend combining quantitative metrics, such as operational KPIs, with qualitative assessments, such as compliance audits and field observations, to provide a more comprehensive picture of performance. Performance measurement that combines process indicators, such as average screening time, with outcome indicators, such as the number of security incidents per 10,000 passengers, can be used to monitor trends and policy effectiveness (Chen & Li, 2016). Therefore, Aviation Security Performance reflects not only the final outcomes of security activities but also the quality with which personnel perform their duties in maintaining airport security.

2.2 Safety Risk Management

Safety Risk Management is a management framework that emphasizes a systematic process of identifying hazards, assessing risk levels, determining control measures, and monitoring the effectiveness of such controls to ensure that risks remain at levels acceptable to the organization (Civil Aviation Safety Authority, 2022). Establishing the risk context is an important and complex stage in the risk management process (Marliyah *et al.*, 2023). Safety Risk Management integrates hazard identification, quantitative and qualitative analysis, mitigation, and monitoring processes while emphasizing continuous improvement through the PDCA (Plan–Do–Check–Act) framework. Its purpose is to reduce the likelihood and consequences of events that may threaten people, assets, and organizational operations (Hillson, 2023). In aviation safety management, this process aims to strengthen an organization's ability to identify risky conditions early and determine appropriate control measures. The Civil Aviation Safety Authority (2022) identifies hazard identification, analysis, mitigation, and monitoring as key components of safety risk management. When these processes are performed repeatedly, they can foster work practices that are more sensitive to deviations, more disciplined in implementing controls, and better prepared to respond to changing operational conditions. A structured risk assessment approach also helps organizations prioritize control and preventive measures more systematically (Bugaike *et al.*, 2024).

The relevance of SRM to Aviation Security Performance primarily emerges through these capabilities. Although SRM originates in the safety domain and does not equate safety hazards with security threats, the practices of risk identification, assessment, control, and monitoring can support personnel preparedness to recognize abnormal conditions and consistently implement procedures. Research on risk management in airport security indicates that systematic risk assessment, monitoring, and decision-support mechanisms can enhance the ability to recognize risky conditions and determine more appropriate preventive actions (Hu *et al.*, 2025). Thus, the better the risk management process is implemented, the greater its potential contribution to personnel vigilance, procedural consistency, and preparedness in carrying out security duties. Based on the discussion, Safety Risk Management is expected to positively contribute to Avsec personnel's performance by improving risk awareness, preparedness, and consistency in task execution. Therefore, the first hypothesis is formulated as follows:

H1: *Safety Risk Management has a positive and significant effect on Aviation Security Performance.*

2.3 Management Information System

In general, a Management Information System (MIS) is defined as an integrated mechanism within an organizational control system involving human resources, technology, governance, documentation, and operational procedures to support various organizational needs (Yustika *et al.*, 2023). MIS can also be understood as a set of procedures and technologies for collecting, storing, processing, and distributing essential data to support organizational decision-making (Frisdayanti, 2019). Laudon and Laudon (2014) explain that an information system consists of integrated elements that collect, process, store, and distribute information to support decision-making, work coordination, operational control, and problem solving. Operationally, MIS consists of data collection subsystems, storage or archiving, analytical processing, and reporting interfaces or dashboards for users. Its primary functions include: (1) processing routine transactions, (2) monitoring operational performance, (3) providing information for tactical and strategic decision-making, and (4) facilitating communication among organizational units (Khaliq & Nasution, 2024).

In airport security duties, the value of MIS lies not merely in the existence of technology but in the system's ability to provide information that personnel can use in decision-making. Accurate, timely, and accessible information helps personnel understand operational conditions, recognize irregularities, and determine appropriate responses. Decision-support systems in airport security screening can also assist detection processes, particularly when officers are dealing with complex screening tasks (Huegli *et al.*, 2023). Conversely, inaccurate system information or guidance can increase the likelihood of missed prohibited items, making system quality and the manner in which personnel use information important components of screening effectiveness (Huegli *et al.*, 2025).

In aviation security management, the digitalization of airport services, such as Flight Information Display Systems (FIDS), biometric e-gates, integrated baggage management, and CCTV monitoring systems, has transformed traditional MIS into integrated platforms that combine operational information technology with real-time analytics (Choi *et al.*, 2024). Digital information services contribute to passenger service efficiency while also presenting challenges related to data integration and security (Sunaryo *et al.*, 2025). MIS functions as a system that collects and integrates data from sensors, security screenings, access records, and threat information to support early detection, incident response, and compliance auditing (Wei, 2009). Airport Security Management Information System, such as ASIMS, integrate operational and security information flows, enabling personnel to monitor anomalies, coordinate response teams, and produce incident reports required by regulators. Therefore, MIS accelerates the flow of critical information required for preparedness and threat mitigation in airport environments (Charernnit, 2023).

Digital transformation also increases the attack surface because the integration of operational technology (OT), information technology (IT), IoT connectivity such as cameras, sensors, and e-gates, as well as passenger data storage, requires layered security controls, including encryption, role-based access control, network segmentation, anomaly monitoring, and privacy policies. This condition underscores the need for an integrated risk management approach to ensure that improvements in information capabilities do not compromise operational security or safety (Indrayani & Amalia, 2023).

These findings indicate that MIS supports Aviation Security Performance by providing the availability and quality of information used to carry out security duties. When information can be obtained quickly and reliably, personnel have a stronger basis for conducting detection, determining responses, coordinating actions, and consistently implementing security procedures (Choi *et al.*, 2024;

Huegli *et al.*, 2023; Huegli *et al.*, 2025). Based on this relationship, MIS is expected to support improvements in Aviation Security Performance by providing more effective information and decision-making support. Therefore, the second hypothesis is formulated as follows:

H2: *Management Information System have a positive and significant effect on Aviation Security Performance.*

SRM and MIS support Aviation Security Performance through different yet complementary functions. SRM helps establish a more structured work process for identifying, assessing, controlling, and monitoring risks, whereas MIS provides the information personnel require to understand operational conditions and determine appropriate actions. In carrying out security duties, the ability to recognize risks is more effective when supported by adequate information, and information provided through the system also requires personnel to assess conditions and determine appropriate responses. Thus, the combined presence of SRM and MIS provides broader support for implementing Avsec duties than considering either factor alone (Civil Aviation Safety Authority, 2022; Choi *et al.*, 2024; Hu *et al.*, 2025; Huegli *et al.*, 2025).

H3: *Safety Risk Management and Management Information System simultaneously have a significant effect on Aviation Security Performance.*

3. Research Method

This study employs a quantitative approach using multiple linear regression analysis, a statistical procedure for estimating the strength of the relationship and the effects of several independent predictors on the dependent variable (Ghozali, 2018). This method was selected because it enables examination of the contributions of Safety Risk Management and the Management Information System, both individually and in combination, to Aviation Security Performance. The research population consisted of 133 Aviation Security (Avsec) personnel assigned at Kualanamu International Airport. The sample size was determined using the Slovin formula with a 5% margin of error, resulting in a total of 100 respondents. Respondents were selected based on the following inclusion criteria: having at least 1 year of work experience and being actively involved in airport security operations.

The sampling process employed a simple random sampling technique, using the list of active Avsec personnel obtained from the airport security unit as the sampling frame. From this list, eligible respondents were randomly selected to ensure that each qualified personnel had an equal opportunity to participate. Data collection was conducted in December 2025 through an online questionnaire distributed via Google Forms. Prior to participation, respondents were informed about the research objectives and that their participation was voluntary. This study examined three variables: Safety Risk Management (X1), Management Information System (X2), and Aviation Security Performance (Y). All variables were measured using a 5-point Likert scale, comprising 8 items for Safety Risk Management, 10 for Management Information System, and 10 for Aviation Security Performance, as presented in **Table 1**.

Research data were collected using a questionnaire developed from the theoretical framework and variable indicators, which was subsequently tested for validity and reliability to ensure data consistency and accuracy. The collected information was then processed using multiple linear regression

in SPSS. The analysis began with prerequisite analysis, namely the verification of classical assumption tests, prior to hypothesis testing and estimation of the multiple regression model.

Table 1. Operational Description of Research Variables

Variable	Indicators	Scale
Safety Risk Management	• Hazard identification • Risk assessment of baggage items • Risk level assessment of dangerous goods • Assessment of potential security threats • Follow-up actions on risk inspections • Optimal utilization of detection equipment • Participation in post-incident evaluations • Continuous monitoring of the SCP area • Availability of accurate passenger data • Access to updated prohibited items information • Ease of use of information systems	Likert 1–5
Management Information System	• Ease of accessing security information • Speed of accessing passenger manifests • System support for decision-making • Restriction of access to security data • Protection of passenger data confidentiality • Timely security notifications • System support for SOP implementation • Rapid response to unruly passengers • Prompt action regarding suspicious items • Compliance with inspection procedures according to SOPs • Consistency in implementing procedures	Likert 1–5
Aviation Security Performance	• Maintaining passenger comfort • Friendly and firm attitude in service delivery • Compliance with regulations and instructions • Attendance discipline • Maintaining a positive AVSEC image • Passenger satisfaction with security services	Likert 1–5

4. Results and Discussion

4.1 Analysis Results

Based on Table 2, the majority of respondents in this study were male Aviation Security (Avsec) personnel, totaling 77 (77%), with the dominant age group being 31-35 years old, comprising 45 (45%). Most respondents had more than 5 years of work experience (64%; 64 respondents) and were assigned to the Security Check Point (SCP) section (47%; 47 respondents). These characteristics indicate that the majority of respondents had adequate operational experience and were directly involved in aviation inspection and security processes. This condition supports the quality of the research data because the respondents possessed relevant knowledge and experience in implementing safety risk management, using management information systems, and performing Aviation Security duties at Kualanamu International Airport.

Table 2. Respondent Profile

No.	Description	Number	Percentage (%)
1	Gender		
	Male	77	77%
	Female	23	23%
2	Age Range		
	< 25 years	29	29%
	25 to 30 years	26	26%
	31 to 35 years	45	45%
3	Last Education Level		
	Senior High School/Vocational High School	51	51%
	Diploma	15	15%
	Bachelor Degree	34	34%
4	Length of Employment		
	1 to 2 years	14	14%
	3 to 4 years	22	22%
	More than 5 years	64	64%
5	AVSEC Work Assignment Division		
	Landside	24	24%
	Airside	29	29%
	SCP	47	47%

Source: Data Analysis Results, 2025

Table 3. KMO and Bartlett's Test

KMO and Bartlett's Test			
Kaiser-Meyer-Olkin Measure of Sampling Adequacy.			.946
Bartlett's Test of Sphericity	Approx. Chi-Square		3973.852
	df		378
	Sig.		.000

Source: Data Analysis Results, 2026

The adequacy of the data structure for factor analysis was evaluated using the Kaiser-Meyer-Olkin (KMO) measure and Bartlett's Sphericity Test. As presented in **Table 3**, the KMO value was 0.946, indicating excellent sampling adequacy for factor analysis. Furthermore, Bartlett's Test showed a significant result ($\chi^2 = 3973.852$; $df = 378$; $p < 0.001$), confirming that the correlation matrix was suitable for factor extraction. These results indicate that the observed variables have sufficient interrelationships to proceed with the Exploratory Factor Analysis (EFA).

The results of the total variance explained analysis indicate that two factors were extracted, each with an eigenvalue greater than 1. The first component explained 54.063% of the total variance, while the second component contributed 28.345%. Together, these two components accounted for 82.408% of the total variance in the observed variables. This finding indicates that the extracted factors sufficiently represent the underlying structure of the research variables (See **Table A1** in the **Appendix**).

The rotated component matrix results indicate that the indicators were grouped into two distinct components. The first component comprises indicators from Safety Risk Management (X1) and Aviation Security Performance (Y), while the second component comprises indicators from the Management Information System (X2). All indicators demonstrated factor loadings above 0.70, indicating strong associations with their respective components (See **Table A2** in the **Appendix**). These

findings confirm that the measurement items show an adequate factor structure and support the construct grouping used in this study.

An instrument item is categorized as valid if the calculated r-value (r-count) > 0.195 and the significance probability (Sig.) < 0.05 . The r-table threshold value of 0.195 was obtained from a significance level of 0.05 with a degree of freedom (df) of 98, calculated from a sample population of 100 respondents (df = 100 - 2).

The test results demonstrate that each questionnaire item is categorized as valid, considering that the calculated r-values for all items exceed the r-table criterion (0.195). Therefore, the measurement instrument used in this study meets reliability requirements for accurately measuring the constructs, ensuring the high credibility of the collected data in addressing the research objectives.

The instrument's reliability, which reflects its ability to provide stable measurement outcomes, was assessed through consistency testing with 100 respondents. In this study, the reliability indicator was considered fulfilled when the Cronbach's Alpha coefficient exceeded the minimum threshold of 0.60.

Table 4. Validity Test

Item	X1	X2	Y	Remarks
X1.1	0.951			Valid
X1.2	0.942			Valid
X1.3	0.939			Valid
X1.4	0.953			Valid
X1.5	0.946			Valid
X1.6	0.933			Valid
X1.7	0.935			Valid
X1.8	0.934			Valid
X2.1		0.907		Valid
X2.2		0.889		Valid
X2.3		0.935		Valid
X2.4		0.926		Valid
X2.5		0.913		Valid
X2.6		0.906		Valid
X2.7		0.882		Valid
X2.8		0.912		Valid
X2.9		0.906		Valid
X2.10		0.913		Valid
Y.1			0.936	Valid
Y.2			0.917	Valid
Y.3			0.930	Valid
Y.4			0.911	Valid
Y.5			0.904	Valid
Y.6			0.896	Valid
Y.7			0.939	Valid
Y.8			0.919	Valid
Y.9			0.920	Valid
Y.10			0.910	Valid

Source: Data Analysis Results, 2025

Table 5. Reliability Test

Variable	Cronbach's Alpha	Remarks
Safety Risk Management (X1)	0.841	Reliable
Management Information System (X2)	0.797	Reliable
Aviation Security Performance (Y)	0.816	Reliable

Source: Data Analysis Results, 2025**Table 6.** Descriptive Statistics

Statistic	X1	X2	Y
Valid N	100	100	100
Missing	0	0	0
Mean	24.09	29.86	30.53
Std. Error of Mean	0.869	0.919	1.041
Median	24.00	30.00	30.50
Mode	16	29	33
Std. Deviation	8.692	9.189	10.410
Variance	75.557	84.445	108.373
Skewness	0.089	-0.144	-0.041
Std. Error of Skewness	0.241	0.241	0.241
Kurtosis	-0.916	-0.139	-0.889
Std. Error of Kurtosis	0.478	0.478	0.478
Range	32	40	40
Minimum	8	10	10
Maximum	40	50	50
Sum	2409	2986	3053

Source: Data Analysis Results, 2025

Referring to the descriptive statistics, the Safety Risk Management dimension (X1) has a mean of 24.09 and a standard deviation of 8.692, indicating a moderate distribution. The Management Information System variable (X2) has a mean of 29.86 and a standard deviation of 9.189, indicating a similar distribution. Meanwhile, the Aviation Security Performance variable (Y) has a mean value of 30.53 with a standard deviation of 10.410. The relatively close standard deviation values indicate similar variability among the three variables. Furthermore, the three variables exhibit relatively low skewness and kurtosis values, indicating that the data distribution is approximately normal. Therefore, it can be concluded that, in general, respondents have varying yet relatively stable levels of Safety Risk Management, Management Information System, and Aviation Security Performance.

Table 7. Normality Test

Test	N	Statistic	p-value
Kolmogorov-Smirnov	100	0.059	0.200

Source: Data Analysis Results, 2025

Based on the normality assessment using the Kolmogorov-Smirnov test, the p-value (Sig.) was 0.200. Since this value exceeds the significance level α (0.05), the research data distribution meets the criteria for normality.

Figure 1. Normality P-Plot

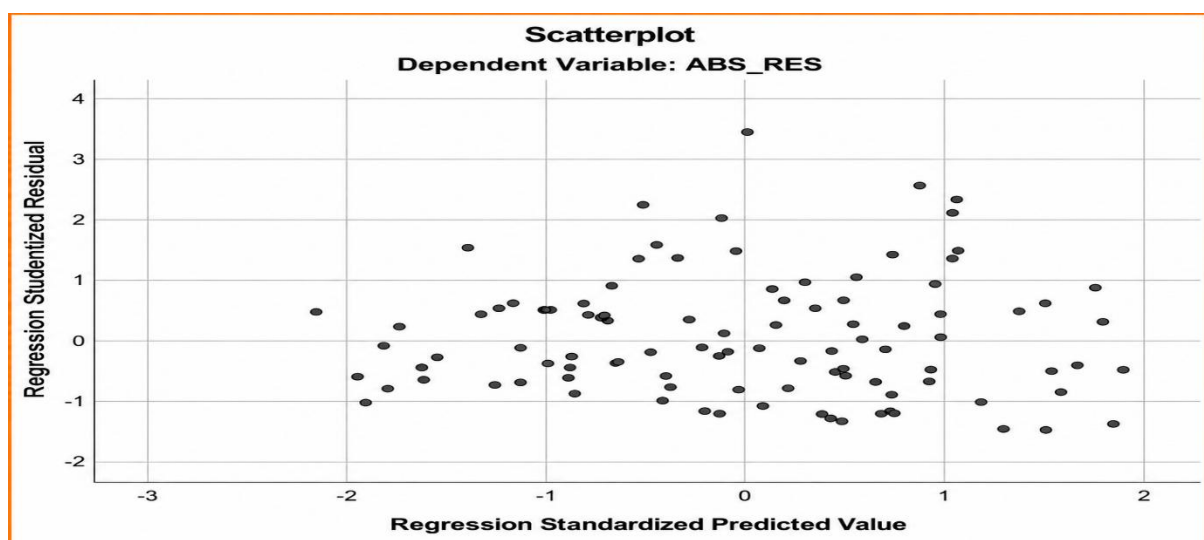
The normality of the residual data distribution was confirmed by examining the P-P Plot (Figure 1), which shows that the points are closely distributed and aligned along the diagonal. This phenomenon confirms that the basic assumption of normality in the regression model has been adequately fulfilled.

Table 8. Multicollinearity Test

Predictor	Tolerance	VIF
Safety Risk Management (X1)	0.999	1.001
Management Information System (X2)	0.999	1.001

Source: Data Analysis Results, 2025

Based on the statistical evaluation, no excessive linear relationship was detected among the independent variables. VIF values indicate the absence of multicollinearity, with each variable not exceeding 10 and tolerance coefficients consistently above 0.1.

Figure 2. Heteroscedasticity Test

The absence of heteroscedasticity was confirmed by the scatterplot (Figure 2), in which the distribution of observation points appeared random, without forming any specific symmetrical pattern, and was scattered above and below the value of 0 on the Y-axis. This data distribution, which does not exhibit accumulation or a systematic pattern, indicates that the assumption of no heteroscedasticity in the regression model has been satisfied.

Table 9. Multiple Linear Regression Results

Predictor	B	Std. Error	β
Constant	-9.609	1.997	–
Safety Risk Management (X1)	0.837	0.052	0.699
Management Information System (X2)	0.669	0.049	0.591

Source: Data Analysis Results, 2025

Referring to the analysis output in the Coefficients table, the estimated multiple regression model is $Y = -9.609 + 0.837X1 + 0.669X2$. The negative constant value (-9.609) indicates that when all predictors remain constant, the value of the dependent variable (Y) decreases by 9.609 units. Meanwhile, the coefficients for predictors X1 (0.837) and X2 (0.669) are positive, indicating a unidirectional relationship. This means that a one-point increase in variable X1 or X2 will linearly affect an increase in variable Y by 0.837 units and 0.669 points, respectively, assuming other supporting factors remain unchanged (*ceteris paribus*).

Table 10. Coefficient of Determination Test (R^2)

R	R^2	Adjusted R^2	Std. Error of the Estimate
0.905	0.818	0.815	4.484

Source: Data Analysis Results, 2025

Based on the coefficient of determination test presented in Table 10, the regression model obtained an R^2 value of 0.818. This result indicates that Safety Risk Management (X1) and Management Information System (X2) explain 81.8% of the variation in Aviation Security Performance (Y). In comparison, the remaining 18.2% represents variation not captured by the proposed model. The model's high explanatory power indicates that both organizational risk management practices and information system support are important factors in aviation security performance. However, the interpretation of this value is limited to the explanatory power of the regression model in the observed research setting, as other contextual factors may also contribute to variation in aviation security performance.

Table 11. T-Test (Partial Test)

Predictor	B	Std. Error	β	t	p-value
Constant	-9.609	1.997	–	-4.811	< 0.001
Safety Risk Management (X1)	0.837	0.052	0.699	16.133	< 0.001
Management Information System (X2)	0.669	0.049	0.591	13.646	< 0.001

Source: Data Analysis Results, 2025

Referring to the presentation in Table 11, the individual relationship between each independent predictor and the dependent variable is described as follows:

Analysis of the Effect of Safety Risk Management (X1) on Aviation Security Performance (Y)

$H_0: \beta_1 = 0$, assumes that variable X1 does not provide a directional contribution to variable Y.

H1: $\beta_1 > 0$, states that variable X1 has a significant positive effect on variable Y.

The initial hypothesis of this study was that X1 would have a positive effect on Y. Based on the regression coefficient test, X1 had a statistically significant effect ($p < 0.001$) with a positive coefficient ($\beta = 0.699$). Since the probability value is lower than the significance level of 0.05, H1 is supported, and H0 is rejected. These results indicate that Safety Risk Management has a statistically significant positive relationship with Aviation Security Performance.

Analysis of the Effect of Management Information System (X2) on Aviation Security Performance (Y)

H0: $\beta_2 = 0$, assumes that predictor X2 does not provide a directional contribution to the dependent variable Y.

H2: $\beta_2 > 0$, states that predictor X2 has a significant positive effect on variable Y.

The regression results show that X2 has a p-value < 0.001 and a positive coefficient ($\beta = 0.591$). Therefore, H2 is supported, and H0 is rejected. This finding indicates that Management Information Systems are positively associated with Aviation Security Performance, suggesting that better information system support contributes to improved security performance.

Table 12. F-Test (Simultaneous Test)

Source	Sum of Squares	df	Mean Square	F	p-value
Regression	8778.972	2	4389.486	218.356	< 0.001
Residual	1949.938	97	20.102		
Total	10728.910	99			

Source: Data processed by the researcher, 2025

Based on the details presented in Table 11, the pattern of the combined effect of independent predictors on the dependent variable is formulated as follows:

H0: Predictors X1 and X2 simultaneously do not affect variable Y.

H3: Variables X1 and X2 simultaneously have a significant effect on variable Y.

Referring to Table 12, the obtained probability value (Sig.) was 0.000, which is below the significance threshold $\alpha = 0.05$. Therefore, the research hypothesis is statistically accepted. Based on the F-test results presented in Table 14, the regression model yielded a p-value of < 0.001 . This result indicates that Safety Risk Management (X1) and Management Information System (X2), when included together in the regression model, significantly explain variations in Aviation Security Performance (Y). Therefore, H3 is supported. The F-test confirms the overall significance of the proposed regression model but does not indicate the presence of interaction or synergistic effects between the independent variables.

4.2 Discussion

4.2.1 The Effect of Safety Risk Management on Aviation Security Performance

The empirical findings of this study confirm that the Safety Risk Management construct has a significant effect on Aviation Security Performance. This is demonstrated by the statistical relationship between SRM and Aviation Security Performance, in which higher SRM scores are associated with higher

performance scores among respondents. This finding indicates that the implementation of risk management practices is related to Avsec personnel's ability to maintain consistency, awareness, and preparedness when performing security-related tasks. However, the relationship identified in this study should be interpreted within the context of the observed research, as the cross-sectional design does not establish a direct causal mechanism.

One factor that may explain this relationship is that structured risk management practices provide personnel with a framework for identifying potential risks, evaluating operational conditions, and determining appropriate responses. Therefore, SRM can be viewed as an organizational capability that supports risk-oriented decision-making and procedural consistency rather than as a single factor that independently determines security performance. This finding is consistent with the concept that risk management contributes to organizational preparedness by supporting systematic identification and control of potential disruptions (Irvan & Maulana, 2023).

The findings of this study are consistent with the research results of Susanto *et al.*, (2024), which found that an in-depth understanding of risk profiling is a core competency that significantly improves personnel accuracy in detecting prohibited items. Similarly, the research findings of Kierzkowski *et al.*, (2024) showed that cognitive aspects in risk management directly contribute to reducing human error during security screening. Furthermore, the development of risk assessment and prevention mechanisms using modern analytical techniques indicates that structured risk management approaches, supported by appropriate analytical tools, can strengthen threat identification and mitigation processes, which are important components of maintaining Aviation Security Performance (Hu *et al.*, 2025). Nevertheless, differences in operational environments, organizational procedures, and personnel characteristics may influence the extent to which risk management practices are translated into actual performance outcomes.

4.2.2 Effect of Management Information System on Aviation Security Performance

The data in Table 10 show that the significance value (Sig.) for the Management Information System variable (X2) is reported by SPSS as 0.000 ($p < 0.001$). Since the p-value is below the 0.05 significance level, H2 is supported, and H0 is rejected. This result indicates that Management Information Systems have a statistically significant relationship with Aviation Security Performance (Y). The findings suggest that better availability, accessibility, and utilization of information systems are associated with improved Aviation Security Performance in airport operations. Rather than functioning merely as an administrative tool, MIS provides information support to assist personnel in operational monitoring, coordination, and decision-making related to aviation security tasks (Huegli *et al.*, 2023).

The positive T-value indicates that the Management Information System predictor (X2) has a positive linear relationship with Aviation Security Performance (Y). This finding indicates that variations in MIS implementation are associated with variations in Aviation Security Performance scores among respondents. Therefore, MIS can be understood as an organizational information infrastructure that supports personnel in accessing relevant information, coordinating operational activities, and responding to security-related conditions.

A well-developed Management Information System can support more structured and efficient work processes by providing timely and accurate information. In aviation security operations, the availability of information can assist Avsec personnel in monitoring operational conditions, managing relevant security data, and improving situational awareness during security activities. However, the

effectiveness of MIS remains dependent on the ability of personnel and organizations to utilize the available information within existing operational procedures. Therefore, the implementation of MIS represents an important supporting factor in maintaining the effectiveness of Aviation Security Performance (Choi *et al.*, 2024).

The findings of this study strengthen previous research discussing Avsec duty report information systems, which concluded that effective management information systems provide convenience for staff in preparing reports and facilitate administrators in summarizing monthly activities (Komalasari & Rusnandi, 2022). In addition, these findings are also consistent with studies demonstrating that information risk management tools/mechanisms (components of MIS/IMS at the organizational level) assist in identifying and mitigating security risks, supporting the claim that information systems and information risk management improve security resilience and task performance (Andersson *et al.*, 2025). Nevertheless, the contribution of MIS to aviation security performance may vary depending on organizational readiness, personnel competence, and the extent to which information systems are integrated into daily operational practices.

4.2.3 The Simultaneous Effect of X_1 and X_2 on Y

The results show that the calculated F-value was 218.356, with a significance (Sig.) of 0.000 ($p < 0.001$). Since the significance value is below the 0.05 threshold, the proposed regression model is statistically significant, indicating that Safety Risk Management (X_1) and Management Information System (X_2), when considered simultaneously, significantly explain the variation in Aviation Security Performance (Y). This finding confirms that the regression model provides a significant overall explanation of the relationship between the independent variables and the dependent variable. However, the F-test does not indicate the presence of interaction or synergistic effects between X_1 and X_2 ; rather, it reflects the combined contribution of both predictors in the regression model.

From a theoretical perspective, the simultaneous relationship between SRM and MIS suggests that Aviation Security Performance is associated with multiple organizational capabilities. SRM provides a structured approach for identifying and managing risks, while MIS supports information availability and operational decision-making. The presence of both capabilities within the model indicates that risk management practices and information support are complementary aspects of aviation security operations.

The findings of this study strengthen prior research indicating that implementing safety risk management has a significant effect on the quality of air traffic controller services (Lestary *et al.*, 2023). Similar support was found in research indicating that the simultaneous integration of regulatory knowledge and risk procedure compliance can reduce security incidents to a minimum (Clare & Kourousis, 2021). These findings indicate that various organizational factors, including risk management practices and procedural support, influence effective aviation security performance. However, the contribution of each factor may differ depending on the operational context.

Furthermore, the consistency and alignment of these findings are strengthened by previous empirical studies stating that human risk factors, including competence and compliance with procedures, are major determinants of aviation operational safety, and that risk management in these aspects directly contributes to preventing the majority of safety incidents (Yazgan, 2018). This is also reinforced by research findings indicating that a strong safety culture must be developed through the simultaneous and integrated implementation of risk management. Therefore, the results of the F-test

support the importance of considering multiple organizational factors simultaneously in understanding Aviation Security Performance, rather than indicating a direct synergistic mechanism among the variables (Chaves, 2020).

5. Conclusion

This study examined the relationships of Safety Risk Management and Management Information System with Aviation Security Performance at Kualanamu International Airport using multiple linear regression analysis. The findings indicate that Safety Risk Management and Management Information System are positively and significantly associated with Aviation Security Performance, both individually and when considered simultaneously in the regression model. The model explains 81.8% of the observed variation in Aviation Security Performance. These results suggest that risk management practices and information system support represent relevant organizational factors associated with the performance of Avsec personnel.

The findings should be interpreted in light of several methodological limitations. First, the cross-sectional design identifies statistical associations but does not establish causal relationships between Safety Risk Management, Management Information System, and Aviation Security Performance. Second, the study was conducted at a single airport with 100 Avsec personnel, which may limit the generalizability of the findings to other airport contexts. Third, the data were obtained through questionnaire-based self-reports, which respondents' perceptions and response tendencies may influence. Therefore, the results should be understood as evidence of statistical relationships within the observed research setting rather than as proof of direct causal effects.

From a practical perspective, airport management may consider strengthening structured risk management practices and improving the accessibility, reliability, and integration of management information systems as part of broader efforts to support Aviation Security Performance. Future studies are encouraged to employ longitudinal or multi-airport designs, include larger sample sizes, and incorporate objective operational performance indicators to examine further the relationships identified in this study.

Statement of Use of Generative AI

During the preparation of this work, the author used generative artificial intelligence tools to support the scientific writing process. Grammarly was used to check grammar, refine writing style, and improve clarity in scientific writing. All interpretations, analyses, and conclusions presented in this study are the sole responsibility of the author.

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Appendix

Table A1. Total Variance Explained

Total Variance Explained						
Component	Initial Eigenvalues			Extraction Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	15.138	54.063	54.063	15.138	54.063	54.063
2	7.937	28.345	82.408	7.937	28.345	82.408
3	.788	2.816	85.224			
4	.408	1.459	86.683			
5	.328	1.173	87.855			
6	.283	1.012	88.867			
7	.274	.980	89.847			
8	.251	.895	90.743			
9	.246	.879	91.622			
10	.229	.818	92.440			
11	.224	.799	93.239			
12	.191	.683	93.922			
13	.184	.658	94.580			
14	.170	.607	95.188			
15	.157	.562	95.750			
16	.148	.529	96.279			
17	.131	.468	96.747			
18	.125	.447	97.194			
19	.118	.420	97.614			
20	.104	.373	97.987			
21	.093	.332	98.319			
22	.090	.322	98.641			
23	.084	.301	98.943			
24	.076	.272	99.215			
25	.069	.245	99.460			
26	.061	.216	99.676			
27	.058	.207	99.883			
28	.033	.117	100.000			

Source: Data Analysis Results, 2026

Table A2. Rotated Component Matrix

Rotated Component Matrixa		
	Component	
	1	2
X1.4	.936	
X1.2	.926	
X1.5	.926	
X1.1	.925	
X1.8	.916	
X1.7	.912	
X1.6	.908	
X1.3	.908	
Y.1	.777	
Y.8	.759	
Y.6	.752	
Y.7	.739	.528



Y.4	.736	.514
Y.9	.732	.527
Y.3	.731	.551
Y.2	.716	.559
Y.5	.710	.522
Y.10	.697	.557
X2.3		.923
X2.5		.913
X2.4		.912
X2.1		.903
X2.10		.902
X2.8		.897
X2.6		.896
X2.9		.894
X2.2		.880
X2.7		.874

Source: *Data Analysis Results, 2026*