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The Effect of Risk Management on Aviation Logistics Effectiveness with Operational Performance as a Mediating Variable at the Cargo Terminal of Sentani Airport

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Abstract: This study examines operational challenges in air cargo services, including delays, security risks, limited infrastructure, and uncertain weather conditions. The study aims to analyse the direct effect of risk management on operational performance and logistics effectiveness, as well as the mediating role of operational performance. A quantitative cross-sectional design was applied to all 30 employees of In Journey Aviation Services at Sentani Airport using saturated sampling. Data were collected through a five-point Likert-scale questionnaire and analysed using partial least squares structural equation modelling. The results show that risk management has a positive and significant effect on operational performance and logistics effectiveness. Operational performance also has a positive and significant effect on logistics effectiveness. In addition, operational performance partially mediates the relationship between risk management and logistics effectiveness. The findings conclude that effective risk management improves aviation logistics services both directly and through stronger operational performance, thereby supporting safer, more reliable, and more efficient cargo handling at Sentani Airport.

Keyword: Cargo Terminal, Logistics Effectiveness, Operational Performance, Risk Management, Sentani Airport

INTRODUCTION

Air transportation plays a vital role in connecting production centres, markets, and communities, particularly in an archipelagic country such as Indonesia. In addition to passenger mobility, aviation supports the rapid distribution of food, medicines, construction materials, and other essential goods. The continuous growth of the aviation industry requires service providers to improve safety, service quality, speed, and operational reliability (Utama & Rezki, 2021). The development of aviation logistics has therefore become an important part of Indonesia's national connectivity and economic development agenda (Bappenas, 2022). However, increasing demand for air transport services must be supported by effective

operational management to ensure that logistics services meet customer expectations and regional distribution needs (Nurcahyo et al., 2023).

Logistics operations in Indonesia still face high distribution costs, unequal infrastructure, inconsistent service quality, and limited access to remote areas. These challenges are more significant in Papua because of its mountainous geography, long distances between regions, limited road access, and unpredictable weather conditions. Sentani Airport serves as one of the main aviation gateways in eastern Indonesia and functions as an important distribution centre for goods transported to Jayapura, mountainous areas, and other remote locations in Papua. Airport infrastructure has been found to positively influence the development of aviation logistics in Papua, while high transportation costs may restrict its growth (Lubis, 2024). Consequently, interruptions at the Sentani Airport Cargo Terminal can directly affect the availability and continuity of essential supplies in areas that depend heavily on air transportation.

The vulnerability of cargo operations at Sentani Airport is reflected in fluctuations in cargo volume. Cargo volume in May 2025 decreased by approximately 25 per cent compared with the same period in the previous year (Antara Papua, 2025). By mid-December 2025, the cumulative decline was reported to have reached approximately 20 per cent compared with 2024. This decline was associated with the limited number of operating aircraft and extreme weather conditions in Papua (Lelemuku, 2025). Air cargo operations also face risks related to delays, damaged goods, documentation errors, security threats, prohibited items, and dangerous materials. The Indonesian Ministry of Transportation has emphasised the need to strengthen air cargo security through modern screening technology, integrated information systems, and better coordination among aviation stakeholders (Kemenhub, 2025). If these risks are not properly managed, they may increase operational costs, disrupt cargo handling, reduce service reliability, and weaken customer confidence.

Risk management is therefore essential for maintaining safe, reliable, and efficient aviation logistics operations. Risk management refers to a systematic and continuous process of identifying, analysing, evaluating, treating, communicating, and monitoring risks that may prevent an organisation from achieving its objectives. It is not limited to avoiding possible threats but also involves preparing appropriate responses to reduce losses and maintain operational continuity (Wali et al., 2022). In aviation logistics, risk management helps organisations anticipate flight delays, equipment failures, adverse weather, security incidents, documentation problems, and coordination failures. Effective mitigation strategies can reduce the consequences of these disruptions and support the continuity of cargo services (Haryati & Hutomo, 2024). In this study, risk management is operationally represented by risk identification, risk analysis, risk treatment, risk communication, and continuous monitoring.

Operational performance is another important factor in determining the success of airport logistics services. It reflects an organisation's ability to perform daily activities efficiently, reliably, and productively while maintaining the required service standards. Operational performance is influenced by the management of employees, physical assets, procedures, information, and technology. Good airport operational performance can reduce handling time, minimise errors, improve coordination, and support consistent service delivery (Keke & Susanto, 2019). In this study, operational performance is measured through process efficiency, service quality, operational reliability, and productivity. Effective asset and resource management may also strengthen an organisation's operational capabilities and competitive position (Maletic et al., 2020).

Logistics effectiveness refers to the ability of a logistics system to deliver goods and related information in accordance with operational requirements and customer expectations. An effective logistics system should ensure that cargo is delivered to the correct destination, in the required quantity and condition, within the expected time, and at a reasonable cost.

Logistics effectiveness can be assessed through delivery time, delivery accuracy, logistics costs, service quality, customer satisfaction, and the organisation's ability to respond to changing conditions (Robi'in, 2021; Styawati et al., 2023). In the context of Sentani Airport, logistics effectiveness represents the cargo terminal's ability to maintain timely, accurate, safe, and dependable services despite geographical, infrastructural, and operational limitations.

The three research variables are theoretically related. Effective risk management can reduce uncertainty, clarify employee responsibilities, and improve organisational preparedness. These improvements are expected to strengthen operational performance by reducing interruptions and enabling employees to complete cargo-handling activities more efficiently. Better operational performance may subsequently improve logistics effectiveness through faster handling, greater service accuracy, more reliable delivery, and better cost control. Previous studies have shown that risk management can reduce losses and improve logistics activities, while stronger operational processes can increase the effectiveness of service delivery (Wali et al., 2022; Zai et al., 2022). Operational performance may therefore function as a mediating mechanism that explains how risk management contributes to logistics effectiveness.

Studies that examine risk management, operational performance, and logistics effectiveness within one integrated model remain limited, particularly in airport cargo terminals in eastern Indonesia. Sentani Airport has distinctive operational characteristics because it serves remote areas, faces difficult geographical and weather conditions, and relies on coordination among airlines, cargo agents, security personnel, ground-handling providers, and other supporting units. This context provides an important basis for testing whether risk management directly improves logistics effectiveness and whether its effect is transmitted through operational performance.

Accordingly, this study aims to analyse the effect of risk management on operational performance, the effect of operational performance on aviation logistics effectiveness, and the direct effect of risk management on aviation logistics effectiveness at the Sentani Airport Cargo Terminal. It also examines the mediating role of operational performance in the relationship between risk management and logistics effectiveness. The research addresses four questions: Does risk management affect operational performance? Does operational performance affect aviation logistics effectiveness? Does risk management directly affect aviation logistics effectiveness? Does operational performance mediate the effect of risk management on aviation logistics effectiveness? These questions are examined in the discussion and answered on the basis of the empirical findings in the conclusion.

METHOD

Research Design

This study employed a quantitative approach with descriptive and hypothesis-testing components. The descriptive analysis was used to explain respondents' perceptions of risk management, operational performance, and aviation logistics effectiveness, while hypothesis testing was conducted to examine the direct and indirect relationships among the three constructs. Based on the data collection period, the study used a *cross-sectional* design because the data were collected from respondents within a single research period (Sekaran & Bougie, 2016). A survey method was applied using a structured questionnaire as the primary data collection instrument (Fowler, 2014).

Research Site and Period

The study was conducted at Sentani Airport in Jayapura, Papua, with a specific focus on employees of PT InJourney Aviation Services involved in airport and cargo-related operations. The research was conducted over three months in 2026. The research stages included

instrument preparation, institutional coordination, data collection, data verification, statistical analysis, and preparation of the research findings.

Population and Sample

The population consisted of all 30 employees of PT InJourney Aviation Services working at Sentani Airport. These employees were selected because they were directly involved in airport operations and had sufficient knowledge of risk management, operational processes, and aviation logistics services.

A saturated sampling technique was used, in which every member of the population was included as a research respondent. Therefore, the final sample consisted of 30 respondents. This technique was considered appropriate because the population was relatively small and all its members had characteristics relevant to the research objectives (Sugiyono, 2022).

Research Variables and Measurement

The study examined three constructs: risk management as the independent variable, operational performance as the mediating variable, and aviation logistics effectiveness as the dependent variable. All constructs were measured reflectively.

Risk management was measured through five dimensions: risk identification, risk analysis, risk evaluation, risk control, and risk monitoring. These dimensions covered the ability to identify operational disruptions, assess the likelihood and consequences of risks, determine treatment priorities, implement mitigation measures, and monitor and document risks.

Operational performance was assessed through process efficiency, service quality, productivity, and operational reliability. These dimensions represented timely task completion, efficient resource utilisation, service compliance, achievement of operational targets, coordination across units, and the ability to overcome operational disruptions.

Aviation logistics effectiveness was measured through timeliness, service accuracy, logistics service quality, and cost efficiency. The indicators included cargo delivery and handling time, correspondence between cargo and documentation, accuracy of tracking information, cargo condition, responsiveness to complaints, customer satisfaction, and the efficient use of operational costs.

Research Instrument

The primary instrument was a closed-ended questionnaire developed from the operational indicators of each construct. The questionnaire consisted of three sections: respondent characteristics, completion instructions, and research statements. Respondent characteristics included age, gender, length of employment, educational background, and work unit.

The instrument contained 39 statements. Risk management was measured using 15 statements, operational performance using 12 statements, and aviation logistics effectiveness using 12 statements. Each statement was rated on a five-point Likert scale, ranging from 1, representing strongly disagree, to 5, representing strongly agree. The five-point scale was selected because it allowed respondents to express different levels of agreement while supporting quantitative statistical analysis (Sekaran & Bougie, 2016).

Documentation and informal, unstructured observation were used as supporting instruments. Documentation included institutional information, field notes, and records related to the implementation of data collection. Observation was conducted to obtain contextual information regarding operational activities and risk management practices at Sentani Airport (Creswell & Creswell, 2018).

Data Collection Procedure

The data collection procedure consisted of preparation, implementation, and final processing stages. During the preparation stage, research permission was obtained from the management of Sentani Airport, coordination was conducted regarding the schedule and technical procedures, and the questionnaire was prepared according to the number of respondents.

During the implementation stage, the researcher explained the research purpose, confidentiality of responses, and questionnaire instructions to the participants. The questionnaire was then distributed directly to all 30 respondents. The researcher assisted respondents when clarification was required to minimise differences in interpretation. Completed questionnaires were collected and checked for completeness.

During the final stage, each questionnaire was coded, responses were tabulated, and the dataset was reviewed for missing or incomplete information. The verified data were organised in a spreadsheet before being imported into SmartPLS version 4.0 for statistical analysis.

Data Analysis

The data were analysed using descriptive statistics and *Partial Least Squares Structural Equation Modeling* with SmartPLS version 4.0. This method was selected because the research model included a mediating construct, the sample size was relatively small, and the method did not require multivariate normality (Hair et al., 2022).

The analysis was conducted in two stages. First, the measurement model was evaluated to assess instrument validity and reliability. Convergent validity was examined using indicator loadings and the *average variance extracted*. Indicator loadings above 0.70 were preferred, although values between 0.50 and 0.60 could be retained for an exploratory model when other measurement criteria were satisfied. An *average variance extracted* value greater than 0.50 indicated adequate convergent validity. Discriminant validity was assessed using the Fornell–Larcker criterion and indicator cross-loadings. Construct reliability was evaluated using Cronbach’s alpha and composite reliability, with values above 0.70 considered acceptable (Hair et al., 2022).

Second, the structural model was assessed using the coefficient of determination, effect size, predictive relevance, and path coefficients. Predictive relevance was evaluated through the blindfolding procedure, with values greater than zero indicating that the model had predictive relevance. Hypotheses were tested through *bootstrapping* with 5,000 subsamples. A relationship was considered statistically significant when the *t*-statistic exceeded 1.96 or the *p*-value was below 0.05.

The mediating role of operational performance was examined through the specific indirect effect of risk management on aviation logistics effectiveness. Partial mediation was established when both the direct and indirect effects were significant, while full mediation was established when the indirect effect was significant and the direct effect was not significant. When the indirect effect was not significant, operational performance was considered not to mediate the relationship (Hair et al., 2022).

RESULTS AND DISCUSSION

Respondent Profile and Descriptive Results

The study involved all 30 employees of PT InJourney Aviation Services working at Sentani Airport. Male respondents accounted for 22 participants or 73.3%, while female respondents accounted for 8 participants or 26.7%. Respondent characteristics based on their educational background are presented in Table 1.

Table 1. Respondent Characteristics Based on Educational Background

Education	Frequency	Percentage (%)
Senior High School/Vocational High School	16	53.3
Diploma III	5	16.7
Bachelor's Degree	9	30.0
Total	30	100

Most respondents were under 30 years old, representing 60.0% of the sample, followed by those aged 31–40 years at 30.0% and those over 40 years at 10.0%. In terms of employment duration, 83.3% of respondents had worked for less than five years, 13.3% had worked for five to ten years, and 3.3% had worked for more than ten years. This profile indicates that the respondents were predominantly young and actively involved in daily airport and cargo operations.

The descriptive results showed that all three research variables were rated very highly. Risk management and operational performance each obtained an overall mean score of 4.29, while aviation logistics effectiveness obtained a mean score of 4.23. These results indicate that respondents generally perceived risk management practices, operational activities, and logistics services at Sentani Airport as well implemented.

Table 2. Descriptive Statistics of Research Variables

Variable	Mean	Category
Risk Management	4.29	Very high
Operational Performance	4.29	Very high
Aviation Logistics Effectiveness	4.23	Very high

Source: Primary data processed, 2026.

Within the risk management construct, risk monitoring received the highest evaluation, whereas risk analysis obtained the lowest mean score of 4.20. Although still categorised as high, this finding indicates that systematic assessment of risk probability and operational consequences requires further improvement. Within operational performance, process efficiency recorded the highest mean score of 4.42, followed by service quality at 4.26, operational reliability at 4.24, and productivity at 4.23. These findings suggest that daily operational processes were considered efficient, although output improvement and coordination across work units could still be strengthened.

Measurement Model Evaluation

The measurement model was evaluated through convergent validity, discriminant validity, and construct reliability. The detailed statistical output showed that the retained indicators had adequate loading values. The average variance extracted values for all constructs exceeded the recommended threshold of 0.50, indicating that each construct explained more than half of the variance in its indicators.

Table 3. Construct Reliability and Convergent Validity

Construct	Cronbach's Alpha	ρ_A	Composite Reliability	Average Variance Extracted
Aviation Logistics Effectiveness	0.971	0.973	0.974	0.756
Operational Performance	0.969	0.970	0.972	0.745
Risk Management	0.974	0.975	0.976	0.732

Source: SmartPLS output, 2026.

All Cronbach's alpha and composite reliability values exceeded 0.70, confirming strong internal consistency. The square roots of the average variance extracted were 0.869 for aviation logistics effectiveness, 0.863 for operational performance, and 0.856 for risk management. These values were higher than the corresponding correlations among the constructs, indicating satisfactory discriminant validity under the Fornell–Larcker criterion. Therefore, the measurement model was considered sufficiently valid and reliable for structural model testing.

Structural Model Evaluation

The coefficient of determination was used to evaluate the explanatory power of the model. Operational performance had an *R*-square value of 0.522, meaning that risk management explained 52.2% of its variance. This value indicates moderate explanatory power. Aviation logistics effectiveness had an *R*-square value of 0.713, showing that risk management and operational performance jointly explained 71.3% of the variation in logistics effectiveness. The remaining 28.7% was influenced by factors outside the model, such as infrastructure capacity, aircraft availability, weather conditions, technology, regulations, and coordination with external stakeholders.

Table 4. Coefficient of Determination

Endogenous Variable	Endogenous Variable	Endogenous Variable	Endogenous Variable
Operational Performance	0.522	0.505	Moderate
Aviation Logistics Effectiveness	0.713	0.692	Moderate to substantial

Source: SmartPLS output, 2026.

The results indicate that the model had a meaningful ability to explain both operational performance and aviation logistics effectiveness. In particular, the relatively high explanatory value for logistics effectiveness demonstrates that risk management and operational performance are important organisational factors in supporting cargo services at Sentani Airport.

Hypothesis Testing

Hypothesis testing was conducted using a bootstrapping procedure. A relationship was considered statistically significant when the *t*-statistic exceeded 1.96 and the *p*-value was below 0.05.

Table 5. Direct and Indirect Effect Testing

Hypothesis	Relationship	Path Coefficient	<i>t</i> -Statistic	<i>t</i> -Statistic	<i>t</i> -Statistic
H1	Risk Management → Operational Performance	723	8.708	0	Supported
H2	Operational Performance → Aviation Logistics Effectiveness	455	2.811	5	Supported
H3	Risk Management → Aviation Logistics Effectiveness	455	2.975	3	Supported
H4	Risk Management → Operational Performance → Aviation Logistics Effectiveness	329	2.786	5	Supported

Source: SmartPLS output, 2026.

The results demonstrate that all four hypotheses were supported. Risk management significantly improved operational performance and aviation logistics effectiveness. Operational performance also significantly improved logistics effectiveness. Furthermore, the significant indirect effect confirmed that operational performance partially mediated the relationship between risk management and logistics effectiveness.

1. Effect of Risk Management on Operational Performance

The first hypothesis proposed that risk management positively affects operational performance. The analysis produced a path coefficient of 0.723, a *t*-statistic of 8.708, and a *p*-value below 0.001. Therefore, H1 was supported. The relatively large coefficient indicates that improvements in risk management are strongly associated with better operational performance at the Sentani Airport Cargo Terminal.

This result suggests that systematic risk identification, assessment, mitigation, communication, and monitoring help employees perform daily operational activities more effectively. Early recognition of potential delays, documentation errors, cargo damage, equipment problems, security threats, and weather disruptions enables operational units to prepare appropriate responses before these risks develop into serious service interruptions.

The finding is consistent with Wali et al. (2022), who argued that effective risk management can minimise operational disruption and improve organisational efficiency. It also supports Munir et al. (2020), who found that supply chain risk management contributes to operational performance, particularly when supported by internal and external integration. In the context of Sentani Airport, this integration involves coordination among cargo acceptance personnel, porters, aviation security officers, regulated agents, airlines, and supporting units.

The result indicates that risk management should not be treated solely as an administrative or compliance requirement. It functions as an operational control system that enables employees to work with clearer priorities, better preparation, and more consistent procedures. Therefore, improvements in risk registers, incident reporting, contingency procedures, employee training, and interunit communication are likely to strengthen operational performance.

2. Effect of Operational Performance on Aviation Logistics Effectiveness

The second hypothesis proposed that operational performance positively affects aviation logistics effectiveness. The analysis produced a path coefficient of 0.455, a *t*-statistic of 2.811, and a *p*-value of 0.005. Therefore, H2 was supported.

This finding demonstrates that efficient, reliable, productive, and service-oriented operations improve the effectiveness of aviation logistics. Faster cargo handling reduces waiting time and the possibility of missed flights. Accurate documentation and cargo inspection reduce delivery errors, while reliable coordination supports the timely movement of goods between the cargo terminal, aircraft, and destination airports.

The high descriptive score for process efficiency reinforces this result. Respondents considered task completion, resource utilisation, and the continuity of daily processes to be important operational strengths. However, productivity had the lowest score among the operational performance dimensions. This indicates that, although work processes were generally efficient, the organisation could still improve output achievement and coordination among operational units.

The finding is consistent with Maletic et al. (2020), who stated that effective asset and operational management can improve organisational performance. It also supports the logistics effectiveness concept proposed by Robi'in (2021), in which the ability to manage the movement of goods and information determines whether logistics objectives can be achieved.

Thus, aviation logistics effectiveness depends not only on infrastructure but also on how consistently personnel, procedures, information, and equipment are managed.

3. Effect of Risk Management on Aviation Logistics Effectiveness

The third hypothesis proposed that risk management directly affects aviation logistics effectiveness. The analysis produced a path coefficient of 0.455, a *t*-statistic of 2.975, and a *p*-value of 0.003. Therefore, H3 was supported.

The result indicates that effective risk management directly contributes to more reliable, timely, safe, and efficient cargo services. Cargo operations are exposed to delays, extreme weather, equipment failure, security threats, prohibited goods, cargo damage, and inaccurate documentation. When these risks are systematically identified and controlled, operational interruptions can be reduced and service continuity can be maintained.

This result supports Zai et al. (2022), who found that risk management contributes positively to logistics activities. It is also consistent with Wali et al. (2022), who explained that risk mitigation can reduce unexpected costs and improve logistics efficiency. At Sentani Airport, where cargo distribution is highly dependent on aircraft schedules and weather conditions, risk management becomes especially important because a single disruption may affect supply distribution to remote areas of Papua.

The finding further demonstrates that risk monitoring should be accompanied by stronger analytical capability. Although risk monitoring received a high descriptive score, risk analysis was rated relatively lower. The organisation should therefore improve the use of risk matrices, probability-impact assessments, historical incident data, and scenario-based analysis. Better analytical practices would enable management to prioritise risks more accurately and allocate resources to the most critical operational threats.

4. Mediating Role of Operational Performance

The fourth hypothesis proposed that operational performance mediates the effect of risk management on aviation logistics effectiveness. The indirect effect had a coefficient of 0.329, a *t*-statistic of 2.786, and a *p*-value of 0.005. Therefore, H4 was supported.

Because the direct effect of risk management on logistics effectiveness remained significant while the indirect effect through operational performance was also significant, operational performance acted as a partial mediator. This means that risk management improves logistics effectiveness through two mechanisms. First, it directly reduces the probability and impact of disruptions. Second, it improves operational performance, which subsequently enhances timeliness, accuracy, service quality, and cost efficiency.

The partial mediation result confirms that risk management policies generate stronger logistics outcomes when they are translated into daily operational practices. Risk identification alone is insufficient unless it leads to clearer procedures, employee preparedness, reliable equipment, faster communication, and effective coordination. Operational performance therefore represents the implementation channel through which risk management produces practical improvements in cargo services.

This finding extends previous studies by showing that the effect of risk management on logistics effectiveness is not solely direct. In the operational context of Sentani Airport, stronger risk management creates a more controlled working environment, and this environment enables employees to perform cargo-handling activities more efficiently and reliably. Nevertheless, the continued significance of the direct effect indicates that risk management also supports logistics effectiveness through mechanisms beyond operational performance, including safety compliance, security control, contingency readiness, and protection of cargo integrity.

Overall, the findings answer the four research questions. Risk management significantly improves operational performance, operational performance significantly improves aviation logistics effectiveness, and risk management directly improves aviation logistics effectiveness. Operational performance also partially mediates the relationship between risk management and logistics effectiveness. These findings emphasise that risk management and operational improvement should be integrated rather than implemented as separate organisational programmes.

CONCLUSION

This study concludes that risk management has a positive but statistically insignificant effect on operational performance at the Sentani Airport Cargo Terminal. This result indicates that risk identification, analysis, evaluation, control, and monitoring have not yet been sufficiently integrated into daily work processes to produce a measurable improvement in operational performance. In contrast, operational performance has a positive and significant effect on aviation logistics effectiveness, confirming that efficient processes, reliable services, higher productivity, and consistent operational execution are essential for improving the timeliness, accuracy, quality, and cost efficiency of cargo services.

Risk management also has a positive and significant direct effect on aviation logistics effectiveness. This finding demonstrates that systematic risk control contributes directly to maintaining cargo safety, service continuity, delivery reliability, and the prevention of operational disruptions. However, operational performance does not significantly mediate the relationship between risk management and aviation logistics effectiveness. Therefore, risk management and operational performance function as two important determinants of logistics effectiveness, but the proposed indirect mechanism through operational performance was not empirically supported.

The contribution of this study to industrial engineering and logistics science lies in demonstrating that improvements in risk management should not be assumed to automatically enhance operational performance. Risk management outcomes need to be translated into measurable operational controls, including standard operating procedures, performance indicators, clearly assigned responsibilities, interunit coordination mechanisms, employee training, and continuous monitoring systems. Integrating these elements can support the development of a more reliable, responsive, and evidence-based cargo-handling system, particularly for airports operating under geographical, infrastructural, and environmental constraints such as Sentani Airport.

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