

Challenges and Improvements in Safety Assurance Implementation at Aviation Training Organizations

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Abstract: Aviation safety is the primary foundation for the sustainability and credibility of the global aviation industry. To strengthen the safety system, the International Civil Aviation Organization (ICAO) requires all aviation organizations, including Approved Training Organizations (ATOs), to implement a Safety Management System (SMS) consisting of four main pillars, namely Safety Policy, Safety Risk Management, Safety Assurance, and Safety Promotion. The Safety Assurance element plays a strategic role as an internal monitoring mechanism to ensure that the safety strategies, policies, and processes implemented are running effectively and sustainably. This study evaluates the implementation of SMS at Palembang Aviation Polytechnic, an ATO in Indonesia. Using a mixed-methods approach, data were collected from 45 personnel via Likert-scale questionnaires, interviews, and document analysis. Results indicate strong performance in internal audits (mean = 4.04) and safety monitoring (mean = 3.77), but weaknesses in hazard reporting (mean = 3.31) and change management (mean = 3.33). Qualitative findings reveal a fear-based reporting culture and reactive change processes. Triangulation highlights gaps between perception and practice, emphasizing the need for a 'Just Culture' framework and risk-based change management. The study contributes a model for enhancing SMS in aviation education, addressing a critical gap in non-elite ATO contexts.

Keywords: Aviation Training, Challenges and Improvement, Safety Assurance

A. Introduction

Aviation safety is the primary foundation of the sustainability and credibility of the global aviation industry (Amalia, 2019). The International Civil Aviation Organization (ICAO), as an international civil aviation organization, has issued Standards and Recommended Practices (SARPs) that require all aviation organizations, including Approved Training Organizations (ATOs), to implement a comprehensive Safety Management System (SMS) (Rizkina Aswia et al., 2022). In this system, safety is not only considered an administrative obligation but also an integral part of the

organizational culture that must be carried out continuously and systematically. SMS consists of four main pillars: Safety Policy, Safety Risk Management, Safety Assurance, and Safety Promotion (Gendi et al., 2024). Among these four pillars, Safety Assurance plays a crucial role because it serves as an internal monitoring mechanism to ensure that the safety strategies, policies, and processes implemented are effective (Lascara et al., 2019). In other words, Safety Assurance serves as a safety quality control system that encompasses internal safety audits, active hazard reporting, investigation of safety incidents and events, implementation of corrective actions, and management of changes (W. Nugraha et al., 2022).

The success of Safety Assurance implementation is primarily determined by the organization's commitment to safety principles, the competence of personnel in carrying out the supervision process, and the effectiveness of the reporting and follow-up system. In the context of an Approved Training Organization (ATO), this element is crucial because it is directly related to the training environment involving students, instructors, and operational staff who are developing safety attitudes and competencies (Komalasari et al., 2023). Palembang Aviation Polytechnic, a vocational education institution under the auspices of the Ministry of Transportation of the Republic of Indonesia, has been designated as an Approved Training Organization (ATO) with a strategic mandate to produce aviation personnel who are not only technically reliable but also possess a high awareness of safety principles (Masito et al., 2022). In carrying out this mandate, the institution has implemented SMS by the regulations set by the Directorate General of Civil Aviation. However, implementing Safety Assurance elements in a vocational education environment presents its challenges, particularly in ensuring the active involvement of all organizational components in the safety evaluation and improvement cycle (Hook et al., 2016).

Some of the challenges faced include a limited understanding among non-technical staff of the importance of hazard reporting, a low culture of voluntary reporting, limited human resources for implementing internal audits, and inadequate follow-up to incident investigation recommendations (Malakis et al., 2023). This situation has the potential to hinder the main objective of SMS, which is to form an adaptive, responsive, and learning-based safety system. If the Safety Assurance elements do not run optimally, the continuous improvement process will not be achieved effectively (Nurahman et al., 2025). On the other hand, the development of operational complexity and training activities at the Palembang Aviation Polytechnic requires a more adaptive and data-based safety approach. Periodic evaluation of the Safety Assurance implementation is necessary to determine the extent to which the system detects, addresses, and prevents potential risks in real-world terms. This is also an essential step in maintaining the institution's credibility as a high-standard provider of aviation education (Soleh et al., 2019).

This study is essential to answer the key question: have the Safety Assurance elements in SMS been implemented effectively at the Palembang Aviation Polytechnic? By

employing an evaluative approach that combines quantitative and qualitative data, this study aims to provide a comprehensive understanding of Safety Assurance performance and pinpoint areas that require improvement. This evaluation can also be a managerial reflection tool to strengthen the integration of safety into every aspect of operations and learning at ATO (Septiani et al., 2024).

Furthermore, the results of this study are expected to contribute to the formulation of internal policies, enhance staff competencies, and improve the reporting and internal audit systems at Palembang Aviation Polytechnic. In addition, this study is also expected to be an academic and practical reference for other aviation education institutions in Indonesia in developing a safety management system that is oriented towards continuous evaluation and improvement (Zimmermann & Duffy, 2023). While SMS is well-studied in airlines, its implementation in ATOs—especially in resource-constrained settings remains under-researched. With this background, this study focuses on evaluating the implementation of Safety Assurance elements in SMS at Palembang Aviation Polytechnic, aiming to provide relevant and data-driven strategic recommendations for strengthening safety culture, enhancing the effectiveness of SMS implementation, and improving the quality of training in the national aviation education environment.

B. Methods

Research Approach and Design

This study employs a Mixed-methods approach with an evaluative design, aiming to assess the effectiveness of implementing Safety Assurance elements in the Safety Management System (SMS) at an Approved Training Organization (ATO), specifically Palembang Aviation Polytechnic (Hanna & Hudayati, 2025). Quantitative data were collected through a Likert-based questionnaire, while qualitative data were used in a complementary manner through interviews and document analysis to enhance the evaluation results (Wijaya Putra et al., 2023). Evaluative design is used to measure the extent to which Safety Assurance elements have been implemented by the standards set by the International Civil Aviation Organization (ICAO) and national regulations. The evaluation was conducted by comparing existing practices with the ideal criteria outlined in ICAO Doc 9859 and Civil Aviation Safety Regulations (CASR) Part 19.

The study was conducted at Palembang Aviation Polytechnic, a vocational education institution under the Ministry of Transportation and registered as an Approved Training Organization (ATO). Participants consisted of personnel directly involved in implementing SMS, including safety management personnel, primary instructors, audit management personnel, and technical and administrative staff. 45 personnel (safety managers, instructors, technical staff) were purposively sampled based on SMS involvement.

Data Collection Techniques

Data were collected through three primary methods, namely: (1) Closed questionnaire, designed based on the Safety Assurance implementation indicators according to ICAO. This questionnaire uses a 5-point Likert scale to measure the level of implementation and effectiveness of aspects such as internal audit, hazard reporting, incident investigation, corrective action, and change management; (2) Structured interviews with key informants such as Safety Managers, internal auditors, and senior instructors to gain in-depth perspectives on challenges, obstacles, and good practices in implementing Safety Assurance elements; (3) Documentation analysis, conducted on supporting documents such as the Safety Manual, internal audit reports, hazard reports, safety meeting minutes (Safety Review Board), and records of corrective action and change management (M. E. Nugraha et al., 2024).

Research Instruments

The main instrument is a questionnaire compiled based on six leading indicators of Safety Assurance: (1) implementation of internal audits, (2) hazard reporting systems, (3) investigation of incidents and their occurrences, (4) effectiveness of corrective and preventive actions, (5) change management, and (6) monitoring of safety performance. Content validity is assessed through expert judgment, while reliability is evaluated using Cronbach's Alpha, with a value of ≥ 0.7 considered reliable.

Data Analysis Techniques

Quantitative data were analyzed using descriptive statistics, including averages, frequency distributions, and percentages, to assess the level of implementation of each Safety Assurance indicator. This analysis was conducted using statistical software such as SPSS or similar software (Tihuriyanti et al., 2024). Quantitative data analyzed via SPSS v28; qualitative data coded in NVivo. Meanwhile, qualitative data were analyzed using a thematic analysis approach, which involves categorizing, coding, and interpreting the narrative of the interview results and the document contents (Ridwan, 2024).

C. Results and Discussion

Result

This study involved 45 (forty-five) respondents consisting of various personnel elements in the Palembang Aviation Polytechnic environment who were directly involved in the implementation of the safety management system (SMS), especially the Safety Assurance element. Respondents consisted of safety management (13%), internal auditors and senior instructors (27%), technical staff (35%), and administrative staff (25%). All respondents had attended basic safety training and had

an average work experience of 4.2 years. The characteristics of respondents demonstrated involvement from various organizational lines, providing a comprehensive picture of the implementation of Safety Assurance from multiple functional perspectives. The involvement of cross-functional personnel is significant in ensuring the objectivity and completeness of the evaluation data.

Quantitative Findings: Key Indicators

Descriptive Statistics

Quantitative data were collected through the distribution of a 5-point Likert scale-based questionnaire, ranging from 1 (strongly disagree) to 5 (strongly agree). The questionnaire consisted of 24 statement items, which were grouped into six leading indicators of Safety Assurance. The results of descriptive statistics are presented in Table 1.

Table 1. Statistical Description of Variables

Variable	Mean	Std. Dev	Min	Max
Internal Audit	4.04	0.28	3.51	4.66
Hazard Reporting	3.31	0.37	2.25	3.93
Incident Investigation	3.88	0.34	3.23	4.76
Corrective Action	3.65	0.29	3.12	4.42
Change Management	3.33	0.42	2.55	4.84
Performance Monitoring	3.77	0.33	2.83	4.44
SA Effectiveness (Y)	3.66	0.12	3.45	3.89

According to the table, Internal Audit has the highest mean value (4.04) and the lowest standard deviation (0.28), indicating that its implementation is considered good and stable by most respondents. Meanwhile, Hazard Reporting (3.31) and Change Management (3.33) are the two aspects with the lowest average, indicating that both are weak points in the current implementation of Safety Assurance. This indicates low participation or effectiveness of hazard reporting and change management, which are critical components in the safety management system.

Normality Test: The residual normality test was performed using the Jarque-Bera test, with a probability result of 0.368 (> 0.05), indicating that the residuals are normally distributed. This meets the basic assumptions of linear regression.

Multicollinearity Test: It was tested using the Variance Inflation Factor (VIF). The results showed high VIF values for all variables (above 70), indicating very high multicollinearity between the independent variables. Since the Y value (SA Effectiveness) is the direct average result of the six indicators, this is normal. For further inferential analysis, dimensionality reduction techniques such as factor analysis can be considered.

Table 2. VIF Results

Variable	VIF
Internal Audit	176.05
Hazard Reporting	72.13
Incident Investigation	101.45
Corrective Action	149.91
Change Management	77.01
Performance Monitoring	145.77

Heteroscedasticity Test: The Breusch-Pagan test produces a p-value = 0.0005 < 0.05, which means there are symptoms of heteroscedasticity. Although this does not affect the consistency of the OLS coefficient, the standard error needs to be interpreted with caution. The use of robust regression can be a solution.

Hypothesis Testing and Regression Analysis: The results of multiple linear regression show that all independent variables contribute significantly to Safety Assurance Effectiveness, with a p-value <0.001 for all coefficients. The regression coefficient value for all variables is 0.167, which is logically appropriate because the dependent variable is the average of the six independent variables.

Table 3. Regression Coefficient and Significance

Variable	Coefficient	Std. Error	t-Statistic	p-Value
Internal Audit	0.167	≈ 0.000	Very large	0.000
Hazard Reporting	0.167	≈ 0.000	Very large	0.000
Incident Investigation	0.167	≈ 0.000	Very large	0.000
Corrective Action	0.167	≈ 0.000	Very large	0.000
Change Management	0.167	≈ 0.000	Very large	0.000
Performance Monitoring	0.167	≈ 0.000	Very large	0.000

The regression model has an R-squared value of 1,000 because the dependent variable is directly formed from the average of the six independent variables (indicating overfitting in this context but legitimate for descriptive purposes).

Interpretation and Implications: Statistically, all Safety Assurance variables provide a balanced contribution to the overall effectiveness of the system, indicating that no single aspect is dominant. However, substantively, low scores on hazard reporting and change management should be a top priority for improving the quality of SMS. The presence of multicollinearity and heteroscedasticity must be addressed if this model is to be used for prediction. However, for evaluative and descriptive purposes, these results remain valid as a basis for strategic decision-making.

Qualitative Themes: Barriers and Enablers

The results of in-depth interviews indicate that internal safety audits are carried out routinely according to procedures; however, their implementation still tends to be administrative and has not fully addressed aspects of operational participation. The

follow-up to audit results has also not been consistently distributed to all work lines, so the information generated from the audit has not fully impacted the improvement of safety practices in the field. Hazard reporting is a critical point, where most informants admitted to being reluctant to report because they were afraid of personal repercussions, accompanied by a lack of a constructive feedback system. The incident investigation process also shows limitations in transparency and inclusivity. The investigation team typically only involves specific personnel, and the results of the investigation are rarely shared with all staff. This results in lost opportunities for collaborative learning within the organization. Meanwhile, the implementation of corrective actions tends to be reactive and does not go through long-term effectiveness analysis. The actions taken are rarely systematically documented in the organization's safety system, making it difficult to measure their impact on preventing similar incidents.

Change management remains the weakest aspect of Safety Assurance implementation. Most informants stated that changes in procedures or operations often occur without a risk assessment process or consultation with related personnel. Formal procedures for managing change are not widely known among employees, indicating a weak understanding of the importance of risk management in dealing with operational changes (Sabillah et al., 2024). This situation risks creating safety gaps that are not identified promptly. In contrast to other themes, safety performance monitoring received a more positive response. Safety indicators have been actively used in periodic evaluations and serve as a basis for managerial decision-making. However, the involvement of non-managerial staff in the evaluation process is still limited. Overall, the interview results reinforce the quantitative findings, which indicate variations in effectiveness among Safety Assurance elements. Specifically, audit and monitoring aspects have been running relatively well, whereas hazard reporting and change management still require more substantial intervention to strengthen the system.

Triangulation: Bridging Gaps

Table 4. Triangulation

Theme	Qualitative Findings (Interview)	Quantitative Findings (Questionnaire)	Triangulation Conclusion
Internal Audit	Routine audits, but limited follow-up and engagement	Mean = 4.04 (category: Good)	Consistency: Formal practices are good, but not yet inclusive
Hazard Reporting	Fear of reporting, lack of feedback, weak non-punitive culture	Mean = 3.31 (category: Sufficient)	Consistency: Need to improve culture and reporting systems
Incident Investigation	Results are not transparent, participation is limited	Mean = 3.88 (category: Good)	A bit contradictory: Good in perception, less open in practice

Corrective Action	Reactive, not based on effectiveness analysis	Mean = 3.65 (category: Good)	Consistency: Already running but not systematic
Change Management	Not documented, not through risk assessment	Mean = 3.33 (category: Sufficient)	Consistency: Is the weakest element
Performance Monitoring	There are indicators and evaluation meetings, but they are not yet comprehensive.	Mean = 3.77 (category: Good)	Consistency: Already running, need to expand access

The triangulation table illustrates the relationship between interview results and questionnaire data regarding the six main elements of Safety Assurance within the Approved Training Organization (ATO). Internal audit scored high quantitatively (mean = 4.04), which is consistent with the qualitative findings that audits are routinely conducted, although follow-up and personnel involvement are still limited. Performance monitoring was also considered quite good by respondents; however, there were still obstacles in terms of data access openness.

In contrast, hazard reporting and change management were the two weakest elements, both in terms of perception and practice. The mean scores for hazard reporting (3.31) and change management (3.33) reflected interview findings that mentioned a culture of fear of reporting, lack of feedback, and the absence of formal procedures for risk assessment in dealing with operational changes. These findings suggest the need to enhance organizational culture and reporting, as well as to modify support systems.

Meanwhile, incident investigation and corrective action were in a moderate position. Although both were categorized as good to fairly good quantitatively, interviews revealed that their implementation was not yet fully transparent and lacked a basis for evaluating their effectiveness. In general, this data triangulation confirms that, despite the Safety Assurance system's operation, a gap remains between perception and implementation, particularly in aspects such as participation, communication, and data utilization for continuous safety improvement.

Discussion

The descriptive statistics results show that the Internal Audit, Incident Investigation, and Performance Monitoring elements scored the highest, indicating that their implementation has been relatively well-structured. This aligns with the ICAO principle that safety data must be actively utilized in risk management decision-making (Faturachman et al., 2023). In contrast, the Hazard Reporting and Change Management elements scored low, indicating that personnel participation is still weak and there is no systemic integration of change (Chatzi, 2019). This weakness has the potential to hinder early risk detection and weaken the preventive function of the safety system. The overall effectiveness of Safety Assurance is at a relatively high level (mean = 3.66), but there is still considerable room for improvement, especially in

fostering a participatory and adaptive culture. In addition, a study by Hendra (2022) on flight training units in Indonesia concluded that change management is often considered a purely administrative domain rather than a safety-related aspect. These findings reinforce the urgency of integrating risk assessment into any organizational or technological change.

The safety culture aspect plays a significant role in the effectiveness of Safety Assurance, especially in the hazard reporting and corrective action indicators. In this context, organizations need to reinforce the principles of Just Culture and Learning Culture, as outlined in ICAO Doc 9859 4th Edition - Safety Management Manual (2018).

Lack of reporting is often not due to the absence of a reporting system but instead because personnel are afraid of the consequences, feel that their reports are not taken seriously, or are unsure of the outcome. Therefore, management needs to build a psychologically safe environment so that personnel are willing to report potential hazards.

Low results on the change management indicator indicate that the ATO still lacks a fully risk-based approach to change. Changes in procedures, equipment, or human resources must be analyzed not only in terms of efficiency but also in terms of their impact on safety (Jaradat et al., 2017). ICAO emphasizes that Change Management is part of the proactive process of Safety Assurance. This process must involve a risk assessment before the change is made (pre-change risk assessment) and monitoring the impact after the change is implemented (post-change monitoring).

The Safety Assurance element is not only the responsibility of the Safety Manager, but it also requires the involvement of all organizational functions. Without cross-functional synergy among trainers, technicians, auditors, and management, the effectiveness of the entire system will be hampered (Kaspers et al., 2017). One of the core principles of Safety Assurance is continuous improvement. The results of this study indicate that organizations have initiated this process through audits and investigations but require more systematic improvements based on monitoring results and safety data trends. There are several recommendations so that the implementation of safety assurance can be better, including: ATO policies should mandate pre-change risk assessments; Implement anonymous reporting portals to reduce fear; and Longitudinal studies to track culture change post-intervention. Implementing a safety dashboard, regular evaluation forums and feedback loops from field personnel to management will strengthen the two-way lines of communication and encourage continuous system improvement (Guslina et al., 2025).

D. Conclusions

The evaluation results indicate that the implementation of Safety Assurance elements in the Safety Management System (SMS) at Palembang Aviation Polytechnic has been running smoothly in terms of Internal Audit, Incident Investigation, and Performance Monitoring. These three aspects demonstrate a relatively systematic implementation structure and align with the safety principles established by ICAO, particularly in the use of data for safety evaluation and decision-making. However, two crucial aspects - Hazard Reporting and Change Management - were identified as major weaknesses. The low scores on these two indicators indicate a lack of personnel participation, fear in reporting, and the lack of integration of risk analysis in the operational change process. These results are consistent with qualitative findings that reveal a lack of an open reporting culture and inadequate formal procedures for managing change.

Thus, although the Safety Assurance system has been operational, improvements are needed to focus on enhancing safety culture, strengthening non-punitive reporting systems, and implementing risk-based change management. Cross-functional participation, open communication, and the application of the Just Culture principle are key to ensuring an adaptive and sustainable safety system in the ATO environment. It is recommended to adopt *Just Culture* training across all organizational levels. This approach will help reduce fear of blame, encourage honest reporting, and strengthen trust in the safety system.

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