

Examining Operational Inefficiencies in Aviation Technical Records Management: Causes, Impacts, and Improvement Strategies

GENE CLAUD P. NAGUIT¹, MICHAEL JOHN M. VILLAR², NOEL T. FLORENCONDIA³

^{1, 2, 3} *Master of Engineering Management, Nueva Ecija University of Science and Technology, Cabanatuan City, Philippines*

Abstract - Aviation technical records management is essential in ensuring aircraft safety, regulatory compliance, and efficient maintenance operations. Despite its importance, many aviation organizations still experience operational inefficiencies in documentation processes, such as delays, incomplete entries, inconsistencies, and human errors. These issues can disrupt maintenance workflows, increase administrative workload, and create challenges during regulatory audits. This study examines the causes and impacts of operational inefficiencies in aviation technical records management through a descriptive analysis of maintenance documentation practices. It focuses on both paper-based and hybrid recordkeeping systems commonly used in aviation operations. Findings indicate that inefficiencies are mainly caused by manual documentation processes, data entry errors, communication gaps between departments, and limited integration of digital systems. These issues often result in delays in record verification, increased workload for technical records personnel, and potential compliance risks during inspections. The study further proposes improvement strategies such as adopting fully integrated digital record systems, standardizing documentation procedures, and strengthening training programs focused on human factors and proper recordkeeping practices. Overall, the study highlights how technological, organizational, and human factors interact in aviation technical records management and provides practical insights for improving efficiency and compliance.

Index Terms - Aviation Maintenance, Documentation Efficiency, Human Factors, Operational Inefficiency, And Technical Records Management

I. INTRODUCTION

1.1 Background of the Study

In aviation operations, technical records play a critical role in ensuring aircraft safety, compliance, and proper maintenance tracking. These records

contain important information such as inspections, repairs, modifications, and part replacements, which serve as proof that an aircraft is maintained in accordance with required standards.

Regulatory authorities like the International Civil Aviation Organization (ICAO, 2020) and the Federal Aviation Administration (FAA, 2021) emphasize that maintenance records must be complete, accurate, and easily accessible. This ensures that aircraft history can be properly traced during audits, inspections, and airworthiness evaluations.

In recent years, many aviation organizations have started using digital systems to improve documentation processes. These systems are intended to make recordkeeping faster and more organized. However, in actual operations, not all organizations have fully transitioned to digital platforms. Some still use a combination of paper-based and digital systems, which can create inconsistencies, duplication of work, and delays in updating records (Lopez & Garcia, 2023).

Based on operational experience, documentation issues are not only caused by system limitations but are also influenced by human factors. Workload pressure, fatigue, and time constraints during maintenance activities can result in incomplete or delayed encoding of records (Li & Wang, 2023). These situations are often connected to working conditions and operational demands rather than individual performance alone (Wiegmann & Shappell, 2021).

Because of these combined factors, aviation organizations may experience delays in record

updating, increased workload for technical records personnel, and difficulty in maintaining accurate maintenance history. These inefficiencies can affect both operational flow and compliance requirements (Ramadhan et al., 2024).

While existing studies have explored digital systems and human factors separately, there is still limited discussion on how these elements interact within real aviation maintenance environments. This study therefore aims to examine how system-related, human-related, and organizational factors collectively contribute to inefficiencies in aviation technical records management.

1.2. Objectives of the Study

This study is conducted to examine the operational inefficiencies present in aviation technical records management.

Specifically, it seeks to:

1. Identify the common causes of delays and inconsistencies in technical records management within aviation maintenance operations.
2. Understand how these inefficiencies affect maintenance workflow and day-to-day operational processes.
3. Examine the impact of documentation issues on regulatory compliance and traceability of maintenance records.
4. Determine possible strategies that can help improve the efficiency and accuracy of technical records systems.
5. Assess the role of training and human factor awareness in improving documentation practices among aviation personnel.

1.3. Significance of the Study

This study is intended to provide practical insights into how aviation technical records management can be improved in real operational settings.

For airline and maintenance, repair, and overhaul (MRO) organizations, the findings may help in identifying common documentation challenges that affect workflow efficiency. This can support efforts

to streamline recordkeeping processes and improve coordination in maintenance operations.

For technical records personnel, this study may help highlight the everyday issues they encounter, such as delays in encoding, data inconsistencies, and workload pressure. Understanding these concerns may support improvements in accuracy and efficiency in their work.

For maintenance engineers and technicians, better technical records management can contribute to smoother coordination of maintenance tasks. When records are complete and updated, it becomes easier to track aircraft history and ensure proper maintenance actions are carried out.

For regulatory authorities, the findings may provide additional reference in understanding recurring documentation issues that can affect compliance monitoring and audit processes.

For aviation students and training institutions, this study may serve as a practical reference in understanding how technical records management works in actual aviation environments, beyond theoretical discussion.

Lastly, for future researchers, this study may provide a baseline for further studies on aviation documentation systems, digital transformation, and operational efficiency improvements in maintenance environments.

1.4 Conceptual Framework

The conceptual framework of this study is built around the idea that aviation technical records management is influenced by a combination of system-related, human-related, and organizational factors. These elements do not operate independently; instead, they interact with each other and collectively affect the efficiency of documentation processes.

In this study, the independent variables represent the main sources of inefficiencies in technical records management. These include manual documentation processes, the use of hybrid paper and digital systems, communication gaps between departments, human factors such as workload and fatigue,

procedural complexity, and the lack of system integration. Each of these contributes in different ways to delays and inconsistencies in aviation documentation.

On the other hand, the dependent variables represent the outcomes of these inefficiencies. These include documentation delays, record discrepancies, workflow inefficiencies, reduced traceability, and compliance-related issues. These outcomes reflect the actual impact of system and human limitations on aviation maintenance operations.

The study assumes that inefficiencies occur when system limitations (such as non-integrated platforms and hybrid documentation processes) interact with human factors (such as workload pressure and fatigue). When combined, these conditions affect the speed, accuracy, and reliability of technical records management in aviation environments.

Overall, the framework suggests that improving aviation technical records management requires addressing both technological systems and human performance factors. Strengthening system integration, standardizing procedures, and enhancing training are seen as key steps toward improving efficiency and maintaining compliance in aviation operations.

1.5 Research Paradigm (IPO Model)

The research paradigm of this study follows the Input–Process–Output (IPO) model, which explains how different factors in aviation technical records management contribute to inefficiencies and how these are analyzed to generate possible improvements.

In this study, the input phase represents the existing conditions and factors that influence technical records management in aviation operations. These include manual documentation processes, hybrid paper and digital systems, communication gaps between departments, human factors such as fatigue and workload, procedural complexity, and the lack of system integration. These inputs are considered the main sources of operational challenges in documentation practices.

The process phase refers to how the collected data is examined and interpreted. This involves analyzing survey responses from aviation professionals to identify common issues encountered in technical records management. Descriptive statistical tools such as frequency count, percentage distribution, and weighted mean are used to determine the level and frequency of inefficiencies. In addition, related literature and aviation regulations are reviewed to support the interpretation of findings and identify patterns behind recurring documentation issues.

The output phase represents the results of the study, which focus on identifying the main causes of inefficiencies, understanding their operational effects, and proposing practical improvement strategies. These include the adoption of fully digital record systems, standardization of documentation procedures, strengthening of training programs, and improved communication between aviation departments. These outputs are intended to support better efficiency, accuracy, and compliance in aviation technical records management.

Overall, the IPO model shows how operational inputs in aviation maintenance environments are processed through analysis and result in practical recommendations aimed at improving documentation systems and reducing inefficiencies.

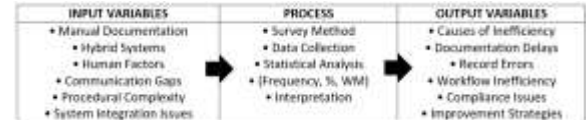


Figure 1. Input–Process–Output (IPO) Model of the Study

1.6 Research Questions

This study is guided by the following questions that focus on understanding the causes and effects of inefficiencies in aviation technical records management:

1. What are the common factors that cause inefficiencies in aviation technical records management?

2. How do these inefficiencies affect maintenance workflow and daily aviation operations?
3. In what way do documentation issues influence regulatory compliance and traceability of maintenance records?
4. What possible strategies can be implemented to improve efficiency and accuracy in technical records management?
5. How does training and human factor awareness contribute to better documentation practices in aviation maintenance?

1.7 Hypothesis of the Study

This study is guided by the following hypotheses:

H1: System-related factors such as manual documentation processes, hybrid paper-digital systems, and lack of system integration contribute to operational inefficiencies in aviation technical records management.

H2: Human factors such as workload, fatigue, and communication gaps significantly affect the accuracy and timeliness of technical records documentation.

H3: Operational inefficiencies in technical records management negatively affect workflow efficiency, compliance, and traceability in aviation maintenance operations.

1.8 Scope and Delimitation

This study focuses on examining operational inefficiencies in aviation technical records management within selected aviation maintenance environments at Ninoy Aquino International Airport (NAIA) and the Greater Manila area, Philippines. The study involves thirty-eight (38) aviation professionals, including technical records personnel, maintenance engineers, and quality assurance staff directly involved in documentation processes.

The study covers key factors affecting technical records management such as manual documentation processes, hybrid paper and digital systems, communication gaps between departments, human factors including workload and fatigue, procedural complexity, and lack of system integration. It also examines operational impacts such as documentation delays, record discrepancies, increased workload, audit verification delays, and reduced traceability.

The research uses a structured questionnaire as the main data-gathering instrument and applies descriptive statistical tools such as frequency count, percentage distribution, and weighted mean. The study does not include experimental testing, system implementation, or inferential statistical modeling.

Other aviation areas such as flight operations, aircraft design engineering, airline financial systems, and passenger services are not included in this study.

Due to the limited sample size and specific operational setting, findings may not be generalized to all aviation organizations globally. However, the study provides relevant insights into common inefficiencies in aviation technical records management within similar maintenance environments.

1.9 Synthesis of Related Literature

The reviewed literature shows that aviation technical records management is shaped by the interaction of technological systems, human factors, and organizational processes. Studies such as Huang et al. (2022) explain that digital documentation systems contribute to improved efficiency, accessibility, and organization of maintenance records. However, Lopez and Garcia (2023) highlight that in some aviation environments, the continued use of hybrid paper and digital systems may result in duplication of work, inconsistencies in data, and delays in record updates.

In addition, human factors are consistently identified as a major contributor to documentation issues in aviation maintenance. According to Li and Wang (2023), as well as Wiegmann and Shappell (2021), factors such as workload pressure, fatigue, and operational stress increase the likelihood of errors and delays in maintenance documentation. These findings suggest that inefficiencies are not solely system-related but are also strongly influenced by working conditions and human performance limitations.

Furthermore, aviation regulations continue to emphasize the importance of complete, accurate, and accessible technical records to ensure safety and compliance. Despite these requirements, many

studies tend to focus on individual aspects such as digital transformation or human error, without fully examining how these factors interact in real operational settings.

Based on the reviewed literature, there is still a gap in understanding how technological systems, human behavior, and organizational processes work together in actual aviation maintenance environments. This study addresses that gap by examining the combined effects of these factors on operational inefficiencies in aviation technical records management.

II. METHODOLOGY

2.1 Research Design

The study uses a descriptive quantitative research design supported by a survey method to examine operational inefficiencies in aviation technical records management. This design is focused on understanding existing conditions in real aviation maintenance environments without manipulating variables or introducing experimental changes.

The purpose of this approach is to describe how technical records processes are currently performed, and how system-related factors and human factors interact within actual aviation operations. In this context, the study does not attempt to change or redesign the system during data collection, but instead observes and interprets the current state of documentation practices.

Quantitative data is gathered and analyzed using frequency count, percentage distribution, and weighted mean. These tools are used to identify the commonality, severity, and perceived impact of inefficiencies in technical records management as experienced by aviation professionals.

2.2 Population and Sample of the Study

The population of this study consists of sixty (60) personnel involved in aviation maintenance operations, particularly those engaged in technical records management, maintenance engineering, and quality assurance functions.

From this population, a sample size of thirty-eight (38) respondents was determined using Slovin's

formula with a 10% margin of error. This ensures that the selected respondents still represent the overall population while maintaining practical data collection limits.

The respondents were selected through purposive sampling. This method was used because the study specifically requires individuals who are directly involved in aviation technical records processes, where documentation, verification, and maintenance tracking activities are actively performed.

Table 1. Distribution of Respondents by Group

Respondent Group	Frequency	Percentage
Technical Records Personnel	12	32%
Maintenance Engineers	15	39%
Quality Assurance Inspectors	11	29%
Total	38	100%

The table presents the distribution of respondents involved in the study. It shows that most of the respondents are maintenance engineers, followed by technical records personnel and quality assurance inspectors. This distribution ensures that the data collected reflects the perspectives of key personnel directly involved in aviation technical records management.

2.3 Research Instruments

The primary instrument used in this study is a structured questionnaire designed to gather information on operational inefficiencies in aviation technical records management.

The questionnaire focuses on key areas such as documentation processes, system usage (manual and digital systems), communication flow between departments, human factors such as workload and fatigue, and compliance-related concerns.

Each item in the questionnaire is designed to identify the frequency and perceived impact of specific inefficiencies experienced in actual aviation maintenance operations.

To ensure clarity and relevance, the instrument was reviewed by aviation maintenance professionals and academic advisers before distribution. This was done to confirm that the questionnaire reflects real operational conditions in aviation technical records management.

2.4 Data Collection Procedure

The data collection process began with securing permission from the selected aviation maintenance environment. After approval was granted, questionnaires were distributed to the 38 selected respondents.

Respondents were given sufficient time to complete the survey to ensure accurate and reliable responses. After collection, all questionnaires were checked, organized, and prepared for statistical analysis.

The collected data was then encoded and processed to identify patterns related to operational inefficiencies in aviation technical records management.

2.5 Statistical Treatment of Data

The data gathered from respondents was analyzed using descriptive statistical tools to determine the level and frequency of operational inefficiencies in aviation technical records management.

Frequency count and percentage distribution were used to identify the most common issues experienced by respondents. Weighted mean was used to determine the overall perception of the severity and impact of each factor.

To interpret the results of the weighted mean, a 5-point Likert scale interpretation was used:

Weighted Mean Range	Verbal Interpretation
4.21 – 5.00	Very High Impact
3.41 – 4.20	High Impact
2.61 – 3.40	Moderate Impact
1.81 – 2.60	Low Impact
1.00 – 1.80	Very Low Impact

This scale provides a standardized basis for interpreting respondents’ perceptions regarding

operational inefficiencies in aviation technical records management. It ensures consistency in evaluating the severity and significance of each identified factor.

III. RESULTS AND DISCUSSION

This chapter presents the results of the study based on the responses gathered from 38 aviation professionals involved in aviation maintenance operations. The discussion focuses on identifying operational inefficiencies in aviation technical records management and interpreting how system-related factors, human factors, and organizational conditions affect documentation processes.

The analysis is guided by the study’s hypotheses and is structured according to the major variables: system factors, human factors, and operational outcomes.

3.1 Average Perception Scores (Weighted Mean Summary)

Indicator	Weighted Mean	Interpretation
Manual documentation causes delays	4.52	Very High Impact
Hybrid system causes duplication	4.31	Very High Impact
Communication gaps affect workflow	4.12	High Impact
Human factors cause errors	4.40	Very High Impact
Lack of system integration	4.28	Very High Impact
Documentation delays occur frequently	4.55	Very High Impact
Record discrepancies are common	4.18	High Impact
Audit verification delays occur	4.05	High Impact
Reduced traceability is experienced	3.92	High Impact

The results show that system-related issues are one of the primary contributors to operational inefficiencies in aviation technical records management.

Manual documentation processes received a very high impact rating (WM = 4.52), indicating that paper-based or non-automated encoding remains a major challenge in aviation maintenance environments. Respondents observed that manual encoding often leads to delays in updating records, especially during high workload conditions where maintenance tasks are prioritized over documentation.

Hybrid paper-digital systems also obtained a very high impact rating (WM = 4.31). This suggests that partial digitalization does not fully eliminate inefficiencies, as duplication of records and inconsistencies between systems still occur.

Lack of system integration (WM = 4.28) further supports this finding, indicating that disconnected platforms between departments contribute to delays in verification and difficulty in maintaining unified maintenance records.

Overall, the results show that system limitations remain a key source of inefficiency in aviation technical records management.

3.2 Causes of Operational Inefficiencies

Causes of Inefficiency	Frequency	Percentage
Manual documentation processes	34	89%
Hybrid paper-digital system	32	84%
Communication gaps between departments	30	79%
Human factors (fatigue/workload)	33	87%
Procedural complexity	28	74%
Lack of system integration	31	82%

The results show that manual documentation processes (89%) are the most frequently identified cause of operational inefficiencies in aviation technical records management. This suggests that despite modernization efforts in aviation organizations, a significant portion of recordkeeping activities still relies on manual encoding or paper-based systems. In operational settings such as NAIA

maintenance environments, this can lead to delays in updating records, especially during high aircraft turnaround pressure.

Closely following this is human factors (87%), which include fatigue, workload pressure, and time constraints. In aviation maintenance operations, personnel often prioritize aircraft safety inspections and repairs over documentation tasks, resulting in delayed or incomplete record entries. This supports established human factors theory, which emphasizes that operational errors often arise from workload imbalance rather than individual negligence.

This observation is consistent with the HFACS developed by Wiegmann and Shappell, which explains that human errors in aviation are not solely the result of individual actions but are influenced by underlying system conditions such as workload, supervision, and organizational processes.

The presence of hybrid paper-digital systems (84%) also indicates that partial digital transformation remains a challenge. Instead of fully improving efficiency, dual systems can create inconsistencies in data entry, duplication of records, and difficulties in synchronizing maintenance history across platforms.

Furthermore, lack of system integration (82%) highlights the absence of fully connected documentation systems between departments such as maintenance, technical records, and quality assurance. This weak integration can slow down data verification and create communication bottlenecks in maintenance workflows.

Communication gaps (79%) and procedural complexity (74%) also contribute to inefficiencies, although at slightly lower levels. These findings suggest that while system issues are dominant, organizational coordination and process design also play supporting roles in documentation inefficiency.

Overall, the data indicates that operational inefficiencies are not caused by a single factor but are the result of interacting system limitations, human performance constraints, and organizational communication structures within aviation technical records management.

3.3 *Operational Impacts on Technical Records Management*

Operational Impact	Frequency	Percentage
Documentation delays	35	92%
Record discrepancies	31	82%
Increased workload	34	89%
Audit and verification delays	29	76%
Reduced traceability	27	71%

The results reveal that documentation delays (92%) are the most significant operational impact of inefficiencies in aviation technical records management. In practical aviation operations, especially in maintenance environments such as NAIA, documentation delays can directly affect aircraft release-to-service timelines. When maintenance tasks are completed but records are not updated promptly, it creates a bottleneck in operational approval processes, potentially delaying aircraft dispatch.

The second most significant impact is increased workload (89%), indicating that inefficiencies in documentation systems do not reduce work but instead redistribute it. Personnel often need to re-check entries, correct inconsistencies, and reconcile paper-based and digital records. This creates additional administrative burden on technical records staff and maintenance coordinators, reducing overall productivity.

Record discrepancies (82%) further highlight risks in data consistency. In aviation, even minor inconsistencies in maintenance records can raise concerns during audits or regulatory inspections. This may require additional verification steps, increasing operational complexity and time consumption.

Meanwhile, audit and verification delays (76%) suggest that inefficiencies extend beyond daily operations and affect compliance processes. Aviation regulatory audits rely heavily on accurate and readily accessible technical records. Any delay in retrieving or validating records can affect audit efficiency and compliance confidence.

Finally, reduced traceability (71%) indicates limitations in tracking the complete maintenance history of aircraft components. This can impact decision-making in maintenance planning, especially in determining part life cycles, service history, and airworthiness assessments.

Overall, the findings suggest that inefficiencies in aviation technical records management have direct operational, administrative, and regulatory consequences, affecting not only documentation speed but also compliance reliability and aircraft operational readiness.

3.4 *Hypothesis-Based Discussion of Findings*

H1: System-related factors contribute to inefficiencies

The results confirm this hypothesis. Manual documentation processes, hybrid systems, and lack of integration were all rated as high to very high impact factors. This suggests that system structure remains a major source of inefficiency in aviation technical records management.

H2: Human factors affect accuracy and timeliness

The results support this hypothesis. The high rating of workload, fatigue, and communication gaps indicates that human conditions significantly influence documentation performance and delay.

H3: Inefficiencies affect workflow, compliance, and traceability

The findings are consistent with this hypothesis. Documentation delays, audit issues, and reduced traceability show that inefficiencies directly affect both operational flow and regulatory requirements in aviation maintenance environments.

3.5 *Synthesis of Findings*

The overall findings indicate that operational inefficiencies in aviation technical records management are not caused by a single factor but by the interaction of system limitations, human factors, and organizational communication structures.

System-related issues such as manual documentation and hybrid platforms create delays in encoding and updating records. Human factors such as workload and fatigue further contribute to incomplete or delayed documentation. Communication gaps between departments add another layer of

inefficiency, affecting coordination and data consistency.

When combined, these factors result in documentation delays, increased workload, record discrepancies, and reduced traceability. These impacts directly affect maintenance workflow efficiency and compliance processes.

Overall, the findings suggest that improving aviation technical records management requires an integrated approach involving system digitalization, standardized procedures, and strengthened human factor management.

3.6 Summary of Results

The results of the study show that inefficiencies in aviation technical records management are mainly caused by system-related limitations and human factors. These inefficiencies lead to documentation delays, increased workload, record inconsistencies, and reduced traceability, affecting both operational efficiency and regulatory compliance in aviation maintenance environments.

IV. SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

4.1 Summary of Findings

This study examined operational inefficiencies in aviation technical records management within selected aviation maintenance environments at Ninoy Aquino International Airport (NAIA) and Greater Manila, involving 38 aviation professionals.

The study focused on identifying the causes of inefficiencies, their operational impacts, and possible improvement strategies in aviation technical records management.

Findings revealed that system-related factors such as manual documentation processes, hybrid paper-digital systems, and lack of system integration are major contributors to inefficiencies. These conditions often result in delays in encoding and updating maintenance records.

Human factors such as workload, fatigue, and communication gaps were also found to significantly affect documentation accuracy and timeliness. In operational settings, maintenance personnel often prioritize technical tasks over documentation, leading to delayed or incomplete record entries.

In terms of operational impact, the study found that documentation delays are the most common issue, followed by increased workload, record discrepancies, audit verification delays, and reduced traceability. These issues directly affect maintenance workflow and compliance processes.

Overall, the findings show that inefficiencies in aviation technical records management are the result of combined system-related, human-related, and organizational factors.

4.2 Limitations of the Study

This study is limited to aviation maintenance personnel involved in technical records management within selected maintenance environments at NAIA and Greater Manila, Philippines. The study involved 38 respondents selected through purposive sampling. The research focused only on technical records management and did not include other aviation functions such as flight operations, aircraft design engineering, financial management, or passenger services.

The study also relied on self-reported data from respondents, which may be influenced by personal perception and operational experience.

Due to the limited sample size and specific location, the findings may not be fully generalizable to all aviation organizations worldwide. However, the study provides relevant insights applicable to similar aviation maintenance environments.

4.3 Conclusions

Based on the findings of the study, the following conclusions are drawn:

1. Operational inefficiencies in aviation technical records management are significantly influenced by manual documentation processes, hybrid systems, and lack of system integration.

2. Human factors such as workload, fatigue, and communication gaps play a major role in affecting the accuracy and timeliness of technical records.
3. Inefficiencies in technical records management directly impact maintenance workflow, resulting in documentation delays, increased workload, record discrepancies, and reduced traceability.
4. Communication gaps between departments contribute to inconsistencies and delays in updating maintenance records.
5. There is a need for a more integrated and standardized approach to aviation technical records management to improve efficiency, accuracy, and compliance.

Overall, the study concludes that inefficiencies in aviation technical records management are not caused by a single factor but by the interaction of system, human, and organizational elements.

4.4 Recommendations

Based on the findings and conclusions of the study, the following recommendations are proposed:

1. Aviation organizations should consider implementing fully integrated digital technical records management systems to reduce reliance on manual documentation and minimize duplication of work.
2. Standard operating procedures (SOPs) for documentation should be strengthened and consistently implemented to ensure accuracy, completeness, and uniformity of records across departments.
3. Regular training programs should be conducted for technical records personnel, maintenance engineers, and quality assurance staff, focusing on documentation accuracy, system usage, and human factors awareness.
4. Communication and coordination between maintenance departments should be improved through structured workflows and shared digital platforms to reduce delays and inconsistencies.
5. Aviation training institutions should include technical records management and digital documentation systems in their curriculum to better prepare future aviation professionals.
6. Future researchers may explore the use of advanced digital solutions such as automated

recordkeeping systems or AI-assisted documentation tools to further improve efficiency in aviation technical records management.

REFERENCES

- [1] International Civil Aviation Organization, *Safety Management Manual (SMM)*, Doc 9859. Montreal, Canada: ICAO, 2020.
- [2] Federal Aviation Administration, *Title 14 Code of Federal Regulations (14 CFR) Part 43: Maintenance, Preventive Maintenance, Rebuilding, and Alteration*. Washington, D.C., USA: FAA, 2021.
- [3] Y. Huang, L. Chen, and R. Smith, "Digital transformation in aviation maintenance documentation systems: Improving efficiency and data accessibility," *Journal of Air Transport Management*, vol. 98, pp. 102–110, 2022.
- [4] M. Lopez and P. Garcia, "Hybrid recordkeeping systems in aviation maintenance: Challenges and operational risks," *International Journal of Aviation Technology and Management*, vol. 15, no. 2, pp. 45–60, 2023.
- [5] J. Li and H. Wang, "Human factors influencing aviation maintenance documentation errors," *Aviation Psychology and Applied Human Factors*, vol. 13, no. 1, pp. 22–34, 2023.
- [6] D. A. Wiegmann and S. A. Shappell, "A human error approach to aviation safety and maintenance reliability," *Aviation Safety Journal*, vol. 9, no. 3, pp. 55–70, 2021.
- [7] A. Ramadhan, T. Yusuf, and D. Kurnia, "Operational inefficiencies in aircraft technical records management systems," *Journal of Aerospace Operations Research*, vol. 11, no. 1, pp. 77–89, 2024.
- [8] S. K. Sharma and R. Gupta, "Digitalization in aircraft maintenance operations: Challenges in MRO documentation systems," *Journal of Aerospace Information Systems*, vol. 20, no. 4, pp. 210–222, 2023.
- [9] R. B. Adams and T. L. Morgan, "Human reliability and documentation errors in aviation maintenance environments," *Safety Science*, vol. 155, pp. 105861, 2022.