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Enhancing Data Verification and Validation Systems to Improve the Accuracy of Indonesian Aeronautical Information Publication

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ABSTRACT

The Indonesian Aeronautical Information Publication (AIP) is the primary reference for flight safety and efficiency. However, discrepancies in AIP Volume I (General and En-Route) persist and pose risks to navigation accuracy. This study evaluates the structural weaknesses in the current data verification and validation framework within the Aeronautical Information Management (AIM) unit. Employing a descriptive qualitative approach with a case study design, data were triangulated through in-depth interviews with [X number] of AIS specialists, operational observations, and a comprehensive audit of current documentation. Findings reveal that the validation process remains predominantly manual, lacks digitized, multi-layered supervision, and exhibits an undocumented feedback loop, resulting in significant vulnerabilities to human error and update latency. To mitigate these risks, this research proposes a strategic transition towards an integrated digital workflow aligned with Aeronautical Data Quality (ADQ) requirements and the AIXM 5.1 standards. The implementation of structured Electronic-SOPs and continuous competency-based training is essential to ensure the integrity of Indonesia's aeronautical data chain, supporting safer and more reliable global flight navigation services.

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INTRODUCTION

Aviation plays a critical role in meeting global mobility demands, offering fast, safe, and efficient transportation. However, the safety and reliability of flight operations depend not only on advanced technology and infrastructure but also on the availability of accurate and timely aeronautical information. Inaccurate or outdated information increases operational risks and can compromise both flight safety and efficiency. Therefore, governments and service providers are under growing pressure to strengthen the systems that manage and disseminate aeronautical data.

Within this context, the Aeronautical Information Service (AIS) is central to ensuring flight safety, regularity, and efficiency. One of its most important outputs is the Aeronautical Information Publication (AIP), which provides critical operational data to all aviation stakeholders. Because of its significance, AIP data must be consistently accurate, complete, and reliable. Inaccuracies in AIP content can directly affect flight planning, navigation, and air traffic management. For this reason, personnel within the Aeronautical Information and Communication units are responsible for ensuring that all released products meet strict quality and accuracy standards.

In Indonesia, the AIP publication process involves multiple verification stages and interagency coordination under national regulatory oversight. Data originating from airports or other authorized entities is first validated at the Aeronautical Information Center of the Air Navigation Service Provider (Perum LPPNPI) before being submitted to the Directorate of Air Navigation, Ministry of Transportation, for publication. While the process is formally regulated, it remains predominantly manual, insufficiently documented, and highly dependent on individual personnel. These limitations increase the risk of human error, delays in data updates, and inconsistencies across information products, thereby reducing the reliability of Indonesia's AIP system.

Although previous research has addressed aspects of aeronautical information management, few studies have examined the weaknesses of Indonesia's AIP verification and validation system or proposed systematic strategies to improve it. This study seeks to address that gap by examining current practices within the Aeronautical Information Management Unit, identifying critical weaknesses, and formulating strategies to enhance system reliability. By proposing structured improvements such as digitalization, the development of clear standard operating procedures, and ongoing capacity building for AIS personnel, this research contributes both practical recommendations for Indonesian aviation authorities and broader insights relevant to states seeking to strengthen compliance with ICAO Annex 15 requirements.

Accurate, timely, and traceable aeronautical information is a foundational requirement for safe and efficient air navigation. Modern operational concepts and technologies — including Performance-Based Navigation (PBN), Area Navigation (RNAV), data-link communications, and satellite voice/data services — have increased reliance on precise digital aeronautical data, and thereby amplified the consequences of inaccuracies or publication delays in official products such as the Aeronautical Information Publication (AIP) and NOTAM. International guidance, therefore, places strong emphasis on Aeronautical Information Management (AIM) and Aeronautical Data Quality (ADQ) to ensure that data used in the Air Traffic Management (ATM) system meets specified levels of accuracy, integrity, and timeliness (ICAO, 2018; ICAO Doc 10066).

In Indonesia, the Civil Aviation Safety Regulation framework and national AIS/AIP workflows require AIS providers to validate, verify, and publish aeronautical information in accordance with AIRAC cycles and national rules. Despite these formal mechanisms and recent organizational moves toward digitalization, operational practice in some units reveals persistent gaps: outdated AIP entries, mismatched contact or procedural data, and slow incorporation of originator updates into official publications. These implementation gaps reduce traceability, increase the risk of human error, and can impair operational decision-making both domestically and in cross-border traffic. Similar problems have been observed internationally, in which NOTAM/AIS system outages and legacy manual processes have driven modernization efforts and policy responses (e.g., FAA NOTAM outages; EUROCONTROL ADQ initiatives).

The literature and AIM guidance suggest three converging remedies: adoption of AIM/ADQ technical standards (e.g., AIXM/GML and controlled data chains); automation/digital workflows that replace legacy manual procedures; and strengthened organizational controls, including clear standard operating procedures (SOPs) and originator training. Empirical work on aeronautical data workflows and AIM implementation points to measurable benefits from digital validation and automated quality checks. At the same time, case studies of outages highlight the necessity of resilient system architecture and backup procedures. However, there is limited peer-reviewed empirical research documenting verification and validation practices for AIP Volume I (General and En-Route) in Indonesia and quantifying how specific discrepancies affect operational safety and efficiency.

This study addresses that gap through an in situ examination of verification and validation practices at the Aeronautical Information Center and selected PIA units, combined with a document

analysis of AIP Volume I entries. The aims are (1) to identify systemic weaknesses in current workflows and documentation, (2) to map observed discrepancies against international AIM/ADQ benchmarks, and (3) to propose practical, implementable strategies — including digitalization, SOP enhancement, and capacity building — to improve AIP data accuracy, timeliness, and traceability in support of national and ICAO AIM objectives.

METODE

This study adopts a qualitative descriptive design, selected to capture a detailed understanding of the processes of verification and validation in the Indonesian AIP Volume I (General and Enroute). Such an approach aligns with prior work in aviation safety contexts where qualitative methods have been effective in uncovering procedural gaps, documentation issues, and organizational practices (Clare, 2021; Kioulepoglou et al., 2025).

The research objectives are: (1) to examine the current data published in the Indonesian AIP Volume I, General and Enroute; (2) to identify factors influencing data accuracy in those publications; and (3) to assess the implications of data inconsistencies for safety and efficiency in Indonesian aviation.

The population comprises all entries in the Indonesian AIP, Volume I: General and Enroute. For sampling, the study focuses on entries that appear out-of-date or inconsistent with ICAO Annex 15 standards. Data collection involves three methods: (a) document observation**,** comprising systematic review of Indonesian AIP entries compared to ICAO standards to identify discrepancies; (b) semi-structured interviews with AIS/AIP personnel at Perum LPPNPI's Aeronautical Information Center and selected PIA units, following practices used in aviation incident reporting studies (Kioulepoglou et al., 2025); and (c) literature review of ICAO Annex 15, national regulations, and peer-reviewed research in aeronautical data quality as done in studies such as Clare (2021).

For data analysis, two complementary methods are employed. First, Gap Analysis is used to map differences between data published in AIP entries and the benchmarks in ICAO Annex 15, similar to methods in aviation safety management research, in which gap models reveal compliance deficiencies and areas for system improvement. Second, descriptive analysis organizes and presents the findings in a structured manner, for example, by category of discrepancy, frequency, and potential severity. Triangulation of findings across document observation, interviews, and literature improves the reliability of results, following qualitative aviation management research best practices (Uzgör, 2025).

RESULT AND DISCUSSION

The Indonesian Aeronautical Information Publication (AIP) is an official document published by Perum LPPNPI (AirNav Indonesia) through the Aeronautical Information Center (PIA). It serves as the primary reference for aviation users to obtain accurate, up-to-date, and reliable information. Volume I of the Indonesian AIP, specifically the General and Enroute sections, contains crucial details, including immigration regulations, pilot health, flight communications, and regional flight routing procedures. The suitability and accuracy of the data in the AIP serve as benchmarks for the safety and efficiency of national and international air traffic operations.

Observations of the Indonesian AIP, Volume I, General and Enroute, indicate that discrepancies persist between the AIP and the actual regulations and field conditions. One concrete example appears in Section GEN 1.3 – Entry, Transit, and Departure of Passengers and Crew. This section still lists 23 international airports, according to AIP Amendment 06, dated September 30, 2004. These airports include Polonia Airport (Medan) and Tabing Airport (Padang), which are no longer operating as international airports. However, according to Decrees of the Minister of Transportation of the Republic of Indonesia, Number KM 31 of 2024 and KM 26 of 2025, only 17 airports currently hold international status. Three recently added international airports, namely S.M. Badaruddin II Airport in Palembang, H.A.S. Hanandjoeddin Airport in Bangka Belitung, and General Ahmad Yani Airport in Semarang, are

also not yet listed in the AIP version. This indicates a delay in updating the data in this official navigation document.

Furthermore, in GEN 1.7, which addresses discrepancies between ICAO standards and national practices, the Indonesian AIP continues to reference Amendment 63, dated August 3, 2017. This section specifies the validity period of medical certificates for pilot license holders (ATPL and CPL) as 6 months. Meanwhile, Regulation of the Minister of Transportation of the Republic of Indonesia Number PM 69 of 2017 concerning Health Standards and Certification of Aviation Personnel specifies in more detail the classification and validity period of medical certificates for various license classes, including additional information such as aircraft type (aeroplane, helicopter, powered-lift) and other technical roles (flight engineer). This discrepancy indicates that the AIP content has not yet fully incorporated the latest national regulations.

A similar situation was also found in section ENR 1.8 – Regional Supplementary Procedures. In AIP Amendment 150 dated September 5, 2024, the AFTN contact address for the Directorate of Air Navigation is listed as WRRRYNYX. However, in Section GEN 3.1-1 of the Indonesian AIP, Volume I, as referenced in Amendment 120 dated September 8, 2022, the same AFTN address is also used for the International NOTAM Office (NOF) at JATSC, Soekarno-Hatta Airport. Although both are under the management of Perum LPPNPI, using a single AFTN address for two different locations or operational units can be confusing, particularly when exchanging critical aviation safety information.

This situation indicates that, although the organizational structure and role of the PIA are stipulated in the Board of Directors Regulations PER.013/LPPNPI/XII/2024 and PER.014/LPPNPI/XII/2024, the actual implementation of AIP data maintenance and updating remains challenging. Institutionally, PIA has adequate authority and organizational structure, including a publication manager and junior managers overseeing the AIP preparation and distribution process. However, from a technical and operational perspective, the data updating process has not been carried out optimally and systematically.

This has the potential to reduce the reliability of the AIP as an official aviation reference, given that changes in regulations, field conditions, and technical information must be promptly reflected in the document. Delays in updating or aligning AIP data with national provisions and ICAO standards can lead to the use of incorrect information in flight planning and implementation, ultimately affecting safety, efficiency, and compliance with international regulations.

Therefore, the current state of the Indonesian AIP Volume I General and Enroute data still requires serious attention, particularly regarding content updates, regulatory synchronization, and the establishment of a digital data verification system to support the accuracy and timeliness of aeronautical information publication. Based on an in-person interview with Publication Personnel at the LPPNPI Tangerang Head Office on June 12, 2025, the discussion focused on strengthening the data verification and validation system to improve the accuracy of Indonesian AIP data. The five questions outlined in the attached section were discussed.

Based on the interview, the data in AIP Volume I, General and Enroute, can be pretty accurate. This is because the latest general and en route data have been processed over the past few years, and all coordinate-resolution data have been standardized, for example, by using hundredths or tenths. The latest data on departures and arrivals have been updated and are considered accurate.

A constraint in AIP Volume I, General and Enroute, is the absence of publication requests from data sources (airports), which prevents them from updating AIP data. To ensure accuracy, PIA must frequently consult data sources to keep AIP data current. The PIA headquarters has sufficient personnel to process publications, as the division of labor is structured according to the number of personnel required to handle the AIP publication process. Supporting facilities, such as computers and printers, are adequate for the publication process. However, AIP work is still performed manually, with data entered in Word and Excel formats, which leads to errors. Therefore, software or applications are needed to facilitate the digital publication process through a system. PIA conducts evaluations at the time of AIP publication by appointing several personnel (the AIM (Aeronautical Information Management) team) to evaluate published AIP data. Data compliance must be assessed continuously to ensure it remains valid and accurate.

The data status in AIP Indonesia Volume I, General and Enroute, and the objectives of Aeronautical Information Services ensure the flow of aeronautical data and information required for

safety, order, economy, and efficiency in accordance with the global Air Traffic System, and prevent damage or errors to aeronautical data and information that could potentially impact the safety of air navigation.

In connection with the above basis, the author analyzes the problems in this research, with a gap analysis model analysis that the author has compiled by comparing the data in AIP Indonesia Volume I General and Enroute, currently with the actual data, with the following research results:

Table 1. Gap Analysis GEN 1.3

No	AIP Volume I	Data AIP	Data Sebenarnya	Referensi
I	II	III	IV	V
1	GEN 1.3 Entry, Transit And Departure of Passengers And Crew. Pada bagian GEN 1.3-3 AMDT 06 30 SEP 04	Subject from countries as referred to article (1) is eligible to enter Indonesia Territory through Immigration Inspection Post : a. AIRPORT 1.Sultan Iskandar muda (Banda Aceh) 2. Polonia (Medan) 3. Tabing (Padang) 4. Sultan Syarif Kasim II (Pekanbaru) 5. SM Badaruddin II (Palembang) 6. Hang Nadim (Batam) 7. Kijang (Tanjung Pinang) 8.Soekarno-Hatta (Jakarta) 9.Halim Perdanakusuma (Jakarta) 10.Husein Sastranegara (Bandung) 11. Adi Sumarmo (Solo) 12. Juanda (Surabaya) 13. Ngurah Rai (Bali) 14. Supadio (Pontianak) 15. Sepinggan (Balikpapan) 16. Juwata (Tarakan) 17. Hasanuddin (Ujung Pandang) 18. Sam Ratulangi (Manado) 19. Pattimura (Ambon) 20. El Tari (Kupang) 21. Selaparang (Mataram) 22. Sentani (Jayapura) 23. Frans Kaisepo (Biak)	17 bandara yang ditetapkan sebagai Bandara Internasional adalah sebagai berikut : 1.Bandara Sultan Iskandar Muda, Aceh Besar, Aceh 2.Bandara Kualanamu, Deli Serdang, Sumatra Utara 3.Bandara Minangkabau, Padang Pariaman, Sumatra Barat 4.Bandara Sultan Syarif Kasim II, Pekanbaru, Riau 5.Bandara Hang Nadim, Banten, Kepulauan Riau 6.Bandara Soekarno - Hatta, Tangerang, Banten 7.Bandara Halim Perdanakusuma, Jakarta Timur, DKI Jakarta 8.Bandara Kertajati, Majalengka, Jawa Barat 9.Bandara Kulonprogo, Kulonprogo, Daerah Istimewa Yogyakarta 10.Bandara Juanda, Sidoarjo, Jawa Timur 11.Bandara I Gusti Ngurah Rai, Badung, Bali 12.Bandara Zainuddin Abdul Madjid, Lombok Tengah, NTB 13.Bandara Sultan Aji Muhammad Sulaiman, Balikpapan, Kalimantan Timur 14.Bandara Sultan Hasanuddin, Maros, Sulawesi Selatan 15.Bandara Sam Ratulangi, Manado, Sulawesi Utara 16.Bandara Sentani, Jayapura, Papua 17.Bandara Komodo, Labuan Bajo, NTT. 1. Bandar Udara S. M. Badarudin II Palembang; Bandar Udara H.A.S. Hanandjoeddin di Bangka Belitung; Bandar Udara Jenderal Ahmad Yani di Semarang.	1.Keputusan Menteri Perhubungan Republik Indonesia Nomor : 31/2024 (KM 31/2004) tentang Penetapan Bandar Udara Internasional pada Tanggal 2 April 2024, menetapkan 17 (tujuh belas) bandar udara di Indonesia yang berstatus sebagai bandara internasional, dari semula 34 bandara internasional. Keputusan Menteri Perhubungan Republik Indonesia Nomor : KM 26 Tahun 2025 TentangPenetapan Bandar Udara S. M. Badarudin

				II Palembang, Bandar Udara H.A.S. Hanandjoeddin di Bangka Belitung , Dan Bandar Udara Jenderal Ahmad Yani di Semarang, sebagai bandar Udara Internasional

Tabel 2. *Gap Analysis GEN 1.7*

No	AIP Volume I	Data AIP	Real data	Referensi
I	II	III	IV	V
2	GEN 1.7 Differences from ICAO Standards, Recommended Practices and Procedures. Pada bagian GEN 1.7-1 AMDT 63 03 AUG 17	Chapter 1 Definitions and General Rules Concerning Licenses 1.2.5.2 The validity of medical examinations in Indonesia is as follows: Class I medical certificate for ATPL and CPL: 6 months	PKPS 67 TAHUN 2017 Medical Certificate Classes Three Classes of Medical assessment Shall be established as follows: Class 1 Medical Certificate; i. commercial pilot licenses; aeroplane, airship, helicopter and powered-lift; ii. airline transport pilot licenses aeroplane, helicopter and powered-lift; iii. Flight engineer license	Peraturan Menteri Perhubungan Republik Indonesia Nomor : PM 69 Tahun 2017 Tentang Peraturan Keselamatan Penerbangan Sipil Bagia 67 (Civil Aviation Safety Regulation Part 67) Tentang Standar Kesehatan Dan Sertifikasi Personel Penerbangan.

Tabel 3. *Gap Analysis ENR 1.8*

No	AIP Volume I	Data AIP	Data Sebenarnya	Referensi
I	II	III	IV	V
3	ENR 1.8 Regional Supplementary Procedures. Pada bagian AIRAC AIP AMDT 150 / 05 SEP 24	1.11.5.2 Where necessary, the Air Traffic Control Centre may be contacted as follows : Directorate of Air Navigation – DGCA Indonesia Telephone : 62-21-3507569 Facsimile : 62-21-3507569 AFTN : WRRRYNYX	AFTN : WRRRYNYX diguna oleh Notam Office yang berlokasi Perum LPPNPI Cabang JATSC	AIP INDONESIA (VOL I) GEN 3.1 – 1 Directorate General of Civil Aviation AIRAC AIP AMDT 120 08 SEP 22 International NOTAM Office (NOF) Postal Address : International NOTAM Office (NOF) Perum LPPNPI (AirNav Indonesia) Soekarno – Hatta International Airport Building 611 – Jakarta Air Traffic Service Centre (JATSC) Jakarta Indonesia - 19120 Telephone : (62) (21) 55910631 Facsimile : (62) (21) 55910659 AFTN : WRRRYNYX E-mail : notamoffice@airnavindonesia.co.id

Based on the results of observations, interviews, and a GAP analysis, several weaknesses are identified in the AIP Indonesia Volume I General and Enroute data verification and validation system, including delays in data updates, reliance on manual input, and the lack of a multi-layered digital monitoring system. Therefore, efforts are needed to strengthen the data verification and validation system, including: (1) Digitalization of the Data Verification and Validation Process; One of the leading solutions is the transformation from a manual input system to a digital-based system. The use of a special application for data verification and validation can minimize typing errors (human error) and speed up the information update process. This application can also automatically integrate data from various sources, with a change-history tracking feature (traceability). (2) Implementation of Consistent Standard Operating Procedures (SOPs); Clear, documented, and regularly updated SOPs are needed for each stage in the data verification and validation process. These SOPs must include technical verification procedures, data update deadlines, and administrative sanctions for negligence in the input or validation process. (3) Strengthening Coordination with Data Originators (Airports); As the primary source of data,

airports play a crucial role in ensuring that data submitted to PIA is up-to-date. Therefore, it is necessary to establish a regular coordination mechanism, either through online meetings (e.g., Zoom) or instant messaging groups (e.g., WhatsApp groups [WAGs]), to expedite information exchange between PIA and airports. (4) Improving Human Resources Competence: To support system strengthening, it is necessary to improve the competency of PIA personnel in digital data management, mastery of aeronautical data processing software, and training in understanding the latest regulations from ICAO and the Ministry of Transportation. (5) Periodic Evaluations and Internal Audits: Periodic evaluations of the AIP system and publications should be part of the quality control process. The formation of an internal audit team within the AIM (Aeronautical Information Management) unit can enhance accountability and facilitate the early detection of potential data discrepancies.

By implementing the above steps, Indonesia's AIP data verification and validation system will become more accurate, efficient, and compliant with international standards. This is crucial for maintaining the credibility of national aeronautical information publications and the safety of flight operations. The research findings, which indicate discrepancies in the AIP Indonesia Volume I General and Enroute, are closely related to theories and applicable regulations governing aeronautical information systems, both nationally and internationally. In ICAO Annex 15 on Aeronautical Information Services (AIS), data accuracy, timeliness, integrity, and traceability are the four main components in ensuring the safety and efficiency of air traffic.

In this context, observations of GEN 1.3 indicate that data still using AIP Amendment 06 dated September 30, 2004, do not reflect current international airport conditions. In fact, the Decrees of the Minister of Transportation, Nos. KM 31 of 2024 and KM 26 of 2025 have officially reduced the number of international airports from 34 to 17. This discrepancy indicates a delay in data updating, which does not comply with the principle of data timeliness as stated in ICAO Annex 15 and the Regulation of the Minister of Transportation of the Republic of Indonesia Number PM 9 of 2023 concerning AIS.

Furthermore, findings from GEN 1.7 also show that the validity period of health certificates for pilot license holders still refers to AMDT 63 of 2017, which is no longer in accordance with Minister of Transportation Regulation Number PM 69 of 2017 concerning Health Standards and Certification of Aviation Personnel. Based on data integrity theory, AIP should reflect the latest relevant standards, and any differences with national regulations should be explicitly stated in the "differences from ICAO standards" regulation. However, in reality, this data has not been systematically updated.

From a procedural perspective, all data updates should be processed through the AIRAC (Aeronautical Information Regulation and Control) mechanism, which ensures a standardized schedule for the periodic, uniform publication of information. However, interviews revealed that not all data had been obtained from the data originator (the airport), preventing implementation of the update process. This discrepancy is evident in Civil Aviation Safety Regulation Part 175, which emphasizes the importance of standardized, participatory data flow between AIS and data providers. Thus, the research results confirm that achieving AIP data accuracy requires not only an internal documentation and verification system but also integration of regulations, data sources, and procedures established in national and international standards. These findings support the need for integration among information digitization systems, dynamic regulations, and ongoing oversight to ensure that AIP documents serve as a reliable source of information for all aviation users.

The urgency of strengthening the data verification and validation system in AIP Indonesia, Volume I, is crucial, given the safety risks posed by inaccurate or outdated data. As found in this research, several data entries, such as the list of international airports (GEN 1.3), differences in ICAO standards (GEN 1.7), and AFTN addresses (ENR 1.8), do not reflect the latest realities that should serve as a reference for flight operations. This introduces potential errors in navigation planning, the issuance of NOTAMs, and the dissemination of flight safety information.

Findings from observations and interviews indicate that the system remains manual, with data entry performed using Microsoft Word and Excel. This is prone to human error, inefficient, and complicates data tracking and auditing (traceability). In terms of infrastructure and human resources, although the number of publication personnel is sufficient, the absence of a digitalization system and specialized training in aeronautical data management exacerbates this situation.

Based on the theory outlined in ICAO's AIS Manual (Doc 8126), modern aeronautical data management requires an integrated digital information management system that supports audit trails,

automated validation, and reminders for the AIRAC update cycle. Such a system not only improves accuracy but also accelerates the distribution of information to all aviation stakeholders. Meanwhile, the LPPNPI Board of Directors Regulation No. PER.014/LPPNPI/XII/2024 provides an institutional mandate for the management and distribution of AIP, but its implementation has not been accompanied by technological support or a data-quality-driven work culture.

Beyond technical aspects, strategically strengthening the system is crucial in response to the increasing complexity of aviation operations in the era of performance-based navigation (PBN) and digital communications. In the context of global Air Traffic Management (ATM), the AIP is the primary reference; therefore, any discrepancies or delays will affect the credibility of AIS providers internationally.

Therefore, system strengthening cannot be postponed. Concrete steps are needed, such as: (1) Process Digitalization: Implementation of specialized software for automated and integrated input, verification, and publication of aeronautical data. (2) Development of New SOPs: Implementation of clear standard operating procedures for each stage of AIP publication, from collection to final verification. (3) Continuous Human Resources Training: Improving the technical competence of AIS personnel through training based on the latest regulations and data processing technology. (4) Proactive Coordination with Data Originators: Establishing a real-time communication and monitoring system for data changes with each airport or data provider unit. (5) Periodic Audits and Evaluations: Evaluating data quality and system effectiveness at each AIRAC cycle to ensure continuous improvement. With this strengthening, the data verification and validation system in Indonesia's AIP will be more reliable, responsive to change, and meet global aviation safety standards.

The findings of this study highlight significant discrepancies in the Indonesian Aeronautical Information Publication (AIP) Volume I, particularly within sections GEN 1.3, GEN 1.7, and ENR 1.8. These sections contain outdated references that do not align with current regulatory frameworks established by the Ministry of Transportation and the latest ICAO provisions. Such inconsistencies indicate systemic delays in updating AIP data, raising concerns about both compliance and the reliability of aeronautical information. This aligns with the broader literature, which emphasizes that the accuracy and timeliness of aeronautical data are critical determinants of aviation safety and efficiency (Adjekum, 2017; Wickramasinghe & Perera, 2020).

A key obstacle identified in this research is the continued reliance on manual data-processing tools, such as Microsoft Word and Excel, which inherently reduce efficiency and increase the likelihood of human error. Previous studies have also noted that manual data management methods are incompatible with the dynamic nature of the Aeronautical Information Regulation and Control (AIRAC) cycle, which requires precise, regular updates (Moccia et al., 2021). Similar challenges were reported in other states where incomplete digitalization and fragmented coordination between data originators delayed the integration of aeronautical information into AIP systems (Zhou & Deng, 2019). These parallels suggest that Indonesia’s experience reflects a broader global challenge in transitioning from manual to fully digital aeronautical information management.

The interviews conducted with personnel from the Aeronautical Information Center (PIA) further illustrate that limited inter-unit coordination and delays in receiving data from originators impede compliance with the AIRAC cycle. This finding is consistent with recent evidence from aeronautical information studies, which stress that information flow and institutional collaboration are as important as technological upgrades in ensuring reliable AIP updates (Fayziev, 2022). Inadequate coordination not only reduces efficiency but also undermines confidence in the AIP as a reference document for international aviation operations.

In terms of implications, the results underscore the urgent need for Indonesia to adopt integrated digital platforms, supported by clear SOPs, staff training, and enhanced data communication channels. Such measures would not only align AIP Indonesia with ICAO Annex 15 standards but also strengthen the state’s credibility in global aeronautical information management. Comparable initiatives in other countries have demonstrated that digitalization significantly reduces processing delays, minimizes data errors, and improves regulatory compliance (Zhou & Deng, 2019; Moccia et al., 2021). By situating its findings within this broader research context, this study provides empirical evidence on the challenges facing a developing state’s aeronautical information system. It offers practical recommendations to strengthen the system.

Ultimately, this research contributes both practically and academically. Practically, it provides a structured set of strategies to improve Indonesia's AIP data management through digitalization, SOP reinforcement, and inter-unit collaboration. Academically, it adds to the limited but growing body of research on aeronautical information management in Southeast Asia, where empirical studies remain scarce. In doing so, the study addresses a critical knowledge gap by linking observed AIP inconsistencies with systemic organizational and technological barriers, thereby informing both aviation policy and academic discourse on air navigation safety.

CONCLUSION

This study evaluates the integrity and operational efficacy of AIP Indonesia Volume I, with a focus on the verification and validation mechanisms in the GEN and ENR sections. The empirical findings lead to several critical conclusions. First, there is a significant discrepancy between current aeronautical data and the prevailing regulatory frameworks. Outdated references in sections GEN 1.3, GEN 1.7, and ENR 1.8 underscore a systemic lag in data synchronization, which, as noted by Stojanovic et al. (2020), constitutes a latent risk to global navigation efficiency and flight safety standards.

Second, the prevailing reliance on manual data management—utilizing basic spreadsheet and word-processing software—represents a significant bottleneck in the Aeronautical Information Management (AIM) lifecycle. This manual dependency increases the risk of human error and undermines the AIRAC cycle's strict periodicity, mirroring the challenges identified by Kurniawan et al. (2021) in the Southeast Asian context. Consequently, this research argues that technical modernization is no longer optional but a strategic imperative.

Finally, this study proposes a holistic system-strengthening framework, encompassing the transition to integrated digital solutions, the modernization of Standard Operating Procedures (SOPs), and the enhancement of inter-agency coordination. Consistent with international benchmarks set by Hasegawa and Fukuda (2022), the adoption of a digital AIM architecture is essential to ensure traceability, timeliness, and compliance with ICAO Annex 15. In conclusion, reinforcing Indonesia's AIP data verification system is paramount for upholding national credibility and ensuring that the AIP remains an authoritative, high-integrity reference for safe and efficient global air navigation.

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