

Analysis of the Use of the CHRONOS Online Slot Time Application in Issuing ATC Clearance at Soekarno-Hatta International Airport

Triyono Yuniarto ¹⁾, Dwi Lestary ²⁾, Yudha Abimanyu ³⁾

^{1,2,3)} Air Traffic Control Study Programme/ Applied Undergraduate Programme Indonesian Aviation Polytechnic of Curug

*Corresponding Author

Email: trivoyuniarto89atc@gmail.com

Abstract

This research aims to analyze the implementation of the CHRONOS Online Slot Time Application in supporting the issuance of Air Traffic Control (ATC) clearance at Soekarno-Hatta International Airport. The study investigates how CHRONOS contributes to improving efficiency in flight scheduling, reducing clearance delays, and identifying technical and operational challenges during peak traffic hours. The research employs a qualitative descriptive method, involving observations, semi-structured interviews, and document studies with key personnel from Clearance Delivery (CD), Aeronautical Reporting Office (ARO), and Air Traffic Flow Management (ATFM) units at Jakarta Air Traffic Service Center (JATSC). The findings indicate that CHRONOS functions effectively at the slot approval stage, but integration issues between CHRONOS and the ATS system hinder real-time data synchronization. Consequently, manual coordination between CD, ARO, and ATFM remains necessary, leading to increased workload and clearance delays when slot times expire. Moreover, discrepancies between approved slot times and system updates cause pushback delays, congestion at aprons, and reduced operational efficiency. The study concludes that while CHRONOS enhances transparency and procedural consistency, further system integration, automated alerts, and improved inter-unit coordination are essential to optimize its performance. These results are expected to support the refinement of Standard Operating Procedures (SOPs) and the application of Collaborative Decision Making (CDM) in air traffic management operations.

Keywords: CHRONOS, ATC Clearance, Slot Time, Air Traffic Flow Management, System Integration

INTRODUCTION

Soekarno-Hatta International Airport (CGK) serves as Indonesia's busiest aviation hub, characterized by high operational complexity and dense traffic during peak hours, which demands a balance between safety, capacity, and efficiency in all operations. The growth of air transport requires effective and efficient regulation of slot times and utilization of airport capacity and infrastructure. Consequently, the Indonesian Ministry of Transportation established a regulatory framework defining slot time as the allocation of specific operating times for aircraft departures and arrivals (Menteri Perhubungan, 2016).

To address these operational challenges, AirNav Indonesia developed the CHRONOS (Collaborative Hub for Real-time Operation of Network Operation Slot) system a digital platform that integrates the submission, validation, and monitoring of slot times by stakeholders such as airlines, Air Traffic Controllers (ATC), Air Traffic Flow Management (ATFM), and the Aeronautical Reporting Office (ARO). The CHRONOS interface provides real-time updates on scheduled and unscheduled flights, slot availability, and airport capacity through the Notice of Airport Capacity (NAC) feature, ensuring consistency between demand and Air Traffic Services (ATS) capacity. However, any mismatch in NAC synchronization can cause ATC clearance delays (Kementerian Perhubungan, 2018).

In accordance with ICAO Doc 9971, ATFM plays a critical role in balancing demand and capacity to maintain safety and operational smoothness (Standar et al., 2024). Since 2018, CHRONOS has been integrated into the JATSC environment as the primary slot management tool supporting coordination and decision-making across operational units. Despite these advancements, challenges persist particularly in system integration between CHRONOS and the

ATS system, resulting in clearance delays when slot times expire. Manual coordination between CD and ARO remains necessary, especially during peak hours, when high workload conditions can lead to operational inefficiencies and potential departure delays.

The research identifies that while CHRONOS supports transparency and data accessibility among stakeholders, its effectiveness is limited by system desynchronization and operational inconsistencies. Therefore, this study seeks to analyze how CHRONOS is applied in issuing ATC clearance at Soekarno-Hatta International Airport, identifying technical and procedural barriers, and evaluating the system's impact on operational smoothness.

Problem Formulation

1. How is the CHRONOS application used in issuing ATC clearance at Soekarno-Hatta International Airport?
2. What operational challenges arise in the application of CHRONOS?
3. What improvement opportunities exist to enhance CHRONOS effectiveness in supporting slot time management and ATC clearance?

Research Objectives

1. To analyze the use of the CHRONOS application in ATC clearance issuance.
2. To identify technical and operational obstacles in its implementation.
3. To propose recommendations for system and procedural improvements to enhance CHRONOS efficiency and integration.

Through this study, the researcher aims to provide practical recommendations for strengthening Collaborative Decision Making (CDM), optimizing CHRONOS-ATS integration, and improving procedural efficiency to ensure smoother ATC clearance operations and flight punctuality at Soekarno-Hatta International Airport.

RESEARCH METHODS

This study employed a qualitative descriptive method, aiming to describe, analyze, and interpret how the CHRONOS Online Slot Time Application is utilized in the issuance of ATC clearance at Soekarno-Hatta International Airport. The qualitative approach was selected to explore operational dynamics, system integration, and coordination among related units namely, Clearance Delivery (CD), Aeronautical Reporting Office (ARO), and Air Traffic Flow Management (ATFM) in real operational conditions (Sugiyono, 2020).

Research Location and Duration

The research was conducted at Jakarta Air Traffic Service Center (JATSC), particularly in the Clearance Delivery Tower Unit, from May to December 2025. Data collection was concentrated during peak operational hours (06:00-09:00 and 16:00-20:00 local time) to capture real-time coordination patterns and slot management behavior under high traffic conditions.

Subjects of the Study

Participants included Air Traffic Controllers (ATCs) assigned at the CD position, ARO officers, ATFM personnel, and airline operations control (OCC) staff directly involved in slot management through CHRONOS.

Data Collection Techniques

Three primary techniques were used:

1. Interviews: Semi-structured interviews were conducted with key personnel to gain insights into the use of CHRONOS, procedural implementation, and encountered obstacles.
2. Observation: Non-participant observation was carried out to document the real-time workflow of clearance delivery and coordination with ARO and ATFM units during active traffic operations.

- Documentation Study: Supporting documents such as Standard Operating Procedures (SOPs), slot allocation regulations, CHRONOS operational manuals, and flight delay reports were reviewed to validate field data and ensure triangulation (Sugiyono, 2020).

Data Analysis

Data analysis followed the Miles and Huberman model, consisting of three stages:

- Data Reduction: Filtering and organizing collected information to focus on relevant patterns, challenges, and relationships.
- Data Display: Structuring information into descriptive narratives, tables, and flow diagrams to visualize the relationship between slot updates, system integration, and clearance issuance efficiency.
- Conclusion Drawing/Verification: Synthesizing findings through triangulation of sources (interviews, observations, documents) to ensure data validity and consistency (Sugiyono, 2020).

Ethical Considerations

All respondents participated voluntarily, with confidentiality guaranteed. The research adhered to AirNav Indonesia's operational data access policies and standard ethical guidelines in qualitative research.

Overall, this methodological framework was designed to identify the correlation between slot time synchronization, system integration, and ATC clearance efficiency, providing grounded recommendations for system enhancement, procedural refinement, and improved inter-unit coordination at Soekarno-Hatta International Airport.

RESULT AND DISCUSSION

Based on interviews, observations, and document analysis, this research reveals that the CHRONOS Online Slot Time Application has been effectively implemented as the official platform for slot management within Jakarta Air Traffic Service Center (JATSC). The system facilitates the submission, approval, and monitoring of slot times in real-time by multiple stakeholders, including Air Traffic Flow Management (ATFM), Aeronautical Reporting Office (ARO), and Clearance Delivery (CD) units. However, the findings show that CHRONOS has not yet achieved full integration with the Air Traffic Services (ATS) system, resulting in data synchronization delays that directly impact ATC clearance issuance and operational efficiency.

Table 1. Summary of Slot Time Synchronization Gaps and Operational Impacts

No	Process Stage	Expected System Flow	Actual Field Condition
1	Slot approval and FPL update	Automatic data entry into EJATSC and CD interface	Manual verification with ARO required
2	Slot renewal after expiration	Direct update reflected on CD	Data delay requiring confirmation
3	ATC clearance issuance	Seamless clearance after slot validation	Clearance delayed pending manual confirmation

From an operational standpoint, CHRONOS functions reliably at the slot allocation and approval level, where ATFM manages requests and ensures consistency with Notice of Airport Capacity (NAC) limits. However, during peak operational hours (06:00-09:00 and 16:00-20:00 local time), CD officers encounter repeated clearance delays due to slot status mismatches. When slot times are marked as expired in the ATS system but have been renewed in CHRONOS, controllers must manually verify updates through ARO, increasing workload and extending clearance processing time. This workflow gap contributes to pushback delays, apron congestion,

and taxi-out inefficiencies, ultimately reducing on-time performance (OTP) for airlines a trend consistent with findings from Setiawan et al. (2017) and Brueckner et al. (2022).

Figure 1. Workflow Relationship Between CHRONOS, ATFM, and ATC Clearance



A process flow showing data synchronization from slot approval to clearance issuance.

Source: Processed Research Data (2025).

Figure 1. Workflow Relationship Between CHRONOS, ATFM, and ATC Clearance

Observational analysis further confirms that the ideal system workflow from slot approval, updated flight plan (FPL), and automatic display on CD has not been consistently achieved. Instead, manual interventions remain common practice, highlighting the discrepancy between procedural standards (*das sollen*) and real-world execution (*das sein*). According to ATFM personnel, these inconsistencies often arise from delayed Flight Approval (FA) issuance, outdated FPL uploads, and system queue congestion during peak demand periods.

Document reviews, including the ATFM and ARO SOPs, reaffirm that CHRONOS serves as the primary slot management platform under national aviation regulations (Menteri Perhubungan, 2016; Kementerian Perhubungan, 2018). Nonetheless, these documents do not clearly define contingency handling procedures for non-synchronized slot data between CHRONOS and the ATS system. Consequently, clearance delivery operations still depend on verbal coordination between units an approach that contradicts the automation and transparency objectives mandated by ICAO Doc 9971 and AirNav Indonesia's ATFM implementation guidelines (Standar et al., 2024).

To improve CHRONOS effectiveness, several corrective measures are proposed:

1. System Integration Enhancement: Establishing full interoperability between CHRONOS and the ATS system to ensure automatic synchronization of slot and FPL updates in real time.
2. Notification and Validation Mechanism: Developing an alert system for CD personnel to detect discrepancies between CHRONOS and ATS databases immediately.
3. Standardized Coordination Protocols: Strengthening the SOP on inter-unit coordination (CD-ARO-ATFM) to minimize procedural ambiguity during slot expiration scenarios.
4. Collaborative Decision Making (CDM): Promoting transparent, shared situational awareness among ATFM, ARO, and CD units to streamline slot management decisions.

In summary, this study confirms that CHRONOS enhances transparency and efficiency in slot time management, yet its operational benefits in ATC clearance delivery remain constrained by system integration and procedural limitations. Bridging these technological and operational gaps will be essential to achieving a more synchronized, reliable, and efficient

clearance process at Soekarno-Hatta International Airport, aligning with ICAO's recommendations for collaborative air traffic management and continuous operational safety improvement.

CONCLUSION

The results of this study conclude that the implementation of the CHRONOS Online Slot Time Application has significantly improved the transparency and traceability of slot time management within Jakarta Air Traffic Service Center (JATSC) operations. However, its effectiveness in supporting ATC clearance issuance remains limited due to the lack of real-time integration between CHRONOS and the Air Traffic Services (ATS) system, which leads to data synchronization delays and reliance on manual verification through ARO and ATFM coordination. These operational gaps contribute to clearance delays and reduced efficiency during peak hours. Therefore, to optimize performance and align with ICAO's collaborative decision-making (CDM) principles, it is recommended that AirNav Indonesia enhance system interoperability, establish automated alert mechanisms, and strengthen inter-unit coordination procedures. Through these improvements, CHRONOS can function as a fully integrated platform, ensuring a more reliable, efficient, and data-driven clearance process at Soekarno-Hatta International Airport.

REFERENCES

- Brueckner, J. K., Czerny, A. I., & Gaggero, A. A. (2022). Airline delay propagation: A simple method for measuring its extent and determinants. *Transportation Research Part B: Methodological*, 162(October), 55–71. <https://doi.org/10.1016/j.trb.2022.05.003>
- Menteri Perhubungan. (2016). Peraturan Menteri Perhubungan Republik Indonesia Nomor PM 57 Tahun 2016 Tentang Penyelenggaraan Alokasi Ketersediaan Waktu Terbang (Slot Time) Bandar Udara. *Jdih.Dephub.Go.Id*, 1–14.
- Kementerian Perhubungan. (2018). Peraturan Direktur Jenderal Perhubungan
- Setiawan, I., Majid, S. A., & Yuliantini, Y. (2017). Airport Factor in Flight Delays in Indonesia. *Jurnal Manajemen Transportasi Dan Logistik*, 2(3), 365. <https://doi.org/10.25292/j.mtl.v2i3.115>
- Standar, P. O., Jatso, C., Penyelenggara, P. L., & Penerbangan, P. N. (2024). INDONESIA.
- Sugiyono. (2020). Metodologi Penelitian Kuantitatif, Kualitatif dan R & D