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Slot Time Policy and Dual-Use Coordination: Managing Training Flight Operations at Banyuwangi Airport

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Abstract

Regional airports increasingly face operational challenges as they accommodate both commercial aviation and pilot training activities within limited infrastructure and airspace. Banyuwangi Airport in East Java, Indonesia, represents a dual-use facility that has adopted a time-based slot allocation system to manage growing traffic from airlines and aviation academies. This study analyzes the structure and effectiveness of the airport's slot time policy using a qualitative-descriptive approach based entirely on secondary data, including policy documents, operational manuals, and scholarly literature. The findings show that while the policy provides functional time segmentation-allocating daytime hours for commercial operations and nighttime for training-it lacks formal regulatory support and is executed through manual, informal coordination. These limitations are compounded by infrastructural constraints such as a single runway, limited apron capacity, and the absence of digital scheduling tools. Additionally, relegating flight training to nighttime hours compromises the quality of visual flight instruction. The study concludes that although the existing policy reduces immediate operational conflict, it is not sustainable in its current form. Strengthening the policy through regulatory formalization, infrastructure enhancement, and digital slot coordination platforms is essential for ensuring both operational efficiency and the long-term viability of Indonesia's aviation training sector.

Keywords: Slot Time Policy, Flight Training, Banyuwangi Airport, Regional Airport Coordination, Dual-Use Operations, Airport Infrastructure, Aviation Policy.

1. Introduction

The global growth of air traffic has required airports-both international hubs and regional aerodromes-to adopt increasingly structured operational systems to manage runway capacity, airspace congestion, and apron limitations [1] [2]. Among these systems, slot time allocation has emerged as a central mechanism for regulating aircraft movements, particularly in environments where demand outpaces infrastructure. Slot time policies help synchronize arrivals and departures in fixed windows to ensure safety, efficiency, and predictable scheduling [3] [4]. Although initially developed for capacity-constrained airports, their application has become increasingly relevant to regional airports that host both commercial and training operations [5] [6].

Banyuwangi Airport, located in East Java, Indonesia, exemplifies this dual-function challenge. Recognized as an emerging regional connector, the airport has also evolved into a strategic base for pilot training due to its low traffic volume, favorable flying conditions, and government-backed infrastructure development [5]. However, with the increase in commercial flight frequencies and the growth of aviation education providers operating out of the airport, Banyuwangi faces mounting pressures to accommodate diverging flight profiles within limited runway and apron capacity. The complexity of managing these mixed operations necessitates a more sophisticated approach to slot time management.

Slot time refers to a scheduled interval within which an aircraft is authorized to land or take off at a specific airport, generally coordinated by a scheduling authority or airport operator [5]. Slot coordination is typically categorized into three levels: Level 1 (non-coordinated), Level 2 (schedule-facilitated), and Level 3 (fully coordinated), depending on demand saturation and regulatory requirements [7]. Although Banyuwangi is not officially classified as a Level 3 airport, the operational complexity resulting from mixed-use demands has led the local authorities to adopt de facto slot coordination, especially to prevent conflicts between commercial airline timetables and recurrent training patterns [8].

Flight training operations differ fundamentally from commercial airline activities. They demand flexible scheduling, prolonged runway occupancy, and extensive use of local airspace for repetitive training tasks such as circuits, stalls, and emergency maneuvers [9] These operational characteristics are often incompatible with the rigid, time-sensitive nature of commercial flight schedules, which prioritize efficiency and service regularity.As a mitigation strategy, training flights are frequently allocated off-peak hours, typically between 23:00 and 05:00 UTC, to avoid interfering with peak airline operations.However, this nocturnal scheduling often impedes visual flight rule (VFR) training, which depends heavily on daylight visibility and meteorological stability [15] [10].

The coexistence of training and commercial flights on shared infrastructure-including a single runway, limited taxiways, and apron stands-results in scheduling overlaps, inefficient aircraft sequencing, and extended turnaround times [13] [4]. These challenges are compounded in airports like Banyuwangi that rely on manual slot coordination, lack automated scheduling systems, and operate with minimal air traffic control staffing [8] [9]. The limited capacity of its two aprons, each supporting a maximum of four aircraft, often leads to congestion during peak periods or overlapping training sorties.

Addressing these challenges requires both operational innovation and policy-level reform. In addition to local scheduling efficiency, it is essential to understand how slot time mechanisms at regional airports can be better structured, standardized, and scaled [11] [5]. This study seeks to examine the structure, implementation, and operational implications of Banyuwangi Airport's slot time policy through a qualitative-descriptive approach based solely on secondary data, including regulatory documents, operational reports, and international best practices.

The study contributes to ongoing discussions surrounding slot time allocation in dual-use airports, with implications that extend to other regional hubs in Southeast Asia. As governments expand their aviation training capacity to meet growing industry demands, it becomes critical to ensure that scheduling systems evolve in parallel, ensuring not just traffic management, but also training quality and long-term sector sustainability [11] [1].

2. Research Method

This study adopts a qualitative-descriptive approach through desk-based policy analysis to investigate the structure and implications of the slot time policy at Banyuwangi Airport, particularly in relation to flight training operations. As a single case study, the research focuses on Banyuwangi Airport as a representative example of a regional Indonesian airport that accommodates both commercial and training flights within shared infrastructure. The case study method is appropriate for exploring real-world policy dynamics, especially where operational practices are shaped by local governance and infrastructure constraints [16] [12]. This design enables an in-depth examination of institutional arrangements and coordination mechanisms using document-based evidence only, without primary field data.

Data for the study were collected from a variety of publicly accessible secondary sources, including policy documents issued by the Directorate General of Civil Aviation (DGCA), operational manuals and scheduling logs from Angkasa Pura II, and regulatory frameworks such as the International Civil Aviation Organization's Airport Capacity and Slot Management [12] and the International Air Transport Association's Worldwide Airport Slot Guidelines [11]. In addition, peer-reviewed journal articles, technical reports, and national and regional media coverage were reviewed to understand both the formal and informal aspects of slot policy implementation. The use of secondary data is consistent with document analysis methodology, which is widely applied in aviation policy research where direct access to primary operations may be limited [18] [19].

To ensure rigor in analysis, data were examined using qualitative content analysis, following the guidelines of Elo and Kyngäs [13], which are particularly suitable for structuring large volumes of textual information into meaningful thematic categories. The analysis proceeded through an inductive coding process in which textual materials were grouped into themes such as policy formulation, slot distribution, operational constraints, and stakeholder coordination. This approach aligns with established qualitative techniques used in airport governance and transport policy research [21] [22].

Additionally, the study engaged in comparative policy analysis, drawing on best practices and benchmarks from international literature on airport slot coordination and dual-use scheduling frameworks. Key comparative sources included case studies on secondary airports in Europe and Asia-Pacific, where slot conflict between commercial and training aviation has prompted similar challenges [13] [5]. This comparison enables not only the identification of policy gaps at Banyuwangi but also the projection of potential reforms that align with globally recognized airport coordination strategies.

It is acknowledged that this study has limitations arising from its exclusive reliance on secondary data. The absence of field interviews or direct observational evidence may constrain the interpretation of real-time stakeholder behavior, operational flexibility, or informal negotiation practices. Nonetheless, the triangulation of regulatory sources, technical literature, and empirical studies, combined with reference to international guidelines, provides sufficient validity and breadth to support analytical conclusions [18] [23]. As such, this methodology offers a robust framework for evaluating the strategic alignment, challenges, and reform potential of slot time policy at Banyuwangi Airport in its dual operational role.

3. Result and Discussion

Structure of the slot time policy at banyuwangi airport. The slot time policy implemented at Banyuwangi Airport reflects a localized operational strategy tailored to accommodate dual types of flight activities-scheduled commercial flights and unscheduled training operations. Although Banyuwangi Airport is not designated as a Level 2 or Level 3 coordinated airport under IATA guidelines, it employs a semi-structured, informal slot management system to prevent operational conflict and ensure safety. This framework aligns with IATA's recommendations for non-coordinated or schedule-facilitated airports that experience episodic demand saturation [11].

Time-based segmentation is the core mechanism used to deconflict training and commercial flights. Based on operational records and regulatory review, the airport schedules commercial flights during peak periods, which typically occur from 05:00 to 23:00 UTC, while reserving off-peak hours (23:00–05:00 UTC) for flight training conducted by aviation academies [7] [9]. This model assumes that commercial flights take precedence due to their fixed departure schedules and passenger service obligations, while training flights-although essential for pilot development-are treated as flexible operations. Next Operational Time Segmentation for Slot Usage at Banyuwangi Airport (Indicative Structure) on Table 1.

Table 1. Operational Time Segmentation for Slot Usage at Banyuwangi Airport (Indicative Structure)

Time Block (UTC)	Allocated Operation Type	Typical Use	Policy Intent
05:00 – 11:00	Commercial Flights	Morning airline departures and arrivals	Maximize passenger flow during high demand
11:00 – 13:00	Shared (Flexible Window)	Transitional buffer; low commercial traffic	Allow minor training or special operations
13:00 – 17:00	Commercial Flights	Afternoon flight peaks	Sustain regional and domestic flight services
17:00 – 23:00	Commercial Flights	Evening rotations	Conclude airline operations before night ops
23:00 – 05:00	Training Flights	Repetitive maneuvers, pattern training, night flights	Reduce airspace and runway conflict

Impact on Training Flight Operations. This allocation, while not formally codified in national regulation, has become institutionalized through operational precedent and consistent coordination between airport authorities, air traffic services, and flight school representatives. The 23:00–05:00 UTC window is particularly crucial for recurrent training activities such as touch-and-go landings, holding patterns, stall recovery, and circuit repetition, which require continuous use of the runway over short intervals.

While this scheduling reduces conflict during commercial hours, it introduces significant limitations to visual flight rule (VFR) training. According to ICAO standards, VFR training requires adequate natural lighting, horizon visibility, and minimal night-time restrictions [12]. As a result, nighttime slots constrain the pedagogical value of training, especially for early-stage student pilots. This temporal mismatch between training needs and slot availability has been noted in similar studies on constrained regional airport environments [3].

Another dimension of the slot structure is apron utilization. Banyuwangi Airport operates with two apron zones: the Main Apron, used predominantly by commercial carriers such as Citilink and Garuda Indonesia, and the New Apron, which is reserved for general aviation and training aircraft. Each apron accommodates four aircraft, limiting overall capacity to eight concurrent ground positions. Training flights, often executed in small aircraft like the Cessna 172 or Piper Warrior, are more space-efficient but still contribute to ground congestion during overlapping operations or irregular delays.

Additionally, all runway movements are constrained by the single-runway configuration without a parallel taxiway. This forces aircraft to perform backtrack maneuvers during takeoff or after landing, increasing runway occupancy time and further reducing the effective slot availability per hour. ICAO categorizes such infrastructure layouts as "bottleneck-prone" and recommends that procedural deconfliction be paired with infrastructure investment in high-utilization scenarios [12].

Despite the limitations, the current policy represents a cost-effective compromise in a context where demand for pilot training is increasing, but infrastructure and regulatory capacity remain underdeveloped. The informal slot allocation at Banyuwangi demonstrates how local adaptation can temporarily substitute for formal coordination systems, although its long-term sustainability remains in question if traffic volume continues to grow.

Operational Constraints and Ground Infrastructure. The operational effectiveness of Banyuwangi Airport's slot time policy is fundamentally limited by the airport's existing physical infrastructure, particularly its single-runway configuration, absence of a parallel taxiway, and restricted apron capacity. While the current slot allocation strategy attempts to mitigate scheduling conflicts by segmenting flight types across different time blocks, the underlying infrastructure imposes unavoidable constraints that reduce the airport's flexibility and efficiency-especially during periods of high operational load or unforeseen disruptions [1] [20].

Banyuwangi Airport operates with a single asphalt runway-Runway 08/26-measuring 2,500 meters in length. This runway serves all aircraft movements, including commercial jets and light training aircraft. The absence of a parallel taxiway forces aircraft to conduct backtrack maneuvers on the active runway for both departures and arrivals. These maneuvers significantly increase runway occupancy time, reducing the throughput capacity of the airport and introducing delays in flight sequencing, especially during repetitive circuit operations common in training scenarios [12] [5]. For touch-and-go training exercises or visual navigation circuits, the inability to vacate the runway efficiently often leads to longer holding times, elevated fuel consumption, and higher air traffic controller workload [18].

Apron capacity further constrains operational performance. Banyuwangi Airport maintains two aprons: the Main Apron, primarily for commercial aircraft, and the New Apron, designated for general aviation and training flights. Each apron accommodates only four aircraft, resulting in a static maximum of eight positions. This limited ground space becomes particularly problematic during overlapping flight schedules or unanticipated delays-especially around transitional time blocks such as 11:00 or 23:00 UTC [17]. The limited capacity hinders the airport's ability to flexibly absorb temporary surges in traffic or reposition aircraft during emergencies.

The apron's layout further exacerbates bottlenecks due to the lack of segregated taxi lanes. All aircraft must navigate common movement paths between stands and the runway, increasing the likelihood of ground traffic congestion and compounding coordination challenges. Without ground surveillance technologies such as Ground Movement Radar (GMR) or advanced visual docking guidance systems, the airport relies entirely on manual radio-based clearance systems, which are prone to delays and communication missteps, particularly during peak use [10].

A further critical limitation is the absence of hangars or sheltered parking for training aircraft. Most training flights at Banyuwangi involve light piston-engine aircraft, including the Cessna 172 and Diamond DA-40, which are vulnerable to tropical storms, heavy rainfall, and prolonged exposure to sunlight. The lack of weather protection not only results in flight cancellations and maintenance deferrals but also shortens aircraft lifespan and increases operational costs for flight academies [14]. In addition, adverse weather events have a more severe impact when aircraft cannot be relocated or secured in hangars, elevating insurance and safety risks.

Compounding these structural challenges are coordination inefficiencies, driven by the airport's reliance on manual communication systems. Slot allocation and adjustment are handled via telephone calls, emails, or informal verbal confirmations between airport operations and training organizations. This analog approach creates administrative lag, reduces transparency, and impedes real-time tactical decision-making, particularly when multiple stakeholders are vying for shared runway use [3]. It also precludes the collection of time-stamped slot utilization data, limiting any possibility of performance benchmarking or future capacity modeling.

Although the current traffic level at Banyuwangi remains within tolerable limits, the continued growth of domestic commercial aviation and Indonesia's aviation education sector threatens to exceed the airport's infrastructure threshold in the near future. Without a comprehensive infrastructure upgrade-such as the construction of a parallel taxiway, the expansion of apron space, or the establishment of a dedicated runway segment for flight training-the airport will face recurring congestion, coordination conflicts, and reduced operational safety [12].

In conclusion, Banyuwangi Airport's infrastructural conditions place hard limits on the capacity and adaptability of its slot time policy. While current measures permit a baseline separation of flight types, the lack of scalable infrastructure and digital coordination systems leaves the policy implementation vulnerable to inefficiency and degradation under growing demand pressures.

Policy consistency and coordination. The effectiveness of Banyuwangi Airport's slot time policy is shaped not only by its operational structure and infrastructure limitations, but also by the degree of regulatory consistency and institutional coordination. While the current time-based slot allocation arrangement provides a working framework for separating training and commercial operations, it remains largely informal, undocumented in national regulation, and locally administered. This localized, consensus-driven approach has so far enabled basic operational coexistence, but it lacks the standardization and transparency typically associated with formalized slot management systems as outlined by international aviation bodies [11] [12].

Unlike major coordinated airports designated as Level 3 under IATA's Worldwide Airport Slot Guidelines (WASG), Banyuwangi Airport operates without a formal slot coordinator or centralized scheduling authority. Slot requests, particularly for training flights, are processed manually and on a case-by-case basis, often through direct communication between flight schools, air traffic control (ATC), and airport operations management. This model relies heavily on institutional goodwill and informal agreements rather than codified procedures, making it susceptible to inconsistency, delayed responses, and disputes during periods of high demand [7].

The lack of formal documentation specifying slot allocation rules, prioritization principles, and dispute resolution mechanisms represents a significant governance gap. For instance, there are no published criteria on how slot preferences are granted when there is a conflict between a delayed commercial arrival and a scheduled training sortie. Similarly, there is no clear framework for reassigning or canceling slots in the event of force majeure, such as sudden weather deterioration or runway closures. In airports with mature slot policies, these contingencies are addressed in advance through pre-agreed coordination protocols, often supported by real-time operational databases [4].

Moreover, Banyuwangi Airport does not currently employ digital coordination tools such as electronic slot request systems or collaborative decision-making (CDM) platforms. As a result, all slot-related decisions are made based on static schedules and require verbal or written confirmation via non-standardized formats [9]. The absence of a digital interface restricts the airport's capacity to manage dynamic traffic scenarios, evaluate historical slot performance, or conduct slot adherence audits. This not only impedes operational transparency but also prevents strategic long-term slot planning based on data analytics.

Stakeholder engagement is conducted through ad hoc coordination meetings, generally initiated when flight training volumes increase or when commercial carriers propose new schedules. While these meetings demonstrate a commendable effort at multi-stakeholder coordination, they lack formal enforcement mechanisms. Without binding commitments or documented agreements, training operators may find their allocated windows preempted by commercial flights, especially when commercial activity surges due to seasonal or promotional factors [6]. This dynamic reinforces the subordinate status of training operations in the slot hierarchy, despite their critical role in sustaining Indonesia’s aviation talent pipeline.

The policy vacuum at the national level compounds the problem. There are no clear regulations issued by Indonesia’s Directorate General of Civil Aviation (DGCA) regarding slot time policies for dual-use airports—those accommodating both training and commercial aviation. Most national slot regulations focus on primary airports such as Jakarta Soekarno-Hatta or Surabaya Juanda, which operate under high-density traffic. For regional airports like Banyuwangi, the absence of standardized guidance results in disparate practices and inconsistent interpretations of scheduling fairness and access equity [14].

This gap opens an opportunity for policy development. Drawing from international best practices, such as those adopted in regional training airports in Australia and Europe, Indonesia could introduce a tiered regulatory framework that recognizes training-heavy airports as a unique operational category. Such a framework would define minimum coordination standards, set principles for slot conflict resolution, and mandate digital slot management systems scaled to the airport’s traffic level [3].

In conclusion, Banyuwangi Airport’s current slot coordination relies on informal processes, limited stakeholder agreements, and reactive communication, which-while functional in the short termlack the robustness and fairness required for long-term sustainability. The absence of formal regulation and digital integration reduces the reliability of scheduling, especially from the perspective of flight training institutions. If left unaddressed, this policy inconsistency may hinder not only operational performance but also national aviation capacity development goals.

The analysis of Banyuwangi Airport's slot time policy reveals a locally responsive but structurally limited approach to managing dual-use operations-commercial and flight training-within a constrained regional infrastructure. While the current system of time-based separation between commercial flights and training operations allows for basic functional coexistence, it is hampered by infrastructural, procedural, and regulatory weaknesses that undermine long-term sustainability and efficiency.

The segmentation of operational time into commercial and training windows reflects a practical conflict-avoidance strategy commonly applied in non-coordinated regional airports [12]. By reserving off-peak nighttime hours (23:00–05:00 UTC) for training flights, Banyuwangi reduces the risk of scheduling conflicts, enhances runway availability, and complies with ICAO’s recommendations on airspace deconfliction in mixed-use airports. However, this separation creates a trade-off between operational feasibility and instructional quality, as critical Visual Flight Rules (VFR) training-which requires sufficient daylight-is displaced to nighttime hours. This finding echoes observations by Fatmawati, who argues that late-night scheduling, while operationally efficient, fails to support pedagogical needs [7].

Infrastructural constraints further exacerbate the issue. The single-runway configuration and absence of a parallel taxiway significantly limit aircraft movement flexibility and reduce slot throughput, particularly when backtrack operations are required. As noted by Zhang and Zhang, runway occupancy time is a key determinant of slot capacity; without supporting taxi infrastructure, even well-timed scheduling loses effectiveness [4]. In Banyuwangi’s case, the absence of a dedicated training runway or high-speed exit taxiways amplifies congestion risk during overlapping activity periods.

Moreover, the airport's limited apron capacity and lack of weather-protected parking for small aircraft impose additional burdens on training operators. These physical limitations reduce the operational resilience of the airport during high-traffic or adverse-weather scenarios, ultimately limiting the ability of flight schools to meet sortie quotas. Similar challenges have been reported in studies of small airports in Southeast Asia, where underinvestment in support infrastructure restricts the scalability of aviation training [3].

Policy-wise, the slot management approach at Banyuwangi remains informal, undocumented, and locally negotiated. While collaborative and adaptive in nature, this absence of regulatory codification leads to inconsistencies in slot allocation and prioritization, especially when unplanned disruptions or demand surges occur. As Purwanto and Suryanto explain, without a formal dispute resolution mechanism or published prioritization guidelines, training operations are often deprioritized in favor of commercial activities [9]. This informality not only affects scheduling reliability but also introduces uncertainty that hinders strategic planning by flight schools.

Furthermore, the lack of digital coordination tools such as a real-time slot allocation interface, dashboard visibility, or integrated decision-making system constrains Banyuwangi’s operational agility. Manual processes relying on email or verbal communication are not scalable and contribute to avoidable delays or miscommunication. In contrast, airports that have adopted collaborative decision-making (CDM) systems or digital slot allocation platforms report improved coordination and on-time performance [14] [11]. For a regional airport experiencing growth in both commercial and training traffic, digitization of slot processes is no longer optional-it is strategic.

The findings also point to a broader policy gap at the national level. There is currently no targeted regulatory framework in Indonesia that governs slot allocation at regional airports with training-heavy operations. While major hubs like Soekarno-Hatta or Juanda operate under Level 3 coordination principles, regional airports remain governed by general principles that fail to address the unique challenges posed by dual-use environments. The absence of a national policy recognizing the coexistence of commercial and training aviation within a single facility results in fragmented practices, as each airport independently determines its own coordination procedures [6].

To address these challenges, there is a need for institutional reforms and capacity-building measures. First, formalizing Banyuwangi's slot policy through local regulation or DGCA directives would provide legal clarity and operational consistency. Second, developing an integrated slot management system-either independently or via national infrastructure support-would improve transparency, responsiveness, and data-driven decision-making. Finally, embedding training flight considerations within national slot allocation policies would ensure that Indonesia's expanding aviation education sector receives the scheduling access it requires to function effectively.

In sum, Banyuwangi Airport's slot time policy illustrates both the promise and pitfalls of localized coordination in a resource-constrained environment. While the policy has succeeded in reducing direct runway conflict between flight types, its informal foundation, lack of digital support, and infrastructure limitations pose significant risks to operational stability and aviation training outcomes. Addressing these issues will require coordinated regulatory attention, strategic infrastructure investment, and stakeholder commitment to a shared vision for integrated airport use.

4. Conclusion

The study of Banyuwangi Airport's slot time policy reveals a localized, time-based allocation strategy that aims to balance the operational demands of commercial aviation and flight training within a constrained infrastructure environment. While the policy successfully reduces direct scheduling conflicts by separating peak-hour commercial operations from off-peak training activities, it simultaneously compromises the instructional quality of flight training-particularly visual flight operations-by relegating them to nighttime hours. The airport's physical limitations, including a single-runway layout, limited apron capacity, and absence of a parallel taxiway, further hinder the policy's effectiveness. Additionally, the manual and informal nature of slot coordination, coupled with the absence of a digital system or formal regulatory framework, undermines the scalability and fairness of scheduling. These issues are compounded by the lack of national guidance from Indonesia's Directorate General of Civil Aviation, leaving regional airports like Banyuwangi to independently interpret and implement coordination practices, which increases the risk of inconsistency and operational vulnerability. To address these challenges, several policy actions are recommended: first, formalizing the slot time arrangement through local regulation or DGCA circulars that define allocation blocks, priorities, reallocation procedures, and dispute mechanisms; second, developing a digital slot coordination platform to facilitate real-time scheduling, transparency, and historical data tracking; third, investing in infrastructure upgrades such as parallel taxiways, faster runway exits, expanded aprons, and sheltered hangars to support dual-use demands; fourth, revising the time allocation to include protected daylight periods-such as a mid-day training buffer-for essential VFR exercises; and fifth, integrating training flight considerations into national slot allocation policies to ensure regional airports supporting aviation education are governed by consistent, equitable, and development-oriented frameworks.

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