

A Qualitative Study on Air Traffic Controller Workload in Flight Operations at Banyuwangi Airport

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Abstract

This study highlights the heavy workload experienced by Air Traffic Controllers (ATC) at Banyuwangi Airport, where training flights make up 95% of total air traffic. This burden is exacerbated because controllers are forced to juggle their primary air traffic duties with additional operational tasks, such as managing the ATS Reporting Office (ATS-RO) and slot times. Using a qualitative case study approach that includes observations and in-depth interviews, this research reveals that these dual responsibilities deprive personnel of their mandatory rest periods. The root of this issue lies in the current personnel calculation formula, which fails to account for administrative workloads and actual flight volumes. Consequently, this study recommends revising the personnel calculation formula, strictly enforcing rest periods, and hiring dedicated ATS-RO staff to safeguard aviation safety.

Keywords: *Workload, Air Traffic Controller, training flight, dual roles, personnel requirement*

INTRODUCTION

Air transportation infrastructure increasingly supports not only commercial flight operations but also pilot training activities, particularly at airports that serve as operational bases for flight training academies. Banyuwangi Airport exemplifies this dual role: alongside scheduled, non-scheduled, and military flights, it functions as the operational base for two flight schools, Akademi Penerbang Indonesia Banyuwangi and Bali International Flight Academy, resulting in training flights accounting for the largest share of aircraft movements at the airport. Training flights differ operationally from scheduled commercial flights in that they involve high-frequency, dynamic movements with relatively short durations and repetitive maneuver patterns such as touch-and-go, circuit training, local training area operations, and cross-country flights, activities through which pilots and crew develop and refine their operational skills (Anissanadhea et al., 2024).

Air Traffic Control units, particularly aerodrome control towers, are required to comply with applicable Standard Operating Procedures while accounting for actual field conditions in order to fulfil the Five Objectives of Air Traffic Services, namely expediting and maintaining an orderly flow of air traffic (Lestary et al., 2023). At Banyuwangi Airport, air traffic service provision is limited to an Aerodrome Control Tower, meaning ATC personnel are responsible not only for tower control functions such as issuing taxi, take-off, and landing clearances and providing traffic information, but also for functions typically assigned to a separate ATS Reporting Office, including flight plan reception, distribution, and coordination with flight schools, as well as slot time service through the CHRONOS application. Under the fourth edition of the Flight Training Activity Service SOP (No. SOP.001/G/06/LPPNPI/OPS/VI/2025, point 4.1.3), aircraft may only be issued a start clearance after submitting a flight plan and confirming slot availability within CHRONOS (Banyuwangi, 2025), a requirement that further embeds slot time administration into ATC's daily control duties.

This concentration of functions within a limited pool of personnel has been linked to disproportionate task distribution and elevated risk of fatigue and human error. Prawira and

Aryono (2025) found that at Banyuwangi Airport, the limited number of ATC personnel produces an uneven task distribution amid training flights that constitute approximately 66 percent of total aircraft movements, heightening fatigue-related risk. Comparable implementation challenges have been documented elsewhere: Dharma and Saputra (2024), examining delay effects of slot time changes on Electronic Flight Progress Strips at I Gusti Ngurah Rai Airport, Denpasar, found that pilots requesting ATC or start-up clearance outside their allocated slot window require the Clearance Delivery unit to contact the ATS Reporting Office for slot updates, while pilots must separately contact their airline operator, consuming additional time. At Banyuwangi, where Clearance Delivery and ATS Reporting Office functions are held by the same personnel, any deviation between allocated slots and actual aircraft movements adds a coordination burden that must be managed simultaneously rather than distributed across separate units.

To manage this workload, the Banyuwangi ATC unit has implemented several measures, including duty schedule arrangements, division of work positions within each duty shift, supervisor appointments through internal memoranda, and additional personnel recruitment. Despite these measures, personnel-reported workload has not decreased. How this workload is formed, which factors shape it, how it affects service delivery and operational safety, and why existing management measures have not reduced it remain insufficiently examined, particularly given that Banyuwangi's traffic characteristics diverge from typical airport operations while prevailing personnel-requirement and fatigue-management instruments remain generic in nature.

This gap motivates the present study, which adopts a qualitative approach to examine ATC workload through the perspectives of ATC personnel, unit leadership, and coordinating partners from the flight schools. Specifically, this study aims to (1) describe the workload experienced by ATC personnel at Banyuwangi Airport; (2) identify the factors that influence this workload; (3) analyze its impact on service delivery and operational safety; and (4) examine the workload management measures undertaken and the obstacles encountered in their implementation.

RESEARCH METHODS

This study employs a descriptive qualitative approach using a single case study design, following Yin's (2018) conception of case study as a strategy for investigating a contemporary phenomenon in depth within its real-life context, and Creswell's (2014) view of case study as an exploration of a bounded system through detailed data collection from multiple sources. This design was chosen because ATC workload at Banyuwangi Airport is embedded in overlapping functions within a single service unit, a phenomenon better understood through depth and meaning than through generalizable measurement (Sugiyono, 2019). The study was conducted at Banyuwangi Airport, East Java, an airport whose Air Traffic Control unit consists solely of an Aerodrome Control Tower, requiring personnel to concurrently perform tower control, ATS Reporting Office, and slot time functions, a configuration that constitutes the bounded system under investigation.

Informants were selected using purposive sampling followed by snowball sampling, which gathers information progressively from one informant to the next (Salganik & Douglas, as cited in Lenaini, 2021), beginning with on-duty ATC personnel and extending to personnel with varied tenure and assignments, unit leadership, and flight school representatives. Eligibility required ATC personnel to hold an active rating and be actively performing control duties at Banyuwangi Airport; of nine ATC personnel assigned to the unit, eight met this criterion, of whom six were interviewed (75 percent), while two could not be included due to leave and scheduling constraints. Table 4 summarizes the informant profile.

Table 1. Profile of Research Informants

Category	n	Description
ATC personnel	6 of 8 eligible (75%)	Tenure ranging from 1 to 16 years; includes one recently assigned supervisor
Unit head	1	Head of Sub-Branch, tenure of 2 years 10 months
Flight school representatives	2	Flight Operations Officer (Akademi Penerbang Indonesia); scheduler (Bali International Flight Academy)

Primary data were collected through in-depth, semi-structured interviews and direct observation, while secondary data were drawn from internal regulatory and operational documents, including the unit's supervisor-appointment memorandum, the fourth-edition tower Standard Operating Procedure, the 2022–2026 air traffic controller personnel-requirement document prepared under the Fatigue Risk Management System, 2025 aircraft movement data, duty rosters, CHRONOS slot submission and flight plan archives, applicable aviation regulations, and relevant prior research. Observation focused on task distribution within duty shifts, use of rest periods, and coordination with external parties, concentrated on the morning shift when traffic density is highest. Interviews were conducted online according to informant availability, lasting 18 to 42 minutes, recorded with consent and transcribed; the interview guide was applied flexibly, with probing questions developed in response to each informant's answers.

Data were analyzed using the interactive model of Miles and Huberman (as cited in Sirajuddin, 2023), comprising data condensation, data display, and conclusion drawing and verification, continued until data saturation was reached, indicated by the absence of new information across informant categories. Data trustworthiness was established through source and technique triangulation (Hardani et al., 2020; Sugiyono, 2019): source triangulation compared accounts across the three informant categories, with differing perspectives described and categorized rather than averaged, while technique triangulation cross-checked interview accounts of personnel composition, rest-period provisions, and task scope against observation and documentary evidence, with any discrepancies reported as findings.

RESULTS AND DISCUSSION

Air traffic services at Banyuwangi Airport are provided by a single Aerodrome Control Tower operated by AirNav Indonesia's Banyuwangi Sub-Branch, staffed by nine ATC personnel (eight holding an active rating), one unit head, and a single ATS Reporting Office officer who is not on duty daily. Traffic is dominated by training flights conducted by two flight schools: of 28,899 recorded movements in 2025, 27,483 (about 95 percent) were training flights, comprising touch-and-go, training-area maneuvers, varied circuit patterns, and cross-country flights, against 889 scheduled and 527 non-scheduled movements. An average of 79 movements per day places the unit in the second-lowest of four national service classifications. In-depth interviews were conducted with all nine informants — six of eight eligible ATC personnel (75 percent), the unit head, and two flight-school representatives — between 26 and 31 July 2026, each lasting 18 to 42 minutes.

Although annual figures classify the unit as low-traffic, hourly movement data for June to July 2026 (61 days, N = 5,748) reveal marked temporal concentration, summarized in Table 5: more than half of all movements occurred within five of the unit's twelve operating hours, and weekday traffic exceeded Sunday traffic more than fourteenfold. This concentration is not

reflected in the unit's official traffic classification, which is based on movements averaged across the full year and full operating day.

Table 2. Temporal Concentration of Aircraft Movements (June–July 2026, 61 days, N = 5,748)

Period	Share of Total Movements	Average Movements
Peak hours, 07:00–11:00 (weekdays)	56.5%	up to 15.8 per hour
Weekdays (Mon–Fri)	93.8%	119.8 per day
Saturday	5.0%	36.1 per day
Sunday	1.1%	8.2 per day

Source: Banyuwangi daily traffic sheets, June–July 2026 (share for day-type rows computed from reported daily averages $\times$ number of each weekday type in the period; N validates to within 0.05% of the reported total).

Informants consistently attributed workload to three converging sources rather than movement volume alone. First, the diversity and unpredictability of training-flight maneuvers required differentiated handling of aircraft sharing the same airspace, compounded by variable trainee readiness — including read-back and hear-back errors and unsupervised solo flights — that demanded closer monitoring; one ATC informant described the traffic mix as almost entirely training flights of many different kinds, a proportion consistent with the recorded 2025 share. Second, the unit's officially ideal duty composition of four personnel — a controller, an assistant, an ATS Reporting Office officer, and a resting controller — was rarely achieved; personnel instead rotated roles within duty shifts of two to three, which informants said left little genuine rest time despite rest periods being formally mandatory. Third, personnel with prior assignments elsewhere reported that workload at Banyuwangi differed from other units due to both personnel availability and the distinctiveness of the traffic itself.

A second cluster of findings concerned the causes of this workload. All ATC informants and the unit head identified the concurrent handling of ATS Reporting Office duties, CHRONOS slot management, and traffic data entry — functions handled by dedicated units elsewhere — as the most consistently cited source of burden; document review confirmed that ATS message handling is formally listed as a core ATC duty under the unit SOP. This burden was compounded by the single, non-daily ATS Reporting Office officer, which pushed reporting duties onto on-duty ATC personnel and, according to flight-school representatives, created delays in external coordination. Training-flight scheduling volatility, driven by shifting student and instructor readiness, frequently misaligned submitted flight plans with allocated slots, requiring manual reconfirmation by ATC; flight-school partners further noted that some commercial slots reserved within the 15-movements-per-hour capacity went unused once the corresponding scheduled flights had been discontinued. Document review identified a structural gap underlying these pressures: the 2022–2026 personnel-requirement formula omits touch-and-go movements from its traffic variable and bases required staffing on a two-person crew, whereas the unit's own SOP specifies three as the ideal composition — a discrepancy the unit head confirmed had not been reconciled.

Regarding impacts, the most frequently reported consequence was the use of mandatory rest periods to perform ATS Reporting Office duties, which informants linked to fatigue risk: with only two personnel on duty, controllers said they could not obtain genuine rest while also serving as assistant or supervisor. Acknowledged operational errors clustered in support tasks — slot and flight-plan entry — rather than in core control functions, attributed by informants to reduced concentration; one flight-school partner separately reported a scheduling clash arising from delayed coordination of night-training activity. No formal incident or safety report existed to verify these accounts, so the impacts reported here reflect informant perception rather than

measured outcomes. Document review found that while the unit SOP limits continuous control duty to two hours with a mandatory one-hour rest, and the personnel-requirement document does recognize ATS Reporting Office duty as a factor for setting maximum control hours, this provision had, according to informants, not been applied in actual scheduling, and implementation of the corporation-wide Fatigue Risk Management System had reportedly stalled at this unit.

On management efforts, the unit had adjusted duty composition to traffic peaks (three personnel in the morning, two in the afternoon) and appointed a rotating supervisor each period; however, because the supervisor role remained attached to an actively controlling officer rather than a dedicated non-controlling position, most informants judged it to have had little effect on workload distribution. Peer assistance occurred informally, but in a compensatory form, with personnel using their own rest time to help colleagues rather than workload being formally reduced. External coordination lacked a clear point of contact, as communication ran through a shared office messaging number; both flight-school representatives said they could not identify which controller they were coordinating with. Personnel numbers had increased from a calculated requirement of six to an actual complement of eight, with a ninth in training, yet informants reported no corresponding reduction in workload, since ATS Reporting Office duties remained attached to whichever ATC personnel were on shift regardless of headcount. The most common improvement suggested by informants was further personnel addition, followed by realigning the Fatigue Risk Management System to actual workload, upgrading equipment to support the supervisor role, additional training, and separating external-coordination responsibilities from active control duty.

These findings support Wickens et al.'s (2004) conception of workload as a level of demand rather than task volume: the unit's low-traffic classification, based on 79 movements per day, understates the workload informants described, extending Putriekapuja et al.'s (2024) finding that time load, not movement count, dominates ATC mental workload, while remaining consistent with Cristi and Zaini's (2020) traffic–workload correlation, which appears necessary but insufficient to capture the full demand at Banyuwangi.

The concurrent handling of ATS Reporting Office, slot management, and data-entry duties by ATC personnel extends Dharma and Saputra's (2024) finding on coordination costs from slot-time changes: rather than requiring coordination between separate units, at Banyuwangi these functions are performed by the same individual simultaneously, removing any structural separation that might otherwise buffer the controller's primary task. The most consequential finding concerns the personnel-requirement formula itself: because it excludes touch-and-go movements and is calculated on a two-person crew basis while the unit's SOP specifies three as ideal, staffing can appear numerically adequate while lived workload remains high — a discrepancy at the level of measurement rather than personnel count.

The impact findings are consistent with ICAO's (2018) view that excessive workload lowers vigilance and increases error risk, with a notable pattern: acknowledged errors clustered in support tasks rather than core control functions, suggesting personnel prioritize cognitive resources toward primary control duties, so performance degradation surfaces in less visible work rather than uniformly across tasks — extending Kireina et al. (2022) on workload's effect on performance. This should be read with an important caveat: the absence of formal incident or safety documentation means the safety impacts identified here represent informant-perceived risk rather than verified outcomes, a limitation inherent to a unit that does not maintain formal error records, and one that constrains the study's conclusions to the existence of potential risk rather than its realization. Notably, the gap identified is one of implementation rather than regulation: a provision recognizing ATS Reporting Office duty in setting maximum control hours already exists but has not been applied in practice, just as unit-wide Fatigue Risk Management System implementation has stalled.

The management-strategy findings confirm the presence of the scheduling, task-rotation, and collaboration strategies identified by Hendiyanto and Isnawijayani (2024), but show them functioning differently than intended: the supervisor role, still attached to active controlling duty, has not produced a genuine division of labor, and peer collaboration operates compensatorily, shifting rather than reducing workload. This partially qualifies Mustika et al.'s (2026) cognitive-buffer thesis: procedural clarity alone has not lowered perceived burden in external coordination at Banyuwangi, because the underlying gap is an absence of a clearly designated point of contact rather than an absence of a procedure. These findings extend Prawira and Aryono (2025), who identified limited personnel as a problem at the same location: this study indicates that increasing headcount, from six to eight personnel, has not proportionally eased workload because the set-crew composition underlying the requirement formula was not revised alongside it. The temporal concentration of movements further reinforces Putriekapuja et al.'s (2024) emphasis on peak-period time load: because current traffic classification and personnel standards rely on annual and full-day averages, the demand concentrated within a handful of peak hours goes unrecognized by the instruments intended to determine adequate staffing.

CONCLUSION

This study concludes that ATC workload at Banyuwangi Airport arises from the accumulation of a training-flight-dominated traffic mix with highly varied and unpredictable maneuver patterns, trainee readiness that requires closer monitoring, and a duty composition of only two to three personnel who must continually rotate roles, a combination that produces demand far exceeding what the unit's official low-traffic classification suggests. The most consistently cited driver of this workload is the concurrent handling of ATS Reporting Office duties, CHRONOS slot management, and flight-data reporting by ATC personnel themselves, compounded by a single, non-daily ATS Reporting Office officer and by the dynamic rescheduling that training flights require; more fundamentally, the prevailing personnel-requirement formula excludes touch-and-go movements and is calculated on a two-person crew basis even though the unit's own procedure specifies three as ideal, which explains why staffing can appear numerically adequate while the workload experienced on duty remains high. This workload manifests chiefly as lost rest periods consumed by ATS Reporting Office tasks, a condition informants associate with fatigue risk, and as acknowledged errors concentrated in support tasks rather than core control functions; because no formal incident or safety record exists, these impacts should be understood as informants' assessed risk rather than a verified safety outcome. The management measures already in place — duty scheduling adjusted to traffic peaks, a rotating supervisory role, informal peer assistance, and additional personnel — have not resolved the underlying workload because the supervisory function remains attached to active controlling duty, peer assistance shifts rather than removes the burden, and added personnel have not changed the work composition itself. Addressing this will require the air navigation service provider to recalculate personnel requirements using a formula that accounts for the ATS Reporting Office function and the traffic's uneven temporal distribution, to apply the existing but unimplemented provision recognizing ATS Reporting Office duty when setting maximum control hours, and for the unit to prioritize additional ATS Reporting Office staffing, with future research extending these findings through quantitative workload measurement, incident and safety data, and comparison with other units where personnel similarly perform cross-functional roles.

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