Contents lists available at JBRI

Journal of Business Research and Insights

journal homepage: https://www.journals.sjp.ac.lk/JBRI

Article

A Precision Timing Analysis to Improve Turnaround Efficiency in Narrow-Body Aircraft Operations

A.J.L.B. Sajana*, A.S. Fernando[a], J.E. Weerasinghe[b]

[a] *University of Moratuwa, Sri Lanka.*
[b] *SriLankan Airlines Ltd.*

To link to this article: *https://doi.org/10.31357/jbri.v11i02.8925*

ARTICLE INFO

Article History:

Received 27.06.2025
Revised 25.10.2025
Accepted 11.11.2025

Keywords:

aircraft turnaround
air transport
ground handling operations
precision time

ABSTRACT

Air transportation is a rapidly growing sector with significant economic implications, contributing to the global flow of goods, people, and ideas. However, the saturation of airport capacities has led to challenges, notably delays, which affect passenger satisfaction. To mitigate this, optimizing ground handling operations is essential. This study explores the turnaround process at Bandaranaike International Airport, focusing on the efficiency of critical operations such as baggage handling, fueling, and passenger boarding. The research identified that the actual average turnaround time (72 minutes) exceeds the standard operational time (60 minutes). The findings underscored the need for improved precision in turnaround timing to enhance operational efficiency and customer satisfaction. This paper recommends specific improvements in scheduling and operational practices to minimize turnaround delays and optimize the use of available resources.

.

To cite this article: Sajana, A.J.L.B., Fernando, A.S., Weerasinghe, J.E. (2025) A Precision Timing Analysis to Improve Turnaround Efficiency in Narrow-Body Aircraft Operations, Journal of Business Research and Insights, 11:02, 01-13, DOI: https://doi.org/10.31357/jbri.v11i02.8925

* Corresponding author. Tel: +94 711415521; Email: binu.jayawardhana97@gmail.com; https://orcid.org/0009-0005-9801-7146
Institution: University of Moratuwa, Sri Lanka

Introduction

The airline industry has experienced rapid growth in recent years, presenting both challenges and opportunities for operational optimization. One critical factor affecting airline efficiency is the turnaround time – the period between an aircraft's arrival and its departure. As airport congestion increases and the demand for faster, more efficient services grows, reducing turnaround time has become a key focus for both airlines and airport authorities. Globally, airports and airlines are increasingly focusing on reducing turnaround times to improve operational efficiency, minimize delays, and enhance passenger satisfaction.

However, despite this global emphasis, there remains a significant gap in related researches within our country regarding the specific factors that influence turnaround efficiency in the context of Sri Lanka. Bandaranaike International Airport (BIA) is the only international airport in the country with scheduled air traffic, yet there is limited empirical evidence and research on how ground handling operations impact turnaround time at BIA. Existing studies often provide generalized operational recommendations or simulations, but few examine the real-world precision timing of critical turnaround activities in a local context. This creates a research need to systematically evaluate current ground handling processes, identify operational bottlenecks, and quantify deviations from standard turnaround times.

Several studies have focused on optimizing aircraft turnaround times. For instance, Hassel (2019) suggested that the efficiency of ground operations is crucial for reducing delays, emphasizing the importance of well-coordinated ground handling activities in aircraft turnaround. Building on this, Evler et al., (2021) explored the role of technological advancements in enhancing turnaround precision, emphasizing the importance of real-time data and automated systems. Maliarenko (2022) highlighted that even with optimized scheduling, critical ground handling operations can still create delays under uncertain conditions. (Sheibani, 2020) demonstrated that simulation-based scheduling and critical path analysis can improve efficiency, but real-world operational bottlenecks often persist. (Szabo et al., 2022) showed that logistical optimization and automation improve turnaround, yet the overall impact of individual operations like baggage handling, cleaning, fueling, and boarding remains insufficiently studied. Despite extensive research on operational procedures, limited studies remain on the holistic impact of individual operations such as baggage handling, cleaning, fueling, and boarding on overall turnaround efficiency. This gap forms the basis for this study's investigation into operational bottlenecks at Bandaranaike International Airport.

This study specifically focuses on narrow-body aircraft for several reasons. Narrow-body aircraft are airplanes with a single aisle and comparatively smaller fuselage dimensions, designed primarily for short to medium haul flights, such as the Airbus A320 and the Boeing 737 series. Budget carriers predominantly operate narrow-body aircraft, making the findings of this research applicable to the majority of turnaround operations at BIA. Analysis of flight schedules from SriLankan Airlines Ltd. indicates that approximately 60-70% of aircraft handled at BIA are narrow-body, highlighting the relevance and impact of this research on routine airport operations. This research aims to address this gap by studying the current turnaround processes at Bandaranaike International Airport and identifying key operations that impact turnaround efficiency. The study evaluates existing operational times against standardized time periods to propose actionable recommendations for reducing delays and improving turnaround precision, ultimately contributing to enhanced airline scheduling and customer satisfaction.

Research Objectives

- *To identify and analyze the current turnaround operations for narrow-body aircraft at Bandaranaike International Airport.*
- *To measure and evaluate the precision timings of critical ground handling operations and identify deviations from standard turnaround schedules.*

- *To identify key operational bottlenecks affecting turnaround efficiency and provide actionable recommendations of practices for improvement in the turnaround operations.*

Literature Review

This literature review examines existing research related to aircraft turnaround operations, with a particular focus on factors influencing precision timings and overall efficiency. The review explores how various aspects of ground handling, passenger movement, and aircraft preparation contribute to turnaround performance.

Ground Handling Process

Ground handling operations encompass a range of activities, each of which plays a role in aircraft turnaround time. According to SriLankan Airlines Ltd. (2020a), baggage handling and fueling are identified as critical factors influencing operational time. Additionally, Picchi Scardaoni et al. (2021) highlighted that check-in efficiency significantly impacts the turnaround process, stressing the need for an optimized flow of passengers and baggage through airport terminals.

Turnaround time is defined as the period between an aircraft's arrival and departure; technically, it is the time between chocks-on and chocks-off (SriLankan Airlines Ltd., 2020a). Precision timings are the detailed breakdown of all turnaround operations, including disembarking, cleaning, fueling, boarding, catering, and water & toilet servicing. Operation timing scales differ for wide-body and narrow-body aircraft, with narrow-body aircraft typically requiring less time for each operation due to smaller passenger capacity and reduced cargo volumes. This differentiation ensures that analysis for narrow-body aircraft accurately reflects real-world operational efficiency at BIA. However, existing studies have largely focused on the overall airport operational efficiency without drilling into specific operational bottlenecks, particularly those that could be addressed through improved precision timing for critical tasks such as boarding clearance and catering.

Passenger Perspective

The topic describes the importance of the check-in process at airports. The closing time of check-in desks and the number of check-in desks required are critical factors in managing passenger flow and reducing turnaround time (Picchi Scardaoni et al., 2021). The optimal time to close a check-in desk and the appropriate number of check-in desks to be used must be determined based on factors such as flight schedules, passenger volume, and anticipated demand (Hassel, 2019). Studies in international contexts indicate that streamlined check-in processes can reduce turnaround times by 5–15% when integrated with precision operation scheduling (Maliarenko, 2022; Szabo et al., 2022).

Aircraft Perspective

The aircraft turnaround process involves several steps, including placing chocks to ensure the aircraft remains stationary, cleaning the cabin, draining and refilling lavatories, conducting pre-flight maintenance checks, and fuelling the aircraft (IATA, 2023). These steps are essential for ensuring the safety, comfort, and airworthiness of the aircraft (SriLankan Airlines Ltd., 2023). International research shows that systematic scheduling of these activities using critical path analysis and simulation can further optimize turnaround times (Sheibani, 2020).

Critical Operations of the Ground Handling Process

This discusses the various operations involved in the aircraft turnaround process, which is relevant to aircraft perspective including baggage handling, catering, and fueling. Baggage handling is identified as one of the most time-consuming processes, and catering services are commonly requested by full-service carriers (IATA, 2023). As mentioned in (Evler et al., 2021) below, Technological advancements and logistical optimization can help reduce turnaround time and increase standardization. Recent studies from other countries reinforce that precision in scheduling, automation, and data-driven management significantly improve turnaround efficiency. (Maliarenko, 2022) demonstrated the benefits of optimized scheduling under uncertain operational conditions. (Sheibani, 2020) showed that simulation-based critical path analysis can enhance turnaround operations. (Szabo et al., 2022) highlighted that logistical optimization and automation further improve operational efficiency. This demonstrates the global relevance of analyzing turnaround processes at BIA, particularly for narrow-body aircraft operations.

Research Methodology

Research Design

This study utilizes a quantitative research design with deductive reasoning to analyze the turnaround processes at Bandaranaike International Airport. Quantitative methods are appropriate for this study because they allow the collection of numerical data on operational times and the statistical analysis of deviations from standard turnaround schedules, enabling objective assessment of precision in ground handling operations (Szabo et al., 2022). Deductive reasoning is applied because the research tests specific hypotheses derived from existing theory and operational standards, such as the IATA Ground Operations Manual and SriLankan Airlines' internal turnaround guidelines, to examine whether actual operational timings align with expected benchmarks. The use of a quantitative-deductive approach ensures that the study can systematically evaluate measurable aspects of turnaround efficiency and identify patterns and deviations that may not be apparent through qualitative observation alone. This approach has been widely adopted in previous research on aircraft ground handling operations, demonstrating its suitability for assessing operational performance and precision timing (Maliarenko, 2022). Data were collected through on-site surveys and secondary records from Sri Lankan Airlines to investigate key ground handling operations and their impact on turnaround time.

Conceptual Framework

The conceptual framework aligns each research objective with the corresponding methodological strategies, ensuring that data collection, analysis, and recommendations are systematically linked to operational outcomes.

To identify and analyze the current turnaround operations secondary data sources were used, including the Standard Ground Operations Manuals (GOM) from SriLankan Airlines Ltd., and insights from the literature review. These sources helped document all ground handling operations, such as disembarking, cleaning, fueling, boarding, catering, and water & toilet services, and provided benchmarks for comparison.

Critical operations were first defined based on operational relevance, considering ground handling tasks that depend on aircraft capacity and the number of passengers handled. Primary data collected through on-site surveys were done gathering information by observation and filling in a structured form to record the actual time spent on each critical operation. The measured times were then compared against standard turnaround schedules from the GOM (SriLankan Airlines Ltd., 2020a) to identify deviations.

Final achievement was through process study and time study methodologies, which analyzed each critical operation to identify the activities causing the greatest delays. Recommendations for operational improvements were then proposed based on these findings, incorporating data-driven scheduling, lean practices, and automation strategies.

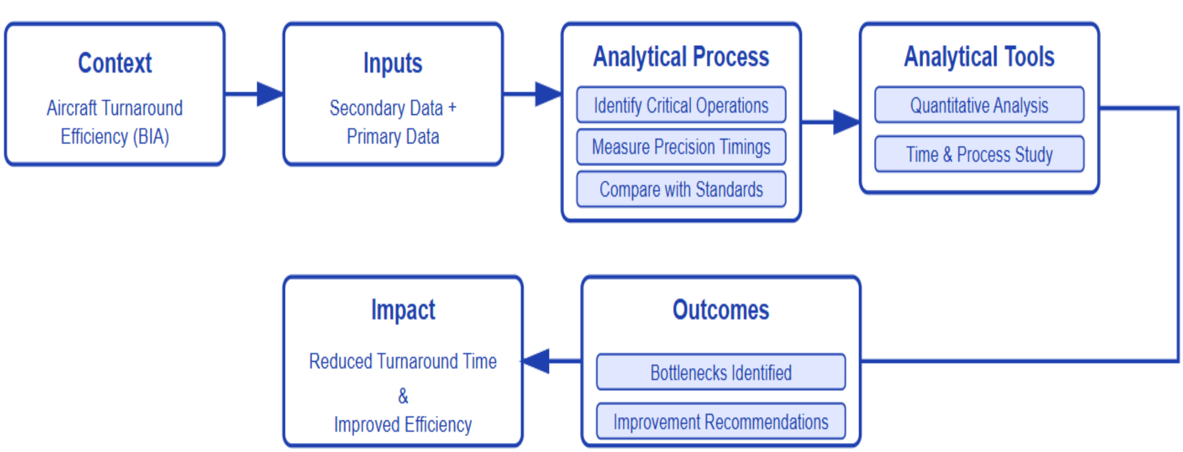

Figure 1: Conceptual Framework

Research Method

The study uses a deductive research strategy & quantitative research technique. The deductive approach enables the testing of existing operational theories and standards, such as those outlined in the IATA Ground Operations Manual (IATA, 2023), against empirical data collected from actual turnaround operations. This ensures the research outcomes are grounded in both theory and practice (Evler et al., 2021). The target sample considered is to UL (IATA two-letter code) aircrafts in Sri Lankan Airlines. The selection of SriLankan Airlines was primarily based on accessibility to reliable secondary data sources, as the airline's operational standards and Ground Operations Manuals (GOM) are directly relevant to UL aircraft turnaround activities (SriLankan Airlines Ltd., 2020a). Access to data from other airlines would require prior permissions and formal approvals, which were not feasible within the study's time frame and scope. The sample, narrow-body aircrafts is derived on the basis of the highest recorded turnaround frequency. The selection of the sample is crucial to the accuracy of the data collected. Selecting this sample ensures the validity and reliability of findings by focusing on the most operationally significant aircraft type.

Data Collection Method

The unit of analysis for this study is a single turnaround of a SriLankan Airlines (UL) narrow-body aircraft. Aircraft turnarounds were selected randomly from weekly flight schedules to ensure unbiased representation of operational variations. This focus allows for a precise examination of real-world turnaround processes at Bandaranaike International Airport (BIA).

Primary data was gathered through structured surveys conducted via direct observation, using a structured questionnaire form developed specifically for this study. The questionnaire was designed to record the time periods of each key ground operation, and to record practical issues and challengers incorporate with ground handling personnel, focusing on operations such as baggage handling, fueling, cleaning, and passenger boarding. Secondary data, including flight dispatch cards, were used to verify operational times. Data on passenger volume and flight schedules were also collected to assess their relationship with turnaround times.

Strategies for Error Control: The data which were collected through surveys were compared and analyzed by using flight dispatch cards of the respective aircraft for further clarification. This double-checks procedure ensured that no errors would affect the analysis of data, or the outcomes drawn from it. As a result, the data collected and used for future conclusions are more accurate and dependable.

Data Analysis Method

The data were analyzed using quantitative descriptive statistics, deviation analyses, which are suitable for examining process-based operational data. Descriptive statistics, including Mean, Median, Standard deviation, and frequency distribution, were used to summarize the observed duration of each ground operation. This approach allowed for identifying patterns and variability within operational activities.

To evaluate turnaround efficiency, the actual recorded times for each ground operation were compared against the standard operational times prescribed in the SriLankan Airlines Ground Operations Manual (GOM) (SriLankan Airlines Ltd., 2020b). This comparison formed the basis of a deviation analysis, which quantified the extent to which observed timings diverged from prescribed standards. The deviation analysis compared the actual times observed with the standard times, highlighting key areas for improvement in operational practices.

Results & Discussion

Introduction

The conducted descriptive analysis of the project, including both quantitative and qualitative aspects, provides insight into the relationship between independent and dependent variables. The results of this analysis provide strong evidence regarding the research findings and demonstrate the success of the research project. The descriptive analysis undertaken in this chapter facilitates a comprehensive understanding of the

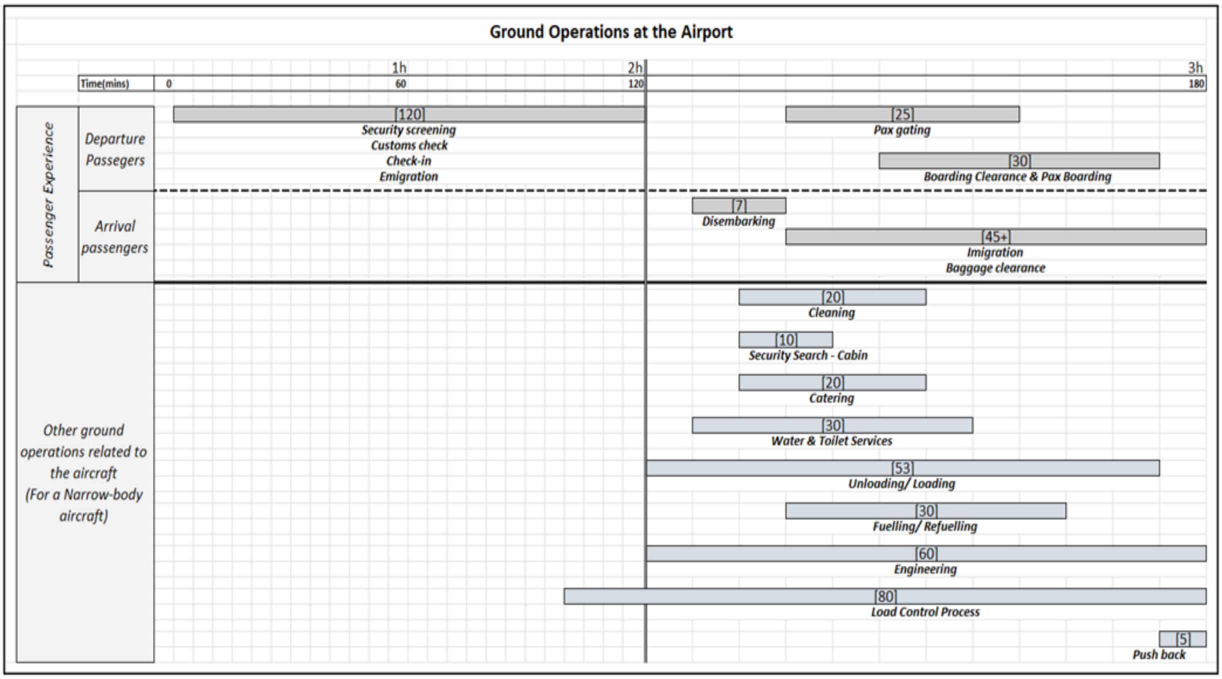

Figure 2: Gantt chart on ground operations at the airport

project's essential elements and provides a foundation for drawing meaningful conclusions.

Findings

Critical ground handling operations were analyzed based on the number of passengers, and the time taken for each critical procedure was calculated through surveys. Critical operations for a turnaround aircraft were identified. It was found that the actual average time which taken by turnaround operations is higher than the time taken by standard minimum operational time periods in each operation. To reduce deviations in time, root causes leading to these deviations should be studied, and better practices should be taken into routine for a clean turnaround duration.

Objectively Analyzed Findings

This study was initially based on four main objectives: identify and analyze the current turnaround operations for narrow-body aircraft at Bandaranaike International Airport, measure and evaluate the precision timings of critical ground handling operations and identify deviations from standard turnaround schedules and identify key operational bottlenecks affecting turnaround efficiency and provide actionable recommendations of practices for improvement in the turnaround operations. The researcher made an effort to put weight on these objectives of exercise specifically for a systematic conclusion on the final root outputs (SriLankan Airlines Ltd., 2020b).

The Gantt chart was depicted from precision timings schedule for A320 & A321 at the Bandaranaike International Airport (CMB) & Mattala Rajapakshe International Airport (HRI). The ground operations are categorized under two main branches such as passenger-related & aircraft-related. The passenger-related operations are discussed in detail, including the estimated time spent on each one of them. The total time allocated for all these operations determines the turnaround time for a narrow-body aircraft at the airport.

The ground handling procedure includes the arrival of passengers, which requires several stages such as disembarking and baggage clearance. The load control stage takes the most time, and pushback is the shortest course. Planes are not designed for backwards movement, so pushback tugs for aircraft are the only option.

Critical Operations

Ground Handling Operations are related to aircrafts, which depend on the capacity and the number of passengers handled. From fig.3. we can identify critical

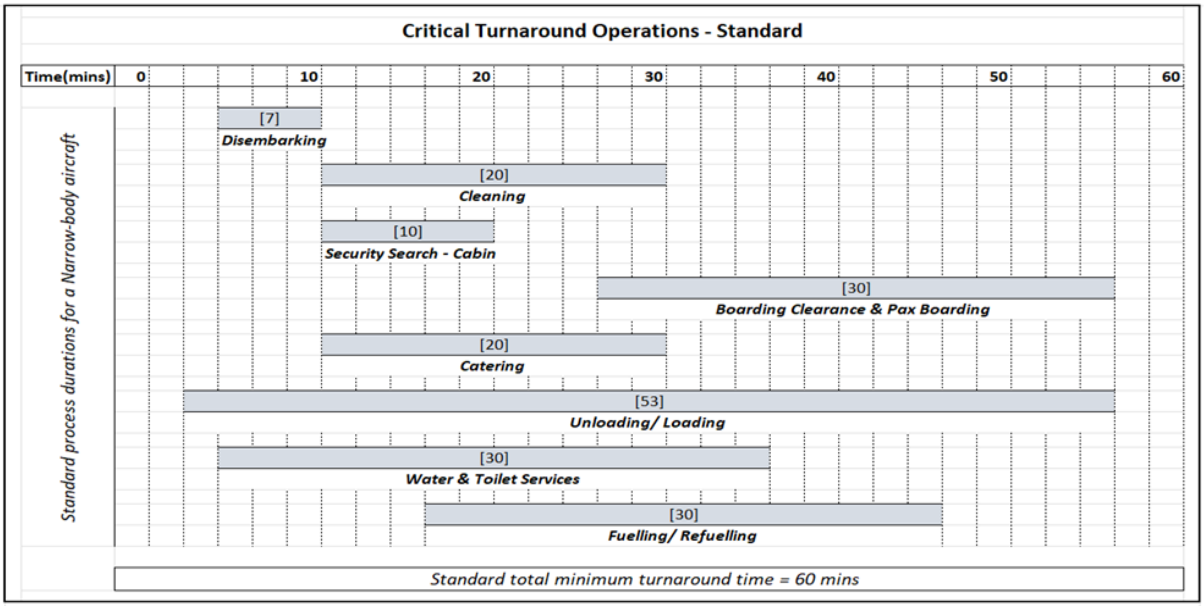

Figure 3: Gantt chart on standard critical turnaround operations

turnaround operations under the ground handling operations of the airport.

The standard process is limited to narrow-body aircraft, and the durations for each operational activity are listed in the Gantt chart. The critical operational activities include disembarking, cleaning, security search of the cabin, boarding clearance and passenger boarding, water & toilet services, and fueling or refueling. The time taken for each activity depends on the seating capacity of the aircraft. Cleaning includes high-maintenance areas such as the cockpit, ashtrays, meal tables, seats/seat pockets, galley, toilets, and hat racks. Security searches are conducted by airport security personnel, and boarding clearance and passenger boarding are given by the Aircraft Dispatcher.

- ***Disembarking***

The process of passengers leaving an aircraft after it has landed depends on the number of passengers and possible emergencies. Ground staff should be prepared to handle emergencies as soon as the aircraft lands, and post-departure messages are vital in pre-arrival arrangements to handle those situations.

- ***Cleaning***

More care and attention are given to each and every item and areas in order to have thorough cleaning and better hygiene standards as high maintenance is set for aircraft cleaning. Carpet in the aisle/s, cockpit, ashtrays, meal Tables, seat pockets, galley, toilets and hat racks are the major areas of work.

- ***Security search cabin***

Process conducted by airport security personnel to ensure the safety and security of passengers and crew members, which depends on the seating capacity of the aircraft.

- ***Boarding clearance and passenger boarding***

It is given by the Aircraft Dispatcher to the Departure Gate staff after obtaining the clearance from the Operating Purser to board passengers once the aircraft cabin is ready for boarding.

- ***Catering***

Airlines use catering trucks to deliver food, beverages, and other supplies to the aircraft. They are often equipped with refrigerated compartments to keep food and beverages at the correct temperature.

- ***Loading and Unloading***

Time for the processes depends on the number of embarking passengers and disembarking passengers, respectively. Equipment like conveyor belts, cargo

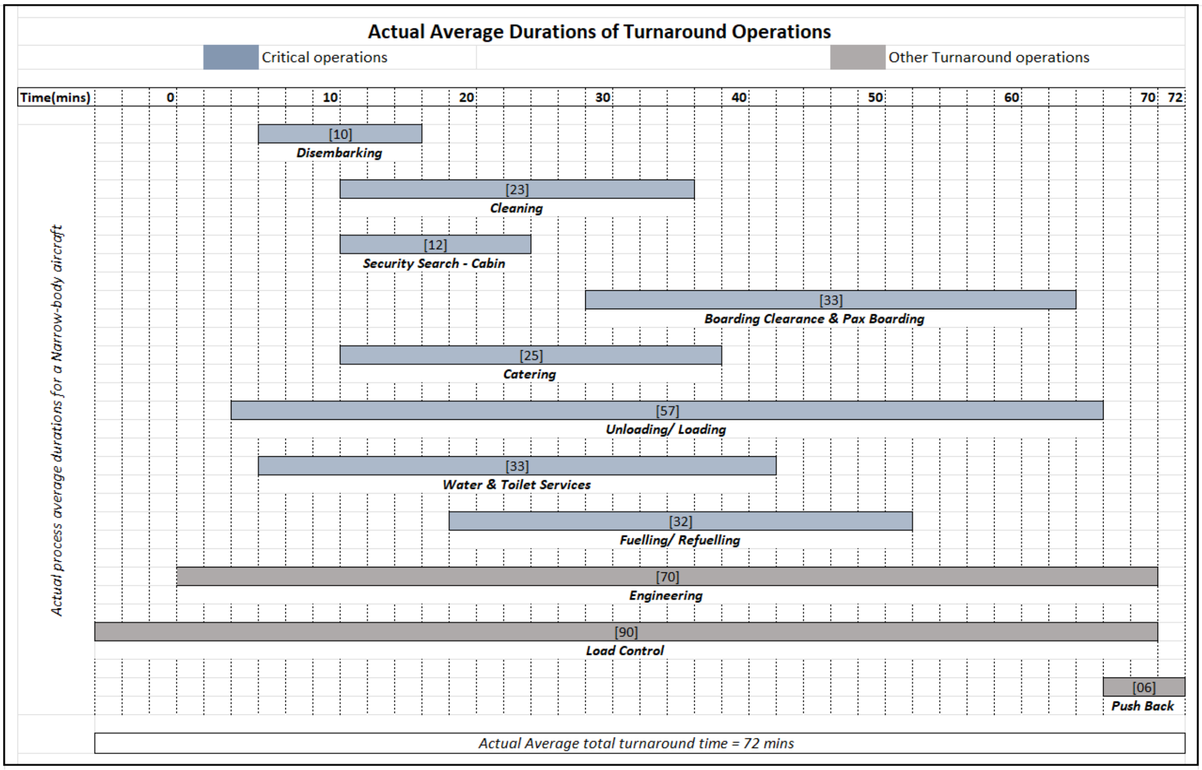

Figure 4: Gantt chart on actual average durations of critical turnaround operations

loaders, belt loaders are used at this stage for bulk handling, securing and positioning as applicable and agreed.

- ***Water and Toilet service***

It depends on the number of embarking passengers and the flight distance. The drill is to flush and drain all water in the tank, fill the tank with fresh potable drinking water using water tanker trucks and draining of thew pre-charged or a concentrated deodorant product using toilet trucks waste tanks, flushing of the waste tanks, adding an amount of pre-charged or a concentrated deodorant product using toilet trucks.

- ***Fueling/Refueling***

The aircraft cannot be re-fueled or de-fueled when passengers or crew are embarking or on board or disembarking unless qualified designated personnel are present. Fuel trucks equipped with fueling equipment and hydrant stations are used in this process.

Descriptive Statistics

This talks about a descriptive analysis that compares the actual and standard times taken for critical operations during loading and unloading of aircraft. The report

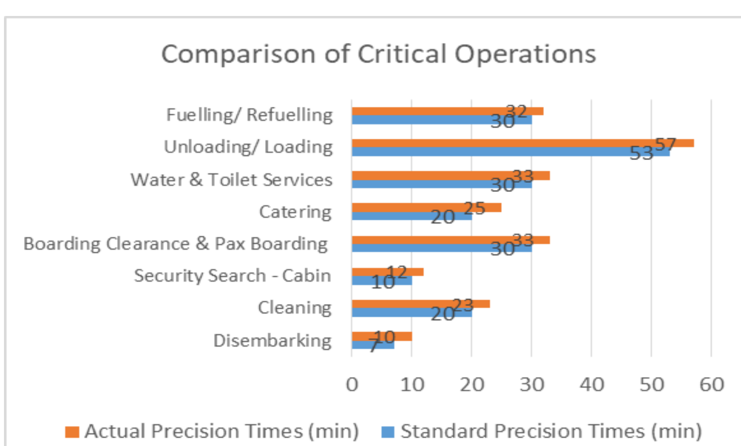

Figure 5: Comparison of Critical Operations

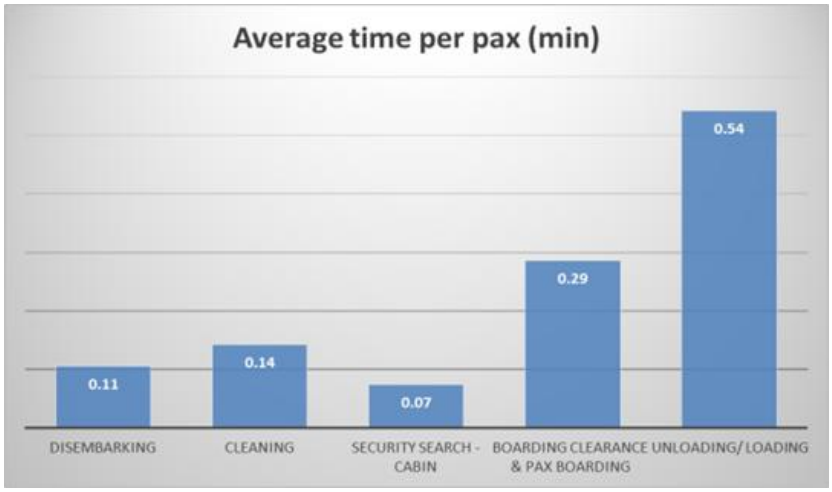

Figure 6: Average time per passenger/seat

shows that actual times are longer than standard times, with loading and unloading taking the longest time. The message also highlights that the data used for actual times is based on real-life situations, where the standard times are based on idealized situations (SriLankan Airlines Ltd., 2020c).

Fig.4. depicts the actual average durations of critical turnaround operations while Fig.5. portrays the descriptive analysis of the comparison between the actual average precision time and the standard minimum time of each critical operation.

The loading and unloading process takes the longest time, while security searches take the shortest time. The actual average time taken for all critical operations is longer than the standard minimum time durations marked, possibly because the seating capacity under standard activity was taken into consideration as the maximum possible or full, while actual activity was calculated from real data taken.

Fig.6. portrays the information about the average time per passenger in critical operations. It was calculated by dividing the time taken for each operation by the average number of passengers for that operation. Cleaning and Security search-cabin parts are related to the time taken for a one seating area with the overhead cabin. The lowest average time per passenger is shown in the operation of the security search cabin, and the highest is shown in the operation of the loading & unloading process. Critical operations such as catering, water and toilet services, and fueling/ refueling are not presented in the bar graph because they have no direct correlation with the 'per-passer' concept.

Deviation Analysis

The information about the deviation between actual and standard precision times of critical operations in the turnaround process is depicted in Fig.7. Deviation is a measure used to find the difference between the observed value and the expected value of a variable, and it indicates how spread out the values are in each dataset. Comparing sets of information and studying their deviations can be an crucial step in any project for precise conclusions. The deviation varies from operation to operation, with the highest deviation shown in catering services and the lowest deviation shown in security searches.

The identification of bottlenecks in critical ground handling operations aligns with Theory of Constraints, which emphasizes that system throughput is constrained by the slowest or most variable process. In this scenario, catering takes a higher amount of extra time compared to something like security checks, it highlights where the bottlenecks are likely to be. The longer times for catering suggest that those steps are more likely to be the constraints that impact overall turnaround time. Meanwhile, shorter extra times for security checks indicate that those steps are not as critical in limiting the overall throughput. This means

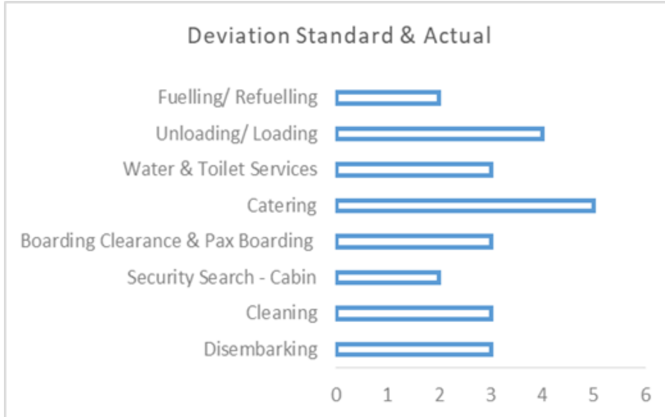

Figure 7: Deviation of critical operations

that, from this TOC perspective, focusing on streamlining the unloading and loading processes will yield the most significant improvements in turnaround times. Similarly, lean management principles advocate the elimination of waste and non value-added activities in operational workflows, which directly supports the study's focus on minimizing delays in baggage handling, cleaning, and boarding. The study's quantitative assessment of precision timings also mirrors the time and motion studies tradition, emphasizing measurement, standardization, and process optimization for improved efficiency. By grounding the findings in these established operations management theories, the study demonstrates that practical improvements in turnaround precision are not only operationally beneficial but also theoretically supported.

Further Analysis

The reported average turnaround time for narrow-body aircraft is greater than the minimum standard time by 12 minutes owing to the variability of the critical operations like baggage handling, cleaning, and catering. Standard and actual time durations of turnaround operations are clearly & comparatively shown by Fig.8. This study also supports other works which outlined the impact of flagging schedule adherence on the turnaround activities and the consequent impact on an airline's operational efficiency and passenger satisfaction (Picchi Scardaoni et al., 2021), (More & Sharma, 2014).

Enhancing these operations calls for strict adherence to process timing, use of monitoring systems, and constant supervision. As ground handling reliability and predictability can be significantly improved by data-driven scheduling, simulation models, as proposed by Schmidt (2017), embrace. In addition, the visibility and coordination of airport stakeholders is further enhanced with the use of digital twins in turnaround management (Conde et al., 2022).

For airlines, remaining competitive entails the need to incorporate lean ground handling methodologies to minimize deviations from the stipulated schedules, alongside use of digital solutions aimed at optimizing resource utilization (Silverio et al., 2013). Future work may focus on enabling the proactive foresight of potential delays through real-time analytics and predictive modelling, which enhances responsiveness in an agile turnaround process.

To strengthen turnaround performance, digital transformation tools offer powerful opportunities. The integration of Internet of Things (IoT) sensors for equipment tracking, AI-based analytics for predictive delay detection, and simulation models for process optimization can together create a smart turnaround management system (Schmidt, 2017). Such systems enable real-time visibility of ongoing ground operations and support decision-making through automated alerts when operations deviate from planned schedules. This aligns with global trends toward data-driven airport ecosystems, where digital twins and AI-based scheduling tools enhance coordination among stakeholders (Silverio et al., 2013).

Furthermore, coordination among airlines, the airport authority, and external ground handling companies is necessary to uniform standard operating procedures for each turnaround activity and streamline communication

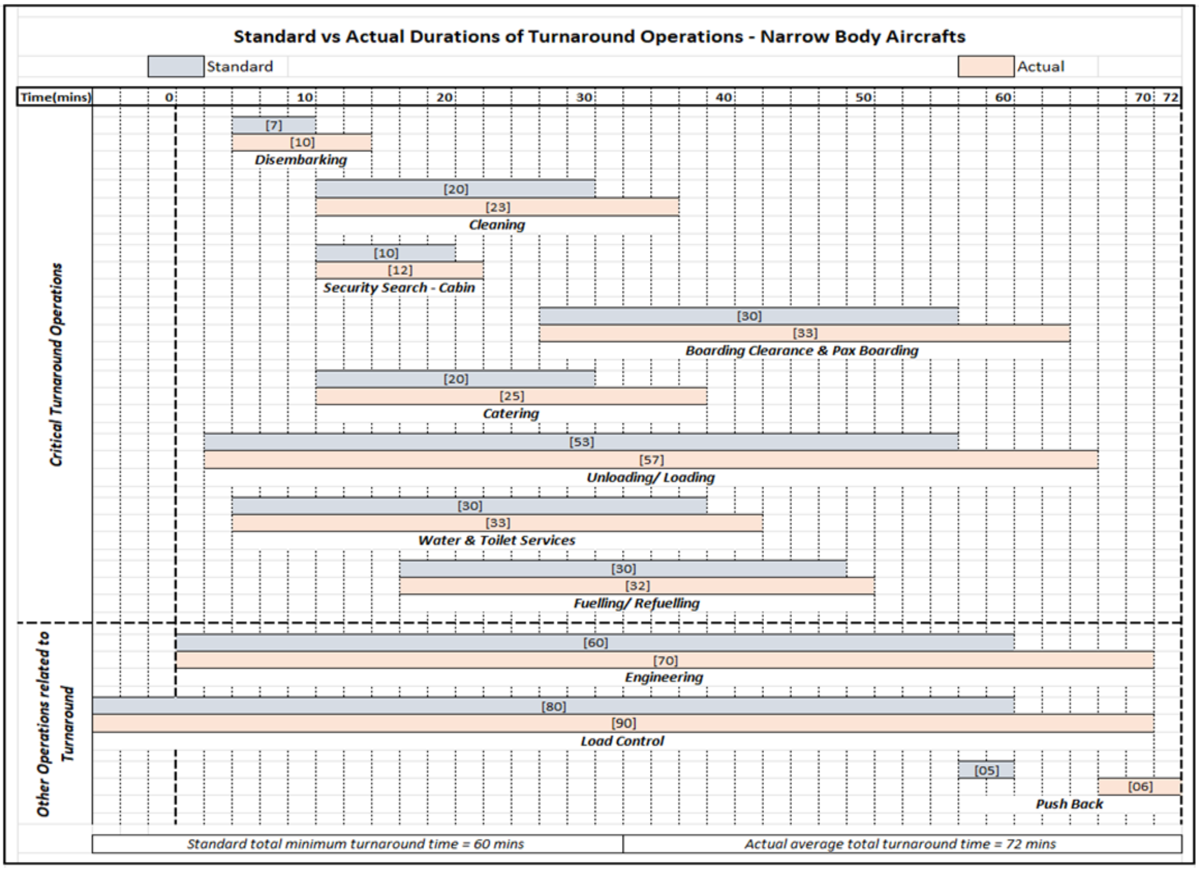

Figure 8: Standard and actual time durations of turnaround operations of narrow-body aircraft

channels. Consolidating information through centralized data-sharing systems can eliminate information silos and enable sudden decision-making, especially during peak times. In addition, AI-driven insights can aid in pinpointing operational problems and recalibrating schedules based on predictive models. Future studies aimed at improving performance may examine human variables such as training competency, workload control, shift alignment, and overall workload management concerning ground crew efficiency. Through these approaches, aircraft turnaround precision can be improved alongside proactive measures towards sustaining operational excellence within rising congestion in airports.

Limitations of the study

Even though this study focuses on the turnaround procedures for narrow-body aircraft at Bandaranaike International Airport, some limitations need to be highlighted. To begin with, the focus of the study was only based on Bandaranaike International Airport and one airline which is SriLankan Airlines. This in turn affects the applicability of results to other airports or airlines that operate in different contexts or have resource constraints. In addition, this study excluded wide-body aircraft as well as cargo aircraft which are likely to have different operational dynamics and turnaround processes.

From the perspective of data, flight dispatch cards, along with structured surveys, were collected. However, self-reporting bias and discrepancies in documentation rendered operational logs unreliable. Furthermore, last-minute changes to staffing, weather conditions, and overall framework were not systematically controlled, which may have impacted turnaround timings.

The descriptive statistics and factor analysis approaches do identify relationships and correlations between concepts but lack the emphasis on causation. Utilizing these two methods while ignoring deeper mechanisms can be limiting to one's findings without considering how a comprehensive statistical or simulation-based approach could deepen insights into delay propagation.

Another restriction of the study has to do with evaluating operational efficiency on a per-passenger basis. For example, the quantification of procedures like cabin cleaning and security search of the cabin does not scale to the number of passengers, as these are done homogenously across the aircraft. Moreover, calculating precisely the time taken for boarding and alighting on a per passenger basis is somewhat hypothetical due to the fact that several items of luggage are carried by each passenger, and most cargo handling systems operate on a weight basis as opposed to counting baggage.

Implications & Conclusion

To summarize this study, it revealed the fact that the average turnaround time for narrow-body aircraft is above the benchmark by approximately 12 minutes and is mainly caused by baggage handling, catering, and loading & unloading delays. These findings confirm that minimal critical ground handling processes can significantly impact overall turnaround efficiency. Therefore, improvement projects on these high-priority operations can deliver the greatest meaningful performance gains.

For performance enhancement, digital transformation should be a leading contributor to optimization turnaround. Real-time monitoring of each and every critical activity via digital dashboards or automated data capture of data can provide immediate visibility to delays and deviations. Usage of technologies such as AI driven predictions, IoT based asset tracking, and process simulation tools can also improve operational accuracy and coordination between ground handling teams to enhance overall reliability and schedule performance.

From the management perspective, outcomes emphasize the necessity of standardized operating procedures, real time tracking, and better interdepartmental communication. Coupling lean philosophy with computer-based management systems will reduce variability, ensure efficient use of resources, and enhance on-time performance. Increased coordination among airline departments and ground handing agents will ensure consistency in task accomplishment and data driven decision making.

Further studies could explore the integration of advanced predictive analytics and machine learning techniques to forecast potential turnaround delays more accurately. Examining the human and organizational factors such as staff training, workload balance, and real-time decision-making could also provide valuable insights into achieving sustainable operational excellence in aircraft ground handling procedure.

Authors' Contributions

A.J.L.B. Sajana carried out the GOM manual studies, participated in the descriptive analysis and drafted the manuscript; A.S. Fernando carried out the literature review and performed the data analysis; J.E. Weerasinghe oversaw the study, participated in its design and coordination and helped with the data collection.

All authors have read and approved the final version of the manuscript and agree with the order of presentation of the authors.

References

Conde, J., Munoz-Arcentales, A., Romero, M., Rojo, J., Salvachúa, J., Huecas, G., & Alonso, Á. (2022). Applying digital twins for the management of information in turnaround event operations in commercial airports. *Advanced engineering informatics*, *54*. Https://doi.org/10.1016/j.aei.2022.101723

Evler, J., Asadi, E., Preis, H., & Fricke, H. (2021). Airline ground operations: optimal schedule recovery with uncertain arrival times. *Journal of air transport management*, *92*. Https://doi.org/10.1016/j.jairtraman.2021.102021

Hassel, V. (2019). *Predicting the turnaround time of an aircraft a process structure aware approach*.

Iata. (2023). *Iata ground operations manual (igom)* (43rd edition).

Maliarenko, D. (2022). OPTIMIZATION OF AIRPORT RESOURCES FOR AIRCRAFT GROUND HANDLING IN CONDITIONS OF UNCERTAINTY. Dorogi i Mosti, 2022(26), 266–273. https://doi.org/10.36100/dorogimosti2022.26.266

More, D., & Sharma, R. (2014). The turnaround time of an aircraft: a competitive weapon for an airline company. *Decision*, *41*(4), 489–497. Https://doi.org/10.1007/s40622-014-0062-0

Picchi Scardaoni, M., Magnacca, F., Massai, A., & Cipolla, V. (2021). Aircraft turnaround time estimation in early design phases: simulation tools development and application to the case of box-wing architecture. *Journal of air transport management*, *96*. Https://doi.org/10.1016/j.jairtraman.2021.102122

Schmidt, M. (2017). A review of aircraft turnaround operations and simulations. In *progress in aerospace sciences* (vol. 92, pp. 25–38). Elsevier ltd. Https://doi.org/10.1016/j.paerosci.2017.05.002

Sheibani, K. (2020). Scheduling Aircraft Ground Handling Operations Under Uncertainty Using Critical Path Analysis and Monte Carlo Simulation. International Journal of Business Strategy and Automation, 1(1), 37–45. https://doi.org/10.4018/ijbsa.2020010103

Silverio, I., Juan, A. A., & Arias, P. (2013). A simulation-based approach for solving the aircraft turnaround problem. *Lecture notes in business information processing*, *145*, 163–170. Https://doi.org/10.1007/978-3-642-38279-6_18

Srilankan airlines ltd. (2020a). *Ground operations manual, part i (ags-mn-01)* (2nd edition).

Srilankan airlines ltd. (2020b). *Ground operations manual, part ii (ags-mn-01)* (2nd edition).

Srilankan airlines ltd. (2020c). *Ground operations manual, part iii (ags-mn-01)* (2nd edition).

Srilankan airlines ltd. (2023). *Airport handling manual (ahm)* (43rd edition).

Szabo, S., Pilát, M., Makó, S., Korba, P., Čičváková, M., & Kmec, L. (2022). Increasing the efficiency of aircraft ground handling— A case study. Aerospace, 9(1). https://doi.org/10.3390/aerospace9010002