# Optimizing Congonhas Airport Operations: A Case Study in Runway System Capacity Expansion

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## Abstract

Congonhas Airport (CGH) serves as a crucial hub for domestic aviation in Brazil, recognized as the second busiest airport in the country as of 2023. Despite the recent privatization of its management, which emphasized operational safety and passenger services, there remains no provision for runway capacity expansion. This study investigates the potential for increasing the runway capacity at CGH through an exploratory qualitative methodology that compares passenger demand and traffic patterns between CGH and São Paulo's Guarulhos Airport (GRU). A computerized simulation was employed to evaluate three operational scenarios, revealing that strategic changes could increase declared runway capacity significantly, allowing for the accommodation of over 4.5 million additional passengers annually. The findings highlight the necessity for infrastructure planning to include a Rapid Exit Taxiway and an updated Airport Master Plan to optimize service levels and operational efficiency. Recommendations are made for AENA to enhance revenue through increased slot availability, ensuring a balance between operational effectiveness and service quality. This research underscores the importance of leveraging existing infrastructure to meet growing aviation demands and proposes actionable strategies to enhance airport capacity without necessitating substantial new investments.

## Introduction

This study investigated the potential to increase the runway system capacity (RSC) at Congonhas Airport (CGH), a key factor in improving operational efficiency. Enhancing RSC can significantly boost customer satisfaction by optimizing operations for both passengers and airlines. The research also explored the revenue opportunities generated by increasing aircraft movements for airlines and the airport operator.

CGH operates two dependent runways, limiting its ability to efficiently handle rising flight volumes. In 2023, the airport served over 22 million passengers and handling 232,000 flight movements. That same year, Aeropuertos Españoles y Navegación Aérea (AENA) secured a 30-year contract to manage the airport, with a focus on improving passenger services and safety. This study evaluated three scenarios for increasing capacity without requiring significant investment in existing infrastructure.

### Problem Statement

Congonhas Airport's runway system struggles to meet increasing demand, yet no plans for expansion exist under its privatization. The challenge lies in identifying low-cost strategies to increase capacity without constructing new runways. This study assessed operational and financial impacts of improving runway efficiency through alternative methods. The research also explored the potential benefits for the broader airport community.

### Project Goals

The first and main objective of this project is to present viable strategies for increasing CGH's RSC without significant financial investments. Specifically, the project is going to explore three fleet mix scenarios designed to maximize existing infrastructure. The secondary goal is to highlight potential revenue growth opportunities for both the airport operator and airlines, ensuring compliance with safety regulations and maintaining high service standards.

**Project Scope**

The project is centered on analyzing current operational demands and identifying the potential for growth at CGH. It compares operational efficiency between CGH and Guarulhos Airport (GRU) to highlight untapped demand. The scope involves commissioning a simulation with the Air Navigation Management Center (CGNA) to evaluate three RSC expansion scenarios, focusing on operational feasibility and economic benefits.

**Definition of Terms and Acronyms**

**AENA:** Acronyms **-** Aeropuertos Españoles y Navegación Aerea - (Spanish Airports and Air Navigation).

**Aircraft Mix or Fleet Mix:** Percent distribution of the aircraft fleet in operation in the analyzed airport, according to the airplane category.

**Airplane Approach Category (AAC):** A classification of airplanes based on its reference landing speed ($V_{REF}$). The category is subdivided into five groups (A, B, C, D, and E.)

**Airport Master Plan:** A long-term plan that helps an airport determine how to develop its facilities and meet the needs of aviation demand. It's a critical tool that helps an airport achieve its mission and realize its full potential.

**ANAC**: Acronyms - Agência Nacional da Aviação Civil - (Brazilian Civil Aviation Authority).

**ATC**: Air Traffic Control.

**CGH**: IATA’s airport designator for Congonhas Airport.

**CGNA:** Centro de Gerenciamento da Navegação Aérea (Air Navigation Management Center).

**DECEA**: Acronyms - Departamento de Controle do Espaço Aéreo - Brazilian Airspace Control Department. The Brazilian Air Navigation Service Providers (PSNA) are responsible for subjects related to the provision of Air Navigation Systems (ANS).

**Declared Runway Capacity (DRC):** The maximum possible number of operations (takeoffs or landings) within a sixty-minute interval, considering the runway occupancy time. Usually, the declared runway capacity value is a percentage (i.e., 80%) of the Theoretical Runway Capacity value. This difference is aimed to account for uncontrolled variables such as weather.

**DOW**: Days of Week

**GRU**: IATA's airport designator for Guarulhos Airport.

**IEPV:** Acronyms **-** Impresso Especial da Proteção ao Voo (Special Flight Protection Form). Type of forms used by DECEA.

**Independent Parallel Approaches**: Simultaneous approaches to parallel or near-parallel runways, where no specific radar separation minimums are required between aircraft on adjacent extended runway centerlines.

**LF:** Load factor (represents the flight occupancy rate).

**MATOP:** Acronyms - Média Aritmética do Tempo de Ocupação de Pista (Average Runway Occupancy Time). MATOP is calculated for each runway threshold since each runway has its configuration. This leads to different average time of runway occupancy in each threshold.

**OTP** (On-Time Performance): The on-time performance of a flight is generally measured by the percentage of flights that depart or arrive within a specific period in relation to the scheduled time. When an on-time performance is said to be within 15 minutes of the departure time, it means that the flight is considered on-time if it departs within 15 minutes of the scheduled time.

**PBB (**Passenger Boarding Bridge): A movable or fixed device used to facilitate passenger boarding and deplanes.

**Percentage By Airplane Category:** Calculated index considering the total daily aircraft movement, reported in the IEPV 100-34 form (Aircraft Movement in Aerodromes) or collected from the Control Tower Management Systems. This index is equal to the percent mean of the one-year sample, based on weekdays (except Saturdays, Sundays, and holidays).

**Percentage Of Runway Utilization at an Aerodrome:** Calculated index considering the total daily aircraft movement. This index equals the percent mean of a one-year sample to approve the data's confidence.

**PSNA**: Acronyms - Órgãos Provedores de Serviço de Navegação Aérea - Air Navigation Service Providers.

**Rapid Exit Taxiway (RET):** A taxiway connected to a runway at an acute angle and designed to allow landing airplanes to turn off at higher speeds than are achieved on other exit taxiways, thereby minimizing runway occupancy time.

**RBAC:** Acronyms – Regulação Brasileira da Aviação Civil (Brazilian Civil Aviation Regulation)

**Reference Landing Speed ($V_{REF}$):** The airplane's indicated airspeed in knots (KIAS) when the aircraft crosses the threshold at 50 feet for landing. This speed is equal to 130 % of the airplane's stall speed on its landing configuration in normal conditions, with full flaps, gear down, and maximum landing weight.

**Runway Occupancy Time:** This is the time an airplane spends on the runway. Regarding the runway system capacity, this time is categorized as runway occupancy time at takeoff and runway occupancy time during landing.

**Runway Occupancy Time by Airplane Approach Category**: This is the arithmetic mean of the runway occupancy time, split by airplane approach category (A through E), between the departure and the arriving runway occupancy time.

**Runway Occupancy Time for Arriving Aircraft:** This is the runway occupancy time for arriving aircraft, initiated from the moment the airplane crosses the threshold, at $V_{REF}/V_{AT}$ until it vacates the runway.

**Runway Occupancy Time for Departure Aircraft**: This is the runway occupancy time an aircraft spends during its takeoff, initiated from the moment it leaves the holding point until the moment it crosses the opposite threshold.

**Runway System Capacity (RSC):** The capacity of a runway system depends on a few operational factors. These factors can be categorized into 4 classes that are related to (1) runway system design (includes fixed factors such as the number and geometric layout of the runways in the runway system, and the number and location of runway exits, and variable factors such as the number of simultaneously active runways and dynamic runway configuration), (2) aircraft movement characteristics (such as arrival rate and fleet mix), (3) environmental factors (such as visibility, ceiling, precipitation, temperature, pressure, wind direction, wind strength, noise abatement regulations, and other environmental constraints), and (4) air traffic control factors (such as minimum separation gap, Airport Traffic Control (ATC) regulations, air traffic controllers' behaviors/preferences, pilots' experience and skill, and airline policies regarding landing, takeoff, and taxiing) (Chen et al., 2023). Basically, the RSC Value can be computed by the following means: (1) table lookup and spreadsheet, (2) analytical, (3) simulation, and (4) empirical.

**Saturation:** Situation in which the air traffic demand is higher than the airport capacity or than a certain control sector.

**SBGR**: ICAO airport designator for Guarulhos airport.

**SBSP**: ICAO airport designator for Congonhas airport.

**SFA:** Acronyms - Stochastic Frontier Analysis is a statistical method used to estimate the efficiency of decision-making units (such as firms, airports, or countries) in producing output given a certain level of inputs. It is particularly useful for analyzing performance in industries where there are variations in efficiency due to factors that can't be fully controlled or measured (i.e., random noise).

**Taxi In**: Refers to the movement of the aircraft from the moment it lands and leaves the runway until it reaches the gate or parking position at the airport.

**Taxi Out**: Refers to the movement of the aircraft from the gate or parking position to the runway, before taking off.

**Theoretical Runway Capacity (TRC):** The maximum runway capacity is calculated during sixty minutes, considering the average time of runway occupancy and the legislation concerning aircraft separation, including the specific rules and procedures adopted to the local operations. It is called **Theoretical** once the variables and model are used to consider an optimum condition.

**Time for Departing Aircraft:** Runway occupancy time for departing aircraft based on when the aircraft leaves the holding point until it crosses the opposite threshold**.**

**Turnaround**: Time spent in minutes by the airplane while parked (gate or remote stand).

**Visual SIMMOD (Simulation Modeling):** is a tool used in the aviation industry to model and simulate various aspects of airport and air traffic operations. The goal is to analyze and optimize airport performance, airspace usage, and airline operations in a controlled, virtual environment.

## Literature Review

This review focuses on some literature that highlights various methodologies for assessing and improving runway capacity, such as analytical models, simulation approaches, and empirical studies. By synthesizing key findings from past research, this review aims to provide a deeper understanding of the challenges faced by CGH, specifically in relation to managing growing demand without major infrastructure investments. Furthermore, it identifies key scholars and industry experts who have contributed to the understanding of runway system capacity and its impact on operational effectiveness.

Airport runway capacity is a pivotal factor in determining an airport's ability to handle air traffic efficiently. Various operational factors, including runway configuration, aircraft mix, air traffic control measures, and weather conditions, influence a runway system's capacity. Studies have shown that optimizing these factors can significantly enhance runway capacity without the need for new runway construction (Chen et al., 2023).

Congonhas Airport, with its strategic location near São Paulo's city center, serves as a vital hub for domestic commercial and business aviation. Despite its high traffic volume, the airport's runway capacity has not been expanded, posing a challenge to its operational efficiency (Oxford Economics, 2017).

Research indicates that computational simulations and statistical models are effective tools for estimating and optimizing runway capacity. For instance, the use of Visual SIMMOD software and Stochastic Frontier Analysis (SFA) has been highlighted as innovative approaches to accurately assess runway system capacity (Chen et al., 2023). These methodologies provide unbiased estimates and practical insights for real-world application in airport operations and planning.

The background of runway capacity research is rooted in the need to enhance airport operations amidst growing air traffic demand. (Hupalo, 2003).

Previous studies have explored various strategies to increase runway capacity at Congonhas Airport. Benchmarking with similar airports and conducting computerized simulations have been key approaches. A case study evaluating the possibility of RSC expansion at CGH proposed strategies to optimize existing infrastructure. The study highlighted the potential benefits of increased runway capacity, including more slots for airlines, new destinations, enhanced passenger experience, and improved financial outcomes for the airport operator. (Luiz et al., 2008).

The literature also underscores the importance of accurately modeling operational factors such as runway occupancy time, aircraft mix, and air traffic control measures. These factors significantly impact runway capacity and must be carefully considered in any capacity enhancement strategy. Using granular data and robust statistical models is crucial for providing reliable capacity estimates and informing operational decision-making. (Dixit & Jakhar, 2021).

Several scholars and practitioners have made significant contributions to airport runway capacity research. According to Chen et al. (2023), their research introduces a novel causal statistical framework, specifically a confounding-adjusted SFA, to estimate runway system capacity. This model offers computational efficiency and practical applicability in airport operations.

Carlos et al. (2009) conducted an in-depth study on CGH's capacity and service levels using computational simulation. The research revealed significant opportunities for optimizing operational efficiency through strategic adjustments to runway utilization. The study identified potential improvements in airport capacity and overall service quality by modeling various scenarios. These findings highlight the importance of data-driven decision-making in managing airport operations effectively. The study underscores how computational simulation can be a powerful tool for enhancing airport performance. Implementing these insights could increase efficiency and better service for passengers at CGH.

These scholars and practitioners have an advanced understanding of runway capacity through research and practical applications, emphasizing data-driven decision-making and innovative modeling techniques. Their work highlights the importance of addressing runway capacity challenges using these methods. Congonhas Airport exemplifies the challenges and opportunities in enhancing runway capacity in high-traffic environments. Their contributions provide valuable insights for improving runway capacity, benefiting airlines, airport operators, and passengers. As air traffic demand grows, ongoing research and innovation in runway capacity management are essential. Ensuring efficient and safe airport operations requires continuous advancements in this field.

## Methodology

This study employs an exploratory qualitative approach to identify strategies for increasing RSC at CGH. It compares passenger and traffic demand between CGH and GRU to uncover latent demand at CGH, thus establishing the feasibility of proposed scenarios. This methodological framework aligns with aviation industry standards and best practices, ensuring the relevance and applicability of findings.

Three proposed scenarios are validated in collaboration with CGNA. Each scenario takes advantage of a new gate structure, including a rapid exit taxiway for runway 35 and universal gates[1]. By focusing on different fleet mixes, these scenarios aim to optimize the existing RSC effectively.

Scenario one focuses on operations involving commercial aviation, only (under Part 121), such as those produced by Embraer, Boeing, ATR, and Airbus. Scenario two expands the operational scope to include commercial and general aviation. Scenario three maintains the current fleet mix, permitting all propeller-driven airplanes to operate alongside various jet types.

A revenue analysis will assess the financial benefits for airlines and AENA stemming from the increased RSC. This evaluation will underscore the economic viability of the proposed capacity expansion, illustrating the potential for enhanced profitability. Ultimately, the findings will emphasize the importance of infrastructure improvements to accommodate the growing demands of the aviation sector.

## Data Collection

### Data Sources

The data for this analysis was collected from several key sources. First, the ANAC SAS Database was utilized to gather detailed slot information and flight schedules (ANAC, 2024a). Second, reports from the ANAC Demand and Supply Database were used to obtain comprehensive data on passenger demand and seat supply in the Brazilian air transport market. (ANAC, 2024b). Finally, fare data for the relevant airports was sourced from ANAC, contributing to the comparison of operational costs and pricing structures (ANAC, 2024c).

[1] Universal Gate – As a universal gate we can consider a gate/parking position that can be used without any restrictions from the EMBRAER 195, passing by the BOEING 737 and the AIRBUS A320, up to the 737 MAX 10 and the AIRBUS A321NEO.

## Data Collected

The primary datasets used in this analysis included aviation data sources. First, historical records were analyzed, encompassing passenger traffic, flight movements, load factor, and fares. Second, future flight schedules and slot allocations were obtained from the ANAC database (SAS system), covering the period from March 31, 2025, to October 26, 2025. Third, market share reports from previous flight operations were reviewed to provide insights into operational patterns over the past five years. Lastly, 2024 fare data from ANAC for GRU and CGH airports were utilized to compare operational costs and revenue projections.

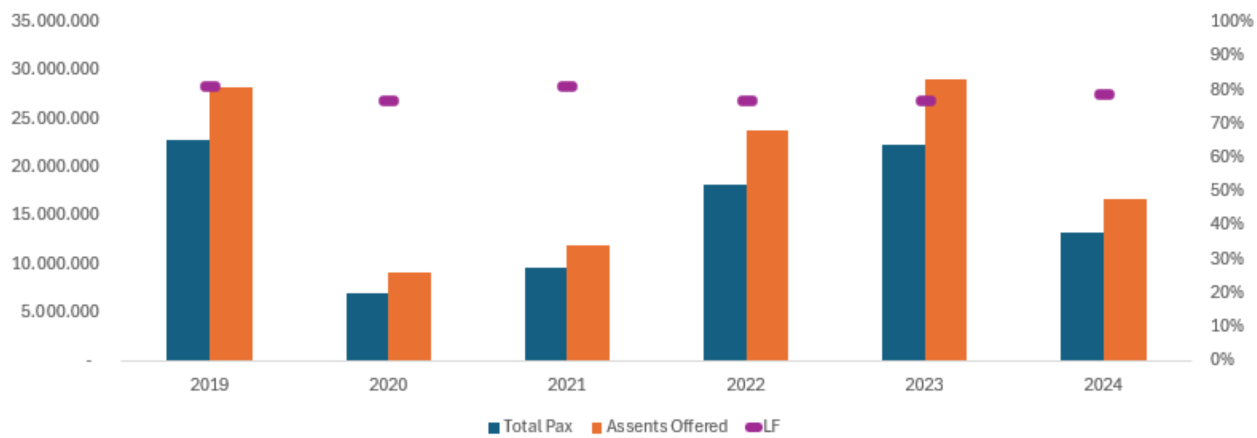
## Data Analysis

Congonhas Airport features two parallel runways situated too close together to operate independently. The lengths of the runways are 17R/35L at 1,760 m (5,774 ft) and 17L/35R at 1,345 m (4,413 ft), with only the 17R runway equipped with a Rapid Exit Taxiway (RET). The airport serves not only commercial aviation but also business, general aviation, and helicopters, presenting a unique fleet mix for ATC. The passenger terminal is located on the south side of the airport and has a total of 30 parking positions. It is important to note that only 12 of those positions are equipped with PBBs, and not all can accommodate every type of aircraft.

The load factors at CGH over the past five years underscore the airport’s constrained demand. Despite variations in the number of passengers and available seats, the LF has consistently remained high. This trend indicates that the demand for flights exceeds the airport's current capacity, constrained by the limited availability of slots.

**Figure 1**

*Load Factor Percentage and Amount of Pax and Assents Offered from 2019*




*Note*. LF among the years at CGH - 2019 (81%), 2020 (76%), 2021 (81%), 2022 (77%), 2023 (77%), and 2024 (79%).

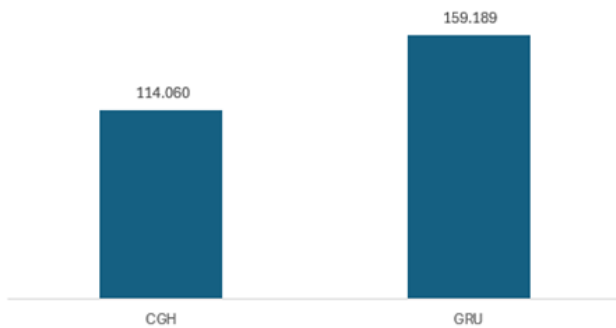
This consistently high LF, even during periods of reduced air travel, such as in 2020 during the COVID-19 pandemic, indicates that CGH is operating near total capacity. The airport's inability to fully meet passenger demand is mainly due to the limitations imposed by the restricted number of available slots. This suggests that operational constraints, rather than fluctuations in demand, are the primary factor limiting further growth.

***Slot and Operational Comparisons Between CGH and GRU***

A comparison between CGH and GRU (Figure 2) reveals significant differences in aircraft movements and operational patterns.

**Figure 2**

*Total Aircraft Movements by Airports (CGH and GRU) - 31mar24 to 26oct24*

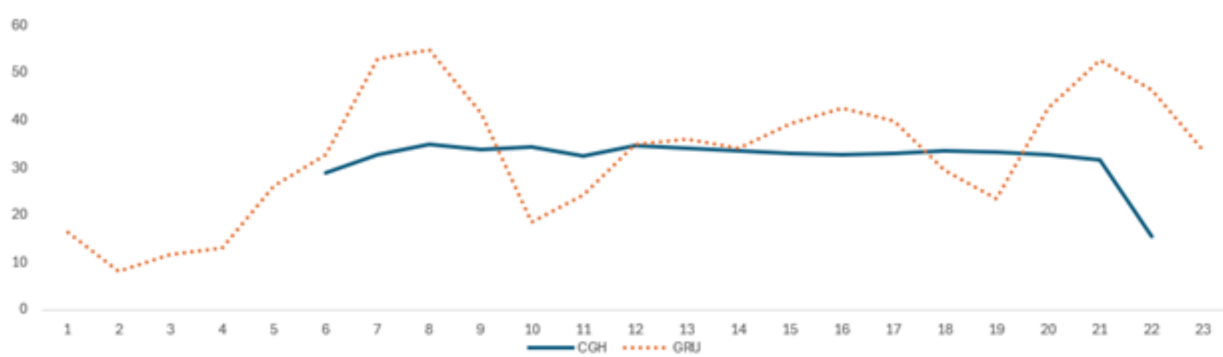



### ***Hourly Movements***

At CGH, hourly movements remain consistent throughout the day, with minimal seasonal or hourly variability (Figure 3). In contrast, GRU demonstrates more significant variability in its movements, reflecting its higher operational capacity, which includes handling international flights. This difference underscores each airport's distinct roles and operational limitations, with CGH primarily focused on domestic traffic and GRU accommodating a broader range of services.

**Figure 3**

*Hourly Movements Comparison Between CGH and GRU*




CGH exclusively operates domestic flights, whereas GRU accommodates domestic and international traffic. This limitation contributes to operational constraints, as CGH lacks the scheduling flexibility and load distribution opportunities available to GRU. A comprehensive comparison of CGH and GRU reveals marked differences in aircraft movements and operational patterns. Moreover, an unofficial simulation conducted by CGNA indicates the potential for increasing movements at CGH. This simulation examined three scenarios for movement capacity, considering various conditions, including commercial and general aviation.

***Current CGH RSC State***

Based on its current infrastructure and operations, CGH has a Theoretical Runway Capacity (TRC) of 55 movements per hour. Its Declared Runway Capacity (DRC) is set at 44 movements, representing 80% of the TRC. This DRC allocates 40 commercial takeoffs or landings on the main runway (17R/35L) and four movements for business or general aviation on the auxiliary runway (17L/35R).

***Proposed Simulation Scenarios***

**Scenario One**. This considers all movements for commercial aviation only, excluding slots for general aviation. Under this scenario, the estimated capacity is 58 movements per hour.

**Scenario Two.** It incorporates four movements per hour for commercial and general aviation, stipulating that they must meet a minimum approach speed in category C. This adjustment increases the capacity to 59 movements per hour.

**Scenario Three.** It also permits four movements per hour for commercial and general aviation but allows a mix of category B and C approach speeds. This scenario results in a slight reduction in capacity to 55 movements per hour.

Table 1 provides a classification of airplanes related to the scenarios simulated considering both commercial and general aviation.

**Table 1**

*Classification of Mix Fleet Over Runway Capability Based on Simulation Scenarios*

| Scenario | Commercial Aviation | | General Aviation | | Airport Renovation |
|---|---|---|---|---|---|
| | Jets | Propeller | Jets | Propeller | |
| I | Yes | Yes | No | No | Yes |
| II | Yes | Yes | Cat C | Cat C | Yes |
| III | Yes | Yes | Cat C<br>Cat B | Cat C<br>Cat B | Yes |

*Note*. For propeller-driven airplanes, they are considered as any piston airplanes such as a Cirrus SR22 and any turboprop airplanes from Cessna C208 Caravan up to an ATR 72-600. As CAT C airplanes, they are classified under ICAO Airplane Approach Category with a VREF/VATF between 121 and 140 knots. As CAT B airplanes, 91 knots to 120 knots.

Based on this unofficial simulation, there is potential to increase the number of movements at CGH by up to 8 additional movements per day dedicated to commercial aviation, only (see Table 2, considering Scenario Two for comparing with the current operation in 2024). This finding further supports the recommendation to expand slot availability for commercial aviation at the airport.

**Table 2**

*Comparison Between Operational Phases Aimed at Increasing Capacity in Commercial Aviation*

| Operation Phases | Real Capacity - Theoretical (100%) | Declared Capacity (80%) | Commercial Aviation | General Aviation |
|---|---|---|---|---|
| Current (2024) | 55 | 44 | 36 | 8 |
| 2025-2028 | 55 | 44 | 36 | 4 |
| 2028 | 55 | 44 | 40 | 4 |
| With Scenario Two | 59 | 48 | 44 | 4 |

*Note: W*ithin the operation of RBAC 121 (Part 121), in scenario 2, general aviation would 'donate' 4 slots for commercial aviation to gain 4 additional slots.

### ***Aircraft Types and Passenger Volumes***

Data from 2019 and 2024 indicates a diverse range of aircraft operating at CGH. Larger aircraft, such as the B738 and A320, dominate passenger counts and seat offerings during this timeframe. The B738 accounted for 29,570,373 passengers while offering 37,706,285 seats. In comparison, the A320 facilitated 26,452,459 passengers and provided 33,994,405 seats. These figures demonstrate that larger aircraft are employed to optimize the limited slots available at CGH. Nonetheless, there are significant opportunities for further growth if additional slots are allocated for operations.

### ***Financial Implications for AENA***

The financial implications for AENA are substantial, particularly with an increase of 60 additional movements per day at CGH, achieved by adding eight more slots during peak operating hours. Key financial metrics include:

- Boarding fee: R$ 52.22
- International fee: R$ 102.50 (Note: CGH currently operates only domestic flights)
- Landing and takeoff fee per movement: R$ 5,041.33
- Percentage of slots used for landing: 50%
- Percentage of slots used for takeoff: 50%
- Operational days per week: Six (assuming one day with low operations)
- Average passengers per flight: 121
- Total new movements per day: 120
- Total new movements per week: 720

- Total new movements per year: 37,440

**Projected Revenue.** The projected revenue from this increase includes:

- Revenue from landings

$$= \frac{Movements\ per\ year}{2} * landing\ fee\ per\ movement = \text{R\$ } 94{,}373{,}697.60$$

- Revenue from takeoffs

$$= \frac{Movements\ per\ year}{2} * landing\ fee\ per\ takeoffs = \text{R\$ } 118{,}284{,}566.40$$

- Total annual revenue

$$= Revenue\ from\ landing * Revenue\ from\ takeoffs = \text{R\$ } 212{,}658{,}264.00$$

- Additional passengers per year

$$= total\ new\ movements\ per\ year * avg\ passager\ per\ flight = 4{,}530{,}240$$

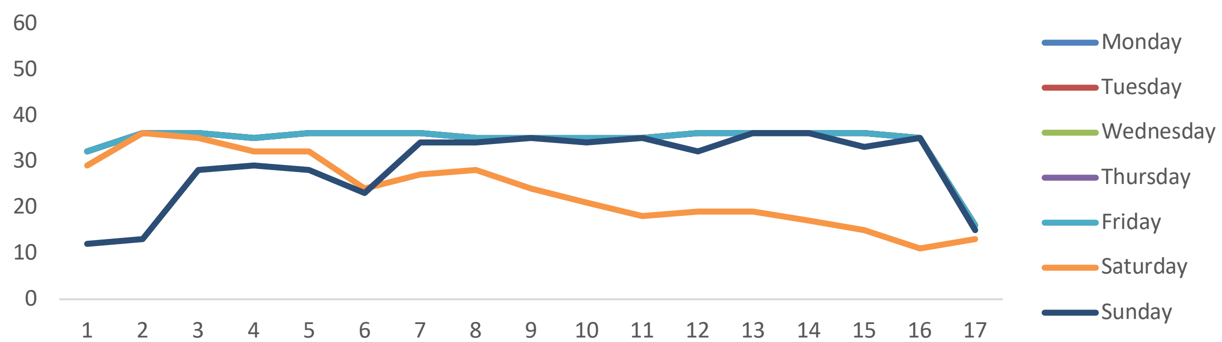
- Total revenue until the end of AENA's contract in 2028 and assuming operations of aircraft types exceeding 52 tons

$$= Total\ Annual\ Revenue * 4\ (remaining\ years) = \text{R\$ } 850{,}633{,}056.00$$

Figure 4 offers a general viewing of movements per hour to analyze the trends during a period of two weeks.

**Figure 4**

*Number of Movement per Hour at CGH in function of Days of Week*



These figures illustrate the significant financial benefits of expanding runway capacity and increasing slot availability at CGH. The trends appear to follow the same pattern from Monday to Friday, as there is no evident seasonal effect, and movements remain flat throughout the week.

### ***Financial Implications for Airlines***

By utilizing the new slots, airlines can substantially enhance their revenue potential. Considering a mix of the primary routes operated, as detailed in Table 3, estimates have been made regarding possible new revenues. Additionally, the potential for market cannibalization has been considered in these estimations. This analysis underscores the financial benefits airlines can achieve through the increased availability of slots. Consequently, airlines stand to gain from both expanded operational capacity and improved market positioning.

**Table 3**

*Average of Ticket Prices and Number of Passengers at CGH and GRU routing other Airports*

| Airport | N°of Pax CGH | N°of Pax GRU | Avg Tkt CGH | Avg Tkt GRU |
|---|---|---|---|---|
| SDU | 2,257,878.00 | 281,157.00 | $417.00 | $651.00 |
| BSB | 1,359,431.00 | 788,247.00 | $392.00 | $467.00 |
| CNF | 1,162,137.00 | 901,286.00 | $304.00 | $341.00 |
| CWB | 958,615.00 | 861,227.00 | $289.00 | $439.00 |
| SSA | 935,000.00 | 763,639.00 | $469.00 | $477.00 |
| FLN | 823,450.00 | 713,974.00 | $449.00 | $455.00 |
| REC | 666,125.00 | 1,256,709.00 | $537.00 | $553.00 |
| POA | 628,402.00 | 529,031.00 | $246.00 | $310.00 |
| GYN | 600,132.00 | 569.58 | $496.00 | $561.00 |
| NVT | 553,050.00 | 436,691.00 | $502.00 | $423.00 |
| GIG | 128,619.00 | 911,316.00 | $254.00 | $387.00 |
| FOR | 295,517.00 | 813,514.00 | $682.00 | $706.00 |
| Final Avg Ticket Price for CGH | | | $419.75 | |

*Note.* The average price values are in Brazilian currency (R$)

**Projected Revenue.** The total new movements per year are estimated at 37,440, reflecting the increased capacity at CGH. With an average of 121 passengers per flight, this results in a total of 4,530,240 passengers annually. Consequently, the total annual revenue for airlines operating at CGH is projected to be R$ 1,901,568,240.00:

$$Total\ Annual\ Revenue\ for\ airlines = additional\ passanger\ by\ year * final\ Avg\ ticket\ Price\ for\ CHG\ \_.$$

Furthermore, the total revenue projected until the end of AENA's contract in 2028 amounts to R$ 7,606,272,960.00. These calculations highlight the significant financial opportunities that can arise from expanding operational capacity at CGH.

## Project Outcomes

### Results

The analysis of historical and projected data demonstrated unmet demand at Congonhas Airport (CGH) due to slot limitations. Expanding the available slots would have allowed airlines to operate more flights, accommodating around 4.5 million additional passengers annually. These improvements required minimal infrastructure upgrades, providing immediate capacity increases without substantial investments.

#### *Simulation*

The study examined ways to increase runway capacity at CGH without major modifications to the existing infrastructure. A comparison between the demand at CGH and GRU identified untapped potential that could be served by increasing runway capacity. Three scenarios involving different fleet mixes were developed to optimize the current runway system. The recommended solution was to increase slot availability, as the airport consistently operated with high load factors. The study analyzed three specific scenarios:

**Scenario One.** Theoretical runway capacity increased from 55 to 58 movements per hour, with a declared capacity of 46.

**Scenario Two.** Theoretical runway capacity increased from 55 to 59 movements per hour, resulting in a declared capacity of 48.

**Scenario Three**. Theoretical runway capacity remained unchanged at 55 movements per hour.

***Financial Benefits***

**AENA.** An estimated additional annual revenue of R$ 212,658,264.00 (approximately USD 37,995,632.02), which would accumulate to a total of R$ 850,633,056.00 (around USD 151,982,528.09) by 2028.

**Airlines.** Projected to gain additional annual revenue of R$ 1,901,568,240.00 (roughly USD 339,622,369.82), leading to a cumulative total of R$ 7,606,272,960.00 (approximately USD 1,358,489,479.26) by 2028.

**Overlapping routes.** CGH and GRU have similar routes, with CGH generally offering lower ticket prices.

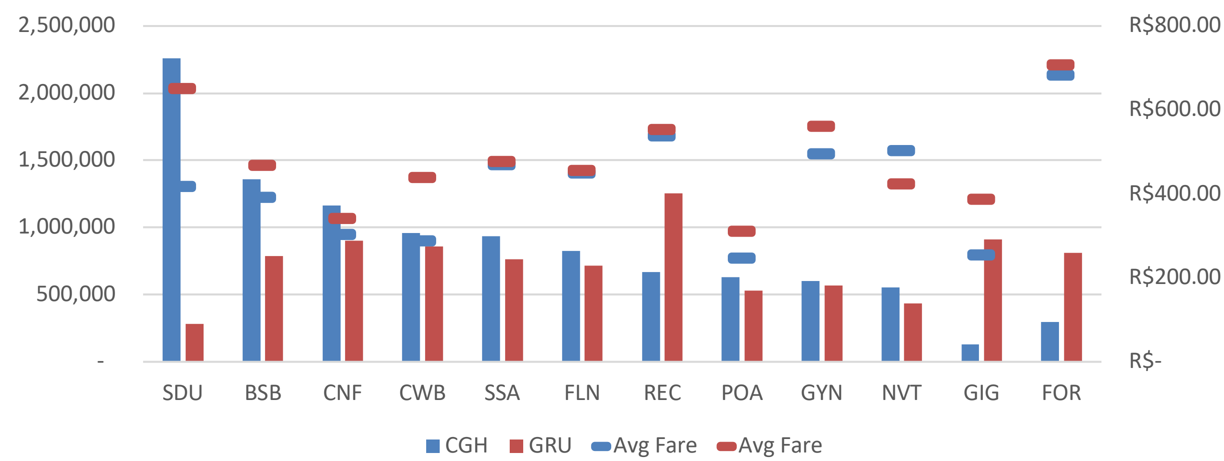
**Optimization opportunities.** Airlines could optimize route planning to maximize revenue while minimizing market overlap.

**Passenger redirection.** Slot expansion at CGH could draw passengers from GRU, but high demand suggests both airports could coexist without significant negative impacts.

A general viewing is offered in Figure 5 between CGH and GRU regarding ticket pricing.

**Figure 5**

*Comparison of the Number of Pax with Respective Average Ticket Prices at CGH and GRU*




## Limitations

The absence of comprehensive international passenger flow data limited the ability to fully assess the potential impact of international flights at CGH. This data gap hindered a complete analysis of the risks of market cannibalization between the airports, particularly concerning overlapping services. Additionally, the lack of detailed passenger movement information between CGH and GRU further restricted a thorough understanding of competitive dynamics between these airports.

Airline strategies may shift unexpectedly, introducing variability to projections. Fleet composition changes, route adjustments, and operational priorities could evolve unpredictably, potentially deviating from the study's assumptions. The uncertainty surrounding these strategic decisions limits the ability to make precise future forecasts.

Moreover, external factors like fluctuations in passenger demand, currency exchange rates, and fuel prices pose significant uncertainties. These variables can greatly affect operational performance and financial outcomes, impacting the feasibility and success of any expansion initiatives at CGH. Unpredictable market conditions could complicate the evaluation of potential benefits from proposed changes, necessitating ongoing assessment as new data emerges.

# Conclusion and Recommendations

## Conclusion

The analysis of Scenario 2, which allows for the largest increase in declared runway capacity at Congonhas Airport (CGH), revealed several significant consequences. Firstly, the projected increase in aircraft movements per hour would generate higher revenue for both AENA and airlines operating at CGH. Additionally, enhanced slot availability would facilitate the creation of new routes, including potential international operations. Furthermore, airport infrastructure planning and the Airport Master Plan would require revisions to accommodate increased passenger demand. Lastly, the surge in demand could affect service levels and the overall quality of passenger experience at the airport.

## Recommendations

Based on the findings from Scenario Two, several strategic actions are recommended for AENA Brasil. The construction of a Rapid Exit Taxiway for RWY 35L is essential to optimize aircraft flow and reduce congestion. Implementing an Apron Control System will enhance apron operations management and improve efficiency. Additionally, operational measures should account for movements from both Commercial Aviation and General/Executive Aviation. Updating the demand forecast curve is crucial to reflect the new operational conditions and anticipated growth. Lastly, the Airport Master Plan must include necessary investments to ensure that service levels and passenger service quality are maintained amidst growing demand.

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