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The Influence of Slot Time and Ground Services on Aeronautical Revenue Through Operational Performance (A Study at PT Angkasa Pura II, Soekarno-Hatta Airport, Tangerang, Banten)

Boy Fajar Prasetiyo[1], Aditya Wardhana[2], Olfebri Olfebri[3]
[1]Institute of Transportation and Logistics Trisakti, Jakarta, Indonesia, fjr.prass@gmail.com
[2]Institute of Transportation and Logistics Trisakti, Jakarta, Indonesia, adityawardanadit@yahoo.com
[3]Institute of Transportation and Logistics Trisakti, Jakarta, Indonesia, olfebri@yahoo.co.id

Corresponding Author: fjr.prass@gmail.com[1]

Abstract: This study examines the influence of slot time optimization and ground service quality on airport revenue, with operational performance as an intervening variable. Focusing on Soekarno-Hatta International Airport, this research integrates concepts of operational management and financial sustainability in airport operations. The findings reveal that optimizing slot time significantly enhances operational efficiency, leading to increased aeronautica revenue. Similarly, ground service quality directly improves passenger satisfaction and operational performance, indirectly contributing to higher income. The study highlights the critical role of operational performance as a mediating factor, bridging the gap between resource optimization and financial outcomes. Recommendations for effective airport management strategies include leveraging advanced scheduling systems and enhancing ground service efficiency to maximize aeronautica revenue potential while ensuring service quality and operational sustainability.

Keyword: Slot Time Optimization, Ground Service Quality, Airport Revenue, Operational Performance, Soekarno-Hatta International Airport, Financial Sustainability

INTRODUCTION

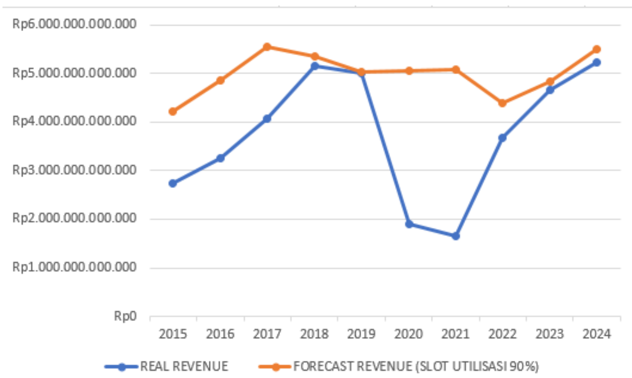
Although the aviation business remains the primary contributor to airport revenue accounting for approximately 60% in 2023 there is still a notable gap in optimizing total airport income (ACI, 2023). Ideally, the growth of non-aeronautical (non-aero) businesses would reduce reliance on aeronautical revenues. However, in practice, the contribution of non-aero sectors has yet to reach its full potential, despite various expansion efforts into property, warehousing, cargo, retail, and airport-related services (ACI, 2023).

What makes this phenomenon unique is the contrast between global trends and local implementation. Internationally, airports are increasingly diversifying their revenue streams. However, in many regions, including developing countries, the implementation of such strategies still faces significant barriers ranging from regulatory limitations to inadequate infrastructure investment. While airports in developed nations have successfully established "airport city" models that function not only as aviation hubs but also as regional economic centers, developing countries often lack standardized frameworks for optimizing non-aero business strategies, raising questions about their overall effectiveness (Rodrigue et al., 2020).

Airports also play a critical role as economic hubs, but they continue to face operational challenges particularly in managing flight slot allocations and commercial service operations. These challenges are especially significant given the fluctuating number of air passengers and the demand for efficient support of airport operations. In Indonesia, air passenger numbers frequently fluctuate unpredictably. To address this, a deseasonalized method is used to forecast passenger volumes at airports, revealing variations throughout the year. Forecasts showed an upward trend, with 2,514,681 passengers in Q1 of 2022 and 2,447,735 passengers in Q4 (Fatmi'aturro'isah et al., 2023).

Despite this, congestion issues persist at Soekarno-Hatta International Airport. One key issue is the current slot time system, which in Indonesia is determined solely based on the Estimated Off-Block Time (EOBT) the reference point when an aircraft is ready to push back. This approach neglects other critical components, such as the Variable Taxi Time (VTT), which should be factored in to accurately determine the Target Take-Off Time (TTOT). As a result, there are frequent cases where an aircraft is on time for its slot but then experiences delays due to congestion on the taxiway while waiting for access to the runway. This bottleneck causes cascading delays in subsequent departure schedules (R et al., 2021).

Flight operations can also create ground-side congestion, particularly at gates, aprons, taxiways, and runways. The latter two are commonly referred to as airport movement areas. Since congestion in these zones can cause both flight and departure delays as well as discomfort for passengers maximizing the efficiency of these bottleneck resources has become a central topic in gate assignment and airport operations literature (Daş et al., 2020).



Source: Operational of Angkasa Pura II (2023)

Figure 1. Estimated Revenue and Actual Revenue Graph 2015-2024

Based on the chart above, it is evident that actual revenue experienced significant fluctuations due to various internal and external factors. One of the main contributors to the sharp decline in 2020 and 2021 was the COVID-19 pandemic, which had a direct impact on global flight operations. Travel restrictions, reduced demand for air travel, and lockdown policies across many countries led to a dramatic drop in slot time utilizationfalling below 40% at several airports. This, in turn, widened the gap between projected and actual revenue (IATA, 2021).

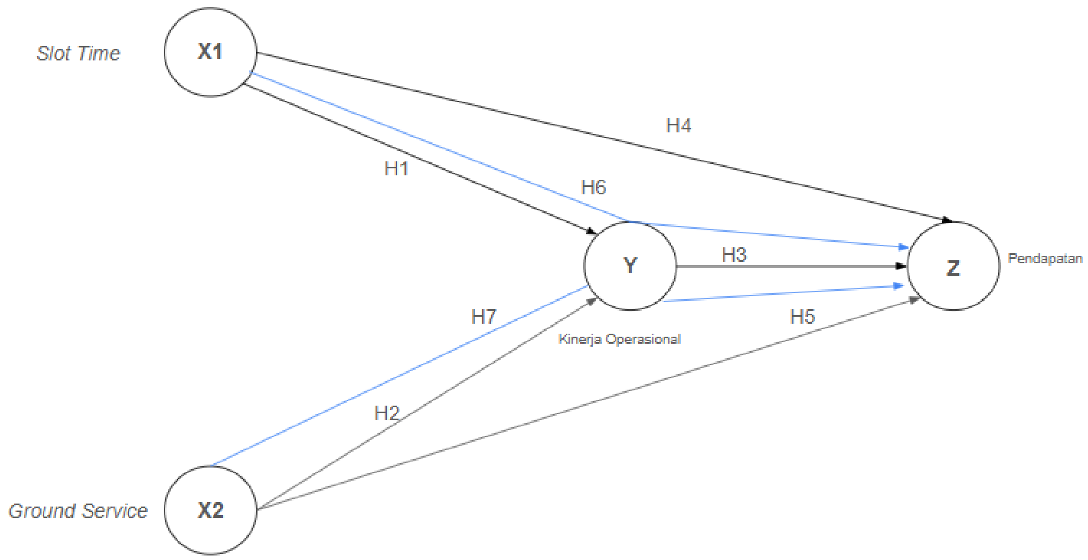
The scheduling of flight slots plays a crucial role in revenue generation for both airlines and airports. Proper slot-time allocation is essential to optimize income. Sufficient availability of slots enables airlines to offer more flights to customers, which can significantly increase revenue from ticket sales and ancillary services. When passengers have access to a wider range of departure times, they are more likely to find flights that suit their needs, thus boosting overall ticket sales.

Moreover, the accuracy and timeliness of slot-time scheduling directly impact revenue performance. A well-planned flight schedule enhances passenger confidence in timely departures and arrivals an important factor in airline selection. Passengers tend to favor airlines known for reliability and punctuality, which can lead to greater market share and higher income. In addition, punctual operations contribute to greater efficiency by minimizing delays and disruptions in flight schedules (Yudistiawan et al., 2024).

Given this background, the topic opens up an opportunity for further research under the title: "The Influence of Slot Time and Ground Services on Aeronautical Revenue Through Operational Performance (A Study at PT Angkasa Pura II, Soekarno-Hatta Airport, Tangerang, Banten)."

METHOD

This research adopts a quantitative approach aimed at analyzing the influence of specific variables on aeronautical revenue at Soekarno-Hatta International Airport. The study utilizes secondary data obtained from PT Angkasa Pura II, including aeronautical revenue figures and slot time data, supported by relevant literature reviews. The research is conducted in a systematic, controlled manner and is based on empirical data to ensure the validity of the findings. This study employs data analysis using SEM-PLS software version 3.9.2. The method was chosen as the research involves multivariate analysis with three variables, namely the dependent variable, the independent variable, and the mediating variable. Its purpose is to evaluate the relationships among variables within a model, including those between indicators and their constructs, as well as among the constructs themselves.

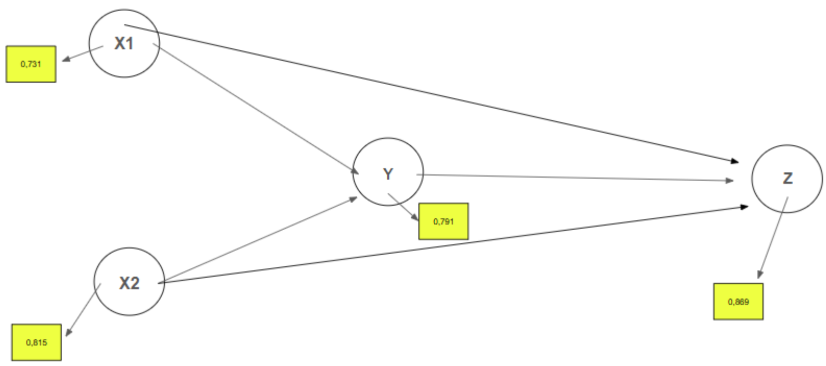


Source: Research Results
Figure 2. Framework

RESULTS AND DISCUSSION

Results

1. Convergent Validity Test



Source: Research Results
Figure 3. Convergent Validity Test

The results presented above indicate that each variable indicator has a loading factor value greater than 0.70, which reflects a high level of validity for each indicator. Thus, it can be concluded that the model has met the requirements for convergent validity.

Average Variance Extracted Test

Table 1. Average Variance Extracted (AVE) Test Result

Variable	Average Variance Extracted
Slot Time	0.703
Ground Services	0.652
Operational Performance	0.680
Aeronautical Revenue	0.714

Source: Research Results

Convergent validity was further assessed through the Average Variance Extracted (AVE). The results show that the AVE values for all constructs exceed 0.5, confirming that the model adequately meets the criteria for convergent validity.

2. Discriminant Validity Test

Table 2. Discriminant Validity Test Result

Variable Indicator	Line Item	Slot Time	Ground Services	Operational Performance	Aeronautical Revenue
Slot Time	**X1**	0.731	0.322	0.271	0.288
Ground Services	**X2**	0.694	0.815	0.568	0.515
Operational Performance	**Y**	0.521	0.592	0.791	0.708
Aeronautical Revenue	**Z**	0.466	0.520	0.697	0.869

Source: Research Results

Based on the cross-loading results presented in the table above, it is evident that the loading values of each indicator item on its respective construct are higher than the cross-loading values on other constructs. This indicates that each construct or latent variable has satisfactorily met the criteria for discriminant validity.

3. Realibility Test

Table 3. Realibility Test Result

Variable	Cronbach's alpha	Composite Realibility (rho_a)
Slot Time	0.860	0.871
Ground Services	0.911	0.912
Operational Performance	0.921	0.923
Aeronautical Revenue	0.933	0.936

Source: Research Results

In the table above, it can be seen that the composite reliability values for all constructs are above the threshold of 0.70, indicating that all constructs demonstrate a strong level of reliability and meet the required minimum standard. Furthermore, the table also shows that the Cronbach's alpha values for all constructs exceed 0.60. Thus, it can be concluded that all constructs possess good reliability in accordance with the established minimum criteria.

4. R-Square Test

Tabel 4. R-square Test Result

Variable	R-Square	R-Square Adjusted
Operational Performance	0.684	0.678
Aeronautical Revenue	0.759	0.753

Source: Research Results

Based on table, the R-square value for operational performance is 0.684, meaning that 68.4% of its variation is explained by slot time optimization, ground service quality, and airport revenue, while 31.6% is influenced by other factors outside the model. Meanwhile, the R-square value for airport revenue is 0.759, indicating that 75.9% of its variation is explained by slot time optimization, ground service quality, and operational performance, with the remaining 24.1% affected by factors not included in the model.

5. Q-Square Test

Q2 = 1 – (1 – R12) × (1 – R22)
Q2 = 1 – (1 – 0.684) × (1 – 0.241)
Q2 = 1 – (0.684 × 0.241)
Q2 = 1 – 0.164844
Q2 = 0.835 → 83.5%

Based on the Q-square test above, the predictive relevance value is 0.835 or 83.5%. The remaining 16.5% can be attributed to other variables not included in this research model.

6. F-Square Test

Table 5. f-square Test Result

Variable	F-Square
Slot Time -> Operational Performance	0.457
Ground Services -> Operational Performance	0.310
Slot Time -> Aeronautical Revenue	0.250
Ground Services -> Aeronautical Revenue	0.371
Operational Performance -> Aeronautical Revenue	0.243

Source: Research Results

The analysis results show varying levels of influence among the variables. Slot time has a strong effect on operational performance with an F^2 value of 0.457, while ground services exert a moderate influence on operational performance with an F^2 value of 0.310. In terms of aeronautical revenue, slot time demonstrates a moderate effect with an F^2 value of 0.250, whereas ground services show a strong impact with an F^2 value of 0.371. Additionally, operational performance itself has a moderate influence on aeronautical revenue, reflected by an F^2 value of 0.243.

7. Direct Test

Table 6. Direct Test Result

Variable	Original Sample (O)	Sample Mean (M)	Standart Deviation (STDEV)	T-Statistics (|O/STDEV|)	P-Values
Slot Time -> Operational Performance	0.176	0.168	0.107	1.644	0.01
Ground Services -> Operational Performance	0.131	0.125	0.081	1.628	0.04
Slot Time -> Aeronautical Revenue	-0.228	-0.197	0.13	1.757	0.019
Ground Services -> Aeronautical Revenue	-0.202	-0.17	0.124	1.627	0.04
Operational Performance -> Aeronautical Revenue	0.875	0.855	0.138	6.347	0

Source: Research Results

The findings indicate that slot time has a positive and significant direct effect on operational performance, with a p-value of 0.01 ($p < 0.05$). Similarly, ground services also positively and significantly influence operational performance, as shown by a p-value of 0.04

($p < 0.05$). Furthermore, slot time demonstrates a positive and significant direct effect on aeronautical revenue with a p-value of 0.019 ($p < 0.05$), while ground services also show a positive and significant impact on aeronautical revenue with a p-value of 0.04 ($p < 0.05$). Lastly, operational performance itself has a positive and highly significant direct effect on aeronautical revenue, as indicated by a p-value of 0.000 ($p < 0.05$).

8. Indirect Test

Table 7. Indirect Test Result

Variable	Original Sample (O)	Sample Mean (M)	Standart Deviation (STDEV)	T-Statistics (|O/STDEV|)	P-Values
Slot Time -> Operational Performance -> Aeronautical Revenue	-0.161	-0.139	0.093	1.722	0.047
Ground Services -> Operational Performance -> Aeronautical Revenue	0.616	0.614	0.145	4.239	0

Source: Research Results

The results show that slot time has a positive and significant effect on aeronautical revenue when mediated by operational performance, with a p-value of 0.047 ($p < 0.05$). This indicates that the hypothesis is supported. Similarly, ground services also have a positive and significant effect on aeronautical revenue through operational performance, as evidenced by a p-value of 0.000 ($p < 0.05$). Therefore, this hypothesis is also accepted.

Discussion

From the results above, the slot time variable (X1) has a positive and significant effect on operational performance (Y). This indicates that the higher the availability and allocation of slot time provided by the airport operator, the better the perceived service quality experienced by air transport users. This finding is consistent with the view that efficiency and slot time optimization are integral to airport service quality, particularly in managing flight frequency and schedule punctuality (ACI, 2023).

The ground services variable (X2) also shows a positive and significant effect on operational performance (Y). This suggests that the success of ground handling services, especially in maintaining punctuality within the 30-minute tolerance limit, directly contributes to customers' perception of service quality.

Furthermore, the relationship between operational performance (Y) and aeronautical revenue (Z) is also positive and significant. This reinforces the idea that positive perceptions of airport operational services can enhance user loyalty, increase service utilization frequency, and ultimately boost revenue in the aeronautical sector.

In addition, this study highlights the mediating role of operational performance (Y) in bridging the effect of slot time (X1) and ground services (X2) on aeronautical revenue (Z). The influence of slot time on aeronautical revenue becomes significant when mediated by operational performance. Similarly, the impact of ground services on aeronautical revenue is stronger when mediated by improvements in service quality.

CONCLUSION

The slot time provided by the airport to airlines reflects the balance of supply and demand, which directly influences airport revenue. Therefore, optimization is required to maximize daily flight schedule occupancy. In addition, ground services at Soekarno-Hatta Airport—covering aspects such as quality, quantity, and service fulfillment—also play a critical role in determining revenue. To encourage higher passenger spending on airport services, the airport must ensure that its services consistently meet or even exceed customer expectations, making service quality improvement an effective strategy for boosting revenue.

Moreover, operational performance has a positive impact on overall airport income. This indicates that the better the operational services offered, the higher the level of satisfaction among airline passengers and airport users, which in turn contributes to the optimization of flight schedules. Furthermore, both slot time and ground services individually show a positive effect on aeronautical revenue, either directly or through the mediation of operational performance. This finding highlights that effective management of slot time and ground services strengthens customer satisfaction and ultimately leads to higher airport revenue.

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