ANALYSIS OF APRON CAPACITY TO THE INCREASING NUMBER OF FLIGHTS AT AJI PANGERAN TUMENGGUNG PRANOTO AIRPORT IN SAMARINDA

Luh Gede Sri Maharani[1,*] Ahmad Musadek[2,] Siti Nurfadhilah[3]

Politeknik Penerbangan Surabaya, Jemur Andayani I/73 Wonocolo Surabaya, Jawa Timur, Indonesia, 60236
[*]*Corresponding author. Email:* luhgedesrimaharani@gmail.com

ABSTRACT
Aji Pangeran Tumenggung Pranoto Airport is located in Samarinda, East Kalimantan, which serves as the capital of East Kalimantan Province. In 2024, the airport recorded a total of 846,252 passengers with 8,827 flights. This increase in flight volume has an impact on the capacity of airport facilities, particularly the apron. This study employs a quantitative forecasting method using secondary data, namely the annual number of flights from 2020 to 2024. The forecasting results indicate that by 2045, based on the arithmetic method, the projected number of flights will reach 26,267.5 flights. When rounded up, the total is 26,268 flights in 2045. Furthermore, the estimated requirement for parking stands in 2045 is 23 stands, an increase of 10 stands from the current 13.

Keywords: *Parking Stand, Forecasting, Apron Capacity.*

1. INTRODUCTION

Samarinda is the capital city of East Kalimantan Province and the largest urban area on the island of Borneo. Strategically located near Indonesia’s future capital, Ibu Kota Nusantara (IKN), the city serves as a key supporting region. Widely recognized by its nickname *Kota Tepian* (“City of the Riverbank”), Samarinda is an important center for governance, trade, and plays a vital role in the nation’s coal industry.

Air connectivity in Samarinda is supported by Aji Pangeran Tumenggung Pranoto Airport, managed as a Category I Airport Management Unit (UPBU). The airport began operations on May 15, 2018, and carries the IATA code AAP (Alpha, Alpha, Papa) and the ICAO code WALS (Whiskey, Alpha, Lima, Sierra). Geographically, it is situated at 0°22'23" S latitude and 117°15'25" E longitude. Since its inauguration, the airport has maintained a terminal building with an area of 12,700 m², designed to accommodate up to 1,140 passengers at a time[1].

Aji Pangeran Tumenggung Pranoto Airport serves as a vital air transport infrastructure supporting connectivity and mobility within East Kalimantan. According to the Aeronautical Information Publication (AIP), the airport is equipped with a runway measuring 2,250 meters in length and 45 meters in width, alongside an apron area of 300 by 123 meters. The facility has a total parking stand capacity of 13 positions, consisting of five stands designated for narrow-body aircraft and eight stands for small-body aircraft, with also utilized for helicopter operations. In addition, the airside facilities are supported by four fixed passenger boarding bridges and two aviobridges[1].

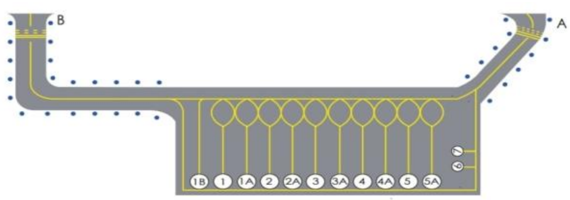

Figure 1. Apron Layout of A.P.T. Pranoto Airport, Samarinda

In line with the annual growth in passenger numbers, records show that in 2023 Aji Pangeran Tumenggung Pranoto Airport served 752,212 passengers. This figure increased in 2024, reaching 846,252 passengers. The steady rise in flight movements each year significantly impacts the overall capacity of airport facilities, one of which is the apron.

The aircraft parking facility (apron) is part of the airside infrastructure and is regulated under the Directorate General of Civil Aviation Decree No. SKEP/77/VI/2005, which serves as a guideline for apron facility standards, stating that aprons must allow sufficient maneuvering space for aircraft operations. Furthermore[2], the Regulation of the Minister of Transportation of the Republic of Indonesia No. PM 41 of 2023 concerning Airport Service Provision stipulates that the availability of parking stands must accommodate the number of aircraft operating during peak hours[3].

This study focuses on analyzing the apron facility at Aji Pangeran Tumenggung Pranoto Airport to determine the required apron capacity in anticipation of increased flight demand in 2045. This aligns with President Joko Widodo's directive, which mandates the Ministry of National Development Planning to formulate the Vision of Golden Indonesia 2045, where the transportation sector is considered one of the main drivers of economic growth and national progress.

1.1. Research Questions

a. What is the required number of aircraft parking stands at Aji Pangeran Tumenggung Pranoto Airport, Samarinda, in the year 2045?

b. What is the projected condition of flight operations at Aji Pangeran Tumenggung Pranoto Airport, Samarinda, in the year 2045?

2. LITERATURE REVIEW

2.1. Airport Definition

The Indonesian Minister of Transportation Regulation No. 39 of 2019 defines an airport as a controlled area situated either on land or water, designated for aircraft takeoffs and landings. It serves as a point for passenger embarkation and disembarkation, cargo handling, and the transition of passengers and goods between different modes of transportation, both intermodal and intramodal. Additionally, airports are required to have essential infrastructure, including safety, security, and both core and supporting facilities[4].

Annex 14 of 2004 issued by the International Civil Aviation Organization (ICAO) elaborates the definition of an airport as a designated area, either on land or water, that may include buildings, equipment, and other installations intended wholly or partially for aircraft operations such as landings, takeoffs, and related activities[5]. Furthermore, the Directorate General of Civil Aviation, through Decree SKEP/77/VI/2005, emphasizes the airport’s role in facilitating air travel, describing it as an airfield specifically planned and constructed with safety infrastructure to support flight operations, passenger transfers, cargo and mail handling, and intermodal connectivity[2].

2.2. Apron Definition

According to Chapter I of Annex 14 "Aerodromes", 6th Edition, July 2013, the apron is defined as a designated area at an airport intended to accommodate aircraft for purposes such as the loading and unloading of passengers, mail, or cargo, as well as for refueling, parking, or maintenance activities[6]. According to the Decree of the Director General of Civil Aviation No. SKEP/77/VI/2005 concerning Technical Requirements for the Operation of Airport Technical Facilities, the apron should allow sufficient space for aircraft maneuvering to minimize delays[2].

Furthermore, the Decision of the Director General of Civil Aviation No. PR 21 of 2023 regarding Technical and Operational Standards for Civil Aviation Safety Regulations Part 139 (Manual of Standards CASR Part 139), Volume I for Land Aerodromes, states that the entire apron area must be capable of supporting the efficient handling of aircraft traffic, particularly during periods of high traffic volume[7]. Additionally, the Regulation of the Minister of Transportation of the Republic of Indonesia No. PM 41 of 2023 on Airport Service Provision mandates that the number of available parking stands must be adequate to serve aircraft operating during peak hours[3].

3. METHOD

This study employs a quantitative forecasting method to analyze the projected trend in the increase of flight operations in the future and its implications for apron capacity at Aji Pangeran Tumenggung Pranoto Airport in Samarinda. As stated by Stevenson and Chuong 2018, forecasting plays a critical role in decision-making by offering key insights into anticipated future demand. In this research, quantitative forecasting is conducted using both time series and causal approaches, which analyze mathematical correlations between dependent and independent variables across a given time period[8].

This study is structured around a systematic framework designed to examine the relationships between relevant variables. The independent variable in this study refers to the projected apron capacity requirements over the next 20 years. Meanwhile, the dependent variable (Y) represents the estimated number of flight movements within the same 20-year period, as well as the predicted number of flights during peak hours.

The population of this study consists of the annual number of flights recorded between 2020 and 2024. The sample specifically focuses on the number of peak hours flights at Aji Pangeran Tumenggung Pranoto Airport during the same period. Data were obtained from secondary sources, including official records and related literature. Microsoft Excel was employed for the analytical process, utilizing arithmetic forecasting techniques in accordance with applicable regulatory standards[9].

4. RESULT AND DISCUSSION

4.1 Apron Capacity During Peak Hours

Flight arrival and departure data at Aji Pangeran Tumenggung Pranoto Airport from January to December 2024 serve as the basis for analyzing apron capacity during peak hours in that year.

Table 1. Number of Flights Data in 2024

Month	Number of Flights		
	Arrival	Departure	Total
January	344	344	688
February	285	285	570
March	309	309	618
April	374	374	784
May	310	310	620
Juny	336	336	672
July	473	472	945
August	**562**	**570**	**1.132**
September	381	383	764
October	350	349	699
November	351	352	703
December	333	335	668
Total	**4.408**	**4.419**	**8.827**

The apron capacity observed in August 2024 represents the number of flight movements that can be accommodated during peak hours. To determine the volume of traffic during these peak periods, it is necessary to first calculate the traffic demand coefficient using the formula developed by *Japan International Coorporatian Agency* (JICA), 1991[10].

$$Md = \frac{My}{365} \qquad (1)$$

Description :
Md = Daily flight operation
My = Annual flight operation

Calculation :
$Md = \frac{1.132}{365} = 3{,}10132$

$$Cp = \frac{1{,}38}{\sqrt{Md}} \qquad (2)$$

Description :
Cp = Peak hour factor
Md = Daily flight operations
Calculation :
$Cp = \frac{1{,}38}{\sqrt{3}} = 0{,}796744$

$$Mp = Cp \times Md \qquad (3)$$

Description :
Mp = Peak hour flight operations
Cp = Peak hour factor
Md = Daily flight operations
Calculation :
$Mp = 3{,}10132 \times 0{,}796744$
$= 2{,}47095810208$
= 3 flight operations per hour

The peak hour apron capacity is determined using a formula developed by JICA 1991 [10], as outlined below:

$$\text{KJP} = \frac{\text{N} \times \text{T}}{60} + \text{A} \qquad (4)$$

Description :
KJP = Peak hour capacity (aircraft/hour)
N = Number of flight operation during peak hour
T = Gate Occupation Time (GOT), assumed based on aircraft type C
A = Reserve for aircraft parking (typically 1 aircraft)
Calculation :
$\text{KJP} = \frac{3 \times 45}{60} + 1$
= 3, 25
= 4 flight operation per hour

The apron capacity during peak hours in August 2024, which represents the existing year, is estimated at 4 flight operation per hour, based on the assumption that the reserve number of parking stands (A) is 1.

4.2 Flight Operation During Peak Hours

Peak hour flights refer to the condition in which flight operation reach their maximum within a one hour interval. To identify and analyze peak hour conditions, the Pignataro Method is used. This method calculates peak hour volume to determine the maximum level of flight operations during peak periods[11].

A. Ratio of Peak Month

In determining the ratio between the number of flights during the peak month and the total number of flights throughout the year (January to December 2024), it was found that August recorded the highest number of arrivals (*Nmonth*), with 562 inbound flights and 570 outbound flights. The total number of arrivals in 2024 (*Nyear*) was 4.408 flights, while the total number of departures during the same year was 4.419 flights.

$$R_{month} = \frac{N_{month}}{N_{year}} \quad (5)$$

Description :
Rmonth = Peak month ratio
Nmonth = Total number of flight operation during the peak month
Nyear = Total number of flight operation throughout the year

1) Arrival

$$Rmonth = \frac{Nmonth}{Nyear}$$
$$Rmonth = \frac{562}{4408}$$
$$Rmonth = 0{,}1275$$

2) Departure

$$Rmonth = \frac{Nmonth}{Nyear}$$
$$Rmonth = \frac{570}{4419}$$
$$Rmonth = 0{,}1290$$

B. Ratio of Peak Day

To determine the peak day ratio, the highest number of daily flight movements (*Nday*) is divided by the total number of flight movements within the observed month (*Nmonth*)[11].

Table 2. Number of Flights in August 2024

TGL	ARR	DPT	TTL	TGL	ARR	DPR	TTL
1	19	18	37	17	20	23	**43**
2	22	23	45	18	18	19	**37**
3	15	14	29	19	18	21	**39**
4	14	15	29	20	18	19	**37**
5	21	20	41	21	20	21	**41**
6	18	19	37	22	24	21	**45**
7	22	21	43	**23**	**22**	**24**	**46**
8	21	23	44	24	16	18	**34**
9	19	18	37	25	21	21	**42**
10	12	13	25	26	16	16	**32**
11	18	15	33	27	15	15	**30**
12	19	22	41	28	18	16	**34**
13	13	13	26	29	16	18	**34**
14	15	16	31	30	17	16	**33**
15	22	21	43	31	12	13	**25**
16	21	18	39	**Total**	**562**	**570**	**1.132**

The highest flight activity was recorded on August 23, 2024, with 22 arrival flights and 24 departure flights operated on that day.

$$R_{day} = \frac{N_{day}}{N_{month}} \quad (6)$$

Description :
Rday = Peak day ratio
Nday = Total number of flight operation on the peak day
Nmonth = Total number of flight operation during the peak month
Calculation :
1) Arrival

$$Rday = \frac{Nday}{Nmonth}$$
$$Rday = \frac{22}{562}$$
$$Rday = 0{,}0391$$

2) Departure

$$Rday = \frac{Nday}{Nmonth}$$
$$Rday = \frac{24}{570}$$
$$Rday = 0{,}0421$$

C. Ratio of Peak Hours

The peak hour ratio is determined by comparing the number of flight operation during the hour with the highest activity (*Nhour*) to the total number of daily flight movements[11]. In this study, flight data from August 23, 2024, is used as the reference. This data serves as the basis for calculating the peak hour ratio relative to the total daily flight operation, using the following formula.

$$R_{hour} = \frac{N_{hour}}{N_{day}} \quad (7)$$

Description :

Rhour = Peak hour ratio
Nhour = Total number of flight operation during the peak hour
Nday = Total number of flight operation in one day

Table 3. Number of Flights in August 23, 2024

No	Period (UTC)	ARR	DPT	Total
1	00.01 - 01.00	2	1	3
2	01.01 - 02.00	2	**4**	**6**
3	02.01 - 03.00	1	1	2
4	03.01 - 04.00	2	2	4
5	04.01 - 05.00	3	2	4
6	05.01 - 06.00	0	1	1
7	06.01 - 07.00	**4**	1	**5**
8	07.01 - 08.00	0	2	2
9	08.01 - 09.00	3	1	4
10	09.01 - 10.00	1	0	1
11	10.01 - 11.00	0	2	2
12	11.01 - 12.00	0	0	0
13	12.01 - 13.00	1	0	1
14	13.01 - 14.00	0	1	1
15	14.01 - 15.00	0	0	0
16	15.01 - 16.00	1	0	1
17	16.01 - 17.00	0	1	1
18	17.01 - 18.00	0	1	1
19	18.01 - 19.00	1	0	1
20	19.01 - 20.00	1	0	1
21	20.01 - 21.00	0	1	1
22	21.01 - 22.00	0	1	1
23	22.01 - 23.00	0	1	1
24	23.01 - 24.00	0	1	1
	Total	**22**	**24**	**46**
	Peak Hour	4	4	**8**

The highest levels of flight activity were observed during two separate time periods. The departure peak was noted from 01:01 to 02:00 UTC, recording 4 flights, while the arrival peak, also comprising 4 flights, occurred between 06:01 and 07:00 UTC.

Calculation :

1) Arrival

$$Rhour = \frac{Nhour}{Nday}$$

$$Rhour = \frac{4}{22}$$

$$Rhour = 0{,}1818$$

2) Departure

$$Rhour = \frac{Nhour}{Nday}$$

$$Rhour = \frac{4}{24}$$

$$Rhour = 0{,}1667$$

Table 4. Ratio Pattern and Peak Hour Flights in 2024

Rasio / Peak Hours	Arrival	Departure
Rmonth	0,1275	0,1290
Rday	0,0391	0,0421
Rhour	0,1818	0,1667
Peak hour flight operation	4	4

The calculated flight ratio data will serve as the basis for projecting the peak hour flight volume in the target year of 2045.

4.3 Forecasted Flight Operation

Forecasted flight operation based on the arithmetic method assume a constant annual increase in flight numbers, resulting in a linear growth trend[9]. The initial step involves determining the value of r', which represents the annual increase in flight operation. This can be calculated using the formula r'= number of movements in year n - number of movements in year n-1. Based on the available data, the number of flights in 2021 (n−1) was 6.693, while in 2020 it was 5.505. Therefore, the value of r' is 6.693 – 5.505 = 1.188 movements.

Table 5. Arithmetic Method Calculation

Year	Flight Operation	r'
2020	5.505	-
2021	6.693	1.188
2022	6.902	209
2023	7.113	211
2024	8.827	1.714
	Total	**3.322**

The annual growth rate of flight operations (r) is determined by analyzing the number of years covered in the dataset, starting from the initial year to the final year of observation. So, n-1 = 5-1 = 4.

$$r = \frac{\Sigma r'}{n} \tag{8}$$

Description :

r = Annual growth rate of flight operations

n = Number of years included in the study (n-1 represents the time interval)

Calculation :

$r = \frac{\Sigma r'}{n} = \frac{3.322}{4} = 830{,}5$

The arithmetic method is used to calculate the projected number of flights in year *n* (p_n). The year 2024 is designated as the base year (n = 0). Therefore, when projecting for the year 2025, n is assigned a value of 1, as it represents one year after the base year.

$$p_n = p_o + n.r \quad (9)$$

Description :
Pn = Projected number of flights in year *n*
Po = Number of flights in the base year (year 0)
r = Annual growth rate of flight operations
n = Number of years since the base year (*n* = 1 for one year after the base year)
Calculation :
p_{2025} = 8.827 + (1×830,5)
p_{2025} = 9.657,5

Table 6. Result of Arithmetic Calculation

Year	*n*	*P2024*	*n x r*	*Pn*
2025	1	8827	830,5	9.657,5
2026	2	8827	1.661,0	10.488,0
2027	3	8827	2.491,5	11.318,5
2028	4	8827	3.322,0	12.149,0
2029	5	8827	4.152,5	12.979,5
2030	6	8827	4.983,0	13.810,0
2031	7	8827	5.813,5	14.640,5
2032	8	8827	6.644,0	15.471,0
2033	9	8827	7.474,5	16.301,5
2034	10	8827	8.305,0	17.132,0
2035	11	8827	9.135,5	17.962,5
2036	12	8827	9.966,0	18.793,0
2037	13	8827	10.796,5	19.623,5
2038	14	8827	11.627,0	20.454,0
2039	15	8827	12.457,5	21.284,5
2040	16	8827	13.288,0	22.115,0
2041	17	8827	14.118,5	22.945,5
2042	18	8827	14.949,0	23.776,0
2043	19	8827	15.779,5	24.606,5
2044	20	8827	16.610,0	25.437,0
2045	**21**	**8827**	**17.440,5**	**26.267,5**

The number of flights at Aji Pangeran Tumenggung Pranoto Airport in Samarinda is projected to reach approximately 26.267,5 flights by the planning year of 2045, which is rounded to 26.268 flights.

4.4 Forecasting of Peak Hour Flights in the Planning Year

To estimate the projected number of flight operation during peak hour in the planning year, the ratio (R) is applied to the forecasted average daily flight volume in the peak operational month of that year[11].

$$N_{peak} = N_{year} \times R_{month} \times R_{day} \times R_{hour} \quad (10)$$

Description :
Npeak = Number of flight operation during peak hour
Nyear = Total projected flight operation in the planning year
Rmonth= Peak month ratio
Rday = Peak day ratio
Rhour = Peak hour ratio
Calculation :
$N_{peak} = 9657{,}50 \times 0{,}1275 \times 0{,}0391 \times 0{,}1818 = 9$

Table 7. Arrival Flight Operations During Peak Hours in the Planned Year

Year	Nyear	Rmonth	Rday	Rhour	Npeak
2025	9.657,5	0,1275	0,0391	0,1818	9
2026	10.488,0	0,1275	0,0391	0,1818	10
2027	11.318,5	0,1275	0,0391	0,1818	10
2028	12.149,0	0,1275	0,0391	0,1818	11
2029	12.979,5	0,1275	0,0391	0,1818	12
2030	13.810,0	0,1275	0,0391	0,1818	13
2031	14.640,5	0,1275	0,0391	0,1818	13
2032	15.471,0	0,1275	0,0391	0,1818	14
2033	16.301,5	0,1275	0,0391	0,1818	15
2034	17.132,0	0,1275	0,0391	0,1818	16
2035	17.962,5	0,1275	0,0391	0,1818	16
2036	18.793,0	0,1275	0,0391	0,1818	17
2037	19.623,5	0,1275	0,0391	0,1818	18
2038	20.454,0	0,1275	0,0391	0,1818	19
2039	21.284,5	0,1275	0,0391	0,1818	19
2040	22.115,0	0,1275	0,0391	0,1818	20
2041	22.945,5	0,1275	0,0391	0,1818	21
2042	23.776,0	0,1275	0,0391	0,1818	22
2043	24.606,5	0,1275	0,0391	0,1818	22
2044	25.437,0	0,1275	0,0391	0,1818	23
2045	**26.267,5**	**0,1275**	**0,0391**	**0,1818**	**24**

It is observed that the number of arriving flights during peak hours shows a consistent increase throughout the period from 2025 to 2045. The year 2032 marks the first instance when peak hour flight movements exceed the current apron capacity.

Table 8. Departure Flight Operations During Peak Hours in the Planned Year

Year	Nyear	Rmonth	Rday	Rhour	Npeak
2025	9.657,5	0,1290	0,0421	0,1667	9
2026	10.488,0	0,1290	0,0421	0,1667	9
2027	11.318,5	0,1290	0,0421	0,1667	10
2028	12.149,0	0,1290	0,0421	0,1667	11
2029	12.979,5	0,1290	0,0421	0,1667	12
2030	13.810,0	0,1290	0,0421	0,1667	13
2031	14.640,5	0,1290	0,0421	0,1667	13
2032	15.471,0	0,1290	0,0421	0,1667	14
2033	16.301,5	0,1290	0,0421	0,1667	15
2034	17.132,0	0,1290	0,0421	0,1667	16
2035	17.962,5	0,1290	0,0421	0,1667	16
2036	18.793,0	0,1290	0,0421	0,1667	17
2037	19.623,5	0,1290	0,0421	0,1667	18
2038	20.454,0	0,1290	0,0421	0,1667	19
2039	21.284,5	0,1290	0,0421	0,1667	19
2040	22.115,0	0,1290	0,0421	0,1667	20
2041	22.945,5	0,1290	0,0421	0,1667	21
2042	23.776,0	0,1290	0,0421	0,1667	22
2043	24.606,5	0,1290	0,0421	0,1667	22
2044	25.437,0	0,1290	0,0421	0,1667	23
2045	**26.267,5**	**0,1290**	**0,0421**	**0,1667**	**24**

The number of departing flights during peak hours shows a steady increase throughout the period from 2025 to 2045. Beginning in 2032 and continuing through the planning year of 2045, the volume of peak hour departures is projected to exceed the current apron capacity. The existing apron is estimated to accommodate flight operation only until 2031.

Based on observational data, the apron at Aji Pangeran Tumenggung Pranoto Airport currently has a total capacity of 13 (thirteen) aircraft parking stands. These include parking stands 1, 2, 3, 4, 5, 1A, 1B, 2A, 3A, 4A, 5A, as well as stands 6 and 7[1].

Table 9. Comparison of Apron Capacity and Flight Operations During Peak Hours

Year	Apron Capacity	Flights During Peak Hours	
		Arrival	Departure
2024	13	4	4
2032	13	14	14
2045	13	24	24

Based on forecasting, the apron capacity at Aji Pangeran Tumenggung Pranoto Airport in Samarinda will no longer be adequate to accommodate the forecasted volume of flight operations by the planning year of 2045.

4.5 Calculation of Required Aircraft Parking Stands

The method applied refers to the formula outlined in *Document 9184-AN/902, Airport Planning Manual Part I: Master Planning, Chapter 7.3.6*. In this calculation, several assumptions are made, including the use of aircraft classified under category Type C and a Gate Occupancy Time (GOT) set at 45 minutes[12].

$$S = \sum\left(\frac{Ti}{60} \times Ni\right) + \alpha \quad (11)$$

Description :
S = Required number of aircraft parking stands
Ti = Gate occupancy time in minutes for aircraft type *i*
Ni = Number of peak hour flight operation for type *i* (Movements – Capacity)
α = Additional buffer stand(s) for operational flexibility
The value of α is determined as follows:
α = 1 for N = 1–9
α = 2 for N = 10–18
α = 3 for N = 19–27
Calculation :

1) Year 2032
$$S = \sum\left(\frac{45}{60} \times (14 - 13)\right) + 1$$
S = 1,75 = 2 Parking stand

2) Year 2045
$$S = \sum\left(\frac{45}{60} \times (24 - 13)\right) + 2$$
S = 10, 25 = 10 Parking stand

The year 2032 represents the point at which the forecasted increase in peak hour arrival and departure flights begins to exceed the current apron capacity. The year 2045 is designated as the planning horizon.

Table 10. Parking Stand Number Comparison

Year	Apron Capacity	Peak Hours		Additional Parking Stands
		Arrival	Departure	
2024	13	4	4	-
2032	13	14	14	**2**
2045	13	24	24	**10**

The current apron capacity, when projected over the next 20 years, does not meet the technical requirements for airport service operations. It is insufficient to accommodate the projected volume of flight operation as stipulated in SKEP 77/VI/2005, and fails to comply with the standards for airport service provision as outlined in Ministerial Regulation No. 41 of 2023. Furthermore, it does not fulfill the Technical and Operational Standards of Civil Aviation Safety Regulations as stated in PR No. 21 of 2023.

4.6 Arithmetic Method

The table below presents the percentage increase in flight operations, along with a graph illustrating the growth trend based on the arithmetic method, which follows a linear pattern[9].

$$\text{Growth (\%)} = \frac{P_t - P_0}{P_0} \times 100\ \% \qquad (12)$$

Description :
P_t = Projected number of flights in year t
P_0 = Number of flights in the base year (initial year)
Calculation :

$$\text{Growth (\%)} = \frac{11.318{,}5 - 10.488{,}0}{10.488{,}0} \times 100\ \%$$
$$= 0{,}0792$$
$$= 7{,}92\ \%$$

Table 11. Arithmetic Method Percentage Growth

Year	Number of Flight	Growth (%)
2025	9.657,5	0 %
2026	10.488,0	7,92%
2027	11.318,5	7,34%
2028	12.149,0	6,84%
2029	12.979,5	6,40%
2030	13.810,0	6,01%
2031	14.640,5	5,67%
2032	15.471,0	5,37%
2033	16.301,5	5,09%
2034	17.132,0	4,85%
2035	17.962,5	4,62%
2036	18.793,0	4,42%
2037	19.623,5	4,23%
2038	20.454,0	4,06%
2039	21.284,5	3,90%
2040	22.115,0	3,76%
2041	22.945,5	3,62%
2042	23.776,0	3,49%
2043	24.606,5	3,38%
2044	25.437,0	3,26%
2045	26.267,5	3,16%

According to Montgomery, Jennings, and Kulahci, the coefficient of determination is a measure that reflects the proportion of total variability in the data that is successfully explained by the forecasting model. In the arithmetic method, which assumes a constant or fixed increase in each period, this coefficient helps evaluate how well the linear trend fits the observed data[13].

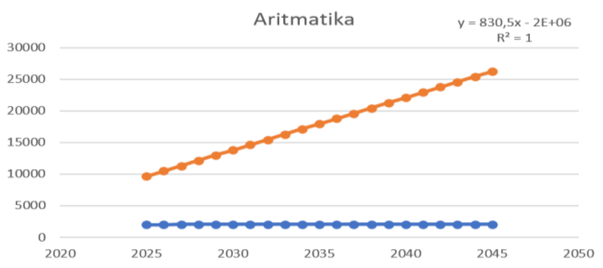

Figure 2. Flight Forecasting Chart Using the Arithmetic Method

The forecasting results indicate that the arithmetic method provides a significant and reliable projection of flight numbers, as demonstrated by the high and positive coefficient of determination (R^2) value, which is closest to 1. The coefficient of determination (R^2) ranges from 0 to 1. A value of R^2 close to 1 indicates that the forecasting model has a strong ability to explain the variations or changes observed in the historical data. Conversely, an R^2 value approaching 0 suggests that the model fails to capture the actual data pattern, making it unsuitable or less appropriate for forecasting purposes[13].

5. CONSCLUSION

In the year 2045, Aji Pangeran Tumenggung Pranoto Airport in Samarinda is projected to require an apron expansion. According to the calculation formula provided in *Document 9184 AN 902 Airport Planning Manual Part I Master Planning Chapter 7.3.6*, the total number of required parking stands in the planning year is 23. This represents an increase of 10 stands from the currently available 13. Forecasting results using the arithmetic method for the period between 2025 and 2045 show a steady annual increase in flight operations. By 2045, the projected total number of flights is 26.267,5, which is rounded up to 26.268. In that same year, the number of peak hour flight operation for arrivals and departures combined is expected to reach 24. These results indicate a significant rise in peak hour traffic during the planning year of 2045.

REFERENCES

[1] Kementerian Perhubungan, "AIP Indonesia (VOL II) WIII AD 2 . 1 Aerodrome Location Indicator And Name WIII – Jakarta / Soekarno Hatta Intl Directorate General of Civil Aviation AIP INDONESIA (VOL II) Directorate General of Civil Aviation," vol. II, no. Vol Ii, 2023.

[2] K. P. Dirjen Perhubungan Udara, "Peraturan Direktur Jenderal Perhubungan Udara Nomor SKEP/77/VI/2005 tentang Persyaratan Teknis Pengoperasian Fasilitas Teknik Bandar Udara," *Kementeri. Perhub.*, pp. 1–140, 2005.

[3] 2023 PM 41 Tahun, Menteri Perhubungan Republik Indonesia," *PM 41 Tahun*, pp. 1–97, 2023.

[4] Kementerian Perhubungan, "PM PerHub RI No.39 tahun 2019," *Peratur. Menteri Perhub. Republik Indones. Nomor PM 39 Tahun 2019*, pp. 1–45, 2019, [Online]. Available: http://hubdat.dephub.go.id/km/tahun 2018/2669-peraturan-menteri-perhubungan-republik indonesia-nomor-pm-115-tahun-2018-tentang pengaturan-lalu-lintas-operasional-mobil-barang-selama-masa-angkutan-natal-tahun-2018-dan-tahun-baru-2019/download

[5] ICAO, *Annex 14 to the Convention on International Civil Aviation - Aerodrome Design and Operations*, vol. 9, no. July. 2022.

[6] *ICAO Annex 14, 6th Edition, July 2013*, vol. I, no. July. 2013.

[7] Direktorat Jenderal Perhubungan Udara, "PR 21 Tahun 2023," *Standar Tek. Dan Oper. Peratur. Keselam. Penerbangan Sipil Bagian 139 (Manual Stand. CASR Part 139) Aerodr. Daratan*, vol. Vol. 1, pp. 1–451, 2023.

[8] W. J. Stevenson and S. C. Chuong, *Operations Management : An Asian Perspective*. Singapore: McGraw-Hill, 2018.

[9] M. Rizky, "Penerapan Metode Time Series Terhadap Analisis Kebutuhan Air Bersih Kota Sukabumi," *J. Student Tek. Sipil*, vol. 3, no. 1, pp. 293–301, 2021, doi: 10.37150/jsts.v3i1.1463.

[10] JICA, "Master plan for Greater Dhaka protection project (study in Dhaka metropolitan area) of Bangladesh Flood Action Plan No. 8A," *Japan International Cooperation Agency*. 1991. [Online]. Available: https://openjicareport.jica.go.jp/617/617/617_101_10987097.html

[11] L. J. Pignataro *et al.*, "Traffic engineering: theory and practice," 1973.

[12] International Civil Aviation Organization, "Airport Planning Manual Part 1 - Master Planning Second Edition," 1987.

[13] D. C. Montgomery, C. L. Jennings, and M. Kulahci, *Introduction to time series analysis and forecasting*. John Wiley & Sons, 2015.