

The Level of Apron Utility at Sultan Hasanuddin International Airport Maros

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Abstract: Demand for flight numbers is an important factor in planning the capacity and facility requirements at the airport. This study aims to forecast the number of airplane movements over the next 5 years using the ARIMA method, determine the utilization level of the apron with Analytical Models for Gate Capacity, and estimate the amount of parking stand (gate) needed using the formula number of airplane gates. The results showed that the best model for forecasting the number of departure and arrival flights was ARIMA (0,1,1). The apron utility rate is 35% with the use of 40 parking stands during rush hour. The need for stand parking for the next 5 years is 55 gates. It was concluded that forecasting the number of airplane movements increased every year. The maximum capacity of 75% is 31%.

Keywords: Flight Demand, Forecasting Models, Apron, Effectiveness

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I. Introduction

Air transportation has become one of the important modes of transportation for medium and long distance travel. Airlines that implement a Low Cost Carrier (LCC) system are the main characteristics of affordable ticket prices. Some airports in Indonesia have experienced a growth in the number of passengers that significantly affects the amount of traffic and capacity including the Apron Sultan Hasanuddin International Airport Makassar. Apron utility level is a measure of the effectiveness of apron utilization, an increase in apron capacity can increase the amount of traffic served so that it has implications for both aeronautical and land-based (non-aeronautical) revenue.

Apron is a certain area on the Aerodrome mainland which is intended to accommodate airplane for loading and unloading cargo and entering/leaving passengers, refueling, parking or airplane maintenance [6,7]. According to Horonjeff (2010: 538) apron capacity is the number of airplane that can be parked during certain time intervals when there is a continuous demand from the airplane to park [9]. Traffic demand is an important factor in planning capacity and facility needs [10] at the airport. Forecasting traffic demand becomes a necessity in determining the size or dimensions of airport facilities [8] in a plan including environmental, economic [4] and social issues, (Bayu Purbo Wartoyo, M. Yamin Jinca, Jamaluddin Rahim, 2017)[4].

Airport development is needed because normal capabilities have exceeded capacity[1,16]. The air side facility capacity of an airport has an effect on flight safety. The delay in air traffic will occur if the needs exceed the capacity available. This case results in financial losses for flight operators, passenger inconvenience, including financial, non-financial losses and increased workload for related officers.

This research was conducted at PT. (Persero) Angkasa Pura I Sultan Hasanuddin International Airport Makassar. Primary and secondary data is obtained by conducting direct interviews, literature and documents to support analysis and discussion. Forecasting the amount of flight traffic use the ARIMA method and calculating the level of utilization of the apron using primary data with Analytical Models for Gate Capacity.

II. Result And Discussion

Forecasting Departure and Arrival Domestic

Data on aircraft movements at Sultan Hasanuddin International Airport Makassar from January 2014 to December 2018 are needed as a basis for obtaining time series forecasting calculations for the growth of airplane movements 36 (thirty six) months ahead. Analysis of forecasting time series of aircraft movement [3] data use the ARIMA method through the application Minitab 19 to obtain the best ARIMA model. Domestic number of departures gets the following results.

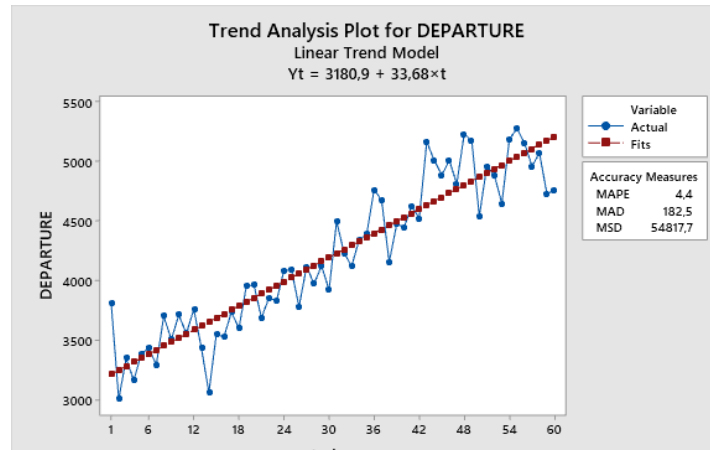


Figure 1. Trend analysis plot for the number of departures of Sultan Hasanuddin International Airport Makassar

Figure 1 above shows a graph of the number of departure flights has increased or an uptrend so that this data is said to be not stationary so that the data must be differentiated. After differentiation the graph has a cut off in lag 1 and based on the results of the ACF and PACF plot analysis, the possible models are: ARIMA (1,1,0); (1,1,1) and (0,1,1).

The best model of the number of departure flights and arrivals is ARIMA (0,1,1), Test for Significance of parameters, Residual normality test, Independence Test and MSE Value are the best. The forecast results from the *Minitab* application 19 with 60 supported data are as follows.

Table 1. Results of forecasting the number of departure flights and Arrival

Year	Month	Index (The Month)	Number of flights	
			Departure	Arrival
			Arima (0,1,1)	Arima (0,1,1)
2020	January	73	5457	5460
	February	74	5487	5490
	March	75	5517	5520
	April	76	5547	5550
	May	77	5577	5581
	June	78	5607	5611
	July	79	5637	5641
	August	80	5668	5671
	September	81	5698	5701
	October	82	5728	5731
	November	83	5758	5761
	December	84	5788	5791
2021	January	85	5818	5821
	February	86	5848	5852
	March	87	5878	5882
	April	88	5908	5912
	May	89	5938	5942
	June	90	5968	5972
	July	91	5998	6002
	August	92	6028	6032
	September	93	6058	6062
	October	94	6088	6092
	November	95	6118	6122
	December	96	6148	6153
2023	January	109	6539	6544
	February	110	6569	6574
	March	111	6599	6604
	April	112	6629	6634
	May	113	6659	6664
	June	114	6689	6695
	July	115	6719	6725
	August	116	6749	6755
	September	117	6780	6785
	October	118	6810	6815
	November	119	6840	6845
	December	120	6870	6875

Source: The Calculation Result, 2019

Apron Utility Level

Based on the results of data processing on the air side facilities carried out by calculating the Notification of Apron Capacity and Notification of Runway Capacity[15]. Notification of Apron Capacity is an apron capacity that must be published by all flights that will land at an airport. Calculation of apron capacity is carried out by taking into account the following matters.

- a) Apron capacity is the number of parking stands equipped with infrastructure and markers and declared at the Aerodrome Manual/Aeronautical Information Publication (AIP)
- b) Considerations for placing airplanes at the apron, namely availability of parking stands
- c) Where: Availability = Number of Parking Stands - Utilization of Parking Stands
- b) The data in the Notification of Apron Capacity must be kept up to date so that it must be updated every time there are additions or reductions in flights.
- c) The Notification of Apron Capacity is one of the basic settings in slot time. From the results of processing data on the capacity of the apron there will be a number of things, namely:
 - i. C = CLOSE TO FULL, the remaining 2 stands (allow for 1 additional flight)
 - ii. X = FULL, the remaining 1 stand (as a reserve parking stand in the event of a delay)
 - iii. NIL = NONE OF ABOVE: stand is still available[13,15]

Table 2. Accumulation and Increase Percentage of Airplane Movement 2014 to 2018

Year	2014	2015	2016	2017	2018
Arrival	41673	44274	50319	56958	59281
Departure	41673	44275	50314	56957	59286
Total	83346	88549	100633	113915	118567
% increase		5,88%	12,01%	11,66%	3,92%

Source: Calculation results, 2019

In Table 2 explains the accumulation of aircraft movement data per year from 2014 to 2015 departures and arrivals both domestically and internationally. The average aircraft growth index from 2014 to 2018 is 6.69%.

Sultan Hasanuddin International Airport Makassar serves many types of aircraft to serve flights has 44 parking stand facilities and airport operating hours are 24 hours. The increase in the number of scheduled commercial flights, the need for special handling of several types of flights such as VVIP flights, ineffective flight schedules, and too long ground handling times have caused increased flight activity. As a result, it often happens that the plane has to queue to enter the solid current stand parking area which can have an impact on the queue that occurs at taxiways.

The apron capacity of the Sultan Hasanuddin International Airport Makassar normally accommodates 44 airplanes per hour[5]. The many types of flights served at this airport make airside activities, especially the apron, becoming denser. As a result, at certain hours the apron's capacity is considered insufficient to serve flight activities. Based on appendix 3-5, the Apron Capacity Notice of Airport Capacity (NAC) from PT. Persero Angkasa Pura I, Sultan Hasanuddin International Airport, Makassar, in July 2018, it is known that the highest number of aircraft movements is at the parking stand every day at each hour.

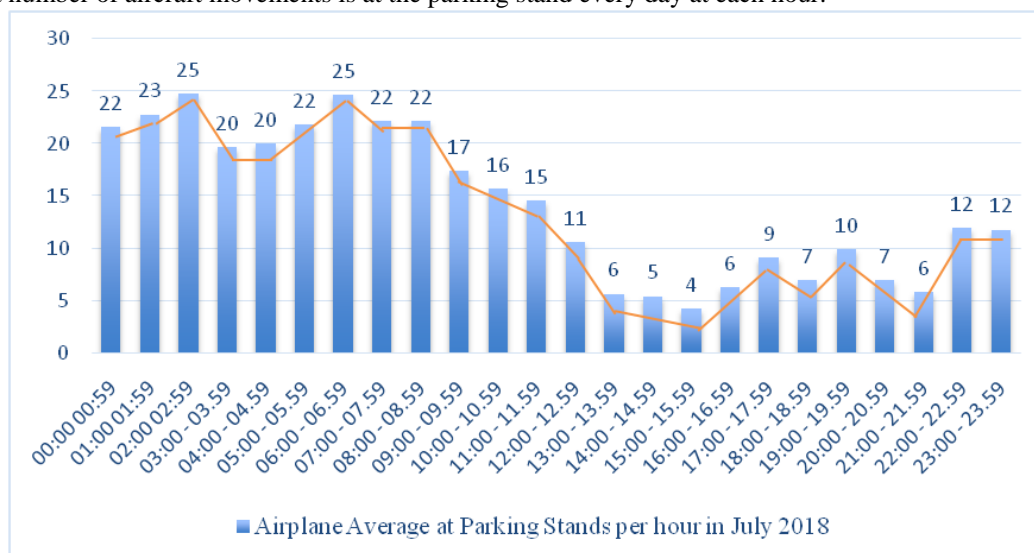


Figure 4. Average Airplane in Parking Stands per hour in July 2018

Note: 24 Hours of Operation Time with Parking Stands as many as 44 airplane

Based on Figure 4, it is known that the total number of aircraft using the parking stand at the apron during July 2018 is 10558 airplane, on average per day as many as 341 aircraft, the average used parking stand capacity per hour is 15 aircraft with a utilization rate of 34% if the parking stand is used thoroughly and evenly. The existing condition of the average number of parking booth capacity used during rush hour between 00.00 and 08.59 WITA is 23 airplanes per hour and the utilization rate is 52.27%. The average number of lowest used parking stand capacity between 12.00 and 21.59 WITA is 7 hourly flights with a utilization rate of 15.91%.

Table 3. The Effectiveness of the Number of Airplane in Peak Hours and the Lowest Hours

Day/Date	Peak and lowest hours	Number of Airplane	Level of Effectiveness
Monday 16/07/2018	06:00 06:59	30 Airplanes	68,18%
Wednesday 18/07/2018	02:00 02:59	30 Airplanes	68,18%
Monday, 29/07/2018	06:00 06:59	30 Airplanes	68,18%
Monday, 3/07/2019	14:00 14:59	1 Airplane	2,27%
Monday, 13/07/2019	15:00 15:59	1 Airplane	2,27%
Monday, 19/07/2021	15:00 15:59	1 Airplane	2,27%

Source: Calculation Results, 2019

Based on the data in Table 3, the highest level of parking stand utilization was 68.18% and the lowest was 1 plane with a utilization rate of 2.27%. To find out the use of apron capacity according to Horonjeff (2010: 539) using the formula;

- μk = gate utilization per hour (60 minutes)
- Nk = Number of gate (parking stand)
- $E(Tg)$ = The expected time for the airplane to use the gate
- Cg = The capacity of the gate is used by airplane per hour

Known:

- μk = 34,1%
- Nk = 44 Airplanes
- $E(Tg)$ = 1,83 hour wide body (10%)
= 1 hour narrow body (90%)

$$\text{Response} = \mu k Nk \geq E(Tg) Cg [9]$$

$$Cg \geq \frac{((1,83) (0,10) + (1) (0,9)) \cdot 341}{24 \text{ hours} \times 44}$$

$$Cg \geq 34,97\% \text{ (rounded off 35\%)}$$

The parking apron capacity of PT. Persero Angkasa Pura I Sultan Hasanuddin International Airport Makassar in July 2018 its use is 15 airplane per hour. If the gate utilization per hour is equal to 35%, it means that the maximum capacity of the apron capacity is that at that condition the apron can accommodate a maximum of 15 airplanes per hour. Although the number of available parking stands is 44 but currently the maximum capacity of the apron is 33 aircraft (75%).

Based on the calculation of the apron capacity that the author did, the capacity of the Sultan Hasanuddin International Airport Makassar apron parking stand was filled with 40.1 airplane per hour or 40 airplane per hour where with this number the parking stand apron was classified as almost full because the parking stand B9, B10, B11 and B12L is provided for wide body aircraft or international flights. This amount is already quite busy because it has to adjust the total number of parking stands with the average airplane parking and the limitations of operating procedures at the airport. Therefore, the use of 15 parking apron utilization stands of Sultan Hasanuddin International Airport Makassar 35%.

The 44 Apron aircraft capacities 24 hours operational serve 35 airplane regular flights (80%) and irregular 9 airplanes (20%)[5]. Factual Conditions the capacity of 41 airplane Apron 24 hours operational serves regular flights 33 airplane (80%) and irregular 8 airplanes (20%). To achieve a maximum effectiveness, the following effectiveness formula can be used.

- a) If the actual output is compared to the desired output is less than 1, effectiveness is not achieved
- b) If the actual output is compared to the desired output is more than 1 or equal to 1, effectiveness will be achieved

Based on the results of the analysis it is said that the utilization rate of the apron capacity has not been effective based on the formula of effectiveness are actual Target is divided by Output is less than equal to 1. The results obtained are less than or equal to 1.

Gate requirements condition for the next 5 (five) years

- n = total gate
- V = Arrival or departure volume during peak hours (flight/hour)

T = Average gate occupancy time

U = Utilization factor (0,5 – 0,8)

$$n = \frac{v \cdot t}{u} [2]$$
$$= \frac{((1.83 \cdot 10\%) + (1.90\%)) \times 30}{0,6}$$
$$= 55$$

Based on the results of calculations for the next five years it requires 55 booths. Based on the results of observations during airplane interviews using the parking stand based on the Standard Operating Procedure for narrow body airplane using *garbarata*, it took 60 minutes at the parking stand while the wide body airplane spent time for time before and after using gate 110 minutes. Total parking apron capacity for 44 (forty four) airplane but there are 3 (three) parking stands that cannot be used yet. The use of stand parking percentage of 90% narrow body [11] and 10% wide body [11]. In the next five years based on the calculation of forecasting it is necessary to optimize 7 parking stands in the old apron and add 11 parking stands.

III. Conclusion And Recommendation

The best model for forecasting the number of departure flights and arrival is ARIMA (0,1,1). The number of domestic flights going forward (2019-2023) in general has increased by 6.69%. The highest total domestic and international flights are predicted in December 2023.

The number of Apron capacity is 44 aircraft per hour with a utilization rate of 35%. The use of the busiest apron hours between 00.00 and 08.59 WITA is 23 airplane per hour, utilization rate is 52.27% and the lowest between 12.00 and 21.59 WITA is 7 airplane per hour with a utilization rate of 15.91%. Parking stands are available for 41 airplane, 3 parking stands in a condition not ready for use, including 4 other parking stands provided for international flight or wide body aircraft so that the availability of airplane parking is considered to be close to full capacity or Close to Full. In the next five years, there are 55 gates.

Development of Sultan Hasanuddin international airport Makassar include the development of taxiways for parallel taxiway and rapid exit taxiway [7,12,13] is needed more quickly in the short term to increase runway capacity 03-21 compared to making a third runway, so that the existing condition of the apron can be declared 44. Old Apron (7 parking stands) is optimized. Forecasting time series the number of airplane movements need to be developed and taking into account economic related factors the level of Gross Regional Regional Income (GDP) and the level of elasticity of airline ticket prices.

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