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ANALYSIS OF RUNWAY AND TERMINAL CAPACITY OF THE POTENTIAL INCREASE OF THE NUMBER OF PASSENGERS AT SANGGU AIRPORT (SOUTH BARITO)

Rahman Aulia Jauhari, Muhammad Ihsan Djajadi Wangsa,
Murniati, and Desriantomy
Civil Engineering Study Program, Faculty of Engineering, University of Palangka Raya
E-mail: Rahmanaj04@gmail.com

ABSTRACT

An airport is a place for aircraft to operate both take-off and landing. Buntok City, South Barito Regency has Sanggu Airport as one of the main entrances for people's transportation routes. Sanggu Buntok Airport is a class III airport managed by UPBU. The airport currently has a runway length of 750 m x 23 m and a terminal building covering an area of 200 m^2.

In this study, an analysis of the runway service capacity was carried out to increase the number of passengers in the future, to meet the number of aircraft operations that can be served by the runway, and it is hoped that the results of this research can be used as evaluation material for the development of Sanggu Airport in the future. And for terminal capacity This study analysis the ground side of the airport, namely the service capacity of the passenger terminal towards the increase of passenger traffic in the future, to find out the number of passengers that can be handled by the terminal. Calculation of the passenger terminal capacity and the required terminal size is based on the SKEP/77/VI/2005. The calculation of maximum capacity is conducted by counting the number of available seats and the current size of the passenger waiting area continued with the calculation of the required terminal waiting area size after forecasting.

From the results, it was found that the average saturation capacity of the runway for VFR conditions was 86 operations/hour and for IFR conditions the average saturation capacity was 58 operations/hour. After forecasting, the number of passengers in 2032 was 430 people with the number of flights being 215 flights and the number of passengers in 2037 being 714 people with the number of flights being 357 flights. Through the result of this analysis, it is known that the maximum waiting area capacity of the Sanggu Airport is 32 passengers, with a room size of 30,94 m^2. Meanwhile, the maximum capacity of the arrival hall is 16 passengers, with an area size of 32,64 m^2. After forecasting is conducted, the predicted traffic of passengers in 2032 is 860 passengers, and 1428 passengers in 2037. The numbers are based on the peak hour traffic of passengers in 2032, namely, 9 passengers/hour, which required a waiting area size of 14,52 m^2 and the number of seats required is 9 seats. For the year 2037, the peak hour passenger traffic is forecasted to be 14 passengers/hour, therefore requiring a waiting area size of 22,59 m^2 and the number of seats required is 14 seats. Based on the calculation, the standard required size for the arrival hall with a peak hour traffic of 9 passengers/hour in 2032, the required size of arriving hall is 18,56 m^2. As for the year 2037 with the peak hour traffic of 14 passengers/hour, the required size of the arrival hall needed is 28,88 m^2. When compared to the current size of the arrival hall of 32,64 m^2 it can be concluded that the current arrival hall is sufficient to serve the airport until the year 2037.

Keywords: airport, runway capacity, terminal capacity, forecasting

1. INTRODUCTION

An airport is a place for aircraft to operate both take-off and landing. Buntok City, South Barito Regency has Sanggu Airport as one of the main entrances for people's transportation routes. Sanggu Buntok Airport is a class III airport managed by UPBU. The airport currently has a runway length of 750 m x 23 m and a terminal building covering an area of 200 m^2.

As time goes by, the population in Buntok City is growing and the economic development of the community will demand better transportation services with a high level of security, safety, speed, and smoothness. Air transportation is the right choice to fulfill these services. Therefore, as a supporting infrastructure for air transportation, it must continue to develop according to the needs of today's society.

2. LITERATURE REVIEW

According to Law No. 1 of 2009 concerning Aviation, an airport is an area on land or waters with certain boundaries that are used as a place for airplanes to land and take off, boarding passengers, loading and unloading goods, and places for inter-mode transportation, which are equipped with aviation safety and security facilities, as well as basic facilities and other supporting facilities.

A runway is a square area on the surface of an airport (aerodrome) that is prepared for the take-off and landing of aircraft, safely and efficiently under various conditions.

Runway capacity can be defined as the ability of the runway system to accommodate aircraft landings and takeoffs expressed in the number of aircraft movement operations per unit time (in operations per hour or per year).

Passenger terminal building facilities are buildings provided to serve all activities carried out by passengers from departure to arrival. This passenger terminal has the following sections.

3. METHODOLOGY

Runway capacity calculations are calculated using a method developed by the Federal Aviation Administration (FAA). In this study, the runway capacity calculation is calculated using the concept of saturation, meaning the number of aircraft operations that can be accommodated by the runway continuously by ignoring the delay that occurs.

In determining the saturation capacity of the runway, the following calculation steps are required:

1. Percentage of Arrivals
2. Number of Exits
3. Percentage of Irregular Aircraft
4. Basic Capacity (C_b)
5. Exit Factor (E), for IFR and VFR conditions
6. Uncertain Factor (T), based on Mix Index
7. Finding Saturated Capacity Using the Formula, $C = C_b . E . T$

Calculation of passenger terminal capacity and terminal area requirements based on SKEP/77/VI/2005. The parts that count are the departure lounge area and arrival hall.

The passenger terminal consists of several areas and each area has its own calculation method in accordance with SNI 03-7046-2004. The calculation of the maximum capacity is done by calculating the number of *seats* available and the area of the current passenger waiting room, followed by calculating the need for the area of the terminal waiting room after *forecasting*. From the calculation results, it can be seen whether after *forecasting* passengers, the area of the existing terminal waiting room is still sufficient or not.

4. RESULT AND DISCUSSION

4.1 Annual Passenger Data of Sanggu Airport

For forecasting, data on the number of annual passengers is required to be obtaine from the Directorate General of Civil Aviation. Annual passenger data can be seen in table 4.1 Passenger Data Year 2010 – 2019.

Table 4.1 Passenger Data Year 2010 – 2019.

No	Year	Passenger		
		Departure	Arrival	Σ
1.	2010	55	69	124
2.	2011	58	71	129
3.	2012	89	78	167
4.	2013	95	89	184
5.	2014	96	99	195
6.	2015	109	110	219
7.	2016	114	117	231
8.	2017	122	124	246
9.	2018	140	190	330
10.	2019	183	202	385

Sumber: Direktorat Jendral Perhubungan Udara

4.2 Forecasting the Number of Passengers at Sanggu Airport

Forecasting is usually used as a scientific basis for planning or making decisions. To estimate the number of passengers served by Sanggu Airport in the future, forecasting is carried out using three (three) different techniques and comparing the forecasting results so that a value that is close to reality is obtained. The data used are 2010-2019 data, because in the last 3 years 2020-2022 there was a pandemic, so activities at Sanggu airport were temporarily suspended. However, the analysis is still carried out with the hope that conditions will return to normal in 2023.

4.3 Passenger Number Forecast

By comparing the three previous forecasting methods, it can be determined which forecasting method will be used. Based on the calculation of the value of the correlation coefficient (r) each forecasting method has a good data relationship with close to 1 (one). But the method that will be used is the exponential trend, because the results of the exponential trend forecasting have the highest level of data correlation and the MAE value is in the middle.

Table 4.2 Results of Forecasting Number of Passengers

No	Year	Trend Linear	Trend Exponential	Trend Logaritmik
1.	2023	355	345	307
2.	2024	378	382	315
3.	2025	400	423	323
4.	2026	423	468	330
5.	2027	445	518	337
6.	2028	467	573	343
7.	2029	490	635	349
8.	2030	512	702	355
9.	2031	535	777	360
10.	2032	557	860	365
11.	2033	579	952	370
12.	2034	602	1,054	374
13.	2035	624	1,166	379
14.	2036	647	1,291	383
15.	2037	669	1,428	387
Correlation				
%		94.09	97.21	85.3726
Mean Average Error (MAE)				
MAE		21.480	24.022	35.811

Sumber: Analysis and Calculation

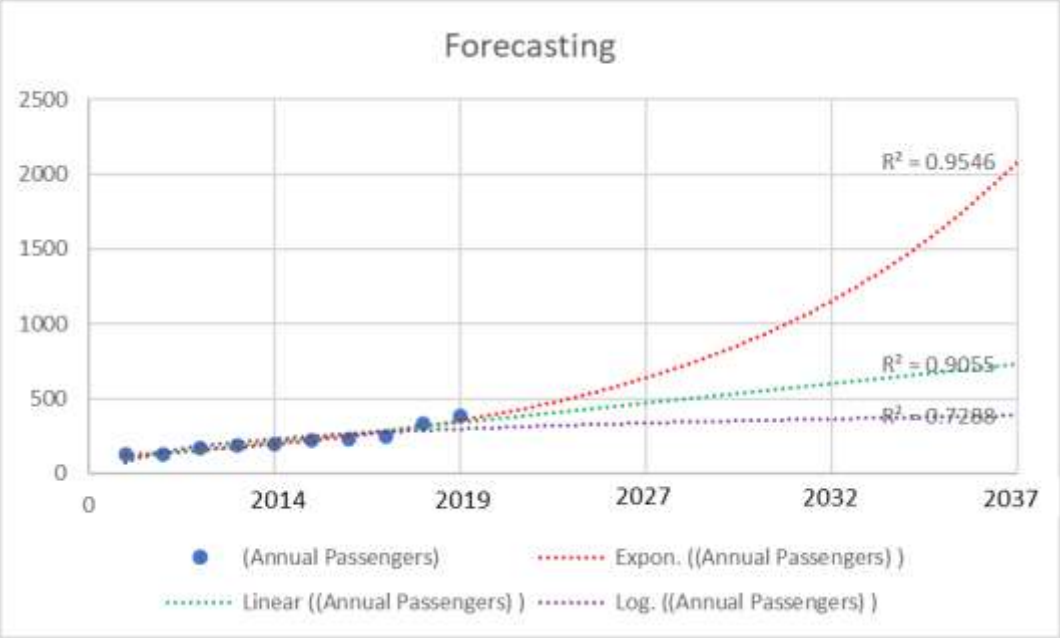

Figure 4.1 Comparison Graph of Each Trend

4.4 Sanggu Airport Runway Capacity Calculation

The Federal Aviation Administration (FAA) has developed a method of calculation for runway capacity. In the FAA Advisory Circular (AC)150/5060-5, there are calculation instructions for different aircraft compositions and different runway configurations.

4.5 Exit Factor

Sanggu Airport has one runway with directions 15-33. It has a length of 750 m and a width of 23 m, which is equipped with one taxiway. The distance of the exit taxiway from the end of the runway can be seen in the table.

Table 4.3 Distance of the exit taxiway from the end of the runway

Taxiway	*Distance of the exit taxiway from the end* (m)	
	15	33
A	240	550

4.6 Basic Runway Capacity

To obtain the basic capacity, the values of the mix index and percent arrival are plotted into a graph of VFR and IFR.

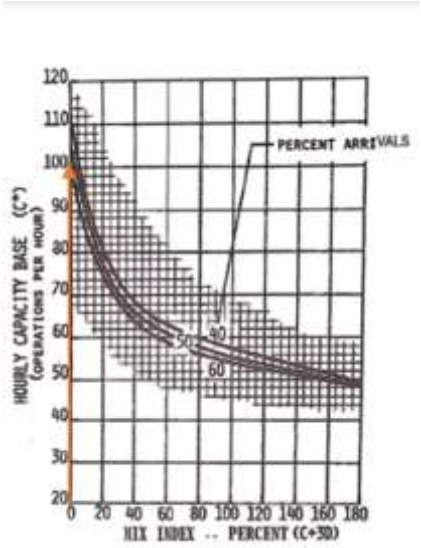

Figure 4.2 Plot of Basic Capacity Graph for VFR Conditions

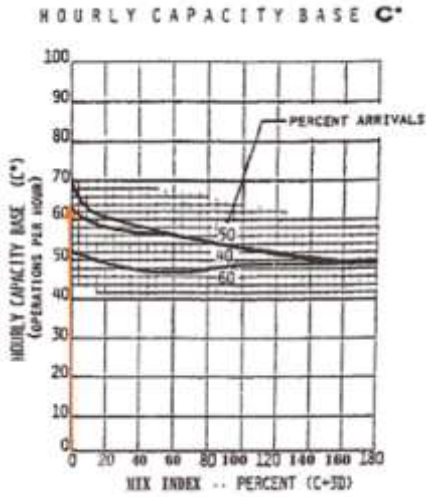

Figure 4.3 Plot of Basic Capacity Graph for IFR Conditions

From the plotting results in the graph, Figure 4.2. And Figure 4.3. The basic capacity (Cb) is 100 for VFR conditions and 61 for IFR conditions.

4.7 Runway Saturated Capacity

After getting the basic capacity data and exit factor, the next step is to calculate the saturated capacity with the formula: C = Cb . E . T.

Runway 15 with VFR condition, E = 0,86, T&G value = 0% and T&G factor = 1

$$C = 100 \times 0{,}86 \times 1$$

$$C = 86$$

Runway 15 with IFR condition, E = 0,95:

$$C = 61 \times 0{,}95 \times 1$$

$$C = 57{,}950 \approx 58$$

Runway 33 with VFR conditions, E = 0.86:

$$C = 100 \times 0{,}86 \times 1$$

$$C = 86$$

Runway 33 with IFR conditions, E = 0, 95:

$$C = 61 \times 0{,}95 \times 1$$

$$C = 57{,}950 \approx 58$$

If it is assumed that the runway usage rates in directions 15 and 33 are the same, then the average saturation capacity is:

VFR condition:

$$C = \frac{86 + 86}{2} = 86\ Operasi/jam$$

IFR condition:

$$C = \frac{58 + 58}{2} = 58\ Operasi/jam$$

Capacity obtained theoretically does not consider the delay that occurs, if there is a delay of more than 30 minutes then there may be a delay in the flight schedule which will affect the existing flight operations.

4.8 Estimated Number of Aircraft Movements

In estimating the number of flights required, it is necessary to know the Passenger Load Factor (PLF) because departing planes are not always fully loaded. To calculate the average PLF, data on the number of flights and data on the number of passengers are taken from 2015 to 2019. The calculation of the value of the Passenger Load Factor can be seen in Table 4.4.

Table 4.4 Calculation of Passenger Load Factor (PLF)

Year	Passenger (A)	Flight (B)	K_{total}	PLF
2015	219	120	2160	10.14%
2016	231	146	2628	8.79%
2017	246	158	2844	8.65%
2018	330	112	2016	16.37%
2019	385	130	2340	16.45%
$PLF_{Average}$				12.08%

From Table 4.4 PLF The average is 12.08% meaning that only 12.08% of seats are occupied by passengers from the average capacity of the aircraft, therefore it can be calculated the possibility of the number of passengers filling the seats for each aircraft are:

$$\text{Average Number of Passengers Transported} = K_r \times PLF_{rata-rata}$$

$$= 18 \times 12{,}08\%$$

$$= 2{,}174 \cong 2\ Penumpang$$

After obtaining the average number of passengers transported, it can be estimated the number of flight operations in 2032 and 2037 by dividing the number of passengers by the average aircraft capacity.

$$\text{Number of Flight Operations } 2032 = \frac{Number\ Passengers\ at\ 2032}{Average\ Passengers}$$

$$= \frac{430}{2}$$

$$= 215\ Flight$$

$$\text{Number of Flight Operations 2037} = \frac{Number\ Passengers\ at\ 2037}{Average\ Passengers}$$
$$= \frac{714}{2}$$
$$= 357\ Flight$$

From the calculation of the number of flights per year obtained, it is also estimated that the number of flights that occur per day in 2032 and 2037.

Flight operations in 2032

$$Number\ of\ Operations\ per\ day = \frac{215\ Flight}{96\ Day}$$
$$= 2{,}240$$
$$\cong 2\ Flight$$

Flight operations in 2037

$$Number\ of\ Operations\ per\ day = \frac{357\ Flight}{96\ Day}$$
$$= 3{,}719$$
$$\cong 4\ Flight$$

the above calculation, it can be seen that the movement of commercial passenger aircraft per hour until 2037 did not increase significantly take effect. It should also be noted that this calculation only does not take into account the possibility of unscheduled operations.

The recapitulation results of the calculation of runway capacity and the estimated number of flight operations at Sanggu Airport can be seen in Table 4.5 and Table 4.6.

Table 4.5 Runway Capacity Calculation Results

	Runway Derection	Exit Factor (E)	Mix Index	Percent Arrival	Basic Capacity	Saturation Capacity
VFR	15	0.86	0	50.00%	100 opr/hour	86 opr/hour
	33	0.86				
IFR	15	0.95			61 opr/hour	58 opr/hour
	33	0.95				

Sumber: Analysis and Calculation

Table 4.6 Flight Operation Calculation Results

Year	Estimated Number of Passengers	Estimated Number of Passengers for a day	Number of Flight	Operation/Day
2032	430	9	215	2
2037	714	14	357	4

Sumber: Analysis and Calculation

4.9 Depature Terminal

The departure terminal includes a passenger waiting room area, where the passenger waiting room must be able to accommodate airplane passengers who will depart during peak hours. The current condition of the passenger waiting room is as follows:

Number of seats = 20 *seats*

Number of *gates* = 1 *gate*

Room area = 30.94 m^2

Standard standing space= 2 m^2 /person

To find out the maximum capacity that can be accommodated by the passenger waiting room, the calculation is carried out as follows:

Area of the bench = (0.5 x 0.6) m x 20 = 6 m^2

Area to stand = 30.94 m ^{2} – 6 m ^{2} = 24.94 m ^{2}

Number of standing passengers = 24.94 m ^{2} / 2 m ^{2} = 12 people

Number of *seats* = 20 = 20 people

Maximum capacity = 12 + 20 = 32 people

4.10 Standard Waiting Room Area Requirements

After knowing the number of passengers departing at *peak times*, for the forecasting years 2032 and 2037, it can be calculated the need for a standard waiting room area so that passengers feel comfortable.

a. Waiting Room Area Needs in 2032

Number of passengers departing during *peak hour* = 9 people

$$A = C\left(\frac{u.i + v.k}{30}\right)m^2 + 10\%$$

$$A = 9\left(\frac{60 \times 0{,}6 + 20 \times 0{,}4}{30}\right)m^2 + 10\%$$

A =14.52 m ^{2}

The area of the waiting room needed in 2032 to comply with the KSEP/77/VI/2005 standard so that passengers still feel comfortable is 14.52 m ^{2}.

b. Waiting Room Area Needs in 2037

Number of passengers departing during *peak hour* = 14 people

$$A = C\left(\frac{u.i + v.k}{30}\right)m^2 + 10\%$$

$$A = 14\left(\frac{60 \times 0{,}6 + 20 \times 0{,}4}{30}\right)m^2 + 10\%$$

A =22.5 8 m ^{2}

The area of the waiting room needed in 2037 to comply with the KSEP/77/VI/2005 standard so that passengers still feel comfortable is 22.59 m^2.

From the calculation results, it can be seen that the existing waiting room is still sufficient and suitable for use until 2037. The area of the waiting room currently used is 30.94 m^2 and the required waiting room area until 2037 is 22.5 8 m^2.

Waiting Room Existing Capacity:

Area = 30.94 m^2

Number of seats = 20 *seats*

Estimated Standing Capacity = 12 people

Maximum Capacity = 32 people

Table 4.7 Waiting Room Area Requirements After Forecasting

Year	**Passengers Depart *Peek Hour***	**Number of *seats* Existing**	**Area of Operating Waiting Room (m^2)**	**Area Requirement After Forecasting (m^2)**
2032	9	20	30.94	14.52
2037	14			22.58

4.11 Arrival Terminal

The arrivals terminal includes an arrivals *hall*, where the arrival *hall* must be able to accommodate passengers as well as passenger pick-ups at busy times. The currently condition of the arrival hall is as follows:

Room area = 3 2.64 m^2

To find out the maximum capacity that can be accommodated by the *hall* arrival is calculated as follows:

Area to stand = 3 2.64 m^2

Number of standing passengers = 32.64 m^2 / 2 m^2 = 16 people

Maximum capacity = 16 people

4.12 Standard Arrival Hall Area Requirement

After knowing the number of passengers arriving at peak time, for the forecasting years 2032 and 2037, the hall needs can be calculated standard arrival so that passengers feel comfortable.

a. Hall Area Requirement Arrival Year 2032

Number of passengers arriving at peak hour = 9 people

$$A = 0{,}375\ (b + c + 2.c.f) + 10\%$$

$$A = 0{,}375\ (0 + 9 + 2.9.2) + 10\%$$

A =18.56 m^2

Hall area arrivals required in 2032 to conform to the KSEP/77/VI/2005 standard so that passengers still feel comfortable is 18.56 m^2.

b. Waiting Room Area Needs in 2037

Number of passengers arriving at peak hour = 14 people

$$A = 0{,}375\ (b + c + 2.c.f) + 10\%$$

$$A = 0{,}375\ (0 + 14 + 2.14.2) + 10\%$$

A =28.88 m^2

Hall area arrivals required in 2032 in order to conform to the standard KSEP/77/VI/2005 so that passengers still feel comfortable is 28.88 m^2.

From the calculation results, it can be seen that the current arrival hall is still sufficient and suitable for use until 2037. Hall area The current used arrival is 32.64 m^2 and hall The waiting arrival time required until 2037 is 28.88 m^2.

Existing Capacity *Hall* Arrival:

Area = 32.64 m^2

Maximum Capacity = 16 people

Table 4.8 Requirement of Arrival Hall Area After Forecasting

Year	Passengers Depart *Peek Hour*	Area of Operating Arrival Hall (m^2)	Area Requirement After Forecasting (m^2)
2032	9	32.64	18.56
2037	14		28,88

Source: Calculation Results

5. CONCLUSION AND RECOMMENDATION

5.1 CONCLUSION

Based on the results of the analysis and calculations that have been carried out, the following conclusions can be drawn:

1. Capacity on the existing runway of Sanggu Airport based on the Federal Aviation Administration method (FAA) for Visual Flight Rules (VFR) flight conditions when viewed from the direction of Runway 15 and direction 33 are the same, namely 86 operations/hour, for Instrument Flight Rules (IFR) flight conditions when viewed from directions 15 and 33 are the same, namely 58 operations/hour.
2. After forecasting for 2032 and 2037, the estimated number of passengers in 2032 is 430 passengers and in 2037 is 714 passengers, with an estimated number of flights in 2032 is 215 flights and flights per day are 2 operations/day, for 2034 the number of flights is 357 and the flights per day are 4 operations/day. The number of flights does not include unscheduled flights that may occur. This number of flight operations in 2032 and 2037 still does not exceed the runway capacity and it is still possible to add flight routes or increase the number of flight operations for existing routes.

3. The capacity of the Sanggu Airport terminal waiting room is 32 passengers, with a room area of 30.94 m ^{2}. While the maximum capacity of the arrival *hall* is 16 passengers, with a room area of 32.64 m ^{2}.

4. After doing forecasting for the forecast years 2032 and 2037, the estimated number of passengers in 2032 is 860 passengers, and in 2037 is 1428 passengers. Based on the calculation of the standard requirements for the waiting room area, it was found that with the peak number of passengers in 2032 being 9 passengers/hour, the need for the waiting room area is 14.52 m^2 and the number of seats needed is 9 seats. For the year 2037 with the number of passengers at peak hour 14 passengers/hour, then the need for the waiting room area is 22.59 m^2 and the number of seats needed is 14 seats. When compared with the current number of seats with 20 seats in the waiting room, it can be concluded that the current waiting room is still suitable for use until 2037, because the number of seats is still fulfilled. Based on the calculation of the standard requirements for the arrival hall area, it was found that with the peak number of passengers, in 2032 being 9 passengers/hour, the need for the arrival hall area is 18.56 m^2. For the year 2037 with the number of passengers at peak hour 14 passengers/hour, then the hall area requirement arrival is 28.88 m^2. When compared with the existing area with an area of 32.64 m^2. It can be concluded that the hall The current arrivals are still suitable for use until 2037.

5.2 RECOMMENDATION

Based on the conclusions above, there are several recommendations that can be given, namely:

1. The results of this study show that the current movement of aircraft at Sanggu airport, both in current conditions and in the next 10 and 15 years, still does not meet the runway capacity. Therefore, additional routes or the number of flights for existing routes can be made so that the runway can function optimally.
2. Related to the airport management's efforts to add flight routes, it is necessary to think about expanding the apron to be able to accommodate aircraft as support for smooth air traffic, therefore further research can be carried out.

3. The results of this study show that the existing condition of the terminal airport Sangu can still accommodate up to 20 passengers, while in 2037 there will only be 14 passengers during peak hours. It is possible to enlarge the aircraft type of the existing type. With the existing type of aircraft as it is now, it turns out that the waiting room capacity has not been fulfilled because it can only accommodate 18 passengers (aircraft quota), therefore it is recommended that airport managers can operate larger types of aircraft because the number of more passengers because with the aircraft the number of passengers will fulfill the capacity of the waiting room and the capacity of the waiting room will be missed if the aircraft operating is larger than the current type of aircraft. So that the capacity of the waiting room can be optimal.

4. Related to the effort manager airport to enlarge the type of aircraft, it is necessary to consider the ability of the existing *runway*, therefore can further research was conducted.

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