Development Planning of Air Side Airport Facilities at Buli Airport, East Halmahera.

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Abstract. East Halmahera Regency in North Maluku Province is a district rich in natural resources in the form of mining products. Therefore, one of the leading sectors is mining. As an industrial area being developed by the Ministry of Industry, regional development has also increased and is affected by various factors, one of which is the performance of air transportation that provides access by helping business travellers and tourists come to East Halmahera faster and more comfortably. Currently, the aircraft operating at Buli Airport are of the ATR 72-600 type. It is considered necessary to improve the service capabilities to meet future demands and support the air traffic flow to and from the economic gateway of East Halmahera. Additionally, this study aimed to ascertain the number of passengers who will use Buli Airport in 2032 and assess the dimensions of airside facilities including runway, taxiway, and apron that will be used by the Bombardier CRJ 1000 Nextgen planes. From the data obtained, we could estimate and make predictions about the demand and availability in the future. The data was analyzed using three (3) trend analysis methods: least squares, quadratic and exponential. One of the best trends was selected based on the smallest value of the sum of square error that was then used to estimate the number of passengers and aircraft in 2032. The analysis results estimated the number of passengers in 2032 using the quadratic method and obtained a total number of passengers of 50548 per day, while the corresponding number of aircraft was as many as 861, with two movements daily. The design results showed the need for the runway to be 2271 m, 149 x 15 m taxiway, and widening for the apron 97 x 75 m.

Keywords: airport development, apron, runway, taxiway

1. Introduction

Based on the law number 1 of 2003, East Halmahera Regency is a new autonomous region resulting from the expansion of Central Halmahera Regency in North Maluku. Maba as the capital district. The district saves mining material wealth. One of the leading commodities is Nickel. Due to the operating mining companies, the intensity of the flight passengers at Buli Airport has increased. However, the increase in passenger flow, it is necessary to develop in the future. To find out the needs of passengers in a study area, the number of passengers will greatly influence it. Estimates of the number of passengers are carried out using the Trending Analysis Method. If you look at the statistical formula, trend analysis includes one measure of timer series data, namely data collected from time to time describing the development of an activity. As a result, trend analysis is an analysis used to find out how much development occurs in an event where the development follows a straight line (linear) and a curved line (non-linear) for a short period of time or a long period of time. Owing to the time period, trend analysis can be used to project in developing data. An airport covers a very wide range of
activities, which have different integrity. The airport system is divided into two, namely the land and air sides. Those are both limited by the terminal. In the airport system, the properties of land vehicles and air vehicles have a strong influence on design. Indonesia has adopted the International Civil Aviation Organization (ICAO) methodology, namely the use of a code system, known as the Aerodrome Reference Code. The purpose of providing this reference code is to set standards for individual aerodrome facilities suitable for use by aircraft in a performance range or provide methods that simple to transform as a regulation of airport characteristics in planning air side facilities, resulted in availability of the facilities are able to service the aircraft used by the facility. The code is composed of two elements: firstly, a number related to the length of the reference field; and secondly is a letter related to the width of the wings and the width of the outer wheel axis. A certain specification is made by referring to the appropriate among using one of the two code elements or a combination of the two code elements. Letters or code numbers in an element used for designs that are associated with critical aircraft characteristics for the provided facilities. Buli Airport currently uses ATR 72-600 (Wings Air) aircraft with routes to Buli - Ternate and Ternate - Buli flights. However, the type of aircraft is considered insufficient for the mobility of future air transport passengers, the aim of this study is to determine the development of the air side of Buli Airport, East Halmahera for the next 15 years will come with a CRJ 1000 Nextgen aircraft as a planned aircraft.

2. Methodology of Research
The method used is the study of literature collecting theoretical references as material to compile and analyze in this study. In forecasting or estimating future air traffic, this calculation or analysis uses three methods. Those are linear (Least Square), exponential, and quadratic analysis [11].

- linear (Least Square) 
  \[ Y = a + b \] (1)

- exponential
  \[ Y = a \cdot e^x \] (2)

- quadratic
  \[ Y = a + b + cx^2 \] (3)

Each existing data can be estimated in number (in graphical form) in the x-year by looking at the trend pattern of data movements. In making a decision that will be made in the future based on a time series, a forecasting method is appropriate in choosing the best trend using SSE is needed so that it has a fairly small error value.

- Sum of Square Error
  \[ S = \Sigma(Y - Y')^2 \] (4)

Then, in analyzing the development of the air side includes runway, taxiway, and apron, analyzed according to the standards set by ICAO [7].

Flowchart illustrates the flow in a program or system procedure logically. In this case, it can be seen as in

Figure 1. Flow Chart
3. Results and discussions

3.1 Buli Airport Specification

Buli Airport is an airport located in East Halmahera Regency, North Maluku. The airport was built and managed by the Directorate General of Civil Aviation. The existing specifications of Buli Airport are RunwayDimensions: 1500 x 30 m, Longitudinal slope1%, Transverse 0.8%, TaxiwayDimensions: 75 x 15 m, and ApronDimensions: 40 x 60 m.

3.2 Passenger and Airplane Projection

Air traffic data, both aircraft movements and passenger movements are required for this final project. These data are secondary data used to analyze existing conditions and forecast growth in air traffic movements. Secondary data obtained were data on aircraft movements using the airport runway of Buli and passenger movement data for 2013-2017 which were obtained from the Director General of Transportation Buli Airport.

Table 1. Secondary Data on the Number of Aircraft in 2013-2017

| No | Year | Sum Arrival | Sum Departure | Sum |
|----|------|-------------|---------------|-----|
| 1  | 2013 | 382         | 382           | 764 |
| 2  | 2014 | 373         | 373           | 746 |
| 3  | 2015 | 361         | 361           | 722 |
| 4  | 2016 | 365         | 365           | 730 |
| 5  | 2017 | 362         | 362           | 724 |

(Source: Buli Airport Office)

Table 2. Secondary Data Number of Passengers in 2013-2017

| No | Year | Total Arrival | Total Departure | Total |
|----|------|---------------|-----------------|-------|
| 1  | 2013 | 16521         | 17611           | 34132 |
| 2  | 2014 | 16291         | 17383           | 33674 |
| 3  | 2015 | 16512         | 17680           | 34192 |
| 4  | 2016 | 16717         | 17875           | 35492 |
| 5  | 2017 | 17244         | 18174           | 35418 |

(Source: Buli Airport Office)

From the data on the movement of passengers and aircraft above, they can be obtained for 5 years, a calculation might be done using the trend analysis. Those are least square, exponential, and quadratic. One of them is considered as the most accurate chosen by looking at the smallest error value taken from the least squares error number (SSE) of each trend. As a result, it considered as the best trend.

4.2.1 Passenger Projection Calculation (Passengers arrive):

The selected SSE score of 10921.6 was chosen due to it has fewer errors compared to other trends. Become Passenger Forecast using quadratic Trends.

Table 3. The Movement passenger 2018-2032
Figure 2. Diagram of passenger movements 2018-2032

3.2.2 Aircraft Projection Calculation (Aircraft arrive):

The selected SSE score of 26.8 was chosen due to it has fewer errors compared to other trends. Become Aircraft Forecast using quadratic Trends.

Table 4. Aircraft Movement 2018-2032

| Year | Y   | X |
|------|-----|---|
| 2013 | 382 | -2|
| 2014 | 373 | -1|
| 2015 | 361 | 0 |
| 2016 | 365 | 1 |
| 2017 | 362 | 2 |
| 2018 | 368 | 3 |
| 2019 | 377 | 4 |
| Year | Y  | X |
|------|----|---|
| 2020 | 391|  5|
| 2021 | 408|  6|
| 2022 | 429|  7|
| 2023 | 454|  8|
| 2024 | 483|  9|
| 2025 | 517| 10|
| 2026 | 554| 11|
| 2027 | 595| 12|
| 2028 | 640| 13|

**Figure 3.** Diagram of passenger movements 2018-2032

### 3.3 Passenger Transport Capacity

It is assumed that the type of aircraft operating is the same as in 2017 and calculated for wide-body aircraft due to the wide-body aircraft greatly affect runway use, taxiways, and aprons. The calculation is based on the estimated number of passengers in the year 2032 as many as 50,548 people (most of them are passengers arriving and departing), and the estimated number of aircraft is 861 aircraft. The aircraft that operates is a type of ATR 72-600 with a capacity of 70 seats. The aircraft capacity of 70 seats is considered to be smaller than the average number of passengers in one day = 140 people for the year 2032. It can be concluded that the type of aircraft currently at Buli Airport it cannot serve the number of passengers properly in 2032. Resulted in needed for additional aircraft at Buli Airport.

### 3.4 Airside Planning

1) Runway Length and Width

**Runway Length**

The required runway length (ARFL) for each ARFL aircraft manufacturer for Bombardier CRJ 1000 Nextgen aircraft is 1996 m, however it still has to be corrected for several factors as follows.

- **Correction of elevation**
  
  Buli Airport Elevation (h) = 1.57 m.

  Correction factors can be calculated for elevation (Fe).

  \[
  Fe = 1 + \left[ 0.07 \times \left( \frac{h}{3} \right) \right]
  \]

  \[
  Fe = 1 + \left[ 0.07 \times \left( \frac{1.5}{3} \right) \right]
  \]

  \[
  Fe = 1.00037 \text{meter}
  \]
The length of the runway due to the influence of elevation is:
\[ Fe = 1,00037 \times 1,996 = 1996.73 \text{ meters} \]

- Correction of temperature
  the temperature at Buli Airport is 28.6 °C.
  Correction factors can be calculated against temperature (Ft).
  \[ Ft = 1 + (0.01 \times (T - (15 - 0.0065 \times h))) \]
  \[ Ft = 1 + (0.01 \times (28.6 - (15 - 0.0065 \times 1.57))) \]
  \[ Ft = 1.136 \text{ meters} \]
  The runway length due to temperature is:
  \[ Ft = 1.136 \times 1996.73 = 2268.49 \text{ meters} \]

- Correction of the slope of the runway
  Airport slope Buli (s) = 1%.
  Can be calculated slope correction factor (Fs)
  \[ Fs = 1 + 0.1 \times S \]
  \[ Fs = 1 + 0.1 \times 0.01 \]
  \[ Fs = 1.001 \text{ m} \]
  The length of the runway due to the influence of the slope of the runway
  \[ Fs = 1.001 \times 2268.49 = 2270.759 \approx 2271 \text{ m} \]
  Runway length after correction of elevation, temperature and slope is taken 2271 m This length
  is the minimum length that must be met and for the sake of comfort and increased safety.
  Runway width
  Based on ICAO requirements in Annex-14 Aerodromes, runway width for airports with code C
  must not be less than 45 m.

2) Taxiway Length and Width:

**Taxiway Length**
The Aircraft use in airports of Buli is a plane type bombardier crj 1000 nextgen according
Aerodrome Reference Code issued ICAO have the numeric code 4 and C for code letter.
From the calculations above, the length of the taxiways is 149 meters.

**Taxiway Width**
According the standards established by ICAO in Annex 14-Aerodromes for the Bombardier
CRJ Nextgen 1000 has a code letter C is then defined the width of the taxiway is not less than
15 m.

3) Apron Length and Width:

**Apron Length**
The Bombardier crj 1000 nextgen planes that have wingspan of 26.2 meters (Aircrafct parking
position) to other objects 4.5 meters. Thus the minimum length of the apron is needed to find
out the number of planes that can be parked as follows:
Planning parked for 3 Bombardier CRJ 1000 nextgen planes.
\[ \text{Apron length} = (3 \times Pp) + (4 \times c) \]
\[ = (3 \times 26.2) + (5 \times 4.5) \]
\[ = 96.6 \approx 97 \text{ meters} \]

**Apron Width**
Bombardier CRJ 1000 Nextgen type planes have a length of 39.1 meters and the aircraft center
line distance parking position taxilane to the object of 24.5 meters, the largest length is taken.
Thus the plan apron width needed is as follows:
The apron width (H) is the sum of:
a: Is the clearance between the nose of an airplane and the plane edge = 4.5 m
b: Plane length = 39.1 meters
c: Distance of the center line Aircraft parking position taxilane to object = 24.5 meters
d: Half of the width of the taxiway = 7 meters
Then the apron width (H) = 4.5 + 39.1 + 24.5 + 7 = 75 m
4. Conclusions

Based on the available data five years back, it could be processed for passengers estimate for the next 15 years to obtain results, namely in 2032 the estimated number of passengers is 50,548 people and passengers per day as many as 140 people. The result of analysis using the Linear Trend, Exponential and Quadratic Analysis methods, obtain the flight frequency in 2032 with 2 flights using Bombardier CRJ 1000 Nextgen planes. On the air side, the runway experiences a dimension increase of 771 meters which was originally 1500 m to 2271 meters while the runway width should not be less than 45 meters, with the existing width 30 so it needs a 15 meter width increase so that Bombardier CRJ 1000 Nextgen could be landed Taxiway's long dimension taxiway analysis results are 149 meters and also dimensions are 15 meters wide with 45° angles, while the apron's length requirement for development is 97 meters, greater than the existing apron length 60 meters needs to be extended 37 meters and the apron's width for development is 75 meters, greater than the existing width of the 40 meter apron. It can be parked 3 (three) of the largest types of Bombardier CRJ 1000 Nextgen by having the type of parallel parking.

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