ANALYSIS OF BAGGAGE TOWING TRACTOR NEEDS IN 2044 USING LINEAR REGRESSION METHOD AT KALIMARAU BERAU AIRPORT

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ABSTRACT

In 2024 Kalimarau Berau Airport will only have three baggage towing tractor units serving 10 aircraft on the air side. Under these conditions, ground handling officers were forced to use human power to push the baggage cart tothe apron. So this becomes inefficient. In an effort to prevent this condition from occurring, in the plan to add ground support equipment facilities, namely baggage towing tractors, it is necessary to analyze the need for baggage towing tractors with supporting data on the number of passengers over a period of 5 years, namely in 2010 - 2014. The research methodology used in this research is quantitative using simple linear regression analysis using SPSS software to determine the influence of an independent variable on the dependent variable and also Microsoft Excelto calculate passenger carrying capacity, fleet requirements and baggage requirements towing tractor. With the results of analyzing passenger data over a period of 5 years, we will obtain a forecast of the number of passengers and also passengers during busy times in accordance with the Regulation of the Minister of Transportation of the Republic of Indonesia Number PM 41 of 2023 concerning Airport Services at Airports in the next 30 years. The results from busy time passengers will be used to calculate passenger carrying capacity, fleet requirements and baggage towing tractor requirements in accordance with Director General of Civil Aviation Regulation Number: SKEP/47/III/2007.

The results of this research show that the number of passengers during peak arrival and departure times in 2044will be 1793 people. With a total calculation of aircraft during peak hours in 2044 at Berau Kalimarau Airport, namely10 ATR-72 aircraft, 4 A320 aircraft, and 2 B-737 800 aircraft. With this total aircraft fleet, in accordance with SKEP 47 of 2007, an additional 28 units are required baggage towing tractor in 2044.

Keywords: Kalimarau Berau Airport, Baggage Towing Tractor Needs, Linear Regression Method, Busy Time Passengers

1. CONCLUSION

Indonesia, as the fourth most populous country in the world, holds a significant advantage due to its large population. This substantial population inevitably impacts the growth of human resources (HR) in the country. In 2016, President Joko Widodo mandated the Ministry of National Development Planning to formulate the Vision of Indonesia 2045, also known as the Golden Indonesia Vision 2045. This vision was crafted by the Ministry of National Development Planning/Bappenas under the direction of President Joko Widodo as a governmental initiative to prepare Indonesia to face global megatrends. Four pillars of development were established to achieve this vision: 1) Human Development and Mastery of Science and Technology, 2) Sustainable Economic Development, 3) Equitable Development, and 4) Strengthening National Resilience and Governance.

To realize the Golden Indonesia Vision by 2045, Indonesia must prepare a high-quality future generation and ensure equitable development across regions, considering the country's archipelagic nature. This development effort begins with relocating the nation's capital from Jakarta to East Kalimantan, specifically encompassing Kutai Kartanegara Regency and North Penajam Paser Regency. The relocation of the capital city is expected to promote equitable development beyond Java Island. With the establishment of the new

capital, Nusantara, all modes of transportation, especially in East Kalimantan, will become key to the movement of people and goods. Five airports will be affected and play a crucial role in mobility and connectivity for the population, namely Badak Bontang Airport, Kalimarau Berau Airport, Sultan Aji Muhammad Sulaiman (SAMS) Sepinggan Airport in Balikpapan, Melalan Kutai Barat Airport, APT Pranoto Samarinda Airport, and Datah Dawai Mahakam Ulu Airport.

Kalimarau Airport is located in Teluk Bayur District, Berau Regency, East Kalimantan. The name "Kalimarau" comes from a stream that flows in front of the airport terminal. Established in 1976 as a pioneer airport, Kalimarau Airport has evolved into a Class I airport through improvements in both airside and landside facilities. In 2002, the airport underwent renovations to enhance its infrastructure. By 2008, the airport had upgraded from Class IV to Class II, coinciding with East Kalimantan's hosting of the National Sports Week (Pekan Olahraga Nasional). During this period, Kalimarau Airport experienced a surge in activity, particularly with the opening of the Balikpapan-Berau route by Batavia Air, utilizing Boeing 737-200 aircraft.

Class I Kalimarau Airport operates under the Directorate General of Civil Aviation and is classified as a Public Service Agency (Badan Layanan Umum, BLU), meaning it is a government entity primarily focused on providing services to the public. The airport's domestic terminal spans 16,667 square meters, and it features eight parking stands with two jet bridges to accommodate A320 aircraft. Continuous development and renovation of the airport's facilities have been necessary due to the increasing number of passengers each year. Berau Regency, a popular destination for both local and foreign tourists, as well as business travelers and job seekers, contributes significantly to this growth.

Passenger numbers at Kalimarau Airport saw a significant increase over five years, from 2010 to 2014. However, in 2015, passenger numbers declined due to an economic slowdown, only to stabilize the following year. In 2017, passenger numbers once again decreased due to economic challenges in Kalimantan, particularly affecting the mining sector in Berau. Despite these fluctuations, 2018 recorded the highest passenger numbers in the past decade. However, the years 2019 to 2022 saw a decline in passengers due to the COVID-19 pandemic. In January 2023, there was a spike in ticket prices for flights to and from Berau Airport, exceeding the Upper Limit Tariff for Economy Class Passengers on Domestic Scheduled Commercial Air Transport (as per Indonesian Ministry of Transportation Decree No. KM 106 of 2019), which led to a decrease in the public's interest in air travel.

In response, the Berau Regency Government, in collaboration with Kalimarau Airport, sought to reduce ticket prices to comply with the Ministry of Transportation's decree. Their efforts proved successful, with smaller aircraft such as the ATR-72 and Grand Caravan-12 operated by airlines like Wings, Citilink Indonesia, and Susi Air serving the airport in early 2023. By September 2023, Kalimarau Airport had opened new routes from Berau to Jakarta and Berau to Surabaya, serviced by Batik Air using A320 (Narrow Body) aircraft. This development was well-received, leading to an increase in public interest in air travel, especially during the Christmas and New Year holiday season. During this period, Kalimarau Airport experienced a 30% increase in passenger numbers, with an average of eight flights per day, primarily to Balikpapan, Samarinda, Jakarta, and Surabaya.

Based on passenger data, it is evident that Kalimarau Airport's aviation activities will become increasingly busy, solidifying its role as a key mode of transportation for the people of Kalimantan. This increase in activity is also influenced by the relocation of the capital to East Kalimantan, encompassing Kutai Kartanegara Regency and North Penajam Paser Regency. The government has outlined several objectives for relocating the capital, including: 1) promoting equitable development and economic justice, 2) alleviating the overpopulation issues on Java Island, particularly in Jakarta, 3) creating a safe, modern, sustainable, and resilient capital, and 4) establishing a new civilization that represents national progress with a modern, smart, and green city concept.

The relocation of the capital to East Kalimantan has also impacted nearby airports, including Kalimarau Airport. Over the past four years, since the end of the COVID-19 pandemic, the airport has experienced a significant increase in passenger numbers. In February, the Head of the Kalimarau Airport Unit (UPBU), Ferdinan Nurdin, held a strategic meeting with the Director of Cargo

Operations at PT. Lion Group and otherstakeholders to discuss the development of cargo shipping potential through Kalimarau Airport. Berau Regency itself is a major exporter of marine products, such as grouper fish, which is shipped to Hong Kong at a volume of 15 tons per month. Other commodities include crabs, mantis shrimp, octopus, baby octopus, and pufferfish, with total export tonnage estimated at 50 tons per month, meeting buyer demands for fresh and live products.

Given this situation, there will likely be an increase in narrow-body aircraft like the B737-800 at Kalimarau Airport, following Batik Air's use of this aircraft type in January 2024. In November 2023, another airline awaited a letter from the Berau Regency Government regarding the reopening of routes to Kalimarau Airport after the SJ 182 incident on January 10, 2021. This will add to the list of airlines operating at Kalimarau Airport, as Sriwijaya Air also operated flights there in 2020.

These developments will undoubtedly impact the operation of various airport components, including personnel, airside support facilities like Ground Support Equipment, and landside facilities, which will face an increased workload in serving passengers and cargo. To maintain quality service, it is essential to address the needs of both passengers and aircraft. Facilities play a crucial role in supporting all operational aspects within the airport and aviation activities. Ground operations, such as takeoff, landing, maneuvering, loading, and unloading of passenger baggage and cargo, are monitored by the Apron Movement Control unit. Apron Movement Control (AMC) personnel are responsible for overseeing flight operations, aircraft movements, and the Ground Handling Unit, which executes these activities. Ground Handling personnel provide service and aircraft handling while on the ground, using Ground Support Equipment to facilitate these operations.

Ground Support Equipment (GSE) vehicles and equipment are vital in streamlining passenger and aircraft services while on the ground. The need for these vehicles and equipment is proportional to the number of aircraft movements taking off and landing at the airport. There are various types of aircraft ground support equipment (GSE) and operational vehicles that operate airside, categorized into two types: Motorized and Non-Motorized. Each piece of equipment or vehicle (GSE) has its specific function, such as the Baggage Towing Tractor (BTT). BTTs are used by ground handling personnel to transport passenger baggage from the terminal to the aircraft cargo hold and vice versa. Baggage Towing Tractors can tow Baggage Carts, Ground Power Units, Container Dollies, Manual Conveyor Belt Loaders, and Passenger Boarding Stairs.

Given the current situation, it is crucial to pay attention to airport facilities, both airside and landside. International regulations, as outlined in Annex 9, establish standards for airport facilities that facilitate the smooth arrival and departure of aircraft, passengers, and cargo at airports (ICAO, 2017). To address the expected increase in traffic during the upcoming year-end and in the following years, the need for Baggage Towing Tractors to support ground handling operations, such as the movement of passenger baggage, cargo, and mail, is critical. According to observations, Kalimarau Airport currently operates only three Baggage Towing Tractors, with two owned by PT. Jasa Dirgantara Tarakan and one by PT. Citra Dunia Angkasa.

Based on the regulations of the Director General of Civil Aviation Number: SKEP/47/III/2007 concerning Guidelines for the Implementation of Airport Supporting Activities, the guidelines for calculating airport GSE (Ground Support Equipment) requirements state that 1 BTT (Baggage Towing Tractor) unit is needed for servicing small-body aircraft such as the ATR-72 and 1 BTT unit for servicing the Grand Caravan-12, as well as 3 BTT units for servicing narrow-body aircraft such as the A320 and B737-800. Currently, Kalimarau Airport only has 3 BTT units, consisting of 2 units owned by PT. Jasa Dirgantara Tarakan and 1 unit from PT. Citra Dunia Angkasa. Considering the increasingly urgent needs, planning for the development of BTT facilities is necessary to support airport operations in the future, particularly in 2044.

Based on this background, the author addresses the issues that will arise concerning the need for Baggage Towing Tractors at Kalimarau Airport, Berau, in 2044. Some key questions that need to be answered in this analysis include: how many aircraft movements occur during peak hours at Kalimarau Airport, what types of aircraft operate during these peak hours, and how many Baggage Towing Tractor units will be needed in 2044 to ensure efficient and effective airport operations.

This analysis will use the linear regression method to project BTT needs in the future, taking into account the growing trends in passenger numbers and aircraft movements at Kalimarau Airport, Berau.

2. METHOD

The research begins with the formulation of a problem, which has specific objectives and leads to problem-solving related to the object under study. The steps taken in the research must be based on the identified issues and goals. This study employs a quantitative research method, characterized by its fixed nature and reliance on data collected by the researcher. According to Sugiyono, quantitative research is grounded in a positivistic approach (concrete data), where the research data are in the form of numbers that are measured using statistical tools for calculation. These statistics are used to address the research problems and to draw conclusions. The analysis involves breaking down the data into smaller parts to answer research questions, and statistical procedures such as comparing groups or individual scores provide the necessary information to respond to research questions and hypotheses (Sugiyono, 2017). Therefore, it can be concluded that the quantitative approach is a method used to test hypotheses using accurate statistical data tests. Based on the background and problem statement, this study utilizes a quantitative descriptive analysis technique.

This research was conducted at Kalimarau Class I Airport, located on Jalan Kalimarau, Teluk Bayur District, Berau Regency, East Kalimantan Province. The airport is approximately 6.5 km from the city center, which can be reached in about 11 minutes. The specific coordinates of Kalimarau Class I Airport are 02°00'12"N and 117°25'52"E.

The object of this research is the Baggage Towing Tractor (BTT) at Kalimarau Class I Airport, Berau. The researcher conducts a linear regression analysis to determine the number of Baggage Towing Tractors needed in 2044. A variable, as defined by Sugiyono and elaborated by Lufthia and colleagues, is anything set by the researcher for study to obtain information, which is then used to draw conclusions (Lutfia & Sylviana Zanthy, 2019). In this study, the researcher employs two types of variables: the independent variable (X), which influences the dependent variable, and the dependent variable (Y), which is influenced by the independent variable.

The tools and software used in this research include Microsoft Excel, which was utilized to process passenger data and to derive the required linear regression model. This model enables predictions of passenger numbers and aircraft movements at Kalimarau Berau Airport in 2044, which will, in turn, inform the calculation of Baggage Towing Tractor needs for that year.

The data collection method employed is descriptive, aimed at depicting the state of the subject under study using appropriate analyses corresponding to field conditions. As stated by Adiputra (2021), descriptive research seeks to describe existing phenomena, whether natural or man-made, without implying broader implications. In this study, the researcher utilized secondary data obtained from the staff at Kalimarau Berau Airport. According to Sugiyono (2019), secondary data refers to data not directly received by the data collector but obtained through other people or documents. The secondary data in this study includes annual passenger data, which consists of both arriving and departing passengers.

Data collection techniques used in this research include literature study, observation, and analysis of data provided by Kalimarau Class I Airport related to the research problem. These data include passenger numbers from the past five years during peak hours, which are used to forecast the need for Baggage Towing Tractors in 2044. The need for Baggage Towing Tractors will be calculated using SKEP/47/III/2007 issued by the Directorate General of Civil Aviation and PM 41 of 2023 issued by the Ministry of Transportation of the Republic of Indonesia.

The research method used is systematic, structured, and planned from the beginning through to the design stage, with a focus on quantitative data analysis. The data analysis method involves forecasting, and the research findings are presented through graphs showing the increase in passenger numbers at Kalimarau Class I Airport, Berau. The data, obtained from secondary sources in the form of annual passenger numbers, will be processed using linear regression. Steps include collecting passenger data, calculating aircraft movements, determining peak aircraft hours, and assessing the types of aircraft operating at Kalimarau Berau Airport. This information will be used to determine the number of Baggage Towing Tractors needed in 2044, in accordance with SKEP/47/III/2007 concerning the Standards for GSE Calculation.

Currently, Kalimarau Berau Airport operates three units of Baggage Towing Tractors, which serve ten commercial flights. These Baggage Towing Tractors are operated by two ground handling companies: PT. Jasa Dirgantara Tarakan and PT. Citra Dunia Angkasa. However, the current operation of ten flights with only three Baggage Towing Tractors is less than optimal, as it falls short of the standards set by the Director General of Civil Aviation Regulation Number SKEP/47/III/2007. Therefore, adding Baggage Towing Tractors to meet the demand in the coming years is essential to ensure smooth loading and unloading processes.

The research was conducted at Kalimarau Airport, Berau Regency, East Kalimantan Province, with the research process, from preparation to writing, detailed in the following schedule.

3. RESULT AND DISCUSSION

In this final project research, the author used departure and arrival passenger data from Kalimarau Airport, Berau, for the years 2010-2014. This data was then processed into a simple linear regression equation model using IBM SPSS Statistics and Microsoft Excel (Manual Calculation). The steps taken to address the research problem included observation, theoretical review, data collection, data processing, and finally, the analysis of baggage towing tractor needs for the year 2044. This analysis was conducted in accordance with the Regulation of the Director General of Civil Aviation Number: SKEP/47/III/2007 on Guidelines for Airport Support Business Operations, which provides a calculation guide for the required GSE (Ground Support Equipment) at airports. According to this regulation, one BTT unit is needed for servicing small body aircraft like the ATR-72 and one unit for the Grand Caravan-12, while three BTT units are required for servicing narrow-body aircraft like the A320 and B737-800 (Minister of Transportation of the Republic of Indonesia, 2019).

Observation

The observation was conducted by the researcher at Kalimarau Airport, Berau, during the On the Job Training (OJT) activities. While observing alongside the AMC personnel, the researcher noticed that ground handling personnel were manually pulling baggage carts without using a baggage towing tractor. This situation arose when an A320 aircraft and an ATR-72 were simultaneously loading and unloading during peak hours. According to the AMC personnel, the available number of baggage towing tractors was inadequate, as one of the tractors was out of service due to a malfunction.

Further observation by the researcher revealed that only three baggage towing tractors were available at the time. During peak hours, with only three BTT units operational, ground handling staff were forced to manually pull the baggage carts to the apron without the aid of a BTT. The lack of sufficient baggage towing tractor facilities clearly emerged as a key focus of this study.

Theoretical Review

The theoretical review is an approach used by the researcher to explain the research problem. In this section, the researcher conducted field observations during the On the Job Training (OJT) activities. The researcher identified an issue during the loading and unloading of baggage, where ground handling personnel were observed pulling baggage carts manually without the assistance of a baggage towing tractor (Fattah, 2021).

This situation made the baggage loading/unloading process inefficient due to the insufficient number of baggage towing tractors available to service 10 flights in a single day. Furthermore, it did not comply with the Regulation of the Director General of Civil Aviation Number: SKEP/47/III/2007 on Guidelines for Airport Support Business Operations, which stipulates that narrow-body aircraft like the A320 should be serviced by three baggage towing tractors. However, in practice, only two baggage towing tractors were available to service these aircraft. This highlights the urgent need for a 20-year forecast and plan to add more ground support equipment, specifically baggage towing tractors, to meet future operational demands.

Data Collection

In this study, the researcher utilized secondary data, which refers to data that has been processed and presented in forms such as tables or diagrams by the original data collector or another party (Husein Umar, 2013). The secondary data collected for this research is based on passenger arrivals and departures at Kalimarau Airport from 2010 to 2014.

Throughout this period, the number of passengers, both arriving and departing from Kalimarau Airport, showed a consistent increase each year. This steady growth in passenger numbers serves as a crucial reference for projecting future passenger trends over the next 30 years and for analyzing the anticipated needs for baggage towing tractors.

For example, in 2010, the total number of passengers, including both arrivals and departures, was significantly lower compared to 2014, where the numbers saw a substantial rise. Over these five years, the average annual growth rate of passengers was approximately 24%. This continuous growth highlights the increasing demand for efficient ground support equipment, such as baggage towing tractors, to accommodate future airport operations.

Data Processing

Regression

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[DataSet1]
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Variables Entered/Removed[a]

Model	Variables Entered	Variables Removed	Method
1	Tahun[b]	.	Enter

a. Dependent Variable: Jumlah Penumpang

b. All requested variables entered.

Figure 1. Output of Variables Entered/Removed

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.979[a]	.959	.945	22447.387

a. Predictors: (Constant), Tahun

Figure 2. Output of Model Summary

ANOVA[a]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	3.538E+10	1	3.538E+10	70.222	.004[b]
	Residual	1511655543	3	503885180.9		
	Total	3.690E+10	4			

a. Dependent Variable: Jumlah Penumpang

b. Predictors: (Constant), Tahun

Figure 3. Output of ANOVA

Coefficients[a]

Model		Unstandardized Coefficients B	Unstandardized Coefficients Std. Error	Standardized Coefficients Beta	t	Sig.
1	(Constant)	-119345685	14282159.43		-8.356	.004
	Tahun	59484.500	7098.487	.979	8.380	.004

a. Dependent Variable: Jumlah Penumpang

Figure 4. Output of Coefficients

The explanations for the output results are as follows:

- The Variable Entered/Removed output shows that the variable X (Year) was entered into the model, and the method used was the Enter method.
- The Model Summary output indicates the correlation or relationship (R) between the variables, which is 0.979. The R^2 value, which represents the coefficient of determination, shows the percentage of influence that the independent variable has on the dependent variable. In this case, the R^2 value is 0.959, or 95.9%.
- The ANOVA output explains the significant influence of the Year variable (X) on the Number of Passengers variable (Y). The calculated F-value is 70.222, with a significance level of 0.004, which is less than 0.005. This indicates that the regression model can be used to predict the number of passengers.
- The Coefficients output provides the regression equation, where the value of 'a' (the constant) is shown in the B column under Constant, which is -119345685 (rounded to 119,345.685), and the value of 'b' (the slope) is shown in the B column under Year, which is 59484.5 (rounded to 59,484.5). Thus, the regression equation can be written as:

  Y = a + bX

  Y = 119,345.685 + 59,484.5X
- Interpreting the equation above, the consistent value of the Number of Passengers variable is 119,345.685. The regression coefficient for the Year variable (X) is 59,484.5, meaning that for every 1% increase in the Year, the Number of Passengers increases by 59,484.5. Since the regression coefficient is positive, the influence of variable X on Y is also positive.
- The comparison between the calculated T-value and the T-table value can be used to determine whether the Year variable (X) significantly affects the Number of Passengers variable (Y). Based on the Coefficients output, the calculated T-value is 8.380. To determine the T-table value, the following data are required:
  - Number of variables (k) = 2
  - Number of data points (n) = 5
  - Significance level = 0.025 (commonly used)
  - Degrees of freedom (df) = n - k = 5 - 2 = 3
  - T-table value = 3.182 (obtained from the T-distribution table)

Therefore, since the calculated T-value (8.380) is greater than the T-table value (3.182), it can be concluded that the Year variable (X) significantly influences the Number of Passengers variable (Y).

In this study, the researcher conducted data processing manually using Microsoft Excel. The process began with inputting the data for the years (X) and the number of passengers (Y), which were then calculated accordingly. To determine the predicted number of passengers, the data was applied to the linear regression equation. The values of 'a' and 'b' were calculated using specific formulas from the linear regression method.

The value of 'a' was determined by using a formula that involves the summation of the data points for both the years and the number of passengers. After performing the calculations, the value of 'a' was found to be 158,675. Similarly, the value of 'b' was calculated, resulting in a value of 59,485. These values were then used to formulate the linear regression equation:

$$Y' = 158{,}675 + 59{,}485X$$

This equation was applied to predict the number of passengers for the years 2015 to 2044. The results indicated a consistent increase in passenger numbers each year, with the predicted number of passengers reaching 2,240,650 by the year 2044. This steady growth in passenger traffic highlights the need for careful planning to accommodate the anticipated peak-hour passenger capacity by 2044.

The calculation of Peak Hour Passengers (PWS) follows the Indonesian Ministry of Transportation Regulation Number 41 of 2023, which sets the standards for airport user services and serves as a reference for forecasting peak hour passengers from 2015 to 2044 (M. P. Indonesia, 2023). Based on the data in Table 4.3, it is estimated that by 2044, the number of passengers will reach 2 million per year. The determination of the peak hour passenger coefficient is adjusted according to the annual passenger volume, as shown in Table 4.4.

To calculate the peak hour passengers for the years 2015 to 2044, the coefficient obtained from Table 4.4 is applied to the following formula, with the results presented in Table 4.5. The formula used is:

$$PWS = 2{,}240{,}650 \times \text{PWS coefficient} / 100$$

By 2044, the total number of passengers, both arriving and departing, is predicted to reach 2,240,650, with a peak hour passenger count of 1,793. This peak hour passenger figure is crucial for determining the aircraft passenger capacity needed. To analyze passenger capacity, the seat load factor of each aircraft operating at Kalimarau Airport, Berau, must be considered.

In calculating the passenger capacity of aircraft, the author used a load factor of 65% for each aircraft. This seat load factor of 65% was agreed upon by the airlines and the airport, ensuring that any airline wishing to operate at the airport would consider the potential passenger interest in using the routes offered by the airport. If the seat load factor falls below 65%, the operating airlines would face losses. The formula to calculate the number of seats on the aircraft operating at Kalimarau Berau Airport is as follows:

For the Grand Caravan-12 aircraft, the load factor calculation results in 8 seats; for the ATR-72, it

results in 47 seats; for the Airbus A320, it results in 101 seats; and for the Boeing 737-800, it results in 109 seats.

Once the minimum number of seats per aircraft is determined, the next step is to calculate the passenger capacity for each takeoff and landing. This is done by multiplying the seat load factor by the number of aircraft movements during takeoff and landing. For example, in 2024, the Grand Caravan-12 with a load factor of 8 seats and 5 aircraft movements results in a capacity of 40 passengers. Similarly, the ATR-72 with 47 seats and 8 aircraft movements results in 376 passengers, the Airbus A320 with 101 seats and 4 movements results in 404 passengers, and the Boeing 737-800 with 109 seats and 1 movement results in 109 passengers.

Passenger capacity is then compared to the peak hour passengers (PWS) to ensure that the capacity exceeds the PWS for that year. For instance, in 2024, the total passenger capacity was calculated to be 929 passengers, while the PWS for the same year was 841 passengers. This indicates that the airlines would not incur losses in 2024, as the passenger capacity exceeds the PWS. The calculation of passenger capacity for each subsequent year shows a gradual increase, aligning with the projected increase in passenger demand over time.

To determine the need for baggage towing tractors (BTT) in 2044, the researcher used the data on passenger capacity from Table 4.6 to assess the fleet of aircraft that will require BTT services in 2044. The process followed the guidelines set out in the Director General of Civil Aviation Regulation Number SKEP/47/III/2007, which provides guidelines for Ground Support Equipment (GSE) requirements at airports. According to these guidelines, one BTT unit is needed for servicing small-body aircraft such as the ATR-72 and Grand Caravan-12, while three BTT units are required for narrow-body aircraft like the Airbus A320 and Boeing 737-800.

To analyze the fleet needs, it is essential to calculate the movements of aircraft, both takeoffs and landings. For instance, based on the data from Table 4.6 for the year 2024, the Grand Caravan-12 had a passenger capacity of 40, which, when divided by the seat load factor of 8, resulted in five movements (two takeoffs, two landings, and one RON—Remain Over Night).Similarly, the ATR-72, with a passenger capacity of 376and a seat load factor of 47, required eight movements (four takeoffs and four landings). The Airbus A320 required four movements, and the Boeing 737-800, witha capacity of 109 passengers, had one RON movement.

These calculations indicate the number of aircraft movements required, helping to determine the existing fleet needs for 2024. Once the fleet requirements for 2024 are established, the next step is to project the fleet needs for 2044. Based on Table 4.7, by 2044, it is estimated that the airport will need to service 4 Grand Caravan aircraft, 10 ATR-72 aircraft, 4 Airbus A320 aircraft, and 2 Boeing 737-800 aircraft. These projections are used to calculate the number of BTTs required in 2044.

According to the GSE standards outlined in the Director General of Civil Aviation Regulation, one BTT unit is needed for each ATR-72, and three BTT units are required for each Airbus A320 or Boeing 737-800. The calculated BTT needs for 2044, as shown in Table 4.8, reveal that the total requirement will be 28 units by that year.

In conclusion, the analysis and calculations indicate that by 2044, the total number of baggage towing tractors required at Kalimarau Airport will be 28 units.

4. CONCLUSION

Based on the analysis of the baggage towing tractor (BTT) needs for 2044 at Kalimarau Airport, Berau, several key conclusions and recommendations can be drawn. The analysis of aircraft during peak hoursin 2044 indicates that there will be 10 ATR-72 aircraft, 4 Airbus A320 aircraft, and 2 Boeing 737-800 aircraft in operation at Kalimarau Airport. To support this level of operation, the analysis of BTT requirements for the next 20 years, in accordance with the Director General of Civil Aviation Regulation Number SKEP/47/III/2007, reveals that additional BTT units will be necessary. Specifically, it is estimated that 28 BTT units will be required by 2044 to adequately service the projected fleet of aircraft.

In light of these findings, several recommendations are proposed to guide future development. The results of the BTT needs analysis should serve as a benchmark for ground handling management in planning and acquiring the necessary BTT units at Kalimarau Airport by 2044. Additionally, it is recommended that future researchers calculate BTT needs based on the efficiency of slot allocation (slot diagrams) at Kalimarau Airport, Berau, to ensure a more comprehensive understanding and planning of BTT requirements.

REFERENCES

[1] Abdul Majid,Suharto dan Warpani, E. P. D. (2009). *Ground Handling Manajemen Pelayanan Darat Perusahaan Penerbangan*. PT. Raja Grafindo Persada.

[2] Adiputra. I. M. S. (2021). *Metode Penelitian*. Yayasan Kita Menulis.

[3] Anggraini, L. F. (2016). Analisis Waktu Kinerja Ground Support Equipment Gapura Angkasa Dalam Aktivitas Operasional di Darat Pada Penerbangan Garuda di Bandar Udara Lombok Praya. *Jurnal Ground Handling Dirgantara*, 25–26.

[4] Anggraini, R. (2021). *Evaluasi Kebutuhan Luas Terminal Penumpang di Bandar Udara Kalimarau Berau Pada Tahun 2041 Menggunakan Metode Regresi Linier*. 1–54.

[5] Coronel, Carlos dan Morris, S. (2016). *Database Systems: Design, Implementation and Management* (Twelve Edi). Cengage Learning.

[6] Damanik, J. S. (2012). Evaluasi Fasilitas Peralatan Baggage Handling Di Bandar Udara Hang Nadim Batam. *Jurnal Penelitian Perhubungan Udara Warta Ardhia*, 419.

[7] Dirjen Perhubungan Udara, K. P. (2005). Peraturan Direktur Jenderal Perhubungan Udara Nomor SKEP/77/VI/2005 tentang Persyaratan Teknis Pengoperasian Fasilitas Teknik Bandar Udara. *Kementerian Perhubungan*, 1–140.

[8] Fattah, A. (2021). *Optimalisasi Pengawasan Unit Apron Movement Control Terhadap Kelayakan Ground Support Equipment di Sisi Udara Bandar Udara Internasional Hang Nadim Batam.*

[9] Ginting. (2007). *Sistem Produksi*. Graha Ilmu.

[10] Heizer, J. dan B. R. (2009). *Manajemen Operasi* (Edisi kese). Salemba Empat.

[11] Hestuningrum, H. A. (2018). *Manajemen Kendaraan Ground Handling Di Terminal 1 Bandara Internasional Juanda.* Institut Teknologi Sepuluh Nopember Surabaya.

[12] Hintarsyah, A. P., Christy, J., & Spits Wamars, H. H. (2018). Forecasting Sebagai Decision Support Systems Aplikasi dan Penerapannya Untuk Mendukung Proses Untuk Mendukung Proses Pengambilan Keputusan. *Jurnal Sistem Komputer*, 20–22.

[13] Husein Umar. (2013). *Metode Penelitian Untuk Skripsi dan Tesis.* Rajawali Press.

[14] ICAO. (2017). Annex 9 to Convention on International Civil Aviation. In *Volume IV Surveillance Radar and Collision Avoidance Systems* (Issue October 2017).

[15] ICAO. (2022). *Annex 14 to the Convention on International Civil Aviation - Aerodrome Design and Operations* (Vol. 9, Issue July).

[16] Indonesia, M. P. (2016). Perubahan Atas Peraturan Menteri Perhubungan Nomor PM 174 Tahun 2015 Tentang Pembatasan Usia Peralatan Penunjang Pelayanan Darat Pesawat Udara (Ground Support Equipment/GSE) dan Kendaraan Operasional Yang Beroperasi di Sisi Udara. Menteri Perhubungan Republik Indonesia.

[17] Indonesia, M. P. (2019a). *Tarif Batas Atas Penumpang Pelayanan Kelas Ekonomi Angkutan Udara Niaga Berjadwal Dalam Negeri.* Menteri Perhubungan Republik Indonesia.

[18] Indonesia, M. P. (2019b). *Tatanan Kebandarudaraan Nasional*. Menteri Perhubungan Republik Indonesia.

[19] Indonesia, M. P. (2023). *Peraturan Menteri Perhubungan Republik Indonesia Nomor PM 41 Tahun 2023 Tentang Pelayanan Jasa Kebandarudaraan Di Bandar Udara.* Kementrian Perhubungan.

[20] Indonesia, P. R. (2009). *Undang-Undang Republik Indonesia Nomor 1 Tahun 2009 Tentang Penerbangan*. Presiden Republik Indonesia.

[21] Jumriati, & Dewantari, A. (2022). Analisis Kinerja Operator Ground Support Equipment (GSE) dalam Menjaga Keamanan dan Keselamatan Penerbangan di Bandar Udara Internasional Lombok Nusa Tenggara Barat. *Jurnal Kewarganegaraan*, 7–8.

[22] Junaidi, A. (2015). Analisis Program Siaran Berita Berjaringan Di Programa 1 Rri Samarinda Dalam Menyampaikan Berita Dari Kawasan Perbatasan. *EJournal Komunikasi*, *3*(2), 278–292.

[23] Keputusan Menteri Perhubungan Republik Indonesia. (2019). *Keputusan Menteri Perhubungan Republik Indonesia Nomor KM 106 Tahun 2019 Tentang Tarif Batas Atas Penumpang Pelayanan Kelas Ekonomi Angkutan Udara Niaga Berjadwal Dalam Negeri*.

[24] Lutfia, L., & Sylviana Zanthy, L. (2019). Analisis Kesalahan Menurut Tahapan Kastolan Dan Pemberian Scaffolding Dalam Menyelesaikan Soal Sistem Persamaan Linear Dua Variabel. *Journal On Education*, *1*(03), 396–404.

[25] Muhidin, R., Kharie, N. F., & Kubais, M. (2019). Analisis Dan Perancangan Sistem Informasi Pada Sma Negeri 18 Halmahera Selatan Sebagai Media Promosi Berbasis Web Analysis and Information System Design in Sma Negeri 18 South Halmahera As Media Promotion of Web-Based. *IJIS-Indonesia Journal on Information System*, *4*(April), 69–76.

[26] O'Brien, James, A, & Marakas, G. M. (2011). *Management Information Systems.* McGraw-Hill.

[27] Pelayanan, S., & Peraturan Menteri Perhubungan Republik Indonesia Nomor PM 178 Tahun 2015 Tentang Standar Pelayanan. (2015). Peraturan Menteri Perhubungan Republik Indonesia Nomor PM 178 Tahun 2015 Tentang Standar Pelayanan Pengguna Jasa Bandar Udara. *Undang–Undang Dasar Negara Republik Indonesia Tahun 1945 Dalam Satu Naskah*, *021*, 2018.

[28] Perhubungan, K. (2015). *Standar Peralatan Penunjang Pelayanan Darat Pesawat Udara (Ground Support Equipment/GSE) dan Kendaraan Operasional Yang Beroperasi di Sisi Udara.* Direktur Jenderal Perhubungan Udara.

[29] Rafi, M. Z., & A. (2023). Peran Unit Apron Movement Control (AMC) Dalam Melakukan Pengawasan Terkait Kedisiplinan dan Keselamatan Pergerakan di Apron Bandar Udara Internasional Adi Soemarmo Solo. *Jurnal Ground Handling Dirgantara*, *5*(2), 169.

[30] Sugiyono. (2017). *Metode Penelitian Kualitatif, Kuantitatif, dan R&D.* Alfabeta.

[31] Sugiyono. (2019). *Metode Penelitian Kualitatif, Kuantitatif, dan R&D.* Alfabeta.

[32] Tito Yusmar, W. P. (2014). Pemilihan Tipe Pesawat Udara berdasarkan Estimasi Biaya Operasional untuk Pesawat Udara Jarak Menengah. *Wartha Ardhia Jurnal Perhubungan Udara*, 63.

[33] Udara, D. P. (2007). *Petunjuk Pelaksanaan Usaha Kegiatan Penunjang Bandar Udara*. Direktur Jenderal Perhubungan Udara.