

Planning of Cargo Terminal Area Requirement of Komodo Labuan Bajo International Airport

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Abstract: After the COVID-19 pandemic, cargo growth at Komodo Labuan Bajo International Airport shows a significant pattern of increase in cargo growth rates compared to before the COVID-19 pandemic. The increasing demand for cargo services certainly has an impact on the ability of Komodo Labuan Bajo International Airport to provide cargo services to the maximum extent possible. To overcome the pattern of cargo growth, which is expected to continue to increase, it is necessary to build a special terminal for cargo handling. The planning of cargo terminal development is carried out by considering the calculation and processing of data from 3 (three) dependent variables, namely population growth of West Manggarai Regency (X1), aircraft movements at Komodo International Airport (X2), and GRDP per capita of West Manggarai Regency (X3), and 1 (one) independent variable, namely cargo growth at Komodo International Airport (Y). The selected data will be processed with multiple linear regression, which then gives a coefficient value of 26.28490158 (X1), -112.2805486 (X2), 0.754461199 (X3), and a constant value of -10529364 (Y). the results of the constant and coefficient values will be processed to then produce cargo growth forecasts in the plan years. Projections on the amount of cargo growth in the plan years are determined in 2025 (short-term) with an estimated cargo size of 4,312,645 kg and the need for a cargo terminal area is 3240 m², for 2035 (mid-term) with an estimated cargo size of 6,813,018 kg and the need for a cargo terminal area is 3620 m², and for 2045 (long-term) with an estimated cargo size of 9,313,391 kg and for a cargo terminal area requirement of 3895 m².

Keywords: *Class II UPBU Komodo International Airport, Cargo Terminal, Planning*

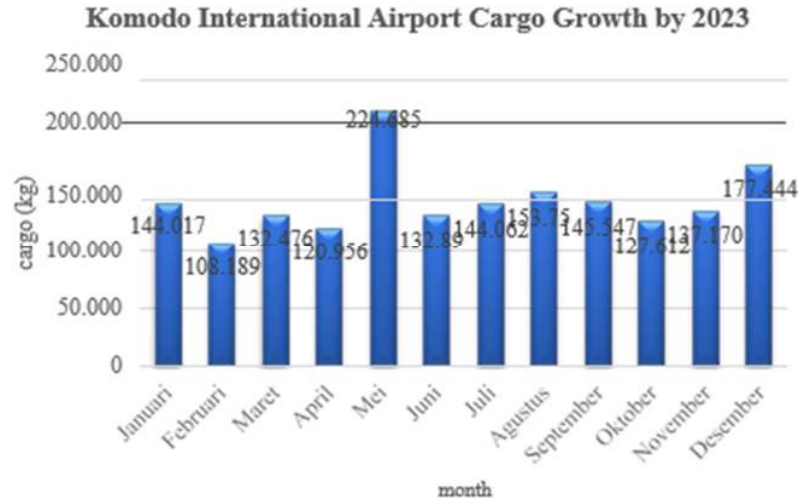
1. Introduction

Komodo International Airport is located at coordinates 08 29' 5.62" N; 199 53' 20.86" E which is located in Labuan Bajo City, West Manggarai Regency, Indonesia. The airport is located on the island of Flores. Komodo International Airport was previously known as Mutiara II Airport.

By continuing to experience developments over time as is known, Komodo Airport has been further upgraded to international airport status as stated in the Decree of the Minister of Civil Aviation of the Republic of Indonesia (KM 31 Tahun 2024).

Based on data from UPBU Komodo, during the COVID-19 pandemic Komodo International

Airport experienced an increase in the number of cargo. Until 2023 yesterday, the increase in cargo showed a significant number, as shown in the graph below. which is quite significant, as will be shown in the following graph.



Source: UPBU Class II Komodo, 2024

Figure 1. 1 LBJ Cargo Growth Chart by 2023

The increasing amount of cargo certainly greatly affects the ability of the Komodo International Airport cargo warehouse capacity to serve the demand for air cargo services. Komodo International Airport to serve the demand for air cargo services. To serve the surge in air cargo demand, UPBU Komodo will carry out a gradual development of the airport cargo terminal (KM 183 Tahun 2022 RIB KOMODO).

As is known, Komodo Airport does not yet have a special cargo terminal for cargo services and only relies on temporary warehouses for cargo storage. This is certainly a problem where, without a cargo terminal facility, the airport may not be able to serve air cargo more efficiently, which can also lead to limitations in the services offered by the airport. This can certainly have a negative impact in several aspects, especially in the field of logistics and supply chain.

With the status of International Airport now held by Komodo Airport, of course there is a need for standards and completeness of cargo handling facilities at the airport.

Air cargo handling facilities and procedures are contained in Annex 9 (Facilitation) and Annex 17 (Security) of the International Civil Aviation Organization (ICAO) as standard provisions and recommended practices covering various aspects of airport operations, including cargo handling.

The planning for the construction of a cargo terminal at Komodo International Airport is expected to meet air cargo handling standards and make Komodo Airport able to maximally

facilitate air cargo services.

Based on the research background, the researcher provides a formulation of the problems that will be discussed in this study. The formulation of the problem is whether the specified variables can significantly affect the projection of cargo growth patterns at Komodo International Airport and whether future projections of air cargo growth can significantly affect the area requirements of the cargo terminal plan at Komodo International Airport.

2. Literature review

2.1 Cargo Terminal

Goods (cargo) terminal building facilities are terminal buildings used for unloading and loading operations of goods from transportation/aircraft served by the airport. Cargo terminals function as a means of processing the delivery and receipt of domestic and international air cargo in order to meet flight safety requirements and other predetermined requirements and change modes of transportation from land to air transportation or vice versa (Directorate General of Civil Aviation, 2005).

Cargo terminals are required to have storage facilities specifically for valuables, dangerous goods (B3) and others. With the function of the cargo terminal as a place for the transfer of goods / cargo between modes, it is necessary to have a cargo inspection room.

2.2 Cargo Terminal Planning

Cargo terminal planning has different factors that affect the need for cargo terminal development at each airport. Planning is intended as a guide for future development, in order to serve the demand for air cargo (Magaña et al., 2017) . According to the Federal Aviation Administration (FAA), several factors involved in cargo terminal planning include needs analysis, land selection, cargo terminal planning, financial design, and project planning. and project planning

2.2.1 Cargo Terminal Area Requirement

Referring to SKEP 347/XII/1999, cargo terminal area requirements need to be considered in the construction of cargo terminals. to maximize the results of area requirements and optimize the use of cargo terminals.

Some factors that need to be considered in determining the cargo terminal area are in accordance with SKEP 347/XII/1999 as follows:

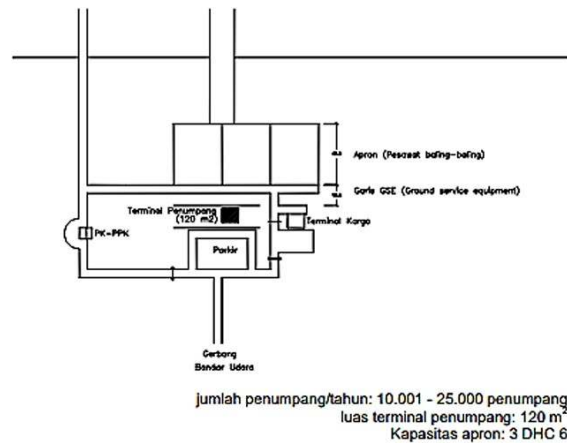
- a. Market Demand Forecast
- b. Flight Activity
- c. Design Capacity
- d. Site Selection
- e. Cargo Handling Concept

The above factors are used as a reference in calculating the required cargo terminal plan area

2.2.2 Cargo Terminal Layout

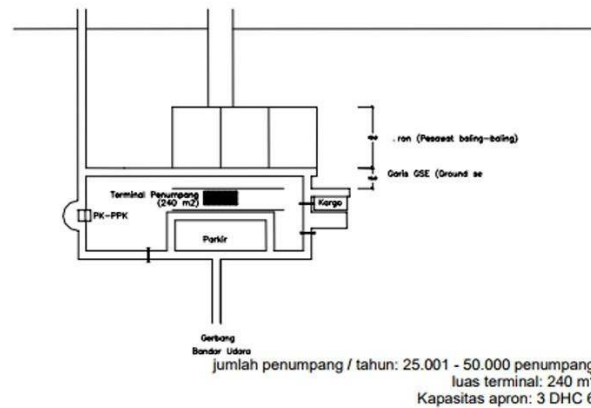
According to SNI 03-7047-2004, it can be said that the layout of the cargo terminal building is determined based on the number of passengers per year, apron capacity, and passenger terminal area. This is determined to determine the location or position of the cargo terminal against other buildings at the airport.

The following is an image related to the layout of the cargo terminal according to SNI 03-7047-2004.



Source: (SNI) 03-7047-2004

Figure 2. 1 Layout of Cargo Terminal with 10,000-25,000 pax/years



Source: (SNI) 03-7047-2004

Figure 2. 2 Layout of Cargo Terminal with 25,001-50,000 pax/years

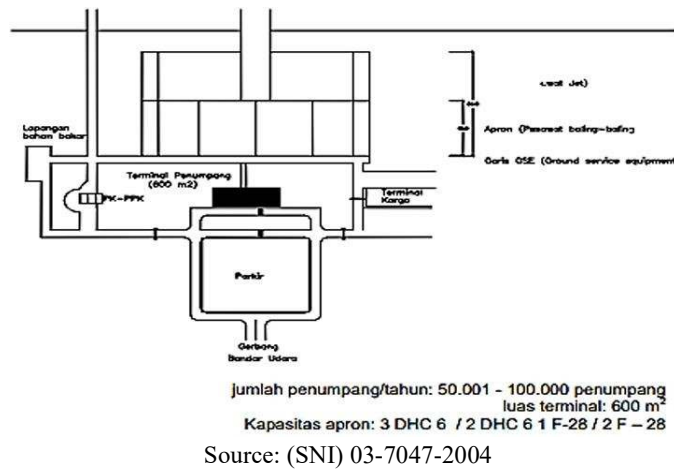
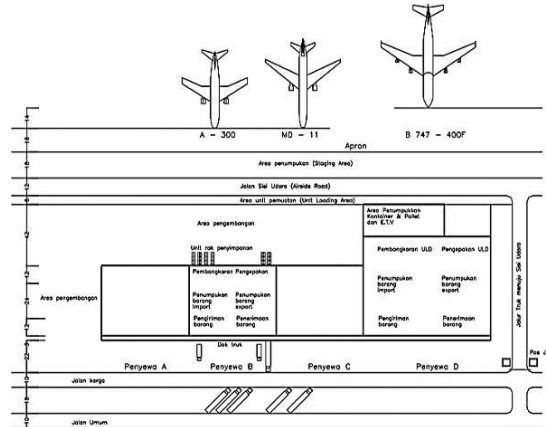


Figure 2. 3 Layout of Cargo Terminal with 50,001-100,000 pax/years

2.2.3 Cargo Terminal Building Form

Cargo terminal buildings are basically designed with a planned system to facilitate the development of cargo terminals for the future, this involves consideration of the operating and storage systems to be used (Directorate General of Civil Aviation Ministry of Transportation, 1999). An overview of the shape of the cargo terminal building can be seen in the following figure.



Source: (SNI) 03-7047-2004 – Top View

Figure 2. 4 Cargo Terminal Building Concept

Please note, the cargo terminal building has several facilities and special rooms intended for valuables, Dangerous Goods and customs.

An inspection room in the cargo terminal building is essential for the inspection of goods entering the cargo terminal (SKEP/40/II/95, 1995). This inspection is carried out due to the transfer between modes of transportation of goods / cargo from land transportation to air transportation modes or vice versa as well as administrative checks related to operations such as customs and excise.

2.3 Calculation Of Cargo Terminal Building Area

Some comprehensive analysis is required in determining the size of the cargo terminal building based on several key factors: the type of services available, operational efficiency, safety standards, as well as the expected cargo volume. expected cargo volume.

Based on SNI 03-7047-2004 (Minister of Transportation of the Republic of Indonesia, 2005), to determine the area of the cargo terminal building, it is necessary to take into account several factors first, including the cargo airline warehouse area, cargo agent warehouse area, cargo terminal width, air side area, and land side area. The following is the calculation (Sigit Priyanto & Mada, 2019).

2.3.1 Cargo Airline Warehouse Area

$$Q = \frac{N}{p}$$

Description:

Q = Cargo Airline Warehouse Area (m²)

N = Annual Cargo Volume (Ton/Year)

p = Annual Cargo Volume/Unit of Warehouse Area (Ton/m²)

The p value has a relationship with the N value. The relationship between the p value and the N value can be reviewed from the table below.

Tabel 2.1 p Value

ANNUAL CARGO VOLUME (Ton)	p (Ton/m ²)
1000	2
2000	3,3
5000	6,8
10000	11,5
50000	15

Source: (SNI) 03-7047-2004

2.3.2 Cargo Agent Area

$$S = \frac{Q}{r}$$

Description:

Q = Cargo Airline Warehouse Area (m²)S = Cargo Agent Warehouse Area (m²)r = Area of Cargo Agent Warehouse / Area of Airline Warehouse (0.5m²)**2.3.3 Cargo Terminal Width**

$$U = \frac{Q + S}{t}$$

Description:

U = Cargo Terminal Width

t = Standard Depth of Cargo Terminal

The Cargo Terminal has a depth standard that is determined by the shape of the cargo airline warehouse and cargo agent. can be seen in the following table.

Tabel 2.2 Cargo Terminal Airside Area Depth Standard

FORM	AIRLINE WAREHOUSE	CARGO AGENT WAREHOUSE
Combine	15 - 20 m	
Separate	15 - 30 m	10 - 15 m

Source: (SNI) 03-7047-2004

2.3.4 Airside Area

$$Y = U \times w$$

Description:

U = Cargo Terminal Width

w = Standard Depth Of Airside (10 - 15 m)

2.3.5 Landside Area

$$X = U \times v$$

Description:

U = Cargo Terminal Width

v = Standard Depth Of Landside

The shape of cargo airlines' and cargo agents' warehouses is a provision of the standard depth of the landside. The following is the table of provisions.

Tabel 2.3 Cargo Terminal Landside Area Depth Standard

FORM	AIRLINE WAREHOUSE	CARGO AGENT WAREHOUSE
Combine	20 - 25 m	
Separate	40 m	15 m

Source: (SNI) 03-7047-2004

2.3.6 Cargo Terminal Area Requirement

The results obtained from the calculation of the above factors, such as the cargo terminal warehouse area, cargo agent warehouse area, air side area and land side area. Then, we can calculate the cargo terminal area requirement as follows

$$Z = Q + S + X + Y$$

3. Research method

The research method used is quantitative methodology by forecasting the growth of the amount of cargo using multiple linear regression (multi-regression) calculation tools.

3.1 Literature Study

As a solid theoretical foundation for this investigation, it is impossible to separate this writing from the presence of theoretical and research reviews from pertinent journals and/or earlier works. Research on the design, development, and building of airport cargo terminals is compiled in this theoretical study and earlier studies.

In this instance, the author's suggestion or point of reference for investigating the planning of cargo terminal area requirements at Komodo Labuan Bajo International Airport is the identification of case studies from other airports that have carried out research pertaining to the planning of cargo terminal area requirements.

3.2 Data Collection

Data collection in this study is aimed at obtaining accurate information/data related to factors affecting cargo growth at Komodo International Airport.

3.2.1 Data Source

a. **Primary Data:** Primary data collection was carried out through direct observation of the research location, interviews with related parties and cargo

warehouse operations staff of the UPBU Class II Komodo International Airport office. The following is a table of primary data presentation.

Tabel 3.1 : Primary Data Presentation

No.	Data Description	Indicator	Interview Question
1	Direct Observation	The author's observation of the condition of cargo handling at the Komodo International Airport - Interview Question Komodo.	
2	Interview	Cargo terminal availability at Komodo International Airport	Is there a cargo terminal at this airport?
		Cargo trend growth at Komodo International Airport in the last three years	how has the cargo growth been in the last three years?
		the necessity for Komodo International Airport to include a cargo terminal	is it important to have a cargo terminal at this airport?

Source: Researcher, 2024

b. **Secondary Data:** Secondary data was collected through annual data reports of UPBU Class II Komodo International Airport, statistical data of BPS (Central Bureau of Statistics) of West Manggarai Regency, KM 29 of 2005 (SNI 03-7047-2004), books and journals related to cargo terminal planning and government regulations related to cargo terminals.

3.3 Data Analysis

The results of data collection are then processed and analyzed for the relationship between variables. It is known that cargo growth at Komodo International Airport is the dependent variable that influences the need for cargo terminals, while population growth, aircraft movements and GRDP per capita in West Manggarai Regency are independent variables. We can know the relationship between variable Y (dependent) and variable X (independent) as follows.

- a. **Population (X₁):** knowing the amount of population growth in West Manggarai Regency gives us an assumption that if the population increases, then the demand for logistics-related tends to increase, which in this case can affect cargo growth.

- b. **Aircraft Movement (X₂):** Komodo International Airport still serves a lot of cargo transportation using commercial (passenger) aircraft, so this is an assumption if an increase in the number of aircraft movements can affect the availability and acceleration of cargo growth at this airport.
- c. **Per-Capita of West Manggarai (X₃):** Economic activity in the region also needs to be considered for cargo growth. GRDP per capita provides a reflection of the level of welfare and economic activity in West Manggarai Regency. It can be assumed that if the level of GRDP per-capita in the region is fairly good, it can indicate economic growth and increase in air cargo growth

4. Results and discussion

4.1 Komodo Labuan Bajo International Airport Cargo

Cargo at Komodo International Airport is experiencing significant growth. This condition certainly greatly affects the availability of cargo terminals at the airport, and again, after the issuance of KM 31 in 2024, which establishes Komodo Airport as an airport with international status, it also strengthens the need for a cargo terminal to be built at the airport to support global logistics and meet the demand for large cargo volumes.

4.1.1 Cargo Growth

Forecasting cargo growth at Komodo Labuan Bajo International Airport is calculated using historical data sourced from the UPBU Class II Komodo International Airport office. For cargo growth using historical cargo data from 2013 to 2023. Komodo International Airport cargo in 2013 to 2023 which is used as a calculation to obtain the amount of cargo growth forecasting can be seen in the following table.

Tabel 4.1 LBJ Airport Cargo Growth (2013 - 2023)

YEAR	KARGO (kg)	CARGO GROWTH RATE (%)
2013	279.482	-14,45
2014	324.469	16,1
2015	266.435	-17,9
2016	563.950	111,7
2017	628.944	11,5
2018	802.308	27,6
2019	777.381	-3,1

2020	662.843	-14,7
2021	2.143.365	223,4
2022	2.218.265	3,5
2023	1.748.806	-21,2

Source: UPBU Class II Komodo International Airport Office, 2024

Then if we look at the development of cargo for the last three years (2020 - 2023), we can see the growth as follows in the table and graph below.

Tabel 4.2 LBJ Monthly Cargo Growth 2020 – 2023

NO	MONTH	YEARLY CARGO (Kg)			
		2020	2021	2022	2023
1	January	39.532	148.560	197.880	144.017
2	February	30.078	146.035	161.929	108.189
3	March	22.690	159.597	188.280	132.476
4	April	3.730	205.330	183.505	120.956
5	May	848	107.944	163.852	224.685
6	June	15.001	196.421	174.027	132.894
7	July	44.851	166.005	227.612	144.062
8	August	45.910	163.569	180.350	153.754
9	September	60.193	189.115	214.475	145.547
10	October	91.479	208.556	168.805	127.612
11	November	129.252	208.277	163.359	137.170
12	December	179.279	243.956	194.191	177.444
TOTAL PER-YEAR		662.843	2.143.365	2.218.265	1.748.806

Source: UPBU Class II Komodo International Airport Office, 2024

Cargo growth forecasting is carried out to determine and provide results of estimated cargo growth conditions at Komodo International Airport for the next 30 years.

4.2 Primary Data Presentation

Primary Data Presentation is the process of compiling and presenting data obtained directly from the original source, generally this data is obtained through direct methods such as surveys, interviews, observations and experiments. The purpose of presenting primary data is to facilitate analysis and convey the findings in the study.

The author presents primary data by direct observation and interviews with Komodo International Airport staff related to the provision of cargo terminal facilities at the airport. The following are results of the author's primary data presentation.

Tabel 4.3 Primary Data Presentation

No.	Data Description	Indicator	Interview Question	Answer	Subject
1	Direct Monitoring	Author's observation of the condition of cargo handling at Komodo International Airport.	-	-	Komodo International Airport Cargo Warehouse
2.	Interview	Cargo terminal availability at Komodo International Airport.	Is there a cargo terminal available at this airport?	Not yet	Komodo International Airport Staff
		Cargo trend growth at Komodo International Airport in the last three years	How has the cargo growth been in the last three years?	From the data we collected, the growth of air cargo at this airport has increased quite significantly	Komodo International Airport Staff
		The need for a cargo terminal at Komodo International Airport	Is it important to have a cargo terminal at this airport?	Of course it is, looking at the current conditions.	Komodo International Airport Staff

Source: Researcher, 2024

4.3 Forecast

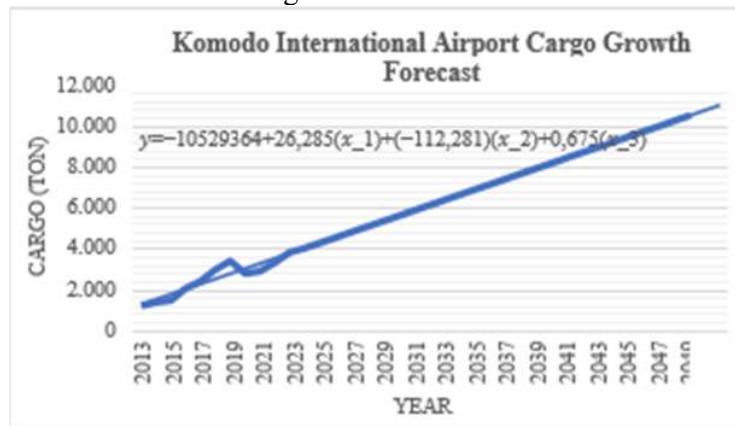
At the multiregression calculation stage, we have obtained the constant value input in the equation.

$$y = \beta_0 + \beta_1 x_1 + \beta_2 x_2 + \beta_3 x_3$$

With the input value of $\beta_0 = -10529364$, $\beta_1 = 26,285$, $\beta_2 = -112,281$, $\beta_3 = 0,675$, which if entered into the multiregression equation is as follows:

$$y = -10529364 + 26,285(x_1) + (-112,281)(x_2) + 0,675(x_3)$$

And then for the results of the calculation of cargo growth forecasting in the plan year can be seen in the following table.



Source: Researcher Analysis, 2024

Figure 4.2 LBJ Cargo Growth Forecast Chart

From the chart analysis above, we can see the details of the cargo growth of Komodo Labuan Bajo International Airport in the plan years in the following table.

Tabel 4.10 LBJ Cargo Growth Forecast

YEAR	FORECAST CARGO (Kg)	CONVERT TO TON
2013	1.243.804	1.244
2014	1.422.499	1.422
2015	1.512.886	1.513
2016	2.107.087	2.107
2017	2.458.080	2.458

2018	3.022.141	3.022
2019	3.437.986	3.438
2020	2.834.562	2.835
2021	2.931.151	2.931
2022	3.356.640	3.357
2023	3.859.381	3.859
2024	4.062.607	4.063
2025	4.312.645	4.313
2026	4.562.682	4.563
2027	4.812.719	4.813
2028	5.062.757	5.063
2029	5.312.794	5.313
2030	5.562.831	5.563
2031	5.812.868	5.813
2032	6.062.906	6.063
2033	6.312.943	6.313
2034	6.562.980	6.563
2035	6.813.018	6.813
2036	7.063.055	7.063
2037	7.313.092	7.313
2038	7.563.130	7.563
2039	7.813.167	7.813
2040	8.063.204	8.063
2041	8.313.242	8.313
2042	8.563.279	8.563
2043	8.813.316	8.813
2044	9.063.354	9.063
2045	9.313.391	9.313
2046	9.563.428	9.563
2047	9.813.466	9.813
2048	10.063.503	10.064
2049	10.313.540	10.314
2050	10.563.578	10.564

Source: Researcher Analysis, 2024

Based on the graph and table above, cargo growth is linearly growing in the plan years.

5. Conclusion

Based on the results of the research on cargo terminal area requirements at Komodo International Airport, it was found that independent variables such as population, aircraft

movements, and GRDP per capita have a significant influence on cargo growth with an influence level of 72.1%. These factors indicate the importance of considering flight activity and economic conditions in projecting future cargo growth patterns. Cargo growth projections for the plan years (2025-2050) show a linear increase affecting cargo terminal area requirements.

The forecasting results show that the cargo terminal area needs to be increased gradually: 3,240 m² in 2025, 3,620 m² in 2035, and 3,895 m² in 2045, in line with the projected increase in cargo volumes. This indicates that planning for terminal construction and expansion should be aligned with growth forecasts to optimize airport facilities for projected needs.

6. Implications

First, the identification of independent variables such as population, aircraft movements, and GDP per capita has a significant impact on the projected growth of cargo at the airport. This shows the importance of considering economic factors and aviation activities in cargo terminal planning in order to meet long-term needs until 2050.

7. Research limitations

There are limitations that the author did in the research, such as the focus of research only on planning the needs of the cargo terminal area. It is hoped that further research can be carried out more broadly on the planning of cargo terminal development, such as calculations of special apron requirements for cargo aircraft, optimization of the use of cargo space and so on.

References

- 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.
- ICAO. (1999). *ICAO Annex 14: Aerodrome Standards - Aerodrome Design and Operations*. July, 194.
<https://www.icao.int/safety/Implementation/Library/Manual/AerodromeStds.pdf>
- Keputusan Menteri perhubungan. nomor 183 (2022). Rencana Induk Bandar Udara (RIB) KOMODO Labuan Bajo.*
- Sigit Priyanto, S. dan D. Y. (2019). WARTA ARDHIA Jurnal Perhubungan Udara Analisis Pengembangan Terminal Kargo Bandar Udara Juanda Surabaya Guna Mendukung Sistem Logistik Nasional (Sislognas) The Analysis of Juanda Surabaya Airport Cargo Terminal Development in Supporting.
- Standar Nasional, & Nasional Indonesia. (2004). *Terminal kargo bandar udara* (pp. 1–14).