



PERFORMANCE ANALYSIS OF WIRELESS ON THE GROWTH OF USERS OF SEA TRANSPORTATION SERVICES IN HUNIMUA PORT - CENTRAL MALUKU

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Abstract Hunimua Harbor is the link between Ambon Island and Seram Island. The flow of growth in sea transportation users at Hunimua Port in the last five years has increased. The preliminary analysis of Hunimua Port shows that in 2021 passenger growth is 21%, 2-wheeled vehicle growth is 17%, 4/6-wheeled growth is 24%, and ship visit growth is 5%, respectively, and Berth Occupancy Ratio (BOR) is 72%. The results showed that the average annual load growth over the next ten years was 1.7% for passengers, 1.2% for R-2 vehicles, and 4.5% for R-4/6 vehicles. The Load Factor in 2026 has reached 68%, and in 2031 it has born 67%, which means that the level of demand for ferry transportation has exceeded the available capacity, based on the Regulation of the Minister of Transportation of the Republic of Indonesia Number PM 104 of 2017 concerning the Implementation of Ferry Transportation. The Berth Occupancy Ratio (BOR) value for 2026 = 82%, and in 2031 = 92%. From the percentage of BOR values in table 2.1 based on UNCTAD standards, Hunimua Port should have more than six piers ready to operate in 2026.	Article history: <i>Submitted 31-03-2023</i> <i>Revise on 27-05-2023</i> <i>Published on 28-05-2023</i> Keyword: <i>Wharf Performance, Berth Occupancy Ratio (BOR), Load Factor, Prediction</i> <i>DOI: http://dx.doi.org/10.26418/jtsft</i>
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1. Introduction

The Maluku Province as an archipelago, which has an area of 581,376 Km², consists of approximately 90% of the sea area of 527,191 and 10% of the land area of 54,185, which consists of 11 regencies/cities (Balai Pengelola Darat Daerah XXIII, Maluku). Based on the assistance of LAPAN satellite imagery, the total number of islands in Maluku Province is 1,412. The area of the islands in this province varies between ≤ 761 km² to 18,625 km² (Titaley, 2006). The number of islands scattered and the sea area is wider than the land area. So that makes the sea transportation system very important to support various activities in Maluku Province. Cruise ship activities are needed to transport or transport passengers and goods to expedite economic activities, so sea transportation infrastructure in the form of a port is necessary. The Maluku area, especially the Central Maluku district, has ports, one of which is Hunimua Port which PT manages. ASDP Indonesia Ferry (Persero) Ambon Branch.

Hunimua Port has two piers to serve trips on the Hunimua – Waipirit route. According to data from the Land Transportation Management Center for Region XXIII, Maluku, five ferries are operating at Hunimua Port, namely KMP. The worst KMP. Inelika, KMP. Cape Koako, KMP. Roka Tenda, and KMP. Sardinela. Ferries sailing from Hunimua port - Central Maluku to Waipirit port, West Seram Regency, still depend on conditions and weather. The Hunimua - Waipirit homecoming flow often sees a surge in passengers on days such as Idul Fitri, Christmas, and New Year.

Based on data obtained from PT Indonesian ASDP ferry, it is necessary to re-analyze the performance of the harbor to see whether the availability of the existing pier is capable of answering the demand or demand for Hunimua Port - Central Maluku in the future (based on the BOR value). As well as restraining the growth of passengers, vehicles, and ship visits in the next 5 and 10 years, then analyzing the Load Factor.

2. Materials and Methods

2.1 Theoretical Frame Work

According to Triatmodjo (2010), a port is an area of water protected against waves. It has sea terminal facilities, including a pier where ships can moor for loading and unloading goods, cranes for cranes loading and unloading goods, and sea warehouses (transit). And storage places where ship unloads their cargo and warehouse where goods can be stored for a long time, waiting for delivery to the destination or shipment.

Passenger ports/terminals are used by people traveling by passenger ships. The passenger terminal is equipped with a passenger station that serves all activities related to the needs of travelers, such as waiting rooms, shipping airline offices, ticket sales points, prayer rooms, toilets, immigration offices, customs offices, security, port directors, and so on. Only so many items must be unloaded that the warehouse can be small. For the smooth entry and exit of passengers and goods, it is better if the entrance/exit are separated. Passengers pass through the upper floors using a bridge to the ship, while goods go through the pier. In ports with significant tidal heights, floating bridges are made, which passengers use to enter the boat and vice versa. It is an example of a passenger port.

Pier can be divided into three types: wharf, pier, and jetty. A Wharf is a pier parallel to the beach and usually coincides with the shoreline. Wharf can also function as a barrier to the ground behind it. Pier is a pier on the shoreline and perpendicular to the coastline. The port of Hunimua has an open wharf type wharf.

2.2 Research Location

The location used for this research is Hunimua Harbor. The area of research location is located in Liang Village, Salahutu District, Central Maluku Regency, Maluku Province, and is managed by PT. (Persero) ASDP Indonesia Ferry.

2.3 Data

This study uses primary data, Observations, and interviews: ship arrival, unloading/loading time, ship sip. and secondary data from PT. ASDP Indonesia Ferry, Maluku, data on port layout data, port area zones, port facilities, and infrastructure, number of ship data, and operational data for the last five years.

In summary, the course of the research is like the following flowchart



Figure 1. Research Location (Land Transportation Management Office for Region XXIII, Maluku

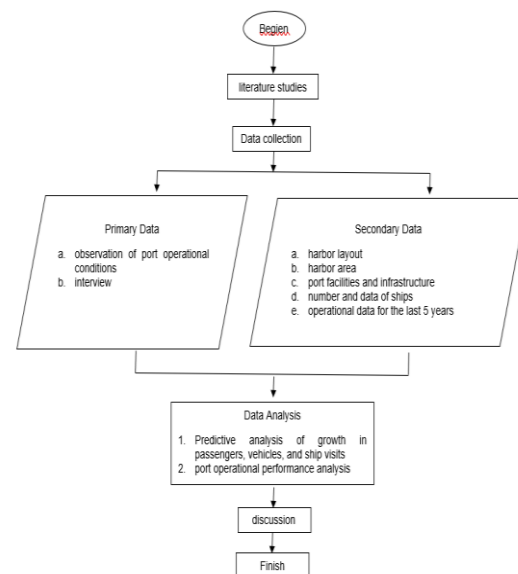


Figure 2. Research Flow Chart

2.4 Analysis Method

This study includes predicting passenger growth, motorcycles (2 wheels), low/heavy vehicles (4/6 wheels), and ship visits. Load factor analysis, Berth Occupancy Ratio (BOR)

2.4.1. Data

2.4.1.1. Ship data

Five ferries are operating at Hunimua Port: Inelika, KMP Terubuk, and KMP Roka Tenda from PT. ASDP Indonesia Ferry (Persero), KMP Tanjung Koako, and KMP Sardinela from PD. Panca Karya

2.4.1.2. Unloading Data

Ferry loading/unloading activities on the Hunimua-Waipirit route can be seen in the table below.

Table 1. Loading and unloading activities (PT. ASDP Indonesia Ferry (Persero) Ambon Branch, 2022)

Years	Payload		
	Passenger	Payload r-2	Payload R-4/6
2017	246.692	205.789	56.206
2018	593.156	228.178	125.792
2019	481.861	204.868	91.995
2020	111.676	40.123	30.433
2021	526.135	228.381	132.171

2.4.1.3. Ship/Trip Visit Data

Data on ship visits/trips on this route since 2017 are presented in Table 2 below.

Table 2. Ship Visit Data/Trip (PT. ASDP Indonesia Ferry (Persero) Ambon Branch, 2022)

No	Years	Hunimua	Information
1	2017	3.153	Three ships
2	2018	3.352	Four ships Five ships
3	2019	3.220	(4 Operational ships 1 Off) Five ships
4	2020	3.005	(4 operational ships 1 Off) 5 Ship
5	2021	3.810	(4 operational ships 1 Off)

3. Result and Discussion**3.1. Passenger Growth Prediction**

To get the growth rate of the number of passengers, data from the previous five years is required, which is available in Table 1 by using buying and selling $Y = a + bx$. To find the value of b and the equation is used as follows:

$$b = \frac{n(\sum xy) - (\sum x)(\sum y)}{n(\sum x^2) - (\sum x)^2} \quad (1)$$

$$b = \frac{5 \times (5.955.966) - (15)(1.959.520)}{5 \times (55) - (15)^2}$$

$$b = \frac{387.030}{50}$$

$$b = 7740,6$$

$$a = \frac{\sum y - (b \times \sum x)}{n} \quad (2)$$

$$a = \frac{1.959.520 - (7740,6 \times 15)}{5}$$

$$a = \frac{1.843.411}{5}$$

$$a = 368.682$$

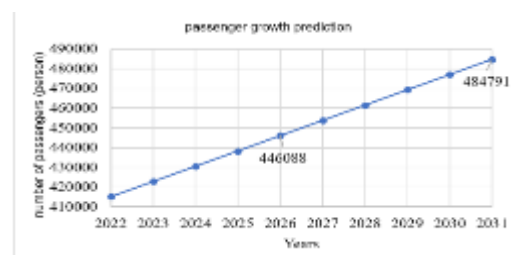
Then we get the linear regression formula to predict passenger growth: $Y = 368.682 + 7740,6x$.

With the linear regression equation obtained on the analysis of passenger growth, predictable growth spurts passengers until 2031, as for the equation used to predict passenger growth n-5 (The year 2026), n-10 (Year 2031), $y = 368.682 + 7740,6x$. can be seen in the table

From Table three, it can be seen that ten growth is predicted in the coming years. Passengers follow the trend of five-year passenger growth data plotted in the graph contained in the following image 3.

Table 3. Recapitulation of passenger growth prediction results

Years	Passenger growth
2022	415.126
2025	438.348
2026	446.088
2027	453.829
2030	477.051
2031	484.791
Growth (%)	1,7%

**Figure 3.** Passenger growth prediction

3.2. Growth Prediction Motor Cycle (2 Wheels)

With the linear regression equation motorcycle until 2031, for the equation used to predict passenger growth n-5 (The year 2026), n-10 (The year 2031), $y = 158.412 + 2.192,3x$. Can be seen in table 4.

Table 4. Recapitulation of motorcycle prediction results

Years	Motor cycle
2022	171.566
2025	178.143
2026	180.335
2027	182.527
2030	189.104
2031	191.297
Growth (%)	1,2%

From Table. 4, it can be seen that ten growth is predicted in the coming years. Motorcycles follow the five-year passenger growth data trend plotted in the graph in The following figure 4.

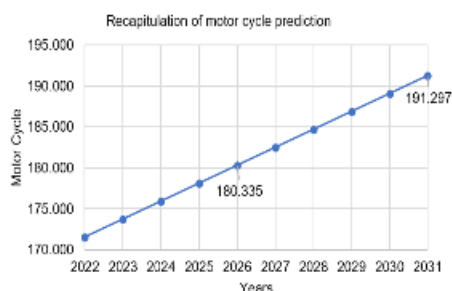


Fig 4. Recapitulation Motor Cycle prediction

3.3. Low/Heavy Vehicles (4/6 wheels)

Table 5. Recapitulation of low/heavy vehicle prediction results

Years	Low/Heavy Vehicle
2022	104.291
2025	121.262
2026	126.919
2027	132.576
2030	149.548
2031	155.205
growth (%)	4,5%

With the linear regression equation low/heavy until 2031, As for the equation used to predict passenger growth n-5 (Year 2026), n-10 (Year 2031), $y = 70.348 + 5.657,1x$. can be seen in the table.

From Table. 5 it can be seen that for 10 growth is predicted in the coming years low/heavy vehicle follow the trend of five-year passenger growth data plotted in the graph contained in The following image:

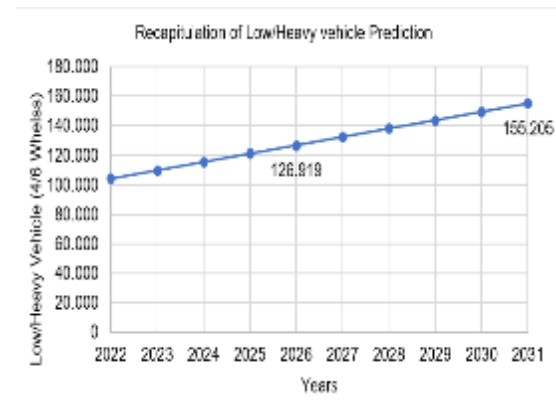


Fig 5. Recapitulation low/heavy vehicle prediction

3.4. Prediction of Ship Visit Growth

Table 6. Recapitulation of ship visit prediction results

Years	Ship Visit
2022	3.598
2025	3.888
2026	3.985
2027	4.082
2030	4.372
2031	4.468
Growth (%)	2,4%

Source: Calculation Analysis

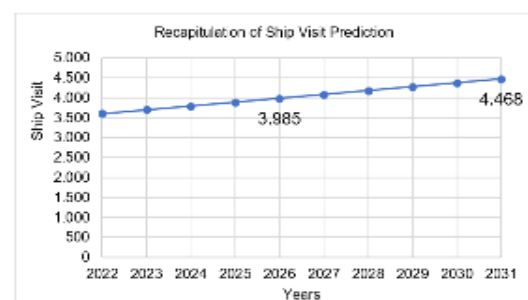


Fig 6. Recapitulation ship visit prediction

With the linear regression equation, ship visit growth is low/heavy until 2031. As for the equation used to predict passenger growth, $n-5$ (2026), $n-10$ (2031), $3.017,9 + 96,7x$. can be seen in the table.

From Table. 6, it can be seen that for ten growth is predicted in the coming years, visit ships follow the trend of five-year passenger growth data plotted in the graph contained in the following image:

3.5. Load Factor Analysis

According to data for 2021, the ferry load capacity is 256 passengers and 22 units of vehicles, so by using analytical data, we can find out the load factor as follows

Available Capacity = Average capacity x Trips

Available Capacity 2026 (passengers) = $256 \times 3.985 = 1.020.160$

Available Capacity 2026 (units of vehicles) = $22 \times 3.985 = 87.670$

$$LF_{2026} = \frac{446.088 + 180.335 + 126.919}{1.020.160 + 87.670} \times 100\%$$

$$LF_{2026} = \frac{753.342}{1.107.830} \times 100\%$$

$$LF_{2026} = 68\%$$

Available Capacity 2031 (passengers) = $256 \times 4.468 = 1.143.808$

Available Capacity 2031 (units of vehicles) = $22 \times 4.468 = 98.296$

$$LF_{2031} = \frac{484.791 + 191.297 + 155.205}{1.143.808 + 98.296} \times 100\%$$

$$LF_{2031} = \frac{831.292,3}{1.242.104} \times 100\%$$

$$LF_{2031} = 67\%$$

The results of the analysis above, in 2026 and 2031, the load factor will exceed 65%, which means that the level of demand for ferry transportation has exceeded the available capacity, which is following the requirements of the Minister of Transportation of the Republic of Indonesia Number PM 104 of 2017 concerning the Implementation of Ferry Transportation. So adding a ferry fleet serving the Hunimua–Waipirit route is necessary

Table 7. Low Factor

Years	Ship Visit	available capacity		Load Factor (%)
		passengers	vehicles	
2026	3.985	1.020.160	87.670	68 %
2031	4.468	1.143.808	98.296	67 %

3.6. Berth Occupancy Ratio (BOR)

Based on the results of the analysis using the equation below. Calculate the 2026 BOR value

$$BOR_{2026} = \frac{kk \cdot (\sum LOA + 5) \cdot BT}{Pier Length \cdot Available Time In One Period} \times 100\%$$

$$BOR_{2026} = \frac{3.985 \times (46,45 + 5) \times 0,17}{8 \times (14,5 \text{ jam} \times 365)} \times 100\%$$

$$BOR_{2026} = \frac{34.854,8}{70.080} \times 100\%$$

$$BOR_{2026} = 82\%$$

Calculate the 2031 BOR value

$$BOR_{2031} = \frac{4.468 \times (46,45 + 5) \times 0,17}{8 \times (14,5 \text{ jam} \times 365)} \times 100\%$$

$$BOR_{2031} = \frac{39.079,4}{70.080} \times 100\%$$

$$BOR_{2031} = 92\%$$

Table 8. Bert occupancy ratio

Years	BOR %
2026	82 %
2031	92 %

Based on the analysis results, it is known that the Berth Occupancy Ratio (BOR) value for 2026 = 82%, and in 2031 = 92%. From the percentage of BOR values based on UNCTAD standards, Hunimua Port should have more than six berths ready to operate in 2026.

Based on the data above illustrates that there is a positive growth in shiploads and ship visits on the Hunimua - Waipirit route. Over the next ten years, the average change in shiploads and ship visits per year is 1.7% for passengers, 1.2% for 2-wheeled vehicles, 4.5% for 4/6-wheeled cars, and 2.4% for ship visit.

1. The load Factor in 2026 has reached 68%. In 2031 it has born 67%, which means that the demand for ferry transportation has exceeded the available capacity of 65%, following the requirements of the Regulation of the Minister of Transportation of the Republic of Indonesia Number PM 104 of 2017 concerning Organizing Transportation Crossing. So adding a ferry fleet serving the Hunimua – Waipirit route is necessary.

4. Conclusion

Based on the research and analysis that has been done, the average payload growth per year over the next ten years is 1.7% for passengers, 1.2% for R-2 vehicles, and 4.5% for R-4/6 vehicles. The Load Factor in 2026 has reached 68%, and in 2031 it has born 67%, which means that the level of demand for ferry transportation has exceeded the available capacity, based on the Regulation of the Minister of Transportation of the Republic of Indonesia Number PM 104 of 2017 concerning Implementation of Ferry Transportation. So adding a ferry fleet serving the Hunimua–Waipirit route is necessary. The Berth Occupancy Ratio (BOR) value for 2026 = 82%, and in 2031 = 92%. From the percentage of BOR values based on UNCTAD standards, Hunimua Port should have more than six berths ready to operate in 2026.

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6. Author's note

The author declares that there is no conflict of interest in publishing this article. The author confirms that the paper is free from plagiarism.

7. References

- Albasri, E. S., Rusmin, M., & Butudoka, M. A. (2022). **Analisis Kinerja Dermaga Terhadap Pertumbuhan Pengguna Jasa Transportasi Laut Di Pelabuhan Rakyat Kota Sorong**. *Jurnal Ilmiah Teknik Sipil (JIMATS)*, 1(1), 24-28.
- Danica Evan, D. E., Budiharso Hidayat, A. T. D., MT, B. H., Hermawan, B. A., & MT, B. A. H. (2021). **Perencanaan Pengembangan Fasilitas Sisi Darat Di pelabuhan Penyeberangan BAUBAU DIKOTa Baubau**. *Perencanaan Pengembangan Fasilitas Sisi Darat Di Pelabuhan Penyeberangan Baubau Dikota Baubau*, 1(1), 1-10.
- Fachrurrazi, T. M., Budiarta, N., & Mataram, N. K. (2013). **Analisis Kinerja Dermaga Terhadap Pertumbuhan Pengguna Jasa Transportasi Laut Di Pelabuhan Padangbai-Bali**. *Jurnal Ilmiah Teknik Sipil*, 17(2), 168-178.
- Gujarati, Damodar. (2006). **Dasar-Dasar Konometrika**. Jakarta: Erlangga
- Peraturan Direktur Jenderal Perhubungan Laut. (2017). Nomor HK 103/2/2/DJPL-17 **Tentang Pedoman Perhitungan Kinerja Pelayanan Operasional Pelabuhan**
- Sembiring, R.K. (1995). **Analisis Regresi**. Bandung: ITB Bandung
- Soedjono Kramadibrata, (2001). **Perencanaan Pelabuhan**. Bandung. ITB bandung
- Sudjana, Prof. Dr. (2003). *Teknik Analisis Regresi dan Korelasi*. Bandung: PT. Tarsito
- Triatmodjo, B. (2009). **Perencanaan Pelabuhan**. Yogyakarta: Beta Offset
- Tehupuring, G. P., Retraubun, N., & Telussa, M. F. (2019). **Analisis Efektifitas Kinerja Dermaga Haria Kecamatan Saparua–Kabupaten Maluku Tengah**. *Manumata: Jurnal Ilmu Teknik*, 5(1), 37-46.
- Wikarma, K., Suweda, I., & Suparsa, I. (2016). **Analisis Kinerja Dan Pengembangan Pelabuhan Laut Di Bali** (Studi Kasus: Pelabuhan Celukan Bawang). *Jurnal Spektran*, 47-58.
- Zurkiyah, Z., & Asfiati, S. (2021). **Analisis Tingkat Pelayanan Dermaga Pelabuhan Penumpang Teluk Nibung Asahan, Tanjung Balai Sumatera Utara**. In *Seminar Nasional Teknik (SEMNASTEK) UISU* (Vol. 4, No. 1, pp. 248-252).