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An Analysis of Service Capacity at Ambon Port

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Abstract - This research aims to determine container services, to determine projections and the need for container facilities in relation to traffic projections. This study used qualitative descriptive analysis, namely a method that explains in the form of numbers from the growth of activities. This research was conducted with interviews, library research and documentation. The results of the study show that the flow of container ships has increased. In 2020 it was projected to be 355 calls. It will continue to increase until it is projected to be 560 calls in 2029. Meanwhile, the projected realization of the flow of goods in containers in 2020 was 1,243.164 tons, and the realization of containers is predicted to be 2,015,767 tons. The Berth Occupancy Ratio can be maintained at a maximum of 70% according to the standards, so the length of the wharf at Ambon Port where in 2021, the flow of containers has reached 128,662 TEUs with the number of container ships 377 Calls, the length of the container reached 352 meters. As for the storage yard, the required storage area is 42,316 m2. As for the storage yard at Ambon Port, until 2029, the required storage area is 42,316 m2.

Keywords: accumulation field, containers, port of Ambon, service capacity

I. INTRODUCTION

Transport by sea plays an important role in the current trading system. Transportation is a very important element [1] for human needs, both for individuals and to support economic life in a region [2]. Eighty-five percent (85%) of world trade is by sea, while 90% of trade in Indonesia is by sea [3]. Sea transportation is the main route of trade, Domestic and International. With increasingly stringent regulations at the port, there will be a decrease in the number of exports/imports of goods through the port [4].

The port is a facility especially important for sea transportation, with this transportation, the required mileage will be felt more quickly, especially for the economic development of an area where the production center of consumer goods can be marketed quickly and smoothly. Apart from that, in the economic field, ports have a positive impact on the development of an isolated areas, especially water areas where accessibility by land is difficult to do properly [5]. That's why the port plays an important role [6], in controlling the movement of goods in the import and export process. PT Pelabuhan Indonesia III (Persero), known as Pelindo III, is a State-Owned Enterprise (BUMN) engaged in port terminal operator services.

Therefore, the Port is a very vital company component because production activities, in this case, loading and unloading services, occur there [7]. A Port is a place that consists of land and waters around it with certain boundaries [8] as a place for governmental activities and economic activities used as a place for ships to dock, dock, board passengers and/or load and unload goods equipped with shipping safety facilities and port support activities as well as a place for intra- and inter-mode transportation [3]. Port buildings used to dock and moor ships carrying out the loading and unloading of goods and boarding and disembarking passengers [9].

Port as infrastructure transportation that supports the smooth running of the sea transportation system has a function that is closely related to social and economic factors. Economically, the port functions as one of the driving wheels of the economy because it is a facility that facilitates the distribution of production results, while socially, the port is a public facility in which interactions between users (community) take place, including interactions that occur due to economic activity [10].

More broadly, the port is the central node of a support area (hinterland) and a link with areas outside it.

Port capacity assessment is intended as an effort to determine the utilization and performance of port management so that it clearly shows the level of effectiveness and operational efficiency of various port facilities. Port capacity assessment is expected to be useful as evaluation material in making investment decisions, as well as planning for container terminal development [11].

The operation of a container terminal is one of the important things to support activities at a port. In the operation of container terminals, there are quite a number of obstacles, such as lack of information, traffic, trucks, waiting time, berth windows, inaccessible operators, and slow terminal performance [12].

The smooth performance of the container crane itself is influenced by the age of the tool, duration of use, maintenance, and professionalism of human resources who operate, including good coordination with related parties, so that services become more efficient and prices become competitive. Therefore, the factors mentioned above must be the concern of related parties in order to

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produce high loading and unloading productivity quickly, smoothly and safely [13].

At the end of 2019, the flow of containers at Indonesian ports decreased due to a decrease in transshipment activities, as an economic gateway for Maluku Province, port service activities at Ambon port must be supported by adequate facilities and infrastructure, so that it is expected to support the smooth flow of goods at Ambon port, and can affect the economic growth of society and support regional development.

Ambon City is the capital of Maluku Province. This city is known as Ambon Manise, which means the beautiful, sweet, beautiful city of Ambon and is the largest and central city in the Maluku Islands region. Ambon is a center for ports, tourism and education and as one of the main cities in the development region of Eastern Indonesia from the aspect of development and economic growth.

The port is managed by PT Pelabuhan Indonesia IV (Persero). Ambon Port consists of Yos Sudarso Archipelago Terminal, which is useful for general cargo, container and passenger services for domestic services and inter-island activities, while for regional activities, both for passenger and goods service activities, there are Slamet Riyadi Terminal and Warehouse Arang Terminal. Data on container activities at the Port of Ambon in 2015 – 2019, namely:

TABLE 1
FLOW OF CONTAINERS AT THE PORT OF AMBON

NO	YEAR	DESCRIPTION		
		BOX	THEUS	TONS of containerized goods
1	2015	74,146	79,279	778,801
2	2016	75,738	80,650	806672
3	2017	103,115	109,679	1,097,659
4	2018	120,061	126,993	1,267,308
5	2019	91,464	98.106	977,707

As an economic gate in the Maluku Province, port service activities must be supported by adequate facilities and infrastructure, especially for container activities which continue to experience growth and development of activities, even though at the end of 2019, the flow of containers at the Port of Ambon has decreased due to a decrease in transshipment activities.

But with the availability of adequate facilities and infrastructure, both in terms of capacity, system and good and regular service performance [1], as well as optimal utilization of storage yards, it is expected to support the smooth flow of goods at Ambon Port. Because the smooth flow of goods movement affects the economic growth of the people in Maluku Province and the surrounding areas and supports regional development.

Some previous research results state that the level of use of the pier is no longer able to accept all the flow of ship visits with a Berth Occupancy Ratio (BOR) value above 100%, above the recommended standard determined by UNCTAD (50%), this has an impact on queues as well as the delay time for ships that want to lean on the port [14]. The level of use of the wharf has exceeded the standard value determined by UNCTAD, which is 50% [14]. Cruise lines needed new equipment to improve the performance of their fleets[15]. The existence of port users must be accompanied by a reduction in service time which results in reduced waiting times and queues of vehicles [4].

Ambon Port is one of the ports that is being developed by PT Pelabuhan Indonesia IV (Persero) to improve its container services, so that it can be input for PT Pelabuhan Indonesia IV (Persero) regarding an overview of the container service capacity at Ambon Port based on the movement of container flows, handling systems, and the level of utilization of container stacking yards at the Port of Ambon until 2029.

In addition, it is hoped that it will also provide an overview of whether the container service capacity at Ambon Port will be able to accommodate the growing number of activities in the coming years.

II. METHOD

The data analysis used in this study is a qualitative descriptive analysis, which is a method that explains in the form of numbers the growth of activities at Ambon Port. Qualitative data analysis may involve the process of collecting data, interpreting and reporting results simultaneously and together [11; 12].

Stages To calculate the projected flow of containers at Ambon Port, the Linear Regression Analysis method is used, which is a statistical method that functions to test the extent of a causal relationship between the Causative Factor Variable (X) and the Consequent Variable. Causal Factors are generally denoted by X or Predictor, while Consequential Variables are denoted by Y or Response. Simple Linear Regression, often abbreviated as SLR (Simple Linear Regression), is also one of the statistical methods used in production to make forecasting or predictions about quality and quantity characteristics.
Simple linear regression formula:

$$Y = a + bX \quad (1)$$

Y = MResponse Variables or Consequence Variables (Dependent)

X =Predictor Variables or Causal Factor Variables (Independent)
a =constant
b =Regression coefficient (slope) of the magnitude of the response generated by the predictor.

The values of a and b can be calculated using the formula below:

a. $= (\Sigma y)(\Sigma x^2) - (\Sigma x)(\Sigma xy)$

$n(\Sigma x^2) - (\Sigma x)^2$

b. $= n(\Sigma xy) - (\Sigma x)(\Sigma y)$

$n(\Sigma x^2) - (\Sigma x)^2$

Y = tons
X = Theus

In reality, qualitative research data analysis is data obtained from interviews with interested parties in the form of oral data with an explanation of the discussion taking place during the collection process [18] and also using quantitative data is data obtained from companies that can be proven by the numbers that will be processed and analyzed according to the analytical method so that growth and development can be achieved.

III. RESULTS AND DISCUSSION

Container services at the Port of Ambon have been carried out based on a container service package, in which part of the Port of Ambon has been assigned the status of a Container Terminal based on the Decree of the Head of the Class I Ambon Port Authority and Harbormaster Office Number:UM.008/2/5/KSOP.ABN-2018, dated 13th April 2018,regarding the Stipulation of Increasing the Operational Capability of Port Facilities From Facilities for Serving General Goods to Serving Containers at Yos Sudarso Pier (Kade 251-685) Ambon Port.

The container service system and procedures are based on the Regulation of the Board of Directors of PT Pelabuhan Indonesia IV (Persero) Number: PD 14 of 2018 concerning Systems and Procedures for Container Service Services at Container Terminals within PT Pelabuhan Indonesia IV (Persero). In general, the main container services at the Port of Ambon can be described as follows:

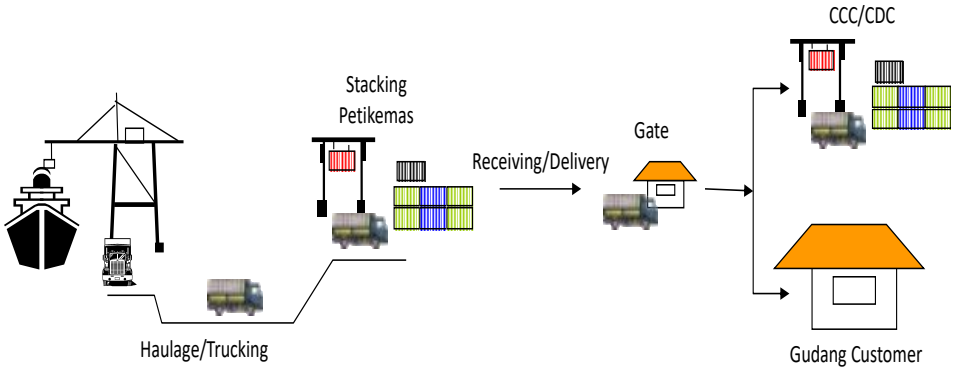

Figure 1: The main container services at the Port of Ambon

Containers are unloaded using a container crane, and then the containers are hauled/trucked to the container yard for stacking. After processing the documents, the containers are then delivered to the Recipient/Owner's Warehouse or taken to the Cargo Consolidation Center (CCC)/Cargo Distribution Center (CDC) location to unload the contents of the container/stripping.

For container loading activities, this is the opposite of loading activities, namely after document processing is completed, containers, both full and empty, originating from the sender's Warehouse or Cargo Consolidation Center (CCC)/Cargo Distribution Center (CDC) locations are received at container yards or stacking yards. After the carrier arrives, the containers that have been stacked in the yard or container yard are hauled/trucked to the wharf for further loading using a Container Crane.

In general, loading and unloading activities and container services at Ambon Port have been carried out well, this can be seen from the achieved container service performance, which consists of loading and unloading performance in the form of B/C/H and facility utilization in the form of docks and stacking yards or containers yards. Recapitulation of the performance of container services at the Port of Ambon in the last 5 (five) months, namely:

TABLE 2
PERFORMANCE OF CONTAINER SERVICES FROM MARCH TO AUGUST 2020

NO	Realization Data		Projection Data (Y = 8.422 + (0,0904 X)		Container Ship Projection	
	(Ton)	(Teus)	(Ton)	(Teus)	Haulage	Call
2010	485,597	51,875	-	-	-	-
2011	541,457	55,546	-	-	-	-
2012	716,518	71,472	-	-	-	-
2013	726,082	73,280	-	-	-	-
2014	771,578	76,448	-	-	-	-
2015	778,801	79,279	-	-	-	-
2016	806,672	80,650	-	-	-	-
2017	1,097,659	109,679	-	-	-	-
2018	1,267,308	126,993	-	-	-	-
2019	977,707	98,106	-	-	-	-
2020	-	-	1,243,164	120,895	341	355
2021	-	-	1,329,009	128,662	341	377
2022	-	-	1,414,853	136,428	341	400
2023	-	-	1,500,698	144,195	341	423
2024	-	-	1,586,543	151,962	341	446
2025	-	-	1,672,388	159,728	341	468
2026	-	-	1,758,233	167,495	341	491
2027	-	-	1,844,077	175,262	341	514
2028	-	-	1,929,922	183,028	341	537
2029	-	-	2,015,767	190,795	341	560

Based on the data above, it can be concluded that service performance at the Port of Ambon has shown a fairly good condition. In general, the condition of container service at the Port of Ambon, namely, the average container ship mooring to carry out container loading and unloading activities, is 33.09 hours. The effective level of time compared to berthing time is 79.06%, meaning that the average container ship that adds up to 33.09 hours of loading and unloading activities is 16.15 hours.

The average loading and unloading speed using one container crane is 20.72 B/C/H. The Berth Occupancy Ratio for six months from March to August 2020 for container berths for 2 (two) berths with a length of 234 meters is 45.74%.

As for the yard occupancy ratio with dwelling time or the length of time, the container stays in the field for an average of 10 (ten) days, with a broken space of 30% and a height of container stacking of 3 (three) tiers and the area of the field needed to store 1 (one) container unit area of 17 M2, the level of yard occupancy ratio of container yards at the Port of Ambon is 38.64%.

When compared with the service performance standards as stipulated, the level of container service at the Port of Ambon is still quite good.

Projection of container flows at Ambon Port, by using historical data for the last 10 (ten) years, namely 2010 – 2019, and by using the Liner Regression Analysis method and data processing using the Microsoft Excel application, by using the causative factor variable (X) in the form of the flow of goods in containers in tons of the effect variable (Y) is the flow of containers in constant, the linear regression equation is obtained as follows Y = 8,422 + (0.09 X).

By using the Microsoft Excel application to calculate Trend Analysis, and using data on the actual flow of containers and container ships as presented in Table 1 above, it can be seen that in the last six months, the average vessel carrying containers was 341 teus, so from this equation it can be Projected goods in containers and continuous flow of containers as well as projected flows of container ships at Ambon Port for the next 10 (ten) years, namely 2020 – 2029 can be presented in the following table 3:

TABLE 3
PROJECTED FLOW OF CONTAINERS AND CONTAINER SHIPS AT AMBON PORT IN 2020 – 2029

No	Month	Ship Traffic (Call)	Container Flow (Teus)	Bt (Hour)	Et/Bt (%)	B/C/H (Box)	Service Performance Bor (%)	Yor (%)
1	March	29	11,943	927.52	76.19%	22.13	52.47%	56.31%
2	April	23	8,674	866.21	81.79%	21.62	57.85%	41.84%
3	May	22	6,558	775.57	84.74%	21.45	46.63%	37.72%
4	June	19	5,720	541.49	75.34%	20.38	32.72%	28.24%
5	July	19	5,574	513.39	75.52%	19.89	31.04%	35.61%
6	August	25	8,290	909.47	80.79%	18.82	53.70%	32.09%
Total		**137**	**46,759**	**4,534**	**-**	**-**	**-**	**-**
Average		**23**	**7,793**	**33**	**79.06%**	**21**	**45.74%**	**38.64%**
Ship Haulage			**341**					

For 2010 the realization of goods in containers was 485,597 tons or 51,875 TEUs, and every year it continues to increase where in 2018, there were 1,267,308 tons or 126,993 TEUs of containers entering Ambon port, while in 2019, the realization of containers was 977,707 tons or 98,106 then this has decreased due to the lack of number of ship visits and also repairs/developments of container facilities and infrastructure that are temporarily being carried out.

While the projected realization of the flow of goods in containers in 2020 is 1,243,164 tons or 120,895 TEUs, it is predicted that in 2029 the realization of containers will be 2,015,767 tons or as many as 190,795 TEUs. As for the flow of container ships, it has also increased, where in 2020, it is projected to be 355 calls, it continues to experience additions until it is projected to be as many as 560 calls in 2029. Calculation of Facility Needs.

Based on the projected results of container flows as described in Table 1 above and taking into account the actual performance of container services at Ambon Port as described in sub-chapter C. above, and by using the Berth Occupancy Ratio (BOR) and Yard Occupancy Ratio (YOR) formulations, as well as taking into account the maximum performance as stipulated in the Regulation of the Director General of Sea Transportation Number: HK.103/2/18/DJPL-16 concerning Performance Standards for Port Operational Services at Commercially Operated Ports, and existing facilities, the formulation of the needs for dock facilities and stacking yards at the Port of Ambon can be submitted as follows:

Dock requirement formula:

$$DRILL = \frac{Vs \times St}{\text{Total Available Time} \times n} \times 100$$

$$n = \frac{Vs \times St}{365 \text{ days} \times 24 \times 70\% \text{ (BOR Mak.)}} \times \text{Berth Length}$$

With a maximum BOR of 70% derived from Regulation of the Director General of Sea Transportation Number: HK.103/2/18/DJPL-16 concerning Performance Standards for Port Operational Services at Commercially Operated Ports, and for Ambon Port Long pier for 1 (one) Berth is 117 meters (existing wharf length is 234 meters/2 berths), so the wharf needs for container services at Ambon Port in the next ten years are as follows:

1. 2020 = ((355 Call x 33 hours) / (365 days x 24 hours x 0.7)) x 117 meters = 223 Meters
2. 2021 = ((377 Call x 33 hours) / (365 days x 24 hours x 0.7)) x 117 meters = 238 Meters
3. 2022 = ((400 Calls x 33hours) / (365 days x 24 hours x 0.7)) x 117 meters = 252 meters
4. 2023 = ((423 Call x 33 hours) / (365 days x 24 hours x 0.7)) x 117 meters = 266 Meters
5. 2024 = ((446 Call x 33 hours) / (365 days x 24 hours x 0.7)) x 117 meters = 281 Meters
6. 2025 = ((468 Call x 33 hours) / (365 days x 24 hours x 0.7)) x 117 meters = 295 Meters
7. 2026 = ((491 Call x 33 hours) / (365 days x 24 hours x 0.7)) x 117 meters = 309 Meters
8. 2027 = ((514 Calls x 33 hours) / (365 days x 24 hours x 0.7)) x 117 meters = 324 Meters
9. 2028 = ((537 Call x 33 hours) / (365 days x 24 hours x 0.7)) x 117 meters = 338 Meters
10. 2029 = ((560 Call x 33 hours) / (365 days x 24 hours x 0.7)) x 117 meters = 352 meters

Based on the data above, it can be found that in order to maintain the maximum Berth Occupancy Ratio at 70% according to the standards set by the Ministry of Transportation, the length of the pier at Ambon Port needs to be added in stages, starting from 2021, where The flow of containers has reached 128,662 TEUs with a total of 377 container ships, so that in 2029 the length of the container wharf at the Port of Ambon will reach 352 meters.

Container field requirement formula.

$$A = \frac{\sum \text{TEUs} \times Dt \times S\_f}{365 \text{ days} \times Sth \times (1\text{-}BS)} \times 100$$

A = area of stacking field (m^2, Ha),
∑TEUs = container flow per year (1 TEU's = 17.0 m^3),

Dt = dwelling time (dwelling time item) (day)
SF = stowage factor (m^3/tonne)
Sth = stacking hight (many stacks)
Bs = broken stowage of cargo (lost volume)

With the projected data for container flows as shown in Table 1 above, and using the average realized performance of container services in the last 6 (six) months of 2020, the need for stacking yard facilities at Ambon Port for the next 10 (ten) years is as follows:

1. 2020 year = ((120,895 Teus x 10 days x 17 m2) / (365 days x 3 tier x 0.7)) = 26,813 m2
2. Year 2021 = ((128,662 Teus x 10 days x 17 m2) / (365 days x 3 tier x 0.7)) = 28,536 m2
3. Year 2022 = ((136,428 Teus x 10 days x 17 m2) / (365 days x 3 tier x 0.7)) = 30,258 m2
4. Year 2023 = ((144,195 Teus x 10 days x 17 m2) / (365 days x 3 tier x 0.7)) = 31,981 m2
5. Year 2024 = ((151,962 Teus x 10 days x 17 m2) / (365 days x 3 tier x 0.7)) = 33,703 m2
6. Year 2025 = ((159,728 Teus x 10 days x 17 m2) / (365 days x 3 tier x 0.7)) = 35,426 m2
7. Year 2026 = ((167,495 Teus x 10 days x 17 m2) / (365 days x 3 tier x 0.7)) = 37,148 m2
8. Year 2027 = ((175,262 Teus x 10 days x 17 m2) / (365 days x 3 tier x 0.7)) = 38,871 m2
9. Year 2028 = ((183,028 Teus x 10 days x 17 m2) / (365 days x 3 tier x 0.7)) = 40,593 m2
10. Year 2029 = ((190,795 Teus x 10 days x 17 m2) / (365 days x 3 tier x 0.7)) = 42,316 m2

Based on the analysis of the needs for the storage yard above, Ambon Port, which has a storage area of 40,622 m2, does not need to add a storage area. To accommodate the growth in container flows, improvements can be made to the service system, including increasing the height of container storage from 3 (three) tiers which is currently being implemented into 4 (four) tiers.

As for loading and unloading equipment in the form of container cranes, in line with the addition of the wharf, it is necessary to add container crane equipment at Ambon Port, this is based on UNTAD (United Nations of Tariff and Trade) standards where for every 100 meters of container wharf must be served by 1 unit of container cranes, the addition of container cranes will be carried out in the 7th year or 2026 where the length of the pier for container services has reached 306 meters so that by the end of the 10th year the number of container cranes at Ambon Port is 3 (three) units.

For container loading and unloading equipment at the stacking yard, the analysis for the next 10 (twenty) years is still very sufficient, there is no need to add to the existing equipment of 5 (five) units of rubber tyred gantry, 5 (five) units of reach stacker and 1 (one) unit 32 Ton forklift units.

Some research results that support this study state that the number of loading and unloading of goods and the area or container stacking depot available at Yos Soedarso Ambon port is the number of unloading 20' containers of 34724 units and the number of unloading 40' containers of 582418 units and the area of stacking areas available containers in 2020 is 21697 m2 [19]. The increasing number of facilities and infrastructure will greatly affect the implementation of ship agency service activities [20]. The results of the research show that at PT. PELINDO IV at the Bitung Container Terminal is appropriate in terms of unloading operations, and the Bitung Container Terminal also always provides truly adequate facilities so that service users feel an orderly and efficient service, especially emphasizing port costs and avoiding risks that could occur during port services [21].

Performance analysis based on productivity (T/G/J) is quite good, because it has reached the specified standards. Performance analysis based on ET:BT is not good enough, because it has not reached the specified standard. An analysis of the cause and effect diagram of the factors affecting the performance of Jamrud Terminal is carried out by dividing it into five groups of problem factors, namely human factors, facilities/machinery, environment, materials, and methods. The proposed improvements are by using an organizational approach, by organizing existing work schedules, and carrying out in-group rotations supervised by port operations [22].

One of the crucial aspects of port activity support was the operation of the container terminal. There are numerous issues with terminal container operations, including a lack of information, traffic, trucks, waiting times, berthing windows, inaccessible operators, and sluggish terminal performance. The Box Crane Hour (BCH), or the productivity of container loading and unloading per crane, Truck Waiting Time, and Crane Operator Waiting Time are only a few of the variables that affect the Berthing Time in the port [12]. The container terminal can be separated into five sections: the gate, the berth area, the quay, the transport area, and the storage yard [23].

International trade flows using containers are mainly driven by trade flows from the United States and Europe and by continuing import demand for raw materials in other large developing countries, notably China and India. The contribution of developing countries to world seaborne trade is also increasing [22].

One of the services of a shipping company in the delivery of goods is a cargo shipping system using containers. Methods in terms of usability, safety, security, integrity, practicality and are dominantly used in sea transportation. The handling of loading and unloading transported by ship conveyance is inseparable from the role of a loading and unloading company (PBM), because, the services of unloading companies are needed to handle and maintain goods or cargo while they are at the port of origin to the port of destination until they are received by their owners [13].

The capacity of a container terminal at a port is determined by the capacity and capability of the hinterland as a support for the existence of the port and is also supported by trading capabilities in the area so that incoming ships can trade [14].

To improve performance, the five areas must be well integrated [24]. Berthing Time is one of the numerous indicators used in the calculation of the terminal's operational performance that are specifically related to the shipping service provided at the wharf. The period of time a ship spends at its mooring, from the time the first rope is tied to the pier until the last rope is let go, is known as the berthing time [12].

In contrast to the results of other studies, it was stated that the results of the assessment of the capacity of the container terminal facility showed very low usage due to product shipments through Teluk Bayur Port which was still very low [11]. Evaluation results of facility utilization container loading and unloading equipment still show that in the dynamic dimension, the actual utilization of container loading and unloading equipment capacity is in the low quadrant.

Thus, to ensure that the Berth Occupancy Ratio can be maintained at least 70% in accordance with the standards set by the Ministry of Transportation, the Port of Ambon must undergo structural rehabilitation. This rehabilitation must begin in 2021 when the flow of containers has reached 128,662 TEUs with a total of 377 container ships Call, so that by 2029 the length of the container wharf at Ambon Port will reach 352 meters.

CONCLUSION

After carrying out an analysis and evaluation of the service capacity of the Port of Ambon, it can be concluded that the flow of container ships has increased, where in 2020 it is projected to be 355 calls, it continues to experience additions until it is projected as many as 560 calls in 2029 while the projected realization of the flow of goods in containers in 2020, there were 1,243,164 tons or 120,895 TEUs and it is predicted that in 2029 the realization of containers will be 2,015,767 tons or as many as 190,795. The Berth Occupancy Ratio can be maintained at a maximum of 70% according to the standards set by the Ministry of Transportation, the length of the wharf at the Port of Ambon where in 2021, the flow of containers has reached 128,662 TEUs with a total of 377 container ships Call, until 2029 the length of the container wharf at the Port of Ambon will reach 352 meters. As for the storage yard at Ambon Port, until 2029 the required storage area is 42,316 m2.

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