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Analysis of the Utilization of the Harbor Area at the Port of Tanjung Perak

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Abstract

Tanjung Perak Port is the initial gateway to Surabaya which handles more than 40% of international goods trade. In this case, the Kertosusilo Gate Area (GKS) has a very important position with its sea area having the busiest shipping lanes in Indonesia with 15,409 vessels operating at the end of 2021. The dense distribution of port activities in sea transportation creates complex problems which impact on delays in cargo delivery in Tanjung Perak Harbor. Problems that arise include sedimentation due to the construction of the Maspion Indonesia Port terminal, narrowing of sea water and changes in sea area which causes narrowing of the Madura Strait sea area, as well as complaints from port users regarding shipping lanes, anchoring areas in terms of depth, area, Vessel Traffic Services (VTS), services. ship guidance and security. Based on these problems, research was carried out on the utilization and needs of the anchorage area at Tanjung Perak Port. Starting with conducting research preparation, collecting data by compiling data related to the general picture of economic growth, especially in the East Java region as well as operational technicalities and conditions of the Tanjung Perak port. So that we can obtain the results of utilization research for a docking area capacity of 20,330 ships per year with a utility value of the docking area at Tanjung Perak Port of 73.5%.

Keywords: *Harbor Area, Shipping Route, Tanjung Perak Harbor*

INTRODUCTION

Indonesia, as the largest archipelago country globally, grapples with the challenges of dense transportation activities, particularly in its maritime sector, leading to complex issues such as delays in cargo delivery. The port of Surabaya, situated in the bustling city of the same name, serves as a crucial gateway to eastern Indonesia and is accessed through Tanjung Perak. The cargoes, and passengers in this area enter and exit through the Tanjung Perak port [1-2]. There are 7 terminals in the Tanjung Perak port area, including Kalimas terminal, Jamrud terminal, Mirah terminal, Berlian terminal, Nilam terminal, Surabaya Container Terminal (TPS), and Teluk Lamong terminal. The study area of Kertosusilo Gate (Gresik, Bangkalan, Mojokerto, Surabaya, Sidoarjo, and Lamongan), also known as GKS, holds significant importance in the context of port development, being an inland area directly linked to the port's operations. GKS stands out as the second-largest metropolitan area in Indonesia, following Jabodetabek.

Despite its bustling nature, GKS manages to maintain a substantial portion of shipping traffic, with Tanjung Perak Port handling over 40% of international goods trade compared to Tanjung Priok, as well as a significant amount of domestic goods [3-5]. The Kertosusilo Gate area boasts one of the busiest shipping lanes in Indonesia,

accommodating a staggering 15.409 ships by the end of 2021. However, the construction of the Maspion Indonesian Port Terminal in this region has led to certain challenges, including sedimentation and narrowing of sea lanes, as well as changes in the area's maritime landscape.

Port users have raised concerns regarding issues such as shipping lanes, anchoring areas, Vessel Traffic Services (VTS), pilotage services, and ship security. Given this scenario, there is a pressing need to conduct research on the future utilization and requirements of the anchorage area, especially considering that the existing channel has a capacity to accommodate 27,000 ships per year. This research aims to address critical questions surrounding the sustainability and efficiency of maritime operations in the Kertosusilo Gate area. By exploring innovative solutions and strategic planning, stakeholders can effectively manage the increasing shipping traffic and address the challenges posed by the changing maritime landscape.

The efficient use of berthing areas in ports is essential for optimizing operational efficiency and port management [6-7]. Tanjung Perak Port, one of Indonesia's largest ports, plays a vital role in facilitating the movement of cargo and passengers in the eastern region of Indonesia. However, a comprehensive understanding of berthing area utilization at this port is still required for successful operations. Previous studies have examined various aspects of berthing area utilization in ports, including factors affecting operational efficiency, strategies for capacity enhancement, and management policies [8-9]. Nonetheless, there remains a knowledge gap, particularly regarding Tanjung Perak Port. Hence, this study aims to provide a more in-depth investigation into the utilization of berthing areas at Tanjung Perak Port. Given this context, this study aims to offer fresh perspectives valuable for policymakers seeking to enhance the efficiency and operational performance of the port, as well as to optimise berthing area utilisation in the future.

To achieve this goal, the research will first determine the current frequency of ship arrivals and departures at Tanjung Perak Port. It will then analyse the utilisation of berthing area capacity and assess the utility value of these areas at the port. A key focus of the study will be the optimisation of shipping lanes and anchoring areas to ensure the smooth and efficient operation of maritime activities. By leveraging advanced technologies and innovative approaches, it is feasible to improve the capacity and functionality of existing infrastructure, thereby reducing congestion and delays. Additionally, the study aims to assess the impact of port development projects on the marine environment and recommend sustainable practices to mitigate negative effects. Furthermore, the research seeks to improve the efficiency and safety of pilotage services and ship security by implementing advanced navigation systems and enhancing training programs for maritime personnel.

By promoting collaboration and knowledge sharing among stakeholders, the research aims to develop comprehensive strategies to address the challenges faced by the maritime industry in the Kertosusilo Gate area. The research on the future use and needs of the anchorage area in the Kertosusilo Gate region is crucial for ensuring the sustainable development of the maritime sector in Indonesia. By addressing key challenges and implementing innovative solutions, stakeholders can enhance the efficiency, safety, and sustainability of maritime operations, thus contributing to the overall growth and prosperity of the region. The identification of problems stemming from the outlined background provides a critical foundation for understanding the challenges facing the maritime sector in the Kertosusilo Gate area. Chief among these issues is the occurrence of sedimentation resulting from the construction activities associated with the Maspion Indonesia Port terminal.

This sedimentation poses a significant obstacle to maritime operations, potentially impeding the movement of ships and necessitating costly dredging efforts to maintain navigable channels. Additionally, the construction activities have led to the narrowing of seawater channels and alterations to the area's maritime geography, particularly impacting the Madura Strait sea area. These changes have profound implications for shipping routes, navigation safety, and environmental sustainability in the region. Furthermore, port users have voiced concerns regarding various aspects of port infrastructure and services, including shipping lanes, deep anchorage areas, VTS, pilotage services, and ship security. These complaints underscore the need for comprehensive assessments and strategic interventions to address the operational challenges faced by Tanjung Perak Port.

To address these pressing challenges, the research aims to achieve the following objectives: (1) To determine the current frequency of ship arrivals and departures at Tanjung Perak Port: This objective seeks to provide insights into the volume and patterns of maritime traffic at the port, allowing for a comprehensive understanding of operational demands and potential bottlenecks. By analysing historical data and monitoring real-time

vessel movements, researchers can identify trends, fluctuations, and peak periods of activity, thus informing strategic planning and resource allocation efforts; and (2) To assess the utilization of berth area capacity and the utility value of berth areas at Tanjung Perak Port: This objective aims to evaluate the efficiency and effectiveness of berth utilization practices at the port. By examining factors such as berth occupancy rates, turnaround times, and berth allocation policies, researchers can identify opportunities for optimization and improvement.

Additionally, assessing the utility value of berth areas entails considering factors such as accessibility, infrastructure quality, and service provision, with the goal of enhancing the overall functionality and value proposition of berth facilities. Through rigorous data collection, analysis, and stakeholder engagement, the research seeks to generate actionable insights and recommendations to address the identified problems and achieve the stated objectives. By leveraging interdisciplinary approaches and collaborating with relevant stakeholders, including port authorities, government agencies, and industry representatives, the research aims to foster sustainable development and resilience in the maritime sector. Ultimately, the findings and outcomes of the research are intended to inform evidence-based decision-making, policy formulation, and infrastructure investments to support the long-term viability and competitiveness of Tanjung Perak Port and the broader maritime ecosystem.

METHOD

An analysis was carried out regarding the total flow of goods based on packaging type in the working area of Tanjung Perak Port and Teluk Lamong Terminal in the period 2017 to 2021. Analysis was carried out regarding ship visits at Tanjung Perak Port in the period 2017 to 2021 based on the type of ship. Analysis was carried out regarding the operational performance of the Tanjung Perak port in 2017-2021 based on the ratio of use of docks, stacking yards and warehouses.

Data collection techniques include field surveys, visual observation, and analysis of documentation related to the capacity of water facilities and the utility of water facilities [10-11]. Thus, the capacity of water facilities can be determined based on the maximum ship service per year with the available berthing area. Then, the analysis of the utility of water facilities is conducted by calculating the number of ship visits, the duration of ship berthing, the operational time of water facility services, port operational performance, ship specifications, and the area of water facilities [12-14].

A calculation analysis was carried out regarding the capacity of the water facilities (docking area) at Tanjung Perak Port. So you can know the maximum ship service per year with the available berth area. An analysis of the capacity of the water facilities at the Port of Tanjung Perak was carried out by calculating the number of ship visits, the length of time the ship was anchored, the operational time or service of the water facilities, the operational performance of the port, ship specifications, and the area of the water facilities.

Regression is a tool used to measure how two or more variables relate to each other in the form of a relationship or function. A clear separation between the independent variable (X) and the dependent variable (Y) is needed to determine the type of relationship. In regression, the components of the determined variable and the determining variable must be present; the first is the dependence of certain variables on other variables or vice versa. These two variables may influence each other, or have a causal relationship. So, regression is a function between the dependent variable Y and the independent variable X, or can be written as the function Y=f(X).

RESULTS AND DISCUSSION

Results

Loading and Unloading Flow Analysis

The flow of goods based on packaging type in the working area of Tanjung Perak Port and Teluk Lamong Terminal in the period 2017 to 2021 shows an increase as seen in the graph below.

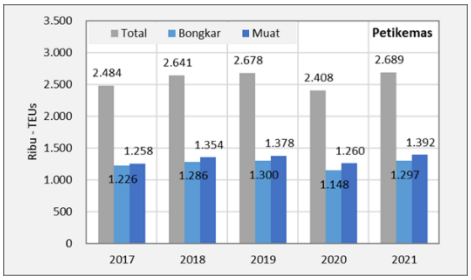

Fig 1. Tanjung Perak Port Container Load Flow Graph 2017-2021

From Figure 1 we can explain the total flow of container cargo in the Tanjung Perak Port working area from 2017 to 2021. It is known that the highest number of flows was in 2018 at 2,641 thousand TEUs, while the lowest number of flows occurred in 2020 at 2,408 thousand TEUs. . So it can be calculated that the total percentage growth in container goods unloaded and loaded in 2017-2021 is 9.33%. Apart from that, the number of non-

container cargo flows in the Tanjung Perak Port working area can be seen in the picture below.

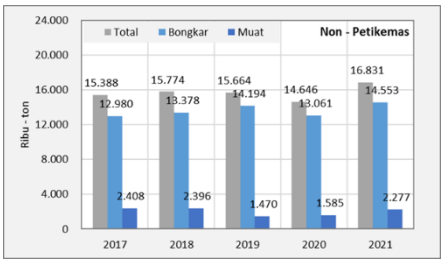

Fig 2. Tanjung Perak Port Non-Container CargoFlow Graph 2017-2021

From Figure 2 we can explain the total flow of non-container cargo in the Tanjung Perak Port working area from 2017 to 2021. It is known that the highest amount of flow occurred in 2021 at 16,831 thousand tons, while the lowest amount occurred in 2020 at 14,646 thousand tons. So it can be calculated that the total percentage growth in non-container goods unloaded and loaded in 2017-2021 is 10.22%.

Ship Flow Analysis

Ship visits at Tanjung Perak Port in the period 2017 to 2021 based on ship type are as shown in table 1 below.

Table 1. Ship visits by ship type at Tanjung Perak Port 2017-2021

Description	Unit	2017	2018	2019	2020	2021
Total Ship						
Tanjung Perak Harbor + Teluk Lamong Terminal	Units	13,308	12,975	12,750	14,109	14,938
	GT	90,908,315	84,902,679	93.141.138	97,222,047	97.175.269
Container Ship						
Tanjung Perak Harbor	Units	4,317	4,088	4,230	4,197	4,175
	GT	53,941,284	50,611,899	55,619,979	54,977,197	50,110,751
Lamong Bay Terminal	Units	227	215	223	221	220
	GT	2,839,015	2,663,784	2,927,367	2,893,537	2,637,408
General Cargo Ship						
Tanjung Perak Harbor	Units	1,729	1,719	1,411	1,704	1,836
	GT	6,814,101	6,499,664	5,396,728	5,938,057	6,443,366
Liquid Bulk Ships						
Tanjung Perak Harbor	Units	631	647	1,060	1,179	1,405
	GT	4,502,115	3,626,126	4,723,084	5,578,380	6,523,262
Dry Bulk Ships						
Tanjung Perak Harbor	Units	111	118	118	200	249
	GT	2,711,846	2,829,146	2,856,853	5,212,305	6,333,999
Lamong Bay Terminal	Units	73	77	77	130	162
	GT	1,771,459	1,848,084	1,866,183	3,404,835	4,137,559
Barge						
Tanjung Perak Harbor	Units	1,411	1,276	1,266	1,194	1,269
	GT	2,930,193	2,616,034	2,492,870	2,326,206	2,531,810
Tugboat						
Tanjung Perak Harbor	Units	1,452	1,463	1,521	2,428	2,686
	GT	284,836	268,607	254,499	411,000	468,086
Passenger ship						
Tanjung Perak Harbor	Units	1,237	950	1,094	739	796
	GT	7,474,474	3,398,884	7,938,369	6,204,587	6,850,058

Description	Unit	2017	2018	2019	2020	2021
Ro Ro Ship						
Tanjung Perak Harbor	Units	981	1,226	983	1,153	1,164
	GT	6,819,428	8,779,928	7,811,670	9,993,092	10,906,640
Motor Boat/Sailboat						
Tanjung Perak Harbor	Units	1,130	1,175	754	958	974
	GT	197,237	474,606	155,327	239.113	231,733
Cruise Ship						
Tanjung Perak Harbor	Units	9	21	13	6	2
	GT	622,327	1,285,917	1,098,209	43,738	597

At Tanjung Perak Port, the dominant types of ships served are general cargo ships, dry bulk ships, liquid bulk ships, container ships, passenger ships and motor sailing ships. The following is an analysis regarding the results of ship projections at Tanjung Perak Port using the assumption of the main size of the largest ship in table 2 below:

Table 2. Analysis of Projected Flow of Ship Visits at Tanjung Perak Port

Ship Type	2017	2018	2019	2020	2021
General Cargo	1729	1719	1411	1704	1836
Dry bulk	111	111	111	111	111
Liquid Bulk	631	631	631	631	631
Container	4,317	4,317	4,317	4,317	4,317
Passenger	2,227	2,227	2,227	2,227	2,227
Motor Sailing Boat	1,130	1,130	1,130	1,130	1,130
Ship Type	**2022**	**2023**	**2024**	**2025**	**2026**
General Cargo	1643	1722	1807	1893	1986
Dry bulk	276	290	304	319	334
Liquid Bulk	1219	1276	1340	1404	1472
Container	4128	4329	4401	4615	4840
Passenger	1998	2077	2161	2247	2337
Motor Sailing Boat	917	962	1009	1057	1110
Ship Type	**2027**	**2028**	**2029**	**2030**	**2031**
General Cargo	2081	2184	2289	2402	2518
Dry bulk	351	367	386	404	424
Liquid Bulk	1543	1619	1697	1780	1866
Container	5074	5320	5581	5850	6133
Passenger	2431	2527	2629	2734	2844
Motor Sailing Boat	1163	1220	1278	1341	1407
Ship Type	**2032**	**2033**	**2034**	**2035**	**2036**
General Cargo	2640	2769	2903	3042	3191
Dry bulk	444	466	489	513	537
Liquid Bulk	1956	2052	2153	2256	2366
Container	6512	6830	7159	7509	7871
Passenger	2957	3076	3198	3327	3459

Ship Type	2017	2018	2019	2020	2021
Motor Sailing Boat	1475	1546	1621	1699	1783
Ship Type	**2037**	**2038**	**2039**	**2040**	**2041**
General Cargo	3347	3509	3680	3859	4047
Dry bulk	563	591	620	650	682
Liquid Bulk	2482	2601	2728	2861	3000
Container	8254	8656	9077	9516	9980
Passenger	3598	3742	3891	4047	4208
Motor Sailing Boat	1869	1960	2056	2156	2260

From table 2 above, it can be explained that the projection results for the number of ship visits at Tanjung Perak Port, the ship projections come from the results of the number of projections from each terminal in figure 3 below:

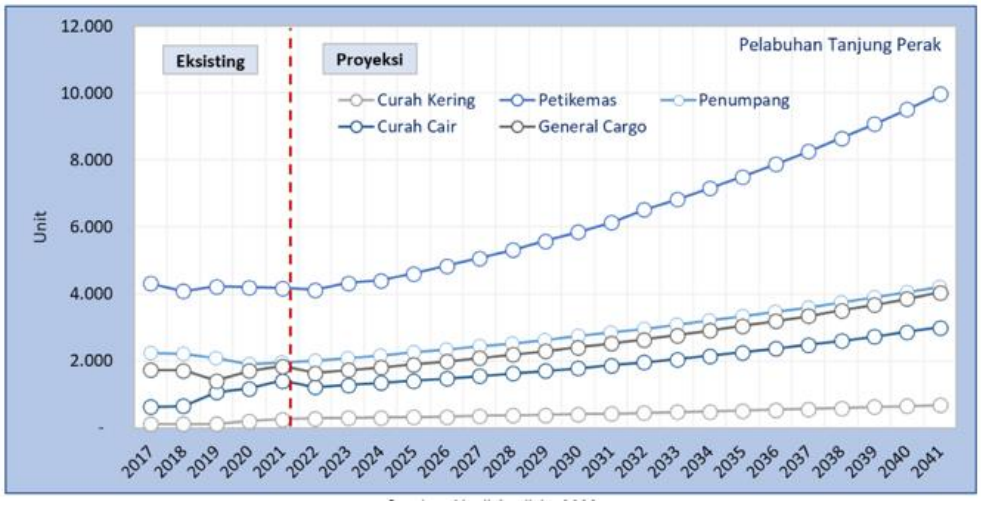

Fig 3. Projection of Ship Visits at Tanjung Perak Port

Port Operational Performance Analysis

Port operational performance can be measured based on the ratio of use of docks, storage yards and warehouses. Based on data from PT Pelindo (Persero), port operational performance is as presented in table 3.

Table 3. Operational Performance of Tanjung Perak Port

Location	Information	2017	2018	2019	2020	2021
Tanjung Perak Harbor						
Emerald	BOR (%)	46.52	47.25	44.00	42.37	48.68
	SOR (%)	22.75	14.93	25.59	16.46	26.51
	YOR (%)	32.53	30.55	30.60	16.78	15.18
Patchouli	BOR (%)	63.61	58.05	51.49	50.53	59.85
	SOR (%)	-	-	-	-	-
	YOR (%)	-	-	-	-	-
Mirah	BOR (%)	64.83	57.89	46.37	44.38	44.57
	SOR (%)	6.50	6.29	7.30	4.26	3.71
	YOR (%)	9.02	6.58	5.67	3.02	2.85
BJTI	BOR (%)	72.21	53.52	46.98	50.95	52.05
	SOR (%)	-	-	-	-	-
	YOR (%)	-	64.72	68.18	62.82	53.15
TPS	BOR (%)	59.42	62.40	43.49	36.86	39.38
	SOR (%)	7.62	5.87	5.89	5.88	5.86

	YOR (%)	35.08	40.78	34.99	37.82	41.23
	BOR (%)	48.09	53.38	52.35	42.59	53.96
DOB	SOR (%)	-	-	-	-	-
	YOR (%)	45.80	41.67	32.51	28.53	23.55

Based on port operational service performance standards in accordance with the Regulation of the Director General of Sea Transportation Number HK.103/2/18/DJPL-16 concerning Port Operational Service Performance Standards at operated and commercial ports in 2016 in table 4 below:

Table 4. Operational Service Performance Standards

Port Name	DRILL (%)	SOR (%)	YOR (%)
Tanjung Perak Harbor			
Emerald	70	65	50
Patchouli	70	-	50
Mirah	70	50	50
BJTI	70	70	70
TPS	70	-	60
DOB	70	-	60
Gresik Harbor	70	-	65
Manyar Terminal	70	-	-

From table 4 it can be seen that the operational performance for all ports is currently below the operational performance that has been stipulated in the Regulation of the Director General of Sea Transportation Number HK.103/2/18/DJPL-16 and Decree of the Tanjung Perak Main Port Authority Office Number: HK .208/04/17/OP.TPr-18. With the analysis of service performance calculations by the Ministry of Transportation related to port operations, it is used as evaluation material to monitor the operational effectiveness of port services as well as benchmarks for the quality of the use of port facilities and port service service times. The value obtained from the calculation of operational service performance standards for the Tanjung Perak port is still below the standard value that has been set.

Water Facility Capacity Analysis

Data on the depth of the turning pool has been submitted in the existing port dock facilities table. Meanwhile, for the depth of the port channel, all ports and TUKS in the Madura Strait use the Surabaya West Shipping Channel (APBS) as the port entry and exit channel. Before the revitalization of APBS, the existing shipping lane was 25 nautical miles long, with a width of 100 m and a depth of -9.5 m LWS, with a ship movement capacity of 27,000 movements/year.

After the APBS revitalization, the channel width became 150 m, the shipping channel length 39.65 nm (73.5 km) and the LWS depth -13 m, with a ship movement capacity of 74,000 movements/year. Apart from that, pipes have also been moved along the APBS route to facilitate ship movement.

In calculating the capacity of water facilities (cabinet area) at Tanjung Perak Port, a specification plan for the ships to be served is needed. For the size specifications of ships at Tanjung Perak Port and Teluk Lamong Terminal, see table 5.

Table 5. Ship Specifications

Ship Type	GT	Length (m)	Vessel Width (m)	Ship Load (m)
Tanjung Perak Harbor				
General Cargo	4,000	104.7	14.7	5.4
Dry Bulk	20,000	145.8	25.8	9.0
Liquid Bulk	4,000	96.9	16.4	6.3
Container	7,000	148.1	23.0	8.8
Passenger	8,300	66.9	9.8	3.9
Lamong Bay Terminal				
Dry Bulk	25,000	152.3	26.8	9.6
Container	26,000	195.2	27.3	10.6

From table 5 it can be explained the specifications of ships that dock at each port or terminal within the working area of Tanjung Perak Port. From the known data regarding the area of water facilities that are currently provided, the size of the ships that will be served and it is assumed that the average length of time for ships to dock is 2 days, it can be seen that the capacity of the anchoring area at Tanjung Perak Port is 20,330 ships per year. For more details regarding the results of the calculation of the berthing area capacity at Tanjung Perak Port, see table 6.

Table 6. Area of Tanjung Perak Port Water Facilities

Aquatic Facilities	Unit	Formula	Area
Harbor Area			
Loa	m		195.0
H	m		11.0
Number of Ships (K)	units		112.0
Depth of anchoring area	m	d = 1.25 x D	13.8
Anchoring Area Radius	m	R = L + 6D + 30	291.0
Landing Area	m2	A = nx π x R2	29,620,000.0
	Ha	A = nx π x R2	2,962.0

So based on table 6 for the area of water facilities at Tanjung Perak Port. It can be seen that with the available water facility area of 2,962 Ha, it can serve a total of 112 ships simultaneously. Then, by obtaining the number of ships that can be served at the same time, the capacity of the berth area within one year or the length of operational time can be calculated. For more details regarding the capacity of water facilities at Tanjung Perak Port, see table 7.

Table 7. Capacity of Tanjung Perak Port Water Facilities

Information	Unit	Formula	Area
Berthing Area Capacity			
Working Time 1 Year (A)	day		365.0
Average length of time the ship is anchored (B)	day		2.0
Capacity ©	boat	A/B	182.5
Berthing Area Capacity	ships/year	K x C	20,330.0

So based on table 7, the capacity of the water facilities (docking area) at Tanjung Perak Port. It can be seen that the available anchorage area can serve as many as 20,330 ships per year.

Aquatic Facility Utility Analysis

The capacity of the water facilities at Tanjung Perak Port is carried out by carrying out calculations using the data that has been obtained. Among the data used to calculate the utility of water facilities include:

a. Number of ship visits
b. The length of time the ship is anchored
c. Water facility operational or service times
d. Port operational performance
e. Ship specifications
f. Area of water facilities

For more details regarding the results of calculations or utility analysis of water facilities, see table 8:

Table 8. Utilities of Tanjung Perak Port Water Facilities

Information	Unit	Formula	Area
Berthing Area Capacity			
Working Time 1 Year (A)	day		365.0
Average length of time the ship is anchored (B)	day		2.0
Capacity ©	boat	A/B	182.5
Berthing Area Capacity	ships/year	K x C	20,329.8
Utility	%		73.5%

From table 8 it can be seen the results of the analysis of utility calculations for the water facilities at Tanjung Perak Port. The calculation of the utility of water facilities at the Port of Tanjung Perak is carried out based on the water facilities (docking area) which have been determined in the Decree of the Minister of Transportation Number KP 455 of 2016 concerning Determination of Shipping Routes for the Port of Tanjung Perak.

Discussion

Calculation of loading and unloading performance with reference to Regulation of the Director General of Sea Transportation Number: HK 103/2/2/DJPL-17 concerning Guidelines for Calculating Port Operational Service Performance is carried out using the following formula: (1) Ship Operating Ratio (SOR): It is a comparison between the amount of warehouse storage space used, calculated in tons per day or m3 days, and the effective storage capacity available in one period. (2) Berth Occupancy Ratio (BOR): This is the level of Berth Occupancy Ratio (BOR). This is a comparison between the amount of time used for each available pier and the amount of time available in one period (month/year) which is expressed as a percentage (%) and is differentiated according to the type of pier or mooring using the formula as follows; (3) Yard Occupancy Ratio (YOR): It is a comparison between the amount of use of the piling yard calculated in tons/day or m3/day or TEUs/day with the effective capacity of the piling yard available in one period. So the higher the SOR, BOR and YOR values, the more efficient the use of loading and unloading facilities at the port [15-18].

The research was conducted over a six-month period, commencing in February 2023 and concluding in July 2023. The study took place at Tanjung Perak Harbor, situated at Jl. East Tanjung Perak No. 620, East Perak, Cantian Customs, Surabaya City, East Java. This location was chosen due to its significance as a pivotal maritime hub, serving as a gateway for goods and vessels in eastern Indonesia. A quantitative forecasting approach was employed in this research, supported by the linear regression method. Quantitative forecasting is suitable when historical data is available, quantifiable, and shows patterns that can be extrapolated into the future [19-21]. The linear regression method, a type of quantitative forecasting, was utilised to predict the number of ships expected to arrive at Tanjung Perak Harbor. This method involves fitting a linear equation to the historical data to model the relationship between the number of ships and relevant factors such as time, seasonality, and economic conditions.

Data collection was conducted using a systematic and standardised procedure to gather primary and secondary data. Primary data was obtained through direct surveys and observations at Tanjung Perak Harbor, while secondary data was sourced from existing records and reports. The research focused on key aspects related to the port's operations, including loading and unloading activities, ship flows, operational performance, and the capacity of water facilities. The population for this study comprised various elements related to the flows of Tanjung Perak port, encompassing cargo loading and unloading operations, vessel traffic, operational efficiency, and the infrastructure capacity of the port. By analysing these factors, the research aimed to provide valuable insights into the current state of affairs at Tanjung Perak Harbor and offer recommendations for enhancing its operational efficiency and capacity utilization.

CONCLUSION

From the results of data collection and the results of analysis of calculations that have been carried out, Tanjung Perak Port is a port that has several terminals including: Kalimas Terminal, Jamrud Terminal, Mirah Terminal, Diamond Terminal, Patchouli Terminal, Surabaya Container Terminal, and Lamong Bay Terminal. For the arrival of ships at Tanjung Perak Port, namely: In 2017, there were 13,308 ships, 90,908,315 GT; In 2018 there were 12,975 ships, 84,902,679 GT; In 2019, there were 12,750 ships, 93,141,138 GT; In 2020, there were 14,109 ships, 97,222,047 GT; and In 2021, there will be 14,938 ships, 97,175,269 GT. The results of calculations for the current anchorage area capacity at Tanjung Perak Port, with several analyzes that have been carried out, are obtained at 20,330 ships per year. By obtaining data on the flow of ships at the Port of Tanjung Perak per year and the value of the capacity of the berth area at the Port of Tanjung Perak, the utility value of the berthing area at the Port of Tanjung Perak is 73.5%.

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