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PORT PERFORMANCE ANALYSIS OF TANJUNG PERAK SURABAYA

Noor Mahmudah*, David Rusadi

Prodi Teknik Sipil, Fakultas Teknik, Universitas Muhammadiyah Yogyakarta, Yogyakarta

ABSTRACT

Port of Tanjung Perak Surabaya is an international hub-port and the key of Indonesian logistic chain, hence it must provide good services. Recently the increase of freight will undoubtedly affect the port performance, so it needs to be analyzed and evaluated with the real condition. This study aims to determine the attributes influencing port performance such as Service Time (ST), Berth Occupancy Ratio (BOR), Berth Throughput (BTP), and Port Capacity (KD) based on ship and cargo activities data in the period of 2009-2015. The port performance indicators are used to measure the optimum services provided by port facilities and infrastructures, which are used intensively. Based on the analysis result, the port performance in the terminal operated by PT. Pelindo (III) Branch Tanjung Perak Surabaya in 2009-2015 has the average Service Time of 24.32 hours with the longest time is 25.7 hours in 2015. Berth Occupancy Ratio in 2009-2015 has average value of 51.38% with the peak value of 51.57% in 2013. This value is less than 55%, which is the benchmark assigned by UNCTAD. Berth Throughput has the average value of 46.534 tons/year. Moreover, dock capacity in the terminal operated by PT. Pelindo (III) Branch Tanjung Perak Surabaya has the average value of 174. 97 million tons/year and it is much higher compare with average demand of 72. 0 million tons/year.

Keywords: Berth Occupancy Ratio, Berth Throughput, Port Capacity, Service Time, Tanjung Perak

1. INTRODUCTION

As the biggest archipelago country in the world, Indonesia needs to develop its role in shipping primarily to increase the economy, social, government, defense and security. Shipping activities are very broad, which is include goods and passenger transportation, beach guardian, hydrography, etc. One of the infrastructures needed to support those shipping activities is port.

Port is a stopping place (terminal) of the vessel. Various activities done in the port are boarding and alighting of passengers, loading and unloading (steve dooring) of cargo, fuel, and water filling, repairing, etc. The port also needs some other facilities such as water breaker, harbour, loading and unloading equipments, warehouses, container yards, offices for the port management as well as shipping liners, waiting room for the passengers, fuel and water filling equipments, etc. (Triatmodjo, 2015).

The problems related to the port facilities and infrastructures in Indonesia are the growth of shipping volume without increasing port capacity, inadequate port technology, lack of crane number, and administration process that lead to the slower down of goods distribution during dwelling time process. This condition will directly or indirectly influence the port performance.

*Corresponding author: E-mail: noor.mahmudah@umy.ac.id

Port of Tanjung Perak Surabaya is an International Hub-Port which is the principal chain of Indonesian logistic so it must provide the good services. The increase of loading in Tanjung Perak Port, inevitably will influence port performance. Therefore, analysis and evaluation of port performance by considering the recent condition is to be carried-out.

The aims of this study are: 1) to determine attributes influencing the performance of port of Tanjung Perak Surabaya; 2) to analyze the port performance of Tanjung Perak Surabaya. However, this study is limited to analyze cargo shipping by using data in the period of 2009-2015. This study does not take into account the operational cost of port, warehouse's performance, and the other logistic chains.

The study related to port performance had been conducted by Siswadi (2005) at C*ontainer Yard Semarang*, particularly to compare the use of Container Crane (CC), Rubber Tyred Gantry (RTG), and Head Truck (HT) with two methods - predicting and simulating. Furthermore Kurniadi and Prasetya (2015) studies how to decrease the Dwelling Time by applying simulation in the Container Yard of Tanjung Perak Port, Surabaya. This study simulated the scenarios by decreasing and increasing container route segmentation.

Indonesian ports can also be classified by considering its function and role. Moreover, it can also be classified based on geographical distance of the sailing/shipping route (national or international level), technical condition (the height of the wave, the change of tidal wave, the depth of the route), the availability of ship fixation infrastructures, navigation tools, capacity services, facility services, industrial potency of the back (low) area and cargo or passengers loads (Lasse, 2014).

According to Triatmodjo (2015), Indonesia government has determined the policy of the development of sea transportation and port service system. It based on the types, ship measurement, and development rate of regions which based on 4th Gate Ways Ports System; Gate Ways Port, Regional Collector Port, Trunk Port Category 1, and Trunk Port Category 2.

2. RESEARCH METHOD

2.1 Study Location

This study was conducted in Port of Tanjung Perak which is part of the Pelindo (III) Port Authority area in Surabaya, East Java Province. This port becomes important because it is hub port or main port. Port of Tanjung Perak Surabaya has a strong influence to a logistic chain especially in East Java Province and eastern part of Indonesia.

2.2 Port Operator of Tanjung Perak Surabaya

PT. Pelabuhan Indonesia III (namely Pelindo III), is one of the State-Owned Enterprises which responsible to the port operating services. Pelindo III supervises 43 ports with 16 branch offices spread along the seven provinces in Indonesia; Central Java, East Java, Bali, West Nusa Tenggara, East Nusa Tenggara, South Kalimantan and Central Kalimantan. Pelindo III is a connector of logistics distribution and equalization, and as a passenger's transit in the eastern part of Indonesia (Pelindo, 2015).

2.3 Research Data

After determining the study location, the data collection was conducted. Primary data were obtained by interviewing the management and technical staffs of PT. Pelindo

(III), while the secondary data obtained from Operational Division of PT. Pelindo III Tanjung Perak, Surabaya. Data used in this study is as presented on Table 1.

Table 1. Primary and secondary data

Data	Type of Data	Year	Source
Effective working hour of port	Primary	2016	Interview staff PT Pelindo (III) Branch Surabaya
The number of gang work	Primary	2016	Interview staff PT Pelindo (III) Branch Surabaya
The *Lay Out* of Tanjung Perak Port	Secondary	2015	PT Pelindo (III) Branch Surabaya
Data of stevedoring and export-import	Secondary	2009-2015	PT Pelindo (III) Branch Surabaya
Data of the ship visits	Secondary	2009-2015	PT Pelindo (III) Branch Surabaya
Data of Tanjung Perak Surabaya Port facility and profile	Secondary	2015	PT Pelindo (III) Branch Surabaya

2.4 Indicators of Port Performance

Several attributes considered as indicators that influence port performance are Service Time, Berth Occupancy Ratio, Berth Throughput, and Port Capacity. Each of those indicators is analyzed with the following formula.

2.4.1 Service Time (St)

Service time consists of operating time (time to process stevedoring which its quality is decided by equipment used and the operator) and not operating time (time at which the operator is resting and the stevedoring activity is stopped for a while, about 5-20%). Service time can be calculated using equation 1 and 2 as follow:

$$Cship = \frac{Loading}{Unit} \quad (1)$$

$$St = \frac{Cship}{(KL \ x \ n)} \ x \ (1 + 0{,}20) \quad (2)$$

Where:
St : Service time (hour /day)
Cship : Ship capacity (ton/ship)
Loading : The amount of load (ton)
Unit : Number of ship/vessel (unit)
KL : Passing capacity (ton/hour)
n : Number of gangs (working unit)

2.4.2 Berth Occupancy Ratio (BOR)

Berth Occupancy Ratio (BOR) or rate of the port usage is a comparison of port time and the number of the available time in one period and is presented in percentage. BOR can be calculated by using equation 3.

$$BOR = \frac{Vs\,.St}{Te\,.n}\ x\ 100\% \qquad (3)$$

Where :

BOR : Berth Occupancy Ratio (%)
Vs : Number of anchored ship/vessel (unit/year)
St : Service time (hour/day)
n : Number of dock
T_e : Effective time (days in a year)

The higher of equipment productivity and the shorter not-operating time will lead to the higher number of Berth Occupancy Ratio (BOR). The United Nations Conference on Trade Development (UNCTAD, 1976) recommended the value of BOR as presented in Table 2.

Tabel 2 Value of Recommended BOR from UNCTAD (1976)

Number of the Groups in Dock	BOR (%)
1	40
2	50
3	55
4	60
5	65
6 -10	70

(Source: Triatmodjo, 2011)

2.4.3 Berth Throughput (BTP)

Berth throughput (BTP) is the port ability to pass some goods which consist of loading and unloading on the dock. BTP can be estimated using equation 4 and 5.

$$BTP = \frac{H.BOR.J.G.P}{L_1} \qquad (4)$$

$$L_1 \quad = L_{oa} + 10\% L_{oa} \qquad (5)$$

Where:

BTP : Berth Throughput (ton/m/year)
H : Number of working days in a year (days)
BOR : Berth Occupancy Ratio (%)
J : Working hour per day (hour)
G : Number of gangs
P : Productivity (ton/hour)
L_1 : Length of port for one vessel
L_{oa} : Vessel length (m)

2.4.4 Port Capacity (K_D)

Port capacity is the port ability to receive the goods/cargo for loading and unloading (stevedoring) that can be calculated using the equation 6.

$$K_D = L.BTP.f \tag{6}$$

Where :
K_D : Port capacity (ton)
L : Length of port (m)
BTP : Berth throughput (ton/m/year)
f : Conversion factor, equals to 1

The calculation of port capacity is then compared to the existing capacity (K_E), thus it can be concluded whether the port needs to increase the length or not.

2.4.5 The Length of Dock (L)

The length of dock obtained from the arrival flow of the ship and the flow of cargo. The formula is provided in equation 7.

$$L = \frac{K_D}{BTP} \tag{7}$$

Where:
L : The length of dock (m)
K_D : Port capacity (ton)
BTP : Berth throughput (TEU/m/year or ton/m/year)

The number of and length of dock can be obtained from equation 8 and 9.

$$n = \frac{Vs\,.St}{Te\,.BOR}\, x\ 100\% \tag{8}$$

$$L = n.L_1 + 10\% L_{oa} \tag{9}$$

Where:
n : The number of dock
V_5 : The number of anchored ship/vessel (unit/year)
BOR : Berth Occupancy Ratio (%)
Te : The effective time (number of days in a year)
L_1 : Length of dock for a ship
L_{oa} : Length of ship/vessel (m)

3. RESULTS AND DISCUSSIONS

3.1 General Data

Layout of the terminals in the Port of Tanjung Perak Surabaya is as provided in the Figure 1 below. The data of terminal facilities managed by PT. Pelindo III, Port of Tanjung Perak Surabaya, as presented in Table 3.

Figure 1. The terminal layout of port of Tanjung Perak Surabaya
(Source: PT. Pelindo III, 2015)

Table 3. Terminal facilities of port of Tanjung Perak, Surabaya

Facilities of Tanjung Perak Port			
Description	Jamrud	Mirah	Nilam
Dock Length (M)	2.190	640	930
Warehouse Area (M^2)	43.265	12.450	-
Large ($M^{2)}$	34.000	24000	40.000
Depth (M)	9	6	8

(Source: PT. Pelindo III, 2015)

The data of anchored ship/vessel and ship loading, passing capacity in port of Tanjung Perak Surabaya in the period of 2009-2015 can be seen in Figure 2, 3, and 4 respectively.

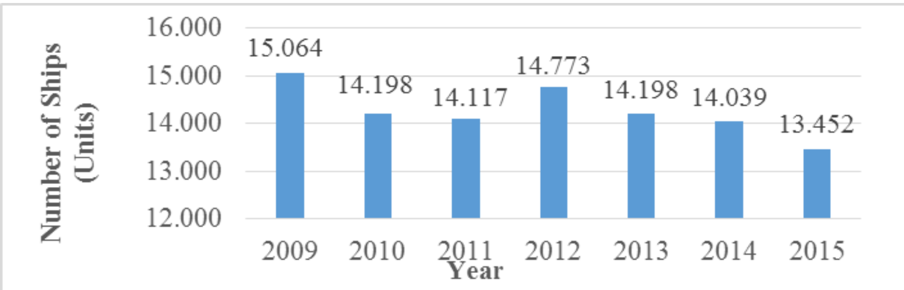

Figure 2. The data of anchored ship in period of 2009-2015
(Source: PT. Pelindo III, 2015)

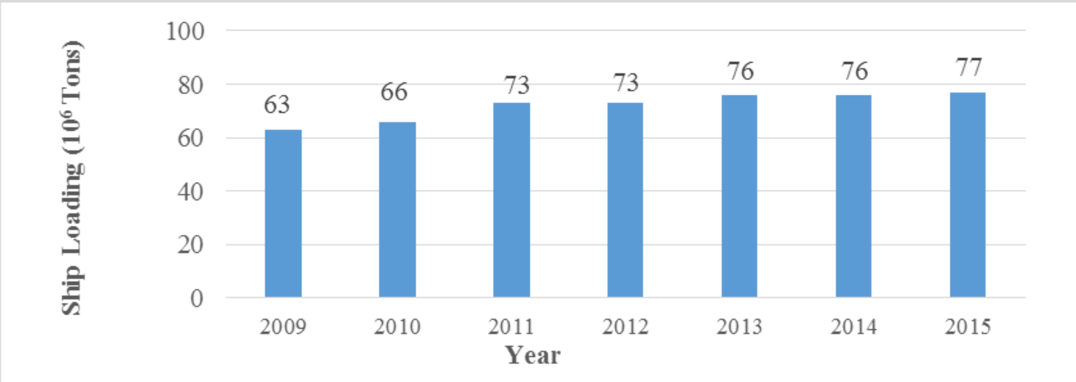

Figure 3. The data of ship loading in period of 2009-2015
(Source: PT. Pelindo III, 2015)

Figure 4. The data of passing capacity in period of 2009-2015
(Source: PT. Pelindo III, 2015)

3.2 Analysis Results and Discussions

3.2.1 Service Time (St)

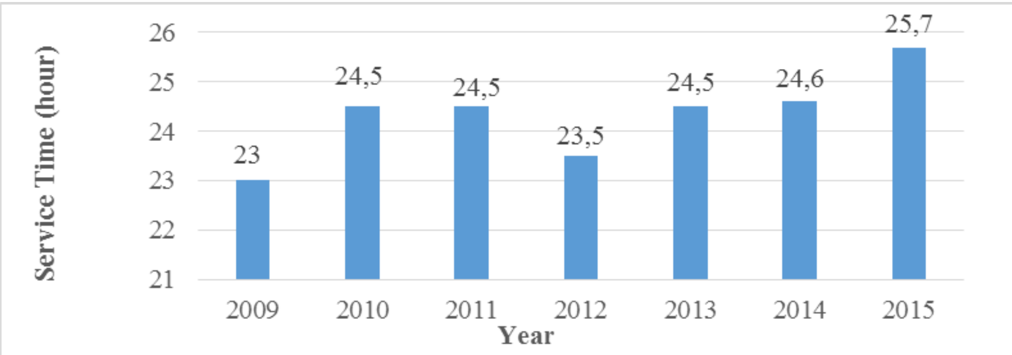

Figure 5. Data of Service Time (St)

Based on analysis data, service time in port of Tanjung Perak Surabaya is increasing. The factors influencing the increase of service time is the ship capacity, which is the comparison between total ship cargo and number of the ship. This condition caused by the decreasing of anchored ship while the cargo is increasing. Furthermore, the capacity for passing by the cargo of ship is also the important factor in increasing service time. Another factor is efficiency in packing cargo and increasing the ship technology. As a result, it may load more goods/cargo then it affects the service time.

3.2.2 Berth Occupancy Ratio (BOR)

Figure 6. The value of Berth Occupancy Ratio (BOR)

The value of Berth Occupancy Ratio, which is reflected in percent, is relatively same with the number about 51%. It indicates that the management system of ship arrival and stevedoring is working adequately. In fact, the attributes which remarkably affect the BOR increasing are Service Time (St) and number of ship arrived. If the value of Service Time is higher so the anchored ships will also take a long time. This phenomenon gives great effects toward BOR performance. Moreover, a significant number of ships visit will increase the value of BOR.

A high value of BOR means the dock is busy thus the limitation of BOR value is needed in order to adjust the number of mooring of each group. The limitation of BOR value is determined by UNCTAD (1976). The average of BOR value at port of Tanjung Perak in the period of 2009-2015 is 51.38%. This value is lower than standard value assigned by UNCTAD (55%).

3.2.3 Berth Throughput (BTP)

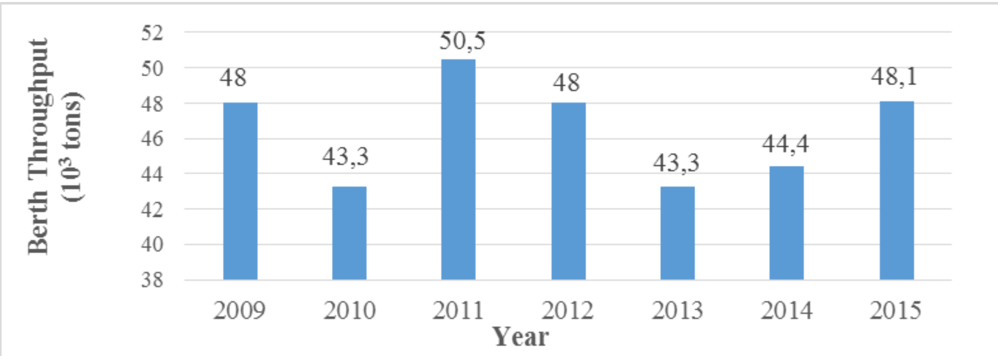

Figure 7 The Value of Berth Throughput (BTP)

Based on the description above, it can be concluded that the fluctuation of BTP seems not high even though, it tends to decrease. The average of BTP in seven years (2009-2015) is 46.534 ton. The stability of BTP correlated with the number of ships visit which sequentially affects BOR value. Productivity is the factor and variable that affects BTP value. The highest BTP value was 50.5 ton in 2011 and rapidly decreasing in 2013 becomes 43.3 ton. This condition is due to the higher productivity factor in 2011 compared to 2013.

3.2.4 Dock Capacity (K_D)

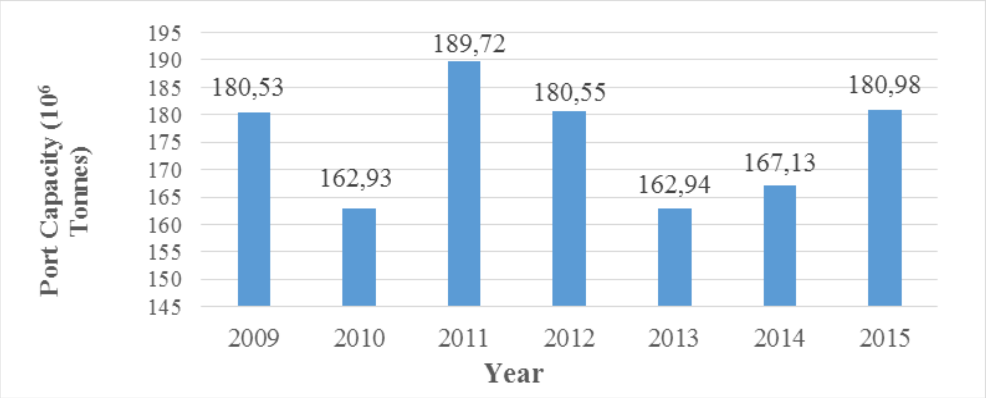

Figure 8. Dock Capacity of Tanjung Perak Port

The changing of dock capacity affected by Berth Throughput (BTP) which tend to be annually changed. A high tendency of goods passing by the dock means the dock capacity will increase. The optimum dock capacity can be estimated by the maximum Berth Occupancy Ratio (BOR) value determined by UNCTAD and maximum productivity of instrument in port.

If it is not limited by those two requirements then dock capacity tends to be increasing as Berth Throughput (BTP) increases. This condition is not in line with the actual situation if it is used in the calculation.

4. CONCLUSIONS

The factor which affects the performance of Tanjung Perak Port, Surabaya is Service time (St), Berth Occupancy Ratio (BOR), Berth Throughput (BTP) and Dock Capacity (K_D). The main factors affecting service time are the ability of the cargo of each ship and the passing capacity in the port. Berth Occupancy Ratio is affected by service time and number of ships arrival. Berth Throughput depends on the productivity of stevedoring. Moreover, the Dock Capacity is affected by Berth Throughput which restricted by the maximum Berth Occupancy Ratio.

The performance of Tanjung Perak Surabaya in the terminal, which is operated by PT Pelindo (III) Branch Tanjung Perak Surabaya in 2009-2015 can be determined from the average value of Service Time of 24.32 hours, with peak Service Time in 2015 is 25.7 hours. The mean value of Berth Occupancy Ratio is 51.38%. The highest value of BOR is in 2013 (51.57%). This Berth Occupancy Ratio value is lower than the standard value recommended by UNCTAD (55%), especially for three units of mooring group. The average value of Berth Throughput is 46.534 ton/hour or 7.72 ton/m/year.

The dock capacity in terminal operated by PT Pelindo (III) Branch Tanjung Perak Surabaya has the average value of 174.97 million ton/year, while the average demand value is 72.0 million ton/year.

Based on those four attributes as stated earlier such as Service Time (St), Berth Occupancy Ratio (BOR), Berth Throughput (BTP), and Dock Capacity (K_D), it can be concluded that Tanjung Perak Port in Surabaya has good performance in providing stevedoring services.

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