The characteristic, performance, accessibility, and prediction of cargo handling in Probolinggo New Terminal Port

Priyambodo\textsuperscript{1} and S H Sutanto\textsuperscript{1}
\textsuperscript{1}Research and Development Agency, East Java Province, Surabaya, 60231, Indonesia

e-mail: priyambodo@stpsatyawidya.ac.id

Abstract. This study is designed to evaluate the two years of operation of the Probolinggo New Terminal Port. Meanwhile, the objective is to acknowledge the characteristics, performance, accessibility, and prediction of its loading and unloading of goods. In order to achieve it, it needs to acknowledge the characteristics of the port, prediction or projection of the ships traffic volume, and goods by using linear regression analysis and qualitative descriptive statistics. The findings show that the characteristics of the port have not yet become a pilotage compulsory port. The port infrastructures are already adequate. The capacity of the Probolinggo New Terminal Port is still categorized as small. The types of boat that load and unload the goods comprise of barges, motorized sailing vessels, motorized sailing boats, and ships. The volume of ship calls and volume of goods loading and unloading at the Probolinggo New Terminal Port are very fluctuating and unstable. The internal accessibility from and to the Probolinggo New Terminal Port is very good and easy, however, for external, there is an obstacle in the area of Klakah. The prediction or projection of ship calls and goods loading and unloading are increased. To the Probolinggo New Terminal Port, it is recommended to improve the port infrastructure and to immediately maximize the role of port information so that the users can be informed about the port’s profile and all facilities of goods loading and unloading.

1. Introduction
The Probolinggo New Terminal Port is a regional feeder port that was established gradually by the Provincial Government of East Java and Central Government of Indonesia since 2010 and started operating in 2016. The Provincial Government of East Java is the only one regional government (province) in Indonesia that is granted the management concession of the Probolinggo New Terminal Port from the Ministry of Transportation for 64 years since 2017. Through the management by PT Delta Artha Bahari Nusantara (PT. DABN) which is a port business agency (BUP – Badan Usaha Pelabuhan) owned by the Provincial Government of East Java. The infrastructures of the Probolinggo New Terminal Port consist of waterways, loading and unloading dock, loading and unloading equipment, roads around the port, stacking fields, and warehouses. The dock consists of Dock-1 with a length of 96 m and a depth of –6 LWS, Dock-2 with a length of 309 and a depth of –11 and –14 LWS. The commodities unloaded in the Probolinggo New Terminal Port include coal, cement, leather, flour, wood, cast sand, and general cargo \cite{1}.

The findings of research conducted by the Research and Development Agency of East Java Province in 2016 stated that the Probolinggo New Terminal Port has good economic prospects due to the growth and development power, as well as having an opportunity. Therefore, it is necessary to open the market opportunity by approaching or inviting the users including port businessmen to offer the services of the Probolinggo New Terminal Port utilization by providing all facilities and
accessibilities [2]. And to improve the economy, it is necessary to support the availability of effective and efficient transportation infrastructure [3].

One of them is that accessibility is a key element in transport geography, because it can measure capacity from one point to another point where in sea transportation the port is a node. The strength of port interaction is determined by its connectivity index. The higher the index value, the more networks / routes connecting the port [4,5].

The users or businessmen in the port that can be approached are the businessmen who own industry of manure and cement in the areas of East Java by directly inviting and providing access, as well as special facilities.

Heretofore, the Provincial Government of East Java has been developing the facilities and infrastructures of the Probolinggo New Terminal Port and had been done, as well as has been operating for two years. As a follow-up action of the development and operationalization, the Probolinggo New Terminal Port requires an evaluation. One of them is evaluating the role of performance where good performance can improve the connectivity index [6,7].

Evaluation is required because the operational development of the Probolinggo New Terminal Port since it started the operation in 2016 needs to be acknowledged on its characteristics, development of ships visits, and volume of ships traffic, as well as the accessibility from and to the port, so that the performance can be documented analyzed. Because with the interesting characteristics of the port will be able to increase ship calls [8].

This is all necessary to be conducted so that the level of port utility will be increased as to how it happened in the utility of dock in the New Palembang Peti Kemas Boom Terminal, which projected growth of ship and container flow in 2018 to 2013 with a method of linear regression. Wherein the projection result shows that in 2018, the level of dock utility or BOR in the New Palembang Peti Kemas Boom Terminal has gone beyond 50% of the recommendation of the United Nation Conference on Trade and Development [9]. This condition is still qualified to the utility standard mandated by the Directorate General of Sea Transportation, which is 70%. Therefore, the dock is still fit to conduct activities of loading and unloading goods [10].

Based on the projection of ship flow growth in the port, it needs to be conducted a similar projection at the Probolinggo New Terminal Port. Therefore, the ship call and volume of ship traffic at the Probolinggo New Terminal Port can have similar decent performance.

2. Methodology
The location of the research is the Probolinggo New Terminal Port with a research time period of 12 months from January to December 2018.

Based on the result or reasoning that is targeted to be acquired or achieved, this research is an applied research which is a type of research to help policy makers or organizational leaders to make a decision about a particular situation, problem, or opportunity in decision-making [11]. With the hope that the research findings can be immediately implemented to practical needs, including to support the on-going development activities or to underlie the policies of decision-making. Accordingly, the technique of data collection used is the types of survey research through a questionnaire, interview, measurement, observation, and FGD. Based on the research method, this is categorized as quantitative, qualitative, and descriptive research [12].

The data required in this research are primary and secondary data. The primary data includes a map survey to acknowledge the accessibility (how are the paths, what kind of conveyance, and how long the distance is). The secondary data are data of the port volume and capacity, the port infrastructure, ship call, data on goods loading and unloading, and port performance. The data source are the Probolinggo New Terminal Port, Transportation Agency of Probolinggo City, Transportation Agency of of East Java Province, Regional Development Planning Board of East Java Province, PT. DABN (Gresik Head Office), PT. DABN Branch Office Probolinggo, and port business actors (users and stakeholders). The data are collected by directly visiting the research location and interviewees and by
conducting an observation, recording, measurement, and interviews with the involved parties, as well as conducting FGDs [13,14].

The characteristics, facilities, infrastructures, hinterland, types of ships, and goods are analyzed using a qualitative descriptive statistical analysis. Meanwhile, accessibility is a measurement of comfort or easiness regarding transfer or distribution of goods, therefore, it is analyzed using an accessibility analysis [15,16]. The port performance is analyzed using a qualitative descriptive statistical analysis. Meanwhile, the prediction or projection of ships and goods traffic volume is analyzed using simple linear regression analysis [17].

3. Results and Discussions

3.1 Port Characteristics
Reviewed by the environmental aspects of the Probolinggo New Terminal Port has not yet been an extraordinary pilotage/delay compulsory area. Therefore, operationally it is still organized by the Harbormaster and Port Authority. Meanwhile, for the stipulation of pilotage/delay compulsory area is currently being managed and still on progress. Besides, the ship traffic has not been able to cover the operational/investment cost of the tug boat provision. However, the Probolinggo New Terminal Port has been certified of the International Ship and Port Security Code (ISPS Code) which is a regulation of the IMO (International Maritime Organization) which specifically regulates activities and steps that must be taken by every country in coping with the threat of Terrorism at seas.

Furthermore, reviewed from the hydrography aspects – oceanography, the condition of the Probolinggo New Terminal Port is sloping and sandy. In the high tide reaches a water level of 160 cm and in the low tide reaches a water level of 54 cm. The current condition has a maximum current speed of 0.277 m/sec with a direction to the west is 283.33°. The minimum current speed is 0.028 m/sec with a minimum current direction of 253.00°.

The topography condition is relatively flat with an average slope of 1°, the condition of the current bathymetry depth −10 m up to −15 with an average depth of port pool −15 m the depth of areas around Dock-1 on average −6 m LWS while the areas around Dock-2 on average −11 m LWS as indicated in Figure 1, and the area of port pool is 5.86 Ha.

Figure 1. The Probolinggo New Terminal Port, Dock-1 and Dock-2
Legally, the operation of the Probolinggo New Terminal Port is implemented by PT. DABN which is based on the agreement of utility partnership for 30 years since August 18th, 2018 between the regional port business agency, in this case, PT. DABN with the Ministry of Transportation, represented by the Harbormaster and Port Authority wherein the goods assets ownership belongs to the state. This utility partnership agreement includes the assets of the dock, causeway, and reclamation funded by the State Budget funds.

Other than the utility partnership agreement, there is also the concession agreement for 64 years since December 21st, 2017 between the port business agency, in this case, PT. DABN with the Provincial Government of East Java wherein the goods assets ownership belongs to the regional government. This concession agreement includes assets established by the Regional Revenue and Expenditure Budget.

The Probolinggo New Terminal Port was established since 2010. The location is exactly next to the old Tanjung Tembaga Port which is managed by PT. Pelindo III. The establishment of this new port, beside considering the over-capacity that had been happening at Surabaya’s Tanjung Perak Port, is aimed to accelerate the delivery of goods to the eastern areas of East Java. This new port was designed after the event of Lapindo mud took place, because, at the moment, the logistics to the east was hampered by the traffic in Porong.

### 3.2 Port Facilities, Infrastructures, and Capacity

The definition of facilities, according to Abubakar et al [18] are vehicles, in this case, ships, pilot boats, and mooring boats. Meanwhile, infrastructures are docks, waterways, terminal, and related facilities, such as waterways, port pools, wave breakers, and telecommunication equipment. In other words, facilities are more about tools or equipment that are moving. The examples of facilities in the scope of the Probolinggo New Terminal Port can be seen in Table 1 below, such as fire truck, water tanker truck, and pickup car, and so on.

Meanwhile, infrastructures are more focused on static things, in which, in the scope of the Probolinggo New Terminal Port include weighbridge, gate post and counter, buildup warehouse, rigid pavement, rigid concrete road, rigid pavement causeway, trestle, water reservoir tub, pipeline facilities to the dock, garage building & CCTV room, etc. as shown in Table 1. Currently, the Probolinggo New Terminal Port has adequate facilities and infrastructures to conduct its port operations, such as docks, stacking fields, warehouses, trestles, causeways, and other unloading equipment.

### Table 1. Existing facilities at the Probolinggo New Terminal Port

| No. | Facilities                                | Volume       | Information              |
|-----|------------------------------------------|--------------|--------------------------|
| 1.  | Weighbridge                              | 2 units      | In + Out                 |
| 2.  | Gate Poss and Counter                    | 1 unit       |                          |
| 3.  | Buildup Warehouse                        | 2 units      | @24 x 60 m               |
| 4.  | Rigid Pavement                           | 54,080 m²    | 260 x 208 m              |
| 5.  | Leveling (Talud)                         | 4 m LWS      |                          |
| 6.  | Rigid Concrete Road                      | 15,000 m²    | 1,000 x 15 m             |
| 7.  | Causeway                                 | 5,760 m²     | 480 x 12 m               |
| 8.  | Trestle                                  | 5,760 m²     | 640 x 9 m                |
| 9.  | Water Reservoir Tub                      | 440 Ton      | 11 x 10 x 4 m            |
| 10. | Pipeline Facilities into Dock            | ±2.3 Km      |                          |
| 11. | Garage Building & CCTV Room              | 384 m²       | 16 x 24 m                |
| 12. | Rest Area Building/Public Facility       | 353 m²       | Toilet, Canteen & Shelter|
| 13. | Fire Truck                               | 1 unit       | 4,000 L                  |
| 14. | Water Tanker Truck                       | 2 units      | @5,000 L                 |
| 15. | Pickup Car                               | 1 unit       |                          |
| 16. | Generator Set Cap. 60 Kva                | 2 units      |                          |
| 17. | Generator Set Cap. 30 Kva                | 1 unit       |                          |
| 18. | Dock I (1,000 DWT/ -6 m LWS)             | 1,720,5 m²   | 93 x 18.5 m, that will be strengthened into 10,000 DWT |
The capacity of the Probolinggo New Terminal Port are, Dock-1 has a length and width of 93 m × 18.5 m which is able to accommodate boats with a maximum size of 1,000 DWT that will be enhanced to 10,000 DWT, with a depth of draft –6 LWS and trestle 1 with a volume of 1,720.5 m³. Dock-2 with a length and width of 300 m x 31 m is able to accommodate boats with a maximum size of 20,000 DWT that will be enhanced to 40,000 DWT, with a depth of draft –11 LWS, and trestle 2 with a volume of 2,304 m³. Furthermore, in order to fulfill the targeted capacity at the Probolinggo New Terminal Port, it is very dependent on the ability of the hinterland as a supporter of the existence of the port and also supported by an ability of trading in the area, therefore, the ships that come can trade.

3.3 Port Hinterland

The hinterland of the Probolinggo New Terminal Port as can be seen in Figure 2 includes the primary hinterland, which is Probolinggo City. The secondary hinterland, which is Probolinggo District. Further, the tertiary hinterland, which are Sidoarjo, Pasuruan, Mojokerto, Malang, Lumajang, Jember, Bondowoso, and Situbondo.

The Probolinggo New Terminal Port is located between the Surabaya Main Port of Tanjung Perak in the west of the Probolinggo New Terminal Port, which is more or less 100 km away and in the east, there is the Banyuwangi Tanjungwangi Port, which is about 160 km away.

3.4 Types of Ships and Goods

There are 3 (three) types of vessels that stop by and conducting activities at the Probolinggo New Terminal Port, which are, the first is barge, the second is motorized sailing vessel (KLM) and motorized sailing boat (PLM), and the third is ship.

From the three types of vessels above, the one conducting loading and unloading activities are barges and KLM and/or PLM. Meanwhile, the most dominant in the activities of loading and unloading of goods are barges as shown in Figure 3. The KLM and PLM boats hardly stop by and load or unload goods. Meanwhile, tug boats do not do activities of loading and unloading foods. They only function to pull big ships like barges during the process of berthing.
Barges load and unload goods at Dock-2 in a large number, either the tonnage or vessel’s size. For instance, MV Golden Kiku with a tonnage of 17,958 GT unloaded raw sugar amounted of 26,000 ton from Thailand and delivered to PT. Cheil Jedang Pasuruan. BG Boat Tama 3368 with a tonnage of 4,388 GT unloaded coal weighed 9,943 ton from Kalimantan and delivered to PT. Pabrik Kertas Tjiwi Kimia Mojokerto. Other than raw sugar, goods from outside the country that will be unloaded is tapioca flour starch 8,151 ton from Thailand. Unloaded by MV Vinaship Gold has a length of 136.40 m with a tonnage of 8,216 GT. Loading and unloading raw sugar and cement can be seen in the following Figure 4.

![Figure 3. Barges containing coal guided by tug boats](image)

Meanwhile, the domestic product is coal from Kalimantan that is delivered to PT. Cheil Jedang Pasuruan. The cement produced by PT. Semen Puger from Jember is delivered to Kalimantan. The unloading of these goods dominate about 89% of the activities at the Probolinggo New Terminal Port and the rest of it, which is 11%, is the activities of loading of goods.

Other than barges, there is another type of boat, which is KLM and PLM, which are classified as traditional people’s shipping, also load and unload goods at the Probolinggo New Terminal Port at Dock-1. However, the domination of loading and unloading at the Probolinggo New Terminal Port is very small. As well as the volume of goods loaded and unloaded at a maximum of only 552 ton and the traditional vessel maximum tonnage is only 264 GT.
As shown in Table 2, it can be explained that the activity of goods unloading at the Probolinggo New Terminal Port dominate the activities compared to the goods loading, in which ± 89.6% is unloading, while the rest of 10.4% is goods loading. The loading are, for instance, cement from PT. Semen Puger and limestone from PT. Bangun Artha Puger that are delivered to outside East Java, which are to Kalimantan and Cilegon, West Java.

**Table 2. Loading and unloading of goods using barges at the Probolinggo New Terminal Port on January – October 2018**

| Month       | Number of Barge (unit) | GT | Domestic Unload (ton) | Domestic Load (ton) | International Unload (ton) | International Load (ton) | Product | Origin of Goods | Destination |
|-------------|------------------------|----|-----------------------|---------------------|---------------------------|--------------------------|---------|-----------------|-------------|
| January     | 8                      | 42,393 | 750 | 6,001 | - | - | - | - | - |
| February    | 10                     | 54,824 | 2,358 | 21 | - | - | - | - | - |
| March       | 16                     | 101,072 | 2,302 | - | - | - | - | - | - |
| April       | 21                     | 70,677 | 9,208 | 19,951 | - | - | - | - | - |
| May         | 25                     | 75,379 | 10,401 | - | - | - | - | - | - |
| June        | 16                     | 33,220 | 6,118 | - | - | - | - | - | - |
| July        | 23                     | 45,450 | 11,801 | 23,985 | - | - | - | - | - |
| August      | 16                     | 36,018 | 4,299 | 32,178 | - | - | - | - | - |
| September   | 11                     | 23,380 | 5,935 | 23,965 | - | - | - | - | - |
| October     | 24                     | 38,799 | 6,878 | 24,000 | - | - | - | - | - |
| Average     | 17                     | 52,121 | 6,005 | 18,585 | - | - | - | - | - |

*Source: processed from the secondary data of 2018*

The fewer goods loaded at the Probolinggo New Terminal Port and sent to outside East Java Province confirms that the industry of primary, secondary, and tertiary hinterland of the Probolinggo New Terminal Port has not yet been developed optimally. This is because there have not been many results of the industry and manufactured products that can be delivered outside East Java Province.

**Figure 5. Loading and unloading of goods with barges at the Probolinggo New Terminal Port, January – October 2018**
Figure 5 shows that the activity of domestic goods unloading using barges dominates the activities at the Probolinggo New Terminal Port from January – October 2018. On average per month, it is unloaded as much as 52,121 ton (89.6%). Meanwhile, the goods loaded is only 6,005 ton (10.4%).

Table 3 and Figure 6 show that the activity of domestic goods unloading using KLM or PLM vessels is very small, both on its volume of goods unloaded and boat tonnage. The goods unloaded are products of sengon and kamedangan wood plants with a volume between 72 – 552 ton, with the boat tonnage between 149 – 264 GT.

**Table 3. Loading and unloading of goods using KLM/PLM vessel at the Probolinggo New Terminal Port, January – October 2018**

| Month   | Number of boat (unit) | GT | Domestic Unload (ton) | Domestic Load (ton) | International Unload (ton) | International Load (ton) | Product          | Origin of Goods | Destination     |
|---------|-----------------------|----|-----------------------|---------------------|---------------------------|--------------------------|-------------------|----------------|----------------|
| January | 1                     | 234| 552                   | -                   | -                         | -                        | Sengon wood       | Berau           | Lumajang        |
| February| -                     | -  | -                     | -                   | -                         | -                        | -                 | -              | -              |
| March   | 1                     | 264| 382                   | -                   | -                         | -                        | Sengon wood       | Berau           | Lumajang        |
| April   | -                     | -  | -                     | -                   | -                         | -                        | -                 | -              | -              |
| May     | 1                     | 149| 300                   | -                   | -                         | -                        | Corn              | Bima            | Probolinggo     |
| June    | -                     | -  | -                     | -                   | -                         | -                        | -                 | -              | -              |
| July    | -                     | -  | -                     | -                   | -                         | -                        | -                 | -              | -              |
| August  | 1                     | 158| 72                    | -                   | -                         | -                        | Kamedangan wood   | Agast           | Probolinggo     |
| September| 1                  | 173| 80                    | -                   | -                         | -                        | Kamedangan wood   | Papua           | Probolinggo     |
| October | 1                     | 263| 425                   | -                   | -                         | -                        | Sengon wood       | Berau           | Probolinggo     |

Source: processed from the secondary data of 2018

**Figure 6. Unloading and loading goods using KLM/PLM vessels at the Probolinggo New Terminal Port, January – October 2018**

3.5 Port Performance

Table 4 presents the performance of the Probolinggo New Terminal Port that can be seen in the value of Berth Occupancy Ratio (BOR), Yard Occupancy Ratio (YQR), Berth Through Put (BTP), and Yard
Through Put (YTP). Besides that, the performance can also be seen through the value of Arrival Rate (AR) and Ton/Alley/Hour (T/A/H) exhibited in Figures 7 and 8.

The BOR data (from the seaside) of each month from 2016 – 2017 at the Probolinggo New Terminal Port (Table 4) can be analyzed as follows. The annual BOR at Dock-1 from 2016 to 2017 experienced a decline from 51.44% to 41.08% and in 2018 up to September decrease further to 38.21%. This was caused by the sluggish economy and within the environment of the port itself, there was construction and finishing of port facilities and infrastructure works.

Meanwhile, the BOR value at Dock-2 experienced an increase between 2016 to 2017 from 36.24% into 46.04%, but it declined to 39.96% in 2018 up to September. This fact shows that BOR is still fluctuating up and down. It has not shown a trend of stable increase or decline. However, in general such a BOR value could be considered as quite good for a port that has just been operating for two years.

Furthermore, the pattern of increase and decline of the BTP is similar to the pattern of increase and decline of the BOR. Generally, the value of BTP exposed in Table 4 could be regarded as quite good, again for a port that has just been operating for two years. The condition also confirms that ship calls are still low if calculated by the average daily visit, which is only 1 ship call.

**Table 4. Performance condition (BOR, BTP, YOR, YTP) 2016 - 2018 at the Probolinggo New Terminal Port**

| No | Aspect | Description |
|----|--------|-------------|
| 1  | Sea Side Condition & Performance (Waters) | Dock |
|    | a Berth Occupancy Ratio (BOR) Jetty I | 2016: 51.44% |
|    |    | 2017: 41.08% |
|    |    | 2018 (up to Sept): 38.21% |
|    | b Berth Occupancy Ratio (BOR) Jetty II | 2016: 36.24% |
|    |    | 2017: 46.04% |
|    |    | 2018 (s/d Sept): 39.96% |
|    | c Berth Through Put (BTP) Jetty I | 2016: 20 ton/m |
|    |    | 2017: 12 ton/m |
|    |    | 2018 (s/d Sept): 11 ton/m |
|    | d Berth Through Put (BTP) Jetty II | 2016: 119 ton/m |
|    |    | 2017: 156 ton/m |
|    |    | 2018 (up to Sept): 132 ton/m |
| 2  | Land Side Condition & Performance (Land) | Stacking Fields |
|    | a Yard Occupancy Ratio (YOR) | 2016: 0.03% |
|    |    | 2017: 0.07% |
|    |    | 2018 (up to Sept): 0.19% |
|    | b Yard Through Put (YTP) | 2016: 0.03 ton/m |
|    |    | 2017: 0.07 ton/m |
|    |    | 2018 (up to Sept): 0.17 ton/m |

Source: PT. DABN 2018

Furthermore, the annual YOR and YTP data (from the land side) from 2016 – 2018 at the Probolinggo New Terminal Port can be seen in Table 4 above and Figure 7 below.
Figure 7. YOR and YTP in 2016, 2017, and 2018 (up to September) at the Probolinggo New Terminal Port

The YOR in Figure 7 shows an increasing tendency, where in 2016 it was 0.03% and increased to 0.07% in 2017, and then increased further to 0.19% in 2018 (up to September). The YTP exhibits a similar tendency as in the case of YOR, that is also experienced an increase from 2016 to 2017 and then up to September 2018. This means a good indication, even though the value is still very small.

Figure 8. Monthly arrival rate in 2016 – 2018 (up to Sept) at the Probolinggo New Terminal Port

In Figure 8 above it is described that the ship arrival rate in 2016 was fluctuating up and down sharply, therefore, the trend of increase or decline could not be predicted because the R-value was more than 1. On average, each month, there are 25 ships unload and load goods at the Probolinggo New Terminal Port. In 2017, the increase and decline rate of the arrival rate was also fluctuating sharply, just like in 2016. The fluctuation was caused by the construction within the port, however, on average, the ships that visit each month was 32, which was still more than in 2016. Furthermore, in 2018 up to September, the arrival rate remained to fluctuate sharply so that it was rather difficult to predict the tendency. With an average ship call each month of 30, lower than in 2017.
Figure 9 above describes that the speeds of loading and unloading of commodities as measured with the unit of T/A/H at the Probolinggo New Terminal Port in 2017, eventually on the average is above the standard. In other words, the performance of goods loading and unloading at the Probolinggo New Terminal Port is good for commodities including tapioca flour, coal, and general cargo. Only the commodity of corn has unloading and loading speeds below the standard.

3.6 Accessibility
The accessibility, or easiness of being able to be reached, in this research can be reviewed from 2 (two) sides. Firstly, the accessibility from inside of the Probolinggo New Terminal Port environment and, secondly, the accessibility from outside of the Probolinggo New Terminal Port.

3.6.1 Accessibility from inside
Accessibility from inside the port environment is the easiness of loading and unloading of goods and its distribution from ships to carrier vehicles followed with movement towards the ways outside the port and advancing further to the main road, or vice versa. To support the accessibility inside the port, there has been provided and equipped with port facilities and infrastructures, including dock, trestle, causeway, roads, and trucks.

The easiness of loading and unloading at the Probolinggo New Terminal Port from ships to carrier vehicles, such as truck, has been proven to operate smoothly. This can be seen from the time to carry goods from the ship to the main road with a distance of ±3.5 km, through a ±60 m long and 9 m wide trestle and a ±480 m long and 12 m wide causeway, that takes only ± 30 minutes.

Then, to enhance the accessibility within the Probolinggo New Terminal Port the trestle and the inner port road to the main road needs to be widened, so that it could better accommodate the entry and exit of container trailer vehicles to the port. In relation to attain better accessibility some companies as the port costumers have proposed certain improvement of facilities.

PT. Penaschop, for instance, suggests the need for the customs areas to be in Probolinggo instead of elsewhere like it has been, which is in Kalibutuh. PT. Cheil Jedang whose party needs a facility of storing warehouse inside the port to accommodate the import of raw sugar and tapioca from Thailand, or an optimization of the existing equipment to accelerate the unloading and loading of goods. Meanwhile, PT. Indopherin Jaya and PT. Palmolite Athisive Industry (PAI) that are in one group currently have a storage tank for liquid materials in Manyar Port, Gresik, some 130 km away from Probolinggo. Their need for liquid cargo has not been able to be served by the Probolinggo New
Terminal Port because this port heretofore has not yet had the facilities to loading and unloading of liquid bulk cargoes. Therefore, in order to unload and load liquid bulk cargoes, there is a necessity of a further discussion between PT. Indopherin Jaya and PT. DABN on the certainty of the handling facilities and location of liquid materials storage, and so on.

3.6.2 Accessibility from outside

With regards to the accessibility from outside, the Probolinggo New Terminal Port is in good standing because it is supported by availability of railway access that has a distance between the port to station of ±1.3 km. Yet for the operation for serving the port the railway needs to be reactivated to be able to enter the port area.

Besides the pre-existing railway access that just needs to be reactivated, the Probolinggo New Terminal Port is also close to the highway access, which is approximately 41 km to the Pasuruan highway gate that has been operating. This is connected to the highway leading to Tanjung Perak Port in Surabaya at a distance of about 71 km and could be reached within some 1 hour 36 minutes. Furthermore, the port is ±9.5 km from the Probolinggo highway gate which is then under the construction process. From this gate it could be expected to take ± 2 hours 15 minutes toward Tanjung Perak Port in Surabaya. Moreover, the port is ± 12 km from the Leces highway gate which is currently in construction progress, could be expected to take ± 2 hours 44 minutes toward the Tanjung Perak Port in Surabaya. So generally the condition of accessibility from the outside of Probolinggo New Terminal Port, which is related to the primary hinterland of Probolinggo City and District as well as Pasuruan District, can be considered as satisfactory (see Table 5).

| No. | Facility              | Description on Accessibility | Remarks                                      |
|-----|-----------------------|-------------------------------|----------------------------------------------|
| 1   | Trestle               | Length of 640 m; Width of 9 m | Require a widening for access of container trailers |
| 2   | Causeway              | Length of 480 m; Width of 12 m|                                               |
| 3   | Access to main road  | Length of 3.5 km, Width of ±9 m| Require a widening for access of container trailers |
| 4   | Railway               | Distance of Station - Port ±1.3 km| Require a railway reactivation toward the port area |
| 5   | Main road             | -                             |                                               |
| 6   | Highway Access        | ±41 km from Pasuruan Highway Exit| Operate, 71 km; 1 hour 36 minutes towards Tg. Perak Port Surabaya |
|     |                       | ±9.5 km from Probolinggo Highway Exit| In progress, 2 hours 15 minutes towards Tg. Perak Port Surabaya |
|     |                       | ±12 km from Leces Highway Exit | In Progress, 2 hours 44 minutes towards Tg. Perak Port Surabaya |

Source: PT. DABN 2018

Meanwhile, the condition of accessibility for the secondary and tertiary hinterland, for instance, from the area of Lumajang and Jember Districts toward the Probolinggo New Terminal Port is hampered by the condition of road infrastructures in the area of Klakah. This is due to the contour which is rather uphill and narrow because of the presence of traditional markets on both sides of the road. Besides that, the road is categorized as the class 3, with a maximum capacity to serve heavy vehicle carrying cargo up to only 10 ton.

Further, in Jember District there is PT. Semen Puger Jember that has been operating since 2012, with cement production capacity of 1,000 ton/day. PT. Semen Puger Jember continually delivers cement to Pontianak in western Kalimantan Island, through Klakah and unloads it at the Probolinggo New Terminal Port on average 2,500 ton/month. The delivery cost is IDR 100/kg (USD 0.007/kg), therefore, the overall cost is IDR 100 × 2,500 ton/month or IDR 250,000,000/month (USD
17,574/month). The delivery uses slim and small jumbo bag packaging carried on trailer vehicles with a cargo capacity of about 35 tons. This certainly causes problems because trailers weighing 35 ton must pass the class 3 road with a maximum capacity of only 10 tons.

Moreover, PT. Semen Puger Jember is currently receiving additional order of cement to be delivered to Kendari, Sulawesi Island, at the amount of ±7,000 ton/month. In the trial stage the company can only serve in the order of 5,700 ton/month. Considering the development of customer orders regarding cement production from PT. Semen Puger in Jember, the aspects of accessibility on secondary and tertiary hinterland become urgent and important to be immediately improved in accordance with the development of these hinterland industrial areas, including Lumajang, Jember, and its surrounding. Furthermore, in the near future in these areas will be operated a new cement factory, PT. Imas Co., which is a foreign investment with a production capacity of ±10,000 ton/day, or 10 times larger than PT. Semen Puger Jember. It could be foreseen the hindrance that will arise in conjunction with the road condition if PT. Imas Co. is starting the production and should deliver the product through the Probolinggo New Terminal Port.

3.7 Prediction of Ship Call and Cargo Shipping

Table 6 below contains the data of ship call and flow of goods at the Probolinggo New Terminal Port from January to September 2018. The data in this table will be used to predict the ship call and volume of cargo to be handled by the port in the near future.

Table 6. Ship call and flow of goods at the Probolinggo New Terminal Port, January – September 2018

| Month   | Period (t) | Number of ship call (Y1) | Volume of Loading and unloading (Y2) | (t)Y1 | t1² | (t)Y2 | t2² |
|---------|------------|--------------------------|--------------------------------------|-------|-----|-------|-----|
| January | 1          | 14                       | 49,144                               | 14    | 1   | 49,144 | 1   |
| February| 2          | 18                       | 57,203                               | 36    | 4   | 114,406 | 4   |
| March   | 3          | 33                       | 103,374                              | 99    | 9   | 310,122 | 9   |
| April   | 4          | 34                       | 99,836                               | 136   | 16  | 399,344 | 16  |
| May     | 5          | 43                       | 86,081                               | 215   | 25  | 430,405 | 25  |
| June    | 6          | 24                       | 39,338                               | 144   | 36  | 236,028 | 36  |
| July    | 7          | 36                       | 81,237                               | 252   | 49  | 568,659 | 49  |
| August  | 8          | 31                       | 72,568                               | 248   | 64  | 580,544 | 64  |
| September| 9         | 20                       | 133,282                              | 180   | 81  | 1,199,538 | 81 |
| Total   | 45         | 253                      | 722,063                              | 1,324 | 285 | 3,888,190 | 285 |

Source: Results of independent process of secondary data, 2018

The calculation is applying the linear regression method to predict the ships call at the Probolinggo New Terminal Port, during the period of October to December 2018, is as follows:

\[ b = \frac{(9)(1,324) - (253)(45)}{(9)(285) - (45^2)} = \frac{11,916 - 11,385}{2,625 - 2,025} = 531 \]
\[ b = 0.98 \]
\[ a = \frac{253}{9} - \frac{(0.98)(45)}{9} = 28.11 - 4.9 \]
\[ a = 23.21 \]
\[ Y_{\hat{o}} = 23.21 + 0.98t \]

Thus, the prediction of ship call for October – December 2018 is as follows:

\[ Y_{(o,c)} = \hat{Y}_{(o,c)} - 23.21 + 0.98 (10) = 33 \text{ ships} \]
\[ Y_{(Nov)} = 23.21 + 0.98 (11) = 34 \text{ ships} \]
\[ Y_{(Dec)} = 23.21 + 0.98 (12) = 35 \text{ ships} \]

The calculation using the linear regression method is also applied to predict the volume of cargo loading and unloading at the Probolinggo New Terminal Port, during the period of October to December 2018 is as follows:

\[ b = \frac{(9)(3,888,190) - (722,063)(45)}{(9)(285) - (45^2)} = \frac{34,993,710 - 32,492,835}{2,625 - 2,025} = \frac{2,500,875}{540} \]

\[ b = 4,631.25 \]

\[ a = \frac{722,063}{9} - \frac{(4,631.25)(45)}{9} = 80,229.22 - 23,156.25 \]

\[ a = 57,072.97 \]

\[ Y_y = 57,072.97 + 4,631.25t \]

Therefore, the prediction of the volume of goods unloading and loading for October – December 2018 is as follows:

\[ Y_{(Oct)} = 57,072.97 + 4,631.25 (10) = 103,385.47 \text{ ton} \]
\[ Y_{(Nov)} = 57,072.97 + 4,631.25 (11) = 108,016.72 \text{ ton} \]
\[ Y_{(Dec)} = 57,072.97 + 4,631.25 (12) = 112,647.97 \text{ ton} \]

The ship call started in 2016 to 2017 was very fluctuating, yet, it had a tendency to grow on an average of 57% annually as revealed in Table 7. The total ship call in 2016 was 300 unit of ships, therefore, each month the average ship call is 25 units and increased in the following year, 2017, into 379 units. Thus each month there were on average 32 units of ships carried out loading and unloading operation.

**Table 7.** Prediction of ship call and volume of goods at the Probolinggo New Terminal Port, October – December 2018 using the calculation of the linear regression method

| Month | Call (unit) | Growth | Growth | Flow of goods (T/m³) | Growth | Growth |
|-------|-------------|--------|--------|---------------------|--------|--------|
|       | 2016 | 2017 | 2018 (est) | 2016-2017 | 2017-2018 | 2016 | 2017 | 2018 (est) | 2016-2017 | 2017-2018 |
| Jan   | 13   | 32   | 14     | 146%   | -56%  | 38,032 | 61,325 | 49,144 | 61%   | -2%    |
| Feb   | 12   | 17   | 18     | 42%    | 6%    | 30,423 | 50,599 | 57,203 | 66%   | 13%    |
| Mar   | 11   | 35   | 33     | 218%   | -6%   | 30,946 | 102,317 | 103,374 | 231%  | 1%     |
| Apr   | 20   | 39   | 34     | 95%    | -13%  | 27,641 | 123,090 | 99,836 | 345%  | -19%   |
| May   | 22   | 47   | 43     | 114%   | -9%   | 40,676 | 109,183 | 86,081 | 168%  | -21%   |
| Jun   | 38   | 40   | 24     | 5%     | -40%  | 56,417 | 89,144 | 39,338 | 58%   | -56%   |
| Jul   | 48   | 44   | 36     | -8%    | -18%  | 47,917 | 64,142 | 81,237 | 168%  | -21%   |
| Aug   | 58   | 24   | 31     | -59%   | 29%   | 31,331 | 35,729 | 72,568 | 14%   | 103%   |
| Sept  | 21   | 31   | 20     | 48%    | -35%  | 31,464 | 31,970 | 133,282 | 2%    | 317%   |
| Oct   | 18   | 27   | 33     | 50%    | 22%   | 32,912 | 52,058 | 103,385 | 58%   | 108%   |
| Nov   | 17   | 26   | 34     | 53%    | 31%   | 17,232 | 49,213 | 108,016 | 186%  | 119%   |
| Dec   | 22   | 17   | 35     | -23%   | 106%  | 47,587 | 46,899 | 112,647 | -1%   | 140%   |
| Total | 300  | 379  | 355    | 432,578 | 815,669 | 1,046,111 |

Average per month: 25, 32, 30, 57%, 1%, 36,048, 67,972, 87,176, 89%, 61%  

Source: PT. DABN and result of prediction processed, 2018

The average growth of ship call each month from 2016 – 2017 was 57% and declined into 1% in the following year, 2018. This is because within the period of time from January to September 2018...
there was physical construction in the environment of the Probolinggo New Terminal Port. Furthermore, from October to December 2018, it was predicted that the ship call would increase to 33 ships in October, 34 ships in November, and 35 ships in December. So, it increased by about 22% up to 106% as can be seen in Table 7.

Meanwhile, the growth of the volume of goods on average per month in 2016 was 36,048 ton and increased in 2017 into 67,972 ton. Therefore, the volume of average growth of goods loading and unloading at the Probolinggo New Terminal Port in 2016-2017 was 89%. Meanwhile, the goods volume growth in 2017 – 2018 was 61%, declined from the previous year. However, within the period of October to December 2018, it was predicted the extent of goods volume would be 103,385 ton in October, 108,016 ton in November, and 112,637 ton in December.

4. Conclusions and Recommendations
A study on the characteristic, performance, accessibility, and prediction of cargo handling in Probolinggo New Terminal Port has been conducted, and the conclusions that can be drawn are as follows:

1. The capacity of the Probolinggo New Terminal Port is still categorized as small, Dock-1 is able to accommodate ships with a maximum tonnage of 1,000 DWT and Dock-2 is able to accommodate ships with a maximum tonnage of 20,000 DWT. The hinterland of this port include the primary hinterland, which is Probolinggo City, the secondary hinterland, which is Probolinggo District, and tertiary hinterlands, which are Sidoarjo, Pasuruan, Mojokerto, Malang, Lumajang, Jember, Bondowoso, and Situbondo. There are 3 (three) types of loading and unloading vessels served in the port, firstly are barges, Secondly are motorized sailing vessels (KLM) and motorized sailing boats (PLM), and thirdly are ships.

2. The performance of the Probolinggo New Terminal Port could be viewed as follows:
   a. The BOR (from the seaside) each year at Dock-1 from 2016 to 2018 experienced a declining trend. Meanwhile, the value of BOR at Dock-2 experienced an increasing trend from 2016 to 2017 and declined in 2018 (up to September). The condition of BOR above shows that BOR is still fluctuating up and down. It has not shown a trend of stable to increase or decline. However, generally, the BOR value between 36% - 51.5% is already quite good for a port that has just been operating for two years.
   b. The BTP also had the same pattern of increase and decline as for the case of BOR. Generally, the value of BTP is already quite good for a port that has just been operating for two years. The condition also confirms that ship calls are still low if calculated by the average daily visit, which is only 1 ship call.
   c. The YOR data (from the land side) from 2016 – 2018 shows a consistent increasing trend. It is similar to the YTP that also experienced an increase with a similar pattern. The ship arrival rate in 2016 and 2017 were fluctuating up and down sharply, therefore, the trend of increase or decline could not be predicted because the R-value was more than 1.0. The fluctuation was caused by the construction within the port, however, on average, in 2017 the ships that visit each month was 32, which was more than in 2016. Furthermore, in 2018 with a prediction up to September, the arrival rate remained to fluctuate sharply so that it was rather difficult to predict the tendency. With an average ship call each month of 30, lower than in 2017.
   d. The speed of loading and unloading of commodities, on average, is above the standard. In other words, the performance of goods loading and unloading at the Probolinggo New Terminal Port is good for commodities including tapioca flour, coal, and general cargo, only the commodity of corn had an unloading and loading speed below the standard.
   e. The accessibility from and to the Probolinggo New Terminal Port is generally good and easy. The accessibility from inside the port environment to carry goods from the ship to the main road with a distance of ±3.5 km through a ±60 m and 9 m wide trestle and a ±480 m long and 12 m wide causeway takes only ± 30 minutes. Meanwhile, the accessibility from outside the port
environment, besides facilitated by the pre-existing railway access that just needs to be reactivated, the Probolinggo New Terminal Port is also close to the highway access.

4. The prediction or projection of ship call is as follows: from October to December 2018, it was predicted that the ship call would increase, which is 33 ships in October, 34 ships in November, and 35 ships in December. The prediction or projection on the volume of cargo loading and unloading is increased as follows: 103,385 ton in October, 108,016 ton in November, and 112,637 ton in December.

Based on the findings from the current study some recommendations are put forward with regards to the possibility in enhancing the performance of the Probolinggo New Terminal Port as listed below:

1. The port has been practicing dry bulk goods loading and unloading using excavator. Therefore, it is recommended to add the facilities of loading and unloading equipment, such as adding more excavators, cranes or conveyors.
2. Besides adding the equipment of loading and unloading, the port is recommended to build warehouses within the port area to accommodate the dry bulk commodities.
3. The accessibility across Puger up to Probolinggo is recommended to be normalized and improved its road class, especially across Klakah because this road’s volume will eventually be increased.
4. In order to increase the capacity of the port, it is recommended to the regional government to ease the business permit, for instance, limestone mining business in the areas of the tertiary hinterland, especially in the area of Puger, Jember.
5. The port management is recommended to maximize the role of port information so that users can easily obtain information regarding cargo loading and unloading.

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