Analysing the cause of idle time in loading and unloading operation at Indonesian international port container terminal: Port of Tanjung Priok case study

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Abstract. Prior study shows that major Indonesian ports still need some improvements to achieve a better logistics performance. This study aims to analyze which variables can influence the present of idle time during loading and unloading process at Container Terminal Operation 2 Tanjung Priok Port Jakarta. The Tanjung Priok Port is chosen since the port is designed as the hub port in the national sea transport system of the country where it handles more than 50% Indonesia’s trans-shipment cargo traffic. This study uses service blueprint, multiple regression analysis, and one-way anova method. The findings show that at the existing Tanjung Priok Port Container Terminal has 17 (seventeen) failure spots, which are categorized into 6 (six) variables namely head truck, computer system, weather, stevedoring worker, equipment failure, and operator activities, that cause the idle time at the port service. Nevertheless, based on the multiple regression analysis, only 5 (five) variables have a significant influence on the cause of idle time excluding weather variable. Finally, with one-way anova test it is found that operator activities at the gate-in process is the most significant influence to the idle-time at the port service.

Keywords: Container, Idle Time, Service Blueprint, Regression Analysis, Tanjung Priok Port

1. Introduction

The global economy growth has an effect to the global international trade where ports plays important gateways to support global international trade. In many countries, ports can be seen as major accelerator of local economic development in the rapid global competitive market [1]. Historically since the early stages of industrialization, ports were designed to support local, regional and global economies activities. One may assume that there is a correlation between ports and the economy growth of a country. Ports are thus having influence to the economic development of countries on local, national, and international level [1].

As the world largest archipelago country and located between the indian and the pacific oceans, Indonesia can become a global maritime axis. Indonesian President Joko Widodo, Jokowi, in late 2014 presented the global maritime axis concept to rejuvinate country’s identity as a maritime nation [2].
Prior study showed that key objective of this global maritime axis concept was to improve inter-island connectivity and upgrading major port infrastructure in Indonesia. By issuing Presidential Regulation No. 26/2012 on Blueprint of National Logistics System Development (SISLOGNAS), Indonesian Government showed its commitment to promote the improvement of national competitiveness as well as to encourage the implementation of the Masterplan of Acceleration and Expansion of Indonesia’s Economic Development (MP3EI) from period 2011 to 2025. All of these governances were developed to become a guidance for relevant stakeholders [3].

Indonesia has a potential to become a host of international hub port. Nevertheless, the productivity and capacity at major Indonesia ports are currently not able to accommodate the increasing demand in the flow of goods for both domestic and international. Major improvements in Indonesian Ports are needed to be implemented so that it can support efficient and effective maritime logistics and connect all islands in Indonesia. In fact, delivering goods from Padang to Jakarta costs more than three times compare with shipping the same container from Jakarta to Singapore [4]. Study done by the World Bank in 2015 argued that the deficiency in maritime logistics, operations, and infrastructure may result in poor connectivity between islands, undermining trade, and less competitiveness. The study also showed that the operation of most Indonesia ports leading to inefficiencies that would have a direct influence to the high logistics costs for business and consumers. The logistics costs in Indonesia equal to 24 percent of Gross Domestic Product (GDP) which can slowdown country’s economic growth [5]. In the latest World Logistics Performance Index (LPI) 2018, Indonesia ranked at 46th place in the world. Compare with other South East Asia Countries, Indonesia ranked below Singapore (7th Place), Thailand (32nd Place), Vietnam (39th Place), and Malaysia (41st Place) [6].

In relation to port competitiveness, it is realized that the main problem of Indonesian ports comprises 3 (three) main issues including the absent of international hub ports, low productivity and capacity of ports, and poor port performance services [7]. Therefore, this study was conducted to analyze the cause of inefficient performance ports in Indonesia. Previous study showed that idle time at the port service leveraged to the high cost of Terminal Handling Charge (THC) [8]. However, different with the previous one, this study will specify which variables may cause an idle time during the loading and unloading container at Container Terminal Operation 2 Tanjung Priok Port Jakarta. The Tanjung Priok Port is chosen as a case study since the port is the largest port in Indonesia with more than 50 (fifty) percent container in Indonesia access via this port. The objectives of this study are to identify which variables can cause the idle time, to analyze which dominant variables that have a significant influence to idle time, and to recommend port operator for reducing the idle time during loading and unloading container. The scope of this study focuses at Container Operational Terminal 2 Tanjung Priok Port for loading and unloading domestic container during period October 2016 until December 2016.

1.1 Port Service Performance Indicator
Port can be defined as a place at the edge of an ocean, river, or lake that serve the need to transport passengers, animals and goods. Roa et al. in 2013 [9] defined port as an area which was connected to sea, ocean or river and was considered as entities, while Flere in 1967 [10] defined port as a place which was provided facilities of terminals and services for ships to deliver goods and/or passengers. Nevertheless, This study will follow the port definition as it was defined according to National Law No. 21 of 1992 (UU21/1992) and Government Regulation (PP) No. 69 Year 2001: “A port is a place which consists of land and surrounding specified border waters, is a place for ships to anchor and harbor, passengers to embark and disembark and/or goods loading and unloading, is equipped with navigation safety facilities and port activities support, and also a place for various intermodal transportation activities”.

Nowadays, many scholars are conducting researches about port performance measures. Study done by Loke et al in 2015 [8] on the delay factors of container transshipment in major Malaysian ports, showed that the main factor to the delay was the idle time during loading and unloading container process. Comparable with major Malaysian ports, Tanjung Priok port has alike challenge dealing with inefficient container operating activities. As the matter of fact, the average dwelling time at Tanjung
Priok Port is 5.5 days which is the longest in Asia while in some items it can take up to a month to clear custom and excise [11]. In today’s dynamic competitive market, various determinants can affect port performance including the local market character, organizational and physical capacity, system integration in logistics, maritime accessibility, competition, dock equipment and parking field, delivery service and inter-connection to the hinterland areas [12]. As a consequence, in current port operating services, there may also valid and useful to include effectiveness and efficiency aspects in measuring port performance which is usually associated with efficiency in operational activities [13].

With regard to the port service performance indicators, the Ministry of Transportation of the Republic of Indonesia through the Directorate General of Sea Transportation has issued the Decree of the Director General of Sea Transportation No. UM.002/38/18/DJPL-11 year 2011 about Standard Port Operational Service Performance [14]. Inside the document, the indicator of port service performance was defined including: Waiting Time (WT), Approach Time (AT), Effective Time per Bert Time (ET:BT), Work Productivity (Loading/Unloading) (Ton/Aisle/Hours), Work Productivity (Box/Crane/Hours), Bert Occupancy Ratio (BOR), Shed Occupancy Ratio (SOR), and Yard Occupancy Ratio (YOR). Correspondingly, this study uses the mentioned eight indicators of port performance with the case of Tanjung Priok port. The performance of Tanjung Priok port for period 2011 to 2015 is given to the following table 1.

| Year | WT (Hours) | AT (Hours) | ET/BT (%) | T/A/H | B/C/H | BOR (%) | SOR (%) | YOR (%) |
|------|-------------|-------------|-----------|-------|-------|---------|---------|---------|
| 2011 | 1.00        | 1.00        | 79.42     | 44.07 | 15.83 | 54.62   | 40.51   | 42.59   |
| 2012 | 1.00        | 1.00        | 80.50     | 55.96 | 16.10 | 56.73   | 31.40   | 44.80   |
| 2013 | 1.00        | 1.00        | 82.00     | 72.23 | 15.58 | 50.25   | 34.33   | 45.37   |
| 2014 | 0.18        | 0.91        | 76.75     | 70.67 | 18.42 | 49.24   | 30.69   | 40.41   |
| 2015 | 1.00        | 1.00        | 64.98     | 75.19 | 22.36 | 36.12   | 15.23   | 36.21   |

Following the decree of the Director General of Sea Transportation No. UM.002/38/18/DJPL-11 year 2011, the performance score scale of Tanjung Priok Port was categorized into three score levels, namely 1 (Poor), 2 (Fair), and 3 (Good). Table 2 shows the port performance scale of Tanjung Priok Port during 2011 – 2015. The ship service performance is formulated as follows: Bert Time (BT) = Bert Working Time (BWT) + Idle Time (IT). Hence, BWT = Effective Time (ET) + Not Operation Time (NOT). From table 2, it is clear that WT and ET/BT have fair performance indicator while work productivity (Box/Crane/Hours) has poor score performance.

| Year | WT (Hours) | AT (Hours) | ET/BT (%) | T/A/H | B/C/H | BOR (%) | SOR (%) | YOR (%) |
|------|-------------|-------------|-----------|-------|-------|---------|---------|---------|
| 2011 | 2           | 3           | 2         | 3     | 1     | 3       | 3       | 3       |
| 2012 | 2           | 3           | 2         | 3     | 1     | 3       | 3       | 3       |
| 2013 | 2           | 3           | 3         | 3     | 1     | 3       | 3       | 3       |
| 2014 | 3           | 3           | 2         | 3     | 1     | 3       | 3       | 3       |
| 2015 | 2           | 3           | 1         | 3     | 2     | 3       | 3       | 3       |

1.2 Idle Time
Looking at the formulation given in the previous paragraph, idle time has an impact to overall container operational process. Dirgahayu in 1999 [16] defined the idle time was a time which was not used properly during bert working time. Ferry Setiawan, Trimaijon, and Ferry Fatnanta (2016) [17] explained that factors which influenced the idle time also include waiting the head truck arrival, the operator arrival, equipment failure, ship maintenance, and weather. While PT Pelabuhan Indonesia (2000) argued that idle time was a time outside break time which was not used during loading and unloading process. Other factors which cause idle time include to the following [16]: late to start working, leave early from
work, waiting for the truck arrival, waiting for equipment maintenance, shipping to shore system, waiting for loading and unloading process, and late document submission.

2. Methods
This study uses both primary and secondary data. First, as a primary data, this study uses participatory observation during 3 (three) months period from October 2016 until December 2016 and followed by an interview with the Gate Coordinator at PT. Pelabuhan Tanjung Priok. The participatory observation was focused on getting some insights during the loading and unloading container process and it was mainly taking place in South Section Terminal 2 Tanjung Priok Port. The data was gathered to find which factors can influence the idle time as well as to identify the failure points of each phases at service blueprint framework. The population of this study monitored 53 (fifty three) container operational shipping samples. The observation phase was resulted in time stamp records of each operational activities during loading and unloading container process. Following the observation phase, the interview with with Gate Coordinator at PT. Pelabuhan Tanjung Priok Container Terminal Operation 2 was performed. The main goal of this interview was to validate all data recorded during the observation phase. Second, this study uses literature reviews such as histories data from January till December 2016, academic papers, reports, and journals as a secondary data to gather various information needed in the implementation of study.

3. Result and Discussion
This study uses service blueprint, multiple regression analysis, and one-way anova method. The data analysis is done by using SPSS software to perform hypothesis testing. First, The service blueprint is used as a framework which allows company to explore all the issues in creating or managing a service. The process of designing a blueprint encompasses to the following issues [18]: Identifying process, this step is mapping the processes that construct the service. Isolating fail points, identification of fail points and the design of fail-safe process are essential. By analyzing the fail point at the design stage, one can reduce the service failures. At Tanjung Priok Container Terminal Operational Port, the process included to the following steps: gate-in, yard operation, bert operation, and gate out. Actions of each steps will be separated into front-stage operator and backstage operator. The front-page operator is a person who is directly contacted with the customer while the backstage is a person who is not having direct contact to the customer. Each step will result in source of documents. In the following table 3 each idle variable is explained:

| Idle Variable | Attributes | Sources                                      | Description                                      |
|---------------|------------|----------------------------------------------|--------------------------------------------------|
| Head Truck    | Container arrive at the break time          | Arwinas Dirghahayu (1999) [16]                | Delay due to the availability of head truck      |
| Computer System | Limitation on the availability of computer system | Araia Weldeselassie Simon (1999) [19]          | Most operation still use manual instead of automatization using computer system |
| Weather Factor | Rain       | Harmaini Wibowo (2010) [20]                  | Delay due to hard rain                          |
|               | Hard wind  | Ferry Setiawan, Trimajion, Ferry Fatnanta (2016) [17] | Delay due to hard wind                          |
| Stevedoring Worker | Less worker            | Ferry Setiawan, Trimajion, Ferry Fatnanta (2016) [17] | Delay due to availability of stevedoring workers |
**Table 3.** Factors which influence Idle Time

| Idle Variable             | Attributes                      | Sources                                      | Description                                        |
|---------------------------|---------------------------------|----------------------------------------------|----------------------------------------------------|
| Waiting for stevedoring   | Ferry Setiawan, Trimajon, Ferry Fatnanta (2016) [17] | Delay due to the indiscipline stevedoring     |
| Equipment Failure         | Equipment maintenance           | Arwinas Dirgahayu (1999) [16]               | Equipment failure during loading and unloading process |
| Limitation of equipment   | Arwinas Dirgahayu (1999) [16]   | Delay due to Limitation on tools or equipment |
| Equipment Quality         | Harmaini Wibowo (2010) [20]     | Delay due to low-quality equipment           |
| Operator Activities       | Waiting for operator arrival    | Ferry Setiawan, Trimajon, Ferry Fatnanta (2016) [17] | Delay due to the indiscipline operators |

Next, the following table 4 describes container operating process at Terminal II Container Operational Port including the fail points (F) or waiting point (W):

**Table 4.** Service Blueprint Result

| Process          | Activities                        | Fail Point / Waiting | Variable Category | Front Stage                  | Person in charge | Back Stage                                      |
|------------------|-----------------------------------|----------------------|--------------------|--------------------------------|------------------|------------------------------------------------|
| Gate In (GI)     | Inspection                        |                      |                    | Permitting Container to be checked | Security 1       | Delivering R/C to Operator GI 1                |
|                  |                                   |                      |                    | Requesting Receiving Card (R/C) e-service from the driver | Security 1       | Security report the result to Operator GI 1    |
|                  |                                   |                      |                    | Controlling Physical Container | Security 1       | Documenting the physical result in R/C          |
|                  | F1.1                              | Computer System      |                    | Receiving R/C from Security 1  | Security 1       | Delivering R/C to Operator GI 2                |
|                  | F1.2                              | Equipment Failure    |                    | Permitting Container to weighbridge | Security 1       |                                            |
|                  | F1.3                              | Equipment Failure    |                    | Calculating Total Container Weight | Operator GI 1    | Delivering the net weight to Operator GI 3     |
|                  | F1.4                              | Computer System      |                    | Delivering Seal Number, Type, Size, Voyage Name to R/C | Operator GI 2    |                                            |
|                  |                                   |                      |                    | Separating First Page R/C to GI and Second Page R/C to Yard Operation | Operator GI 2    |                                            |
|                  | Container Movement Strip (CMS)    |                      |                    | CMS Allocation                      | Operator GI 3    | Printing CMS for Driver                        |
|                  | Allocation                        |                      |                    | Delivering Second Page to Driver for submitting to Yard Operation | Operator GI 2    | Delivering Print Out CMS to Operator GI 2     |
|                  | Delivering Print out CMS          |                      |                    | Delivering CMS to driver for showing the location | Operator GI 2    |                                            |
Table 4. Service Blueprint Result

| Process      | Activities     | Fail Point / Waiting | Variable Category | Front Stage                                                                 | Person in charge          | Back Stage                              |
|--------------|----------------|----------------------|-------------------|------------------------------------------------------------------------------|----------------------------|-----------------------------------------|
| Yard Operation (YO) |              |                      |                   |                                                                              |                            |                                         |
| F2.1         | Operator Activity |                     |                   | Requesting R/C                                                              | Operator YO               | Controlling the container location      |
| F2.2         | Operator Activity |                     |                   | Reading Location above the ship for setting                                  | Operator YO               | Confirming Location Availability        |
| F2.3         | Equipment Failure, Weather |                   |                   | Delivering Location above the ship for Operator Rubber Tyred Gantry (RTG)    | Operator YO               |                                         |
| F2.4         | Equipment Failure, Weather |                   |                   | Operating RTG for container movement                                         | Operator RTG              |                                         |
| F2.5         | Operator Activity |                     |                   | Documenting Location above ship with Single Stack                           | Admin YO                  |                                         |
| Bert Operation (BO) |              |                      |                   |                                                                              |                            |                                         |
| F3.1         | Operator Activity |                     |                   | Documenting the loading and unloading process with Hand Held                 | Operator Documentation    | Writing Seal Number with Tally Sheet    |
| F3.2         | Equipment Failure |                     |                   | Writing Seal Number with Tally Sheet                                         | Operator Documentation    | Mechanic Team Standby                   |
| F3.3         | Stevedoring Worker, Weather, Equipment Failure, Head truck |                   |                   | Giving the instruction to move the container from ship                      | Stevedoring Worker        |                                         |
| F3.4         | Stevedoring Worker, Weather, Equipment Failure |                   |                   | Listening the instruction for container location                           | Stevedoring Worker        |                                         |
| F3.5         | Weather, Equipment Failure |                   |                   | Operating HMC for container movement                                         | Operator HMC              |                                         |
| Gate Out (GO) |              |                      |                   |                                                                              |                            |                                         |
| F4.1         | Operator Activity |                     |                   | Requesting R/C e-service from driver                                        | Operator GO 1             | Comparing the data with delivering container letter |
| F4.2         | Equipment Failure |                     |                   | Printing out Delivering Container Letter                                     | Operator GO 1             |                                         |
|              |                |                      |                   | Permitting Container to leave                                               | Operator GO 1             |                                         |
From table 4, it is clear that there are 17 (seventeen) Fail Points (F) and 7 (seven) Wait Points (W). Concurrently, the fail point’s variables are categorized into the following 6 (six) variables, namely head truck, computer system, operator activities, stevedoring worker, weather, and equipment failure. From the mentioned fail points, all variables will be tested by using multiple regression. This multiple regression analysis is used as a technique for creating a straight-line equation to make estimates [21]. The result of this multiple regression is formulated to the following: 

\[
\text{Idle Time} = 0.374 + 0.804 \times X_1 (\text{Head Truck}) + 1.069 \times X_2 (\text{Computer System}) + 0.077 \times X_3 (\text{Weather}) + 1.754 \times X_4 (\text{Stevedoring Worker}) + 1.045 \times X_5 (\text{Equipment Failure}) + 2.157 \times X_6 (\text{Operator Activities}).
\]

The 0.374 Constanta means that the ship has 0.374 hour idle time during loading and unloading container process. Variable weather has sig value 0.876 > 0.05, accordingly this variable weather can be excluded from the new formulation. The new regression model is thus given to the following formulation: 

\[
\text{Idle Time} = 0.374 + 0.804 \times X_1 (\text{Head Truck}) + 1.069 \times X_2 (\text{Computer System}) + 1.754 \times X_4 (\text{Stevedoring Worker}) + 1.045 \times X_5 (\text{Equipment Failure}) + 2.157 \times X_6 (\text{Operator Activities}).
\]

As operator_activities variable has the largest coefficient, 2.157, this operator_activities variable will be analyzed further with one-way ANOVA test. Therefore, one can find: in which step of operator activities is the most significant influence to the delay of loading and unloading container process.

To perform one-way ANOVA, extra container operation shipping record is needed. According to SLOVIN’s formula with 5% margin error, the population must meet minimal 53 (fifty three) container operational shipping samples to test. From this one-way ANOVA test, it was resulted that the F-Score = 19.930 > the Critical F-Value = 3, therefore one can argue that there is a different influence among operators in each loading and unloading container activities. Next, ANOVA Post Hoc test was performed by using Tukey’s Honestly Significant Difference (HSD) post hoc test which finally this Tukey’s HSD test resulted that the operator_activities variable at gate in phase was the most significant influence to the idle time during loading and unloading container process. The following recommendations are made to improve the port service performance:

- Each phases can be targeted with the amount of successful loading and unloading container and the target finished container processing time. Adding extra facilities so that the process can be faster;
- Bureaucracy and regulation should be less complex especially with regards to the permit. The Port Management should reduce corruption in the authorize port area;
- The payment system for the stevedoring worker should be changed from lump sum wages to the daily wages. Each stevedoring worker can be paid based on hour works and the amount of work done.

This study also has a few limitation. First, it is associated with the validity on the variables that cause the idle time during loading and unloading container process. Through the research process, it was discovered that many variables may also include social, environment, economic factors which may have influence to the delay of loading and unloading process. Second, this study should include extra interview with other gate coordinator and port operators in the fields. Accordingly, comparison with other terminals can be considered to the future study.

4. Conclusion

Based on the analysis done from this study, the following conclusion can be deducted: Fail points are causing the idle time during loading and unloading container process which can be categorized into 6 (six) variables, namely head truck, computer system, weather, stevedoring worker, equipment failure, and operator activities. Weather Variables has the least significant influence to the idle time, it can thus be excluded to the main causes of idle time. This is mainly because the sig value of this weather variable, 0.876 > 0.05. Further, it is found that the most influence to the delay on the container process is at the gate in stage on the operator activities. The main reason is due to indiscipline from the operators with regards to the working time. At the gate in phase, the person in charge is not always stand-by which can lead to the delay of loading and unloading container process. Human factor is thus play an important role to the port performance in overall.
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