GROSTLOG 2018
Global Research on Sustainable Transport & Logistics

ISSN: 2622-5778 (online)
Advances in Transportation and Logistics Research
http://proceedings.itltrisakti.ac.id/index.php/atlr

# Load Capacity Production With Equipment Replacement and The Addition in PT. XYZ at Terminal 3 Tanjung Priok Jakarta

**Moh. Anshori Syams**[1*]
[1]Institut Transportasi dan Logistik Trisakti, Jakarta, Indonesia
*Corresponding Author: mohammad.syams@gmail.com

## Abstract

The problem of this research was that PT. MSA does not know whether the replacement and the partial addition of the equipment in 2015 increased the productivity of PT. MSA significantly. The objective of this research was to compare the initial throughput and the final throughput after the replacement and addition of some loading and unloading equipment which were expected to improve the production performance of PT. MSA. The methodology of this research was quantitative with a comparative method. The population in this research was all of the operational and production reports of the loading and unloading of PT. MSA. Meanwhile, the samples taken were the operational and production reports of the loading and unloading of PT.MSA from 2014 to 2016. The research results showed that the ship throughput was significantly increased between before and after the replacement and addition of the equipment, the quay transfer throughput was significantly increased between before and after the replacement and addition of the equipment, the container yard throughput was significantly increased between before and after the replacement and addition of the equipment, the receipt/delivery throughput was significantly increased between before and after the turnover and equipment addition, and the berthing time in 2016 did not increase significantly (or equal) compared to 2014.

**Keywords :** throughput, performance, port, berthing time

## Introduction

The global maritime network, which consists of tens of thousands of ships around the world by sea and strategic ports around the world, is an important part of international trade. A port system is a collection of components that bridge land and sea that work together to handle cargo that arrives by ship at the port, is relocated to the port terminal in the ship's berth, and finally transported by land connection mode (eg. road network or rail network) to be sent to rural residents who need goods.

ISSN: 2622-5778 (online)
Advances in Transportation and Logistics Research
http://proceedings.itltrisakti.ac.id/index.php/atlr

Loading and unloading company is a business entity operated in the service sector for loading and unloading cargo of ships. Based on the Decree of the Minister of Transportation No. KM 14 of 2002, what is meant by a loading and unloading company (PBM) is an Indonesian legal entity specifically established to organize and undertake of loading and unloading goods activities from and to ships in other words, namely unloading service provider using loading and unloading labours (TKBM) and loading and unloading equipment. This means that the smooth process of loading and unloading sea cargo is a function of the availability and competence of the loading and unloading workforce as well as the availability and sophistication of its equipment loading and unloading.

PT. XYZ is an affiliate of on big group company which operates in port management, was established on March 22, 2005, engaged in the goods loading and unloading from and to ships, especially in containers, i.e. doing stevedoring, cargodoring lift on/lift off and receiving/delivery. The company began commercial operations at Tanjung Priok III Port in June 2008. It has 162 employees (2016 data) and a 11260 square meter container terminal with a total of 332 Teu ground slots.

In the port industry a number of different terms are used to represent production measurements such as 'trade', 'traffic', 'throughput' and 'output'. Traffic, indicating cargo traffic that passes through a port or terminal in time units, and throughput shows businesses involved in cargo movement, in the form of loading and unloading tonnage or number of containers per time unit.

The problem faced by XYZ is that it does not know whether any replacement and the addition of some equipment in 2015 XYZ productivity increased and how significant the productivity increase was when compared to XYZ productivity before the equipment replacement and addition. Consequently, the research will be carried out on the actual throughput that occurs on the ship, at the dock, in the container stacking field and at the container receiving and dispensing doors. The actual throughput that occurs in these four locations will be compared between a

ISSN: 2622-5778 (online)
Advances in Transportation and Logistics Research
http://proceedings.itltrisakti.ac.id/index.php/atlr

year before and a year after the replacement and addition of several equipment loading and unloading in 2015.

Based on the problems faced, the research objectives can be identified as follows:

1. To find out the significant increase in ship throughput between before and after the replacement and addition of some equipment.
2. To determine the increase in significantly quay transfer throughput between before and after the replacement and the addition of some equipment
3. To determine the significant increase in container yard throughput between before and after the replacement and addition of some equipment.
4. To determine the significant increase in receipt/delivery throughput between before and after the replacement and addition of some equipment.
5. To determine the significant increase in berthing time between before and after the equipment replacement and the addition.

Port performance can be used to determine port service level to the port users (ships and goods), which depends on the service time of the ship while in port. The high port performance shows that the port can provide good service (Triatmodjo, 2010).

According to Dewan Produksi Nasional, productivity is defined from various perspectives, namely:

1. Philosophically / psychologically

   Productivity is a mental attitude to always have a view that the life quality today must be better than yesterday, and tomorrow must be better than today. The essence of understanding productivity is mental attitude; and tomorrow's perspective.

2. Economically (financially)

ISSN: 2622-5778 (online)
Advances in Transportation and Logistics Research
http://proceedings.itltrisakti.ac.id/index.php/atlr

Productivity is an effort to get maximum results with the smallest sacrifice of resources. Financial productivity is a productivity measurement over quantified outputs and inputs.

3. Technically

   The definition of technical productivity is the understanding of production efficiency, especially in the use of science and technology. Productivity is formulated as the output ratio to input / output.

Muchdarsyah in Yuli Tri Cahyono and Lestiyana Indira M, (2007: 227) states that what can affect work productivity is as follows:

1. Labor

   The increase in labor contributions to productivity is due to a healthier, more educated and more active workforce. Productivity can increase due to shorter working days. Rewards from supervisors can encourage employees to be more active in achieving achievements. Thus it is clear that labor plays an important role in productivity.

2. Art and management science

   Management is a factor of production and economic resources, whereas art is management knowledge which provides the possibility of increasing productivity. Management includes improvements through the technology application and the use of knowledge that requires education and research.

3. Capital

   Capital is the motion ground of a business enterprise, because with capital the company can provide equipment for humans, i.e. to help do work in increasing work productivity. Adequate facilities will make work morale increase indirectly work productivity can increase as well.

Based on the Decree of the Director General of Sea Transportation Number UM.002 / 38/18 / DJPL-11 December 15, 2011 concerning the Performance

ISSN: 2622-5778 (online)
Advances in Transportation and Logistics Research
http://proceedings.itltrisakti.ac.id/index.php/atlr

Standards of Port Operational Services, operational service performance is measurable work results achieved at the port in carrying out ship services, goods, utility facilities and tools in certain time periods and units. Service performance indicators related to port services consist of:

1. Ship Waiting Time (waiting time / WT) is the amount of time since the mooring submission application after the ship arrives at the landing site until the vessel is moved to the mooring.
2. Time of Guidance Service (Approaching Time/AT) is the amount of time used for a ship to move from the anchored location until the rope is tied in a mooring or vice versa.
3. Effective Time (Effective Time/ET) is the number of hours for a ship that is actually used for loading and unloading as long as the vessel is moored.
4. Berthing Time (BT) is the amount of time ready for mooring operations to serve ships.
5. Container Receiving/Delivery is the speed of delivery/receipt service at the container terminal which is calculated from the time the conveyor enters until the exit which is recorded at the entrance / exit.
6. The level of Dock use (Berth Occupancy Ratio / BOR) is a comparison between the dock usage time and the time available (the dock is ready for operation) in a certain period of time expressed in percentages.
7. Shed Occupancy ratio / SOR is a comparison between the number of stacking room users and available stacking space which is calculated in ton units of days or units of M3 days.
8. Level of Use of Yard Occupancy Ratio (YOR) is a comparison between the amount of stacking space used and available stacking space (ready for operation) which is calculated in tons of days or M3 days.

ISSN: 2622-5778 (online)
Advances in Transportation and Logistics Research
http://proceedings.itltrisakti.ac.id/index.php/atlr

9. Equipment operating readiness is a comparison between the number of equipment that is ready to operate and the amount of equipment available in a certain period of time.

Esmer (2008) suggests that container terminal performance depends on:

1. The ratio of containers is loaded and unloaded; Empty containers are generally not included in port statistics (considered to be another weight) but must be handled;
2. Non-productive movements, that is, handling all containers that do not need to be dismantled but must be removed: most are empty and light containers and which contain hazardous materials, are loaded at the top or on the deck;
3. Automation level of gantry cranes; one of the limitations of the loading and unloading cycle is the time needed to precisely position the spreader on the container (loading), or put the container on the trailer, on special equipment to move the container or chassis that moves in the apron (unloading). Generally, modern gantries are automated and equipped with anti-shake tools, so the operating cycle is more determined by the capacity to move containers without causing operational delays from the ship to the dock.
4. Average weight of containers and proportion of containers amount requiring special attention, such as flats, liquid bulks, reefers and so on; and variations in container size 20/40/45 feet which obviously requires a replacement in the size of the spreader.
5. Commercial limits; most shipping companies visiting the port may have similar commercial restrictions, which will effect on uneven distribution of ship visits.

Esmer also suggested four categories of port performance measurement, namely production, productivity, utilization and service.

1. Production Measurement

ISSN: 2622-5778 (online)
Advances in Transportation and Logistics Research
http://proceedings.itltrisakti.ac.id/index.php/atlr

In the port industry a number of different terms are used to represent production measurements such as 'trade', 'traffic', 'throughput' and 'output'. Traffic, indicating cargo traffic that passes through a port or terminal in time units, and throughput shows businesses involved in cargo movement, in the form of loading and unloading tonnage or number of containers per unit of time.

Throughput measurement includes:

a. Ship throughput

   Measuring all ship loading and unloading activities within a certain period (per shift, per day, per month or per year).

b. Quay transfer throughput

   Measure the number of tons or containers that move between the dock and storage area.

c. Container yard throughput

   This is the amount of movement of goods or containers that occur in storage.

d. Receipt / delivery throughput

   is a activity measure related to the cargo delivery or containers out of the port or terminal and cargo receipt or containers into the port.

Each measurement of this production illustrates the container movement per unit of time. The value of this measurement is very important when estimating resource requirements and the actual cost of handling cargo.

2. Productivity measurement

Productivity measurement calculates the ratio of output to input. Productivity measurements are important for terminal operators because they relate directly

ISSN: 2622-5778 (online)
Advances in Transportation and Logistics Research
http://proceedings.itltrisakti.ac.id/index.php/atlr

to operating costs at the terminal. There are seven different productivity measures that need to be calculated by the terminal operator, namely:

a. Ship productivity

   Broadly speaking, measurement of ship productivity is related to the speed of handling container loading and unloading on ships

b. Crane productivity

   Crane productivity is calculated per crane and is realized in the form of gross value or net amount of container served by time union.

c. Dock productivity

   Dock productivity is an illustration of the relationship between production and dock resources. The productivity of dock resources is measured in a certain period of time, such as the length of the pier can be calculated productivity dock time union or long unity or dock unity if there is more than one dock.

d. Terminal yard productivity

   Similar to dock productivity, dock yard productivity which covers all terminal area is realized in the form of ratio between total production and total dock yard area of time union.

e. Equipment productivity

   Equipment productivity is related to the number of containers handled by time, both for equipment individually or per group of equipment.

f. Employee productivity

   Even with high equipment mechanization, the labor cost is still the largest part of the total terminal costs, thusly it is important to monitor the productivity of hourly workers for a certain period of time.

g. Cost effectiveness

ISSN: 2622-5778 (online)
Advances in Transportation and Logistics Research
http://proceedings.itltrisakti.ac.id/index.php/atlr

Cost effectiveness calculates all cost elements, and it can be said that the simplest disclosure of terminal efficiency is the cost of handling container traffic or throughput within a certain time period (per month or per year).

3. Measurement of utilization

Utilization measurement allows terminal management to determine the production intensity of resources needed. The commonly used utilization measurements include:

a. Dock utilization; which reflects the time allocation for the use of the pier in the time available.

b. Utilization of storage places; which is calculated by comparing the number of container slots filled with the total available slots according to the design capacity.

c. Terminal gate utilization; describes the smooth flow of container transport vehicles is an important factor in calculating the efficiency of terminal operations. Thus terminal gate utilization is a valuable measurement for terminal operators.

d. Equipment utilization; becomes important to note because of the high cost of loading and unloading equipment at the port. Utilization of each equipment is defined as the proportion of effective utilization time in a certain period of time.

4. Service measurement

Service measurement indicates customer satisfaction with the loading and unloading services provided in terms of reliability, compliance with applicable regulations and speed. In principle, service measurement includes:

a. Time to turn around the ship

One important indicator of service for ship operators is the turn-around time of the ship. The total time required by the ship at port during servicing

ISSN: 2622-5778 (online)
Advances in Transportation and Logistics Research
http://proceedings.itltrisakti.ac.id/index.php/atlr

includes waiting time plus berthing time plus loading and unloading service time, plus delay in sailing time. Ideally the turn-around time of the ship consists of the length of time the ship docked at the dock to be unloaded and the additional time to wait as far as possible near zero.

b. Land vehicle turn-around time

For cargo senders or recipients (and transportation entrepreneurs) the size of the important terminal services is the length of time needed to collect or take container of the shipment.

c. Measurement of train services

The train turn-around time is not a useful measurement for the performance of container terminal services on the railroad network.

**Methods**

The design of this research is quantitative with a comparative method which aims to explain the average difference in the data of research variables between before and after a treatment is carried out.

The change (increase) of loading and unloading performance is a change (increase) in performance between before and after the replacement and addition of a portion of equipment loading and unloading as measured by changes (increase) throughput (ship, dock, container yard, and container receipt / shipping). Based on this it can be described as follows:

a. Change (increase) Ship throughput

Changes (increase) in the number of ships carrying container loading and unloading per month.

b. Change (increase) Quay transfer throughput

ISSN: 2622-5778 (online)
Advances in Transportation and Logistics Research
http://proceedings.itltrisakti.ac.id/index.php/atlr

Changes (increase) of the number of containers (Teus) that move from ships to docks and vice versa per month.

c. Change (increase) Container yard throughput

Changes (increase) in the number of containers in the (CY) container yard per month

d. Change (increase) Receipt/delivery throughput

Changes (increase) of the number of containers received or sent from outside the port or outside the port per month

e. Change (increase) of Berthing Time

Changes (increase) in the amount of time ready for mooring operations to service ships.

Data collection is carried out all at once at a certain time and only once by collecting data on productivity indicators of container loading and unloading activities. The data collected is secondary data in the form of Ship throughput reports, Quay transfer throughput, Container yard throughput, and container Receipt/delivery throughput per month within one year before and one year after the replacement and addition of loading and unloading equipment in 2015.

The population in this study is all the loading and unloading operational and production reports of PT. XYZ. While the sample taken is PT. XYZ's loading and unloading production and operational reports, period time from 2014 to 2016.

Research analysis uses paired sample T tests which are used to compare the average of two variables in a group. This calculation is done to find the difference between the values of two variables whether there is an average difference greater than 0. The assumptions that must be fulfilled from the paired sample T test is the average difference must be normally distributed (Sarwono, 2009).

ISSN: 2622-5778 (online)
Advances in Transportation and Logistics Research
http://proceedings.itltrisakti.ac.id/index.php/atlr

In addition this study also uses the Wilcoxon Signed Ranks Test. According to Ghozali (2006) Wilcoxon sign rank tests are used to evaluate certain treatments in two observations, between before and after certain treatments.

**Discussion and Result**

Before testing the hypothesis, the distribution of research data samples needs to be tested first to find out whether the sample used in this study is normal or not. To detect data normality can be done by the Kolmogorov-Smirnov test method. The sample is normally distributed if the asymptotic sig > confidence level is used in the test, which in this case is 95% or a = 5%. Conversely, it is said to be abnormal when asymptotic sig < confidence level. If the test results show the sample is normally distributed, then the different test that will be used in this study is the parametric test (paired sample t-test). But if the sample is not normally distributed, then the different tests to be used The testing results the normality of the research data are as follows:

**Table 1. Test Result of Data Normality**

One-Sample Kolmogorov-Smirnov Test

| | | BTP 2014 | BTP 2016 | KAPAL 2014 | TEUS 2014 | KAPAL 2016 | TEUS 2016 | CY 2014 | CY 2016 | RD 2014 | RD 2016 | 2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| N | | 12 | 12 | 12 | 12 | 12 | 12 | 12 | 12 | 12 | 12 | 1 |
| Normal Parameters a,,b | Mean | 50.6000 | 59.5575 | 11.33 | 8618.58 | 16.33 | 14980.92 | 42.2108 | 44.1975 | 12928.17 | 22471.58 | 3 |
| | Std. Deviation | 3.99912 | 15.05518 | 1.371 | 678.695 | 5.630 | 5217.669 | 8.04438 | 11.59993 | 1018.028 | 7826.548 | 8 |
| Most Extreme Differences | Absolute | .240 | .185 | .187 | .219 | .196 | .167 | .154 | .218 | .219 | .167 | .1 |
| | Positive | .240 | .185 | .168 | .219 | .196 | .167 | .154 | .149 | .219 | .167 | .1 |
| | Negative | -.153 | -.138 | -.187 | -.153 | -.176 | -.111 | -.114 | -.218 | -.153 | -.111 | -. |
| Kolmogorov Smirnov Z | | .832 | .639 | .647 | .757 | .679 | .580 | .535 | .754 | .758 | .580 | .6 |
| Asymp. Sig. (2- tailed) | | .494 | .809 | .797 | .615 | .746 | .890 | .937 | .620 | .614 | .890 | .8 |

a. Test distribution is Normal.

b. Calculated from data.

*Source: Author*

ISSN: 2622-5778 (online)
Advances in Transportation and Logistics Research
http://proceedings.itltrisakti.ac.id/index.php/atlr

Table 1 shows that the Asymp. Sig (2-tailed) value of all sample data shows the smallest value is 0.494 and the largest is 0.999, all of which are greater than the 0.05 error rate of research. Thus it was concluded that the distribution of research data samples was all normally distributed.

## Hypothesis Test

### 1. Different Test of Ship Throughput

**Table 2. Results of Wilcoxon Test of Ship Arrival**

**Test Statistics[b]**

| | KAPAL2016 - KAPAL2014 |
|---|---|
| Z | -2.397[a] |
| Asymp. Sig. (2-tailed) | .017 |

a. Based on negative ranks.
b. Wilcoxon Signed Ranks Test

*Source: Author*

Table 2 shows that the average ship arrivals in 2016 are greater than the average ship arrivals in the year. This significant difference is shown by the Asymp. value Sig (2-tailed) = 0.017 which is smaller than the error rate of the research $\alpha = 0.05$.

**Table 3. Results of Wilcoxon Test of Container Load/Unload**

**Test Statistics[b]**

| | TEUS2016 - TEUS2014 |
|---|---|
| Z | -2.981[a] |
| Asymp. Sig. (2-tailed) | .003 |

a. Based on negative ranks.
b. Wilcoxon Signed Ranks Test

*Source: Author*

Table 3 shows that the average number of containers unloaded/loaded in 2016 was greater than the average number of containers unloaded/loaded in 2014. This significant difference is shown by the value of Asymp. Sig (2-tailed) = 0.003 which is smaller than the error rate the study $\alpha = 0.05$.

ISSN: 2622-5778 (online)
Advances in Transportation and Logistics Research
http://proceedings.itltrisakti.ac.id/index.php/atlr

Based on the results of different tests in terms of the number of ship arrivals and the number of container loading/unloading (TEU's) between 2014 and 2016 as shown in Table 2 and Table 3, it can be proved that:

H1: stated that there is a significant increase in ship throughput after the equipment replacement and addition is proven.

## 2. Different Test of *quay transfer throughput*

**Table 4. Results of Wilcoxon Test of *Quay Transfer Throughput***

**Test Statistics[b]**

| | BTP2016 - BTP2014 |
|---|---|
| Z | -2.197[a] |
| Asymp. Sig. (2-tailed) | .028 |

a. Based on negative ranks.

b. Wilcoxon Signed Ranks Test

*Source: Author*

Table 4 shows that the average BTP in 2016 was greater than the average BTP in 2014. This significant difference is shown by the Asymp. Sig (2-tailed) value = 0.028 which is smaller than the research error level $\alpha = 0.05$.

Based on the results of different BTP tests between 2014 and 2016 as indicated by Table 4.11, it can be proved that:

H2: stated that there is a significant increase in Throughput Quay Transfer after the equipment replacement and addition is proven.

## 3. Different Test of Container Yard Throughput

**Table 5. Results of Wilcoxon *Performance* CY Test**

**Test Statistics[b]**

| | CY2016 - CY2014 |
|---|---|
| Z | -.471[a] |
| Asymp. Sig. (2-tailed) | .638 |

a. Based on negative ranks.

b. Wilcoxon Signed Ranks Test

*Source: Author*

ISSN: 2622-5778 (online)
Advances in Transportation and Logistics Research
http://proceedings.itltrisakti.ac.id/index.php/atlr

Table 5 shows that the average CY performance in 2016 was relatively constant compared to the average CY performance in 2014. This difference is not significant as indicated by the Asymp. Sig (2-tailed) = 0.638 value which is greater than the research error level α = 0.05. Or in other words, performance CY or YOR CY are the same.

Based on the results of the different CY performance tests between 2014 and 2016 as shown in Table 4.12, as well as a description of the effect on a significant increase in CY throughput, it can be proved that:

H3: stated that there is a significant increase in container yard throughput after the equipment replacement and addition is proven.

## 4. Different Test of receipt/delivery throughput

**Table 6. Results of Wilcoxon Test of *Receipt/delivery Throughput***

**Test Statistics[b]**

| | RD2016 - RD2014 |
|---|---|
| Z | -2.981[a] |
| Asymp. Sig. (2-tailed) | .003 |

a. Based on negative ranks.

b. Wilcoxon Signed Ranks Test

*Source: Author*

Table 6 shows that the average Receipt/delivery Throughput in 2016 is greater than the average Throughput Receipt/delivery in 2014. This significant difference is shown by the Asymp. Sig (2-tailed) value = 0.003 which is smaller than the research error level α = 0.05 .

Based on the results of different test Receipt/ delivery Throughput between 2014 and 2016 as indicated by Table 4.13, it can be proved that:

H4: stated that there is an increase in Receipt/delivery A significant throughput after the equipment replacement and addition is proven.

ISSN: 2622-5778 (online)
Advances in Transportation and Logistics Research
http://proceedings.itltrisakti.ac.id/index.php/atlr

## 5. Different Test of Berthing Time (BT)

**Table 7. Results of Wilcoxon's Berthing Time Test**

**Test Statistics[b]**

| | BT2016 - BT2014 |
|---|---|
| Z | -.196[a] |
| Asymp. Sig. (2-tailed) | .844 |

a. Based on negative ranks.

b. Wilcoxon Signed Ranks Test

*Source: Author*

Table 7 shows that the average berthing time in 2016 was relatively slightly higher than the average berthing time in 2014. This difference is not significant as indicated by the Asymp. Sig (2-tailed) = 0.844 value which is greater than the research error level $\alpha = 0.05$. Or in other words, berthing time or the amount of time ready for mooring operations to serve ships in 2014 and 2016 is the same.

Based on the results of different times between 2014 and 2016 as shown in Table 4.14, and the description of berthing time is fixed, it can be concluded that:

H5: stated that there is a significant increase in berthing time after the equipment replacement and addition is not proven.

**Ship throughput**

Ship throughput in 2016 proved to increase significantly compared to 2014. This can occur due to the replacement of crane equipment that serves ships in 2015, which initially two HMC units were replaced with 4 QCC units with higher loading/unloading capacity so that ship service can be accelerated and the terminal can service more incoming ships. This means that more TEU's are served.

Ship throughput is also a function of the ship arrival frequency so that with increasing ship throughput it is suspected that there is an increase in the ship

ISSN: 2622-5778 (online)
Advances in Transportation and Logistics Research
http://proceedings.itltrisakti.ac.id/index.php/atlr

arrivals frequency. With the availability of new QCC equipment with greater capacity, this increase can be served. The next task of PT. XYZ is to predict the increase in the arrival frequency of these vessels to anticipate when the QCC equipment that can only serve loading/ unloading activities is related to the tendency to increase the incoming ships frequency which also means an increase in the volume of incoming containers.

**Quay transfer throughput**

Quay transfer throughput in 2016 has proven to increase significantly compared to 2014. This can occur due to the equipment replacement and addition serving container transfers from the dock to CY in 2015. The equipment replacement and addition was initially RTG 5 to be added by ERTG as much 3 units, as well as the addition of transporting equipment which were initially 8 units of trucking & trailler 45 feet plus 8 units of trucking & 45 feet trailers. This replacement and equipment resulted in increased capacity to move containers from the dock to the stacking field.

Additionally, PT. XYZ also needs to evaluate the replacement utilization and new equipment serving the container transfer from the dock to the stacking facility, with a view to predicting and anticipating how long the replacement and addition of the said equipment can serve the increasing trend of Quay transfer throughput.

**Container yard throughput**

Container yard throughput in 2016 proved to increase significantly compared to 2014, this is evidenced by the 2016 CY occupation ratio (YOR) performance that can be maintained the same as in 2014, and there was no congestion even though in 2016 there was an increase in BTP which increased significant.

This CY performance can be maintained because of the addition of new ERTG equipment. Although it cannot be denied that CY performance is also influenced or is a function of the length of the container in the CY and the extent of the CY field. So that PT. XYZ then needs to evaluate and predict how long the current CY

ISSN: 2622-5778 (online)
Advances in Transportation and Logistics Research
http://proceedings.itltrisakti.ac.id/index.php/atlr

area can be maintained and when it needs to be expanded to keep CY performance and avoid congestion.

**Receipt/delivery throughput**

Receipt/delivery throughput in 2016 has proven to increase significantly compared to 2014. This can occur because of the addition of 45 feet trucking & trailer transport equipment so that the container transfer capacity from the terminal out and from the outside to the terminal increases.

Receipt/delivery throughput is not only a function of the ability or capacity of container transport equipment, but also a function of increasing container loading/unloading which is affected by increased ship arrivals and increased demand from customers (company and EMKL) that require container transport services.

So that PT. XYZ also needs to evaluate and predict the trends in the development of customer demand (company and EMKL) that require container transport services that can affect receipt/delivery throughput.

**Berthing Time (BT)**

Berthing time in 2016 proved to be the same as berthing time in 2014. This means that the amount of time ready for mooring operations to service ships is the same in 2014 and in 2016. Whereas the number of vessels served, the number of containers unloaded and loaded, and the BTP has increased significant. This means that increasing the volume of loading and unloading containers due to the equipment replacement and addition can be served with the same berthing time; in other words the efficiency of berthing time increases.

The performance of berthing time needs to be maintained by PT. XYZ, with a note that it still requires monitoring to detect when berthing time does not increase. Because the increase in berthing time will affect the increase in ship waiting time, which means the ship's service is decreasing.

ISSN: 2622-5778 (online)
Advances in Transportation and Logistics Research
http://proceedings.itltrisakti.ac.id/index.php/atlr

**Conclusion**

Referring to the research objectives and the analysis results that have been carried out, the following conclusions can be identified:

1. Ship throughput increases significantly between before and after equipment replacement and addition, indicated by the Asymp value. Sig (2-tailed) = 0.017 increase in ship arrivals smaller than $\alpha = 0.05$ and by Asymp. Sig (2-tailed) = 0.003 the volume of container loading and unloading is smaller than the research error rate $\alpha = 0.05$.
2. Quay transfer throughput increases significantly between before and after equipment replacement and addition, indicated by the Asymp value. Sig (2-tailed) = 0.028 which is smaller than the error rate of the study $\alpha = 0.05$.
3. Container yard throughput increases significantly between before and after equipment replacement and addition, indicated by performance CY or YOR which remain relatively the same, not significant with Asymp. Sig (2-tailed) = 0.638 which is greater than the error rate of research $\alpha = 0.05$. The success of maintaining the CY or YOR performance shows a significant increase in container yard throughput.
4. Receipt/delivery throughput increases significantly between before and after equipment replacement and addition, indicated by the Asymp value. Sig (2-tailed) = 0.003 which is smaller than the error rate of the study $\alpha = 0.05$.
5. Berthing time in 2016 did not increase significantly (or the same) compared to 2014, indicated by the Asymp value. Sig (2-tailed) = 0.844 which is greater than the error rate of the study $\alpha = 0.05$; whereas the number of ships, container volumes and BTP has increased significantly. This means that the efficiency of berthing time increases, which implies that the ship waiting time is relatively the same (not increasing in length).

ISSN: 2622-5778 (online)
Advances in Transportation and Logistics Research
http://proceedings.itltrisakti.ac.id/index.php/atlr

By considering the projection of PT. XYZ production in the next five years from 2018 - 2022 as shown in Table 4.1, the results of this study have implications for PT. XYZ for:

1. Predicting an increase in the ship arrivals frequency in the next five years to anticipate how long the new QCC equipment can serve container loading / unloading activities is related to the tendency to increase the frequency of incoming ships which also means an increase in the volume of incoming containers.
2. Evaluate replacement utilization and new equipment that serves the container transfer from the dock to the stacking facility, with a view to predicting and anticipating how long the said equipment replacement and addition can serve the trend of increasing Quay transfer throughput.
3. Evaluating and predicting how far the current CY area can be maintained and when it needs to be expanded to maintain CY performance and avoid congestion.
4. Evaluating and predicting the development trends of customer demand (companies and EMKL) that require container transport services that can affect receipt/delivery throughput.
5. To monitor the improvement of berthing time continuously, it should not be significant, because the increase in berthing time will significantly affect the time of the ship waiting time, or will decrease the ship's service.

Recommendations submitted to PT. XYZ is carrying out evaluation and prediction needs in connection with the above study implications, so that it will be able to make company development planning in accordance with the next five-year production projections (2018 - 2022), then flow it into the company's mid-term business plan.

ISSN: 2622-5778 (online)
Advances in Transportation and Logistics Research
http://proceedings.itltrisakti.ac.id/index.php/atlr

**Reference:**

Cahyono, Yuli Tri. Indira M., Lestiyana. 2007. Pengaruh Perencanaan dan Pengawasan Terhadap Produktivitas Kerja Karyawan Pada Perusahaan Manufaktur Di Surakarta. Jurnal Akutansi dan Keuangan.

Esmer, Soner. 2008. "Performance Measurements of Container Terminal Operations". Dokuz Eylul *University, Maritime Business and Administration School* Cilt 10, Sayı: 1, 2008

Ghozali, Imam. 2006. *Aplikasi Analisis Multivariate Dengan SPSS*. Cetakan keempat. Semarang: Badan Penerbit Universitas Diponegoro.

Sarwono, Jonathan, 2009, *Statistik Itu Mudah, Panduan Lengkap Untuk Belajar Komputasi Statistik Menggunakan SPSS 16*, Yogyakarta: Penerbit Andi

Triatmodjo, B. 2010. *Perencanaan Pelabuhan*. Penerbit BETA OFFSET, Edisi Pertama, Yogyakarta.