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Optimization waiting time at container terminal in port of Tanjung Perak Indonesia

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RESEARCH PROPOSAL

OPTIMIZATION WAITING TIME AT CONTAINER TERMINAL IN PORT OF TANJUNG PERAK INDONESIA

By

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Indonesia

A research paper submitted to the World Maritime University in partial fulfillment of the requirements for the award of the degree of

MASTER OF SCIENCE

In

INTERNATIONAL TRANSPORT AND LOGISTICS

2014

DECLARATION

I certify that all the material in this research paper that is not my own work has been identified, and that no material is included for which a degree has previously been conferred on me.

The contents of this dissertation reflect my own personal views, and are not necessarily endorsed by the University.

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ABSTRACT

Title of Dissertation : **Optimization Waiting Time At Container Terminal In Port Of Tanjung Perak Indonesia**

Degree : **Master of Science in International Transport and Logistics**

Infrastructure limitation and unfavourable geographical condition of the sea in Tanjung Perak Port of Surabaya can potentially lower the port performance; in the end, it will reduce the quality of service. Such condition can cause high waiting time at a port.

This research is aimed to analyze the waiting time problems by examining the factors that can directly affect its length and in order to achieve solutions to optimize the waiting time. The data were obtained directly from port authority office at Tanjung Perak Port.

Fishbone technique diagram was used to analyze the problems and then to categorize the causal factors into Manpower, Mother Nature, Methods and Machine. The obtained causal factors were analyzed using Multiple Linear Regression Analysis. Multiple linear regression analysis for hypothesis test is using F test in obvious standard $\alpha = 0{,}05$ is used to know whether as together the free variable (X) have influence to the depend variable (Y).Significant value F to hypothesis test are 0,000 when compared with obvious standard $\alpha = 0{,}05$ that means the significant value F is smaller than the obvious standard $\alpha = 0{,}05$. This thing show that as together the free variable approach time, effective time, not operation time, weather, postpone time, idle time, berth occupancy ratio and turn around time have an significant influence to the depend variable that is waiting time, it means the hypothesis of this research can be acceptedThe most dominant variable, which has the highest r2partial value, is weather (31.58%), while the most non-dominant variable with the lowest r2partial value is the effective time variable (8.53%).

The ability of variables of Approach Time (X1), Effective Time (X2), Not Operation Time (X3), Weather (X4), Postpone Time (X5), Idle Time (X6), Berth Occupancy Ratio (X7) and Turn Around Time (X8) in explaining or giving influences on waiting time variable (Y) is 84.8% and the rest (about 15.2%) are explained by the other variables, which are not discussed in this research.

KEYWORDS : Research purpose, Multiple Linear Regression analysis technique, Dominant variable, Determination Coefficient R

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INTRODUCTION

1.1. Background

Indonesia is the largest archipelago country in the world with more than 17,000 islands and it is on strategic location between two continents (Asia and Australia continents) and between two oceans (Pacific and Indian oceans). The area is from Sabang (the western area) until Merauke (the eastern area) and it is called the Emerald of Equator. The maritime area of Indonesia is around 7.9 kilometer square or two third of the whole area is the maritime area.

As a largest archipelago country, Indonesia really depends on the sea transportation. The existence of vehicle for sea transportation that is adequate has a big role in supporting the mobility of goods and human beings in this country, so it has an important role in supporting the growth of economy and trading. It is common if the contribution of sea transportation on economy and trading in Indonesia reaches 77%, compared with the contribution of other types of transportation, such as air transportation (0.3%), pipe (6.7%), and land transportation (16%).

Table 1.1 : The Contribution of Transportation Mode on Economy and Trading in Indonesia

No.	Transportation Mode	Contribution
1.	Air	0.3%
2.	Pipe	6.7%
3.	Land	16.0%
4.	Sea	77%

Source: Ministry Of Transportation Republic Indonesia

With the high contribution of sea transportation, the existence of Port as the part of sea transportation system has an important role for the economy of Indonesia. Port is one of very important chains from every process of trading in Indonesia and other countries. In terms of its activity, Port has important and strategic roles on the growth of industry and trading and it belongs to business that can give the contribution for the national development. Port is not only a place for loading and discgarging the goods or the place for passengers, but also the connector for the transportation mode and the starting point of economy on the development of economy around the place (Triatmojo, 1996).

One of main Ports in Indonesia is Tanjung Perak Port, located at the position 112 0 32' 22" of East Longitude and 07 0 11' 54" of South Latitude, on Madura Strain, the northern area of Surabaya City. As one of main Ports, Tanjung Perak of Surabaya has very strategic role and function as the starting point of economy for the area of East Java Province particularly, and the area of East Indonesia generally, with the centre of economy at the area of Kertasusila Gate, including Surabaya and Mojokerto Cities, Gresik, Bangkalan, Sidoarjo, and Lamongan Regencies, as well as the area of Jember, Probolinggo, Malang, and Kediri.

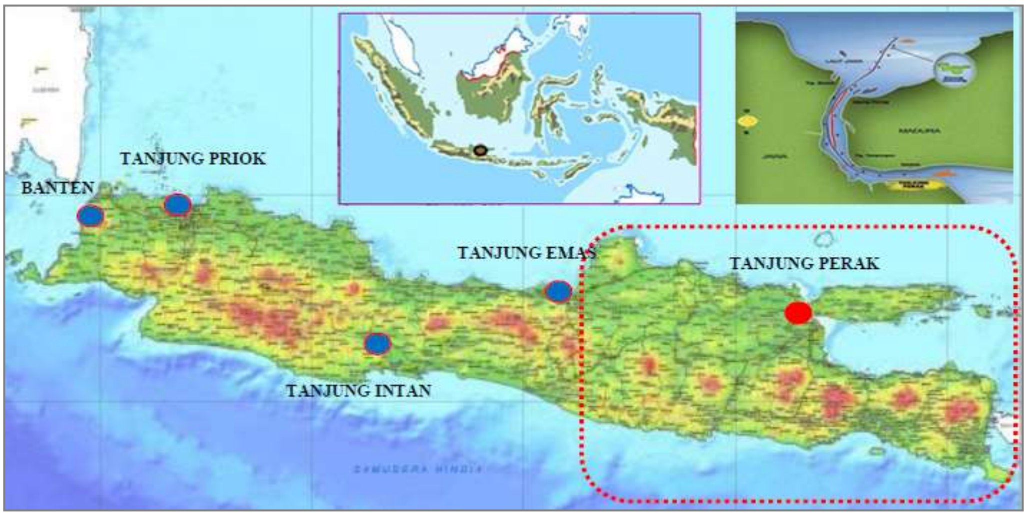


Figure 1.1 : Geographical Location and Hinterland of Tanjung Perak Port

Source: Port Authority of Tanjung Perak Surabaya

Moreover, Tanjung Perak Port also has a function as the transhipment Port for the goods from the area of East Indonesia for the purposes of international or domestic trading. The trading port, Tanjung Perak Port, in terms of domestic or international trading, is described in the following figures.

Figure 1.2 : Trading Port from Tanjung Perak Port

Source: Port Authority of Tanjung Perak Surabaya

Tanjung Perak Port of Surabaya is divided into some zones as what is shown on the following figure.

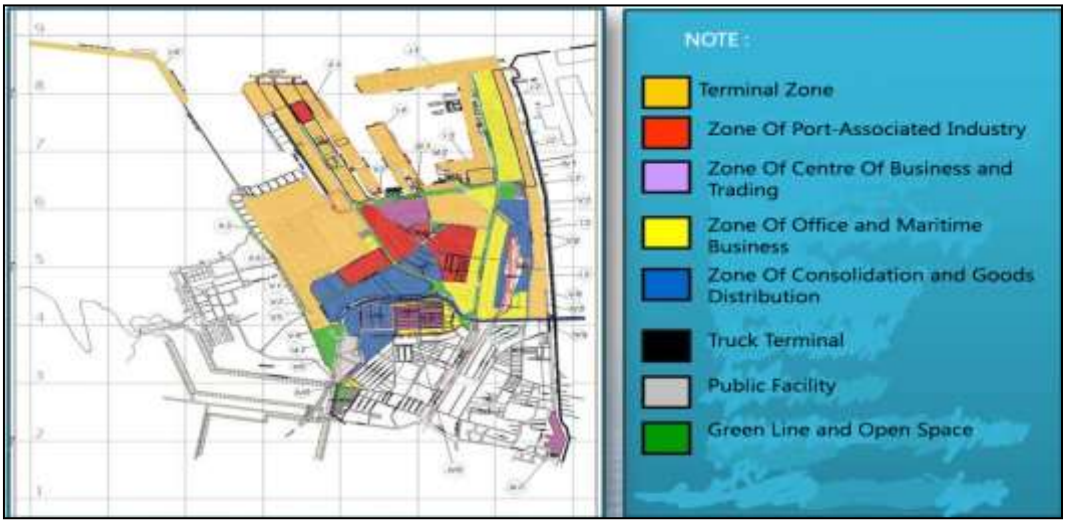


Figure 1.3: The division of zone of Tanjung Perak Port of Surabaya

Source : Port Authority Of Tanjung Perak Surabaya

In the future, Tanjung Perak Port will have an important control for the surrounding potential areas for the improvement of economy, especially industry and trading at national and international levels. The data show the trend on the increase in the flow of container and activities of loading and discgarging at Tanjung Perak Port of Surabaya. This indicates that the industry of East Java has a the increase of value in terms of export and import.

Table 1.2 : Traffic of Tanjung Perak Surabaya Year 2005-2010

No	**Traffic of Port**	**Unit**	**Year**					
			2005	**2006**	**2007**	**2008**	**2009**	**2010**
1.	Goods							
	a. Package	Ton	36,967,617	40,458,734	40,641,954	42,773,607	42,420,352	41,659,451
	b. Container	Box	1,446,681	1,511,494	1,675,329	1,817,242	1,912,301	2,012,279
		Teus	1,775,862	1,852,703	2,041,586	2,190,464	2,270,020	2,407,489
	c. Animal	Tail	56,990	43,459	45,595	48,442	43,319	21,117
2.	Passenger	Person	1,029,974	917,886	1,054,355	1,154,780	937,797	918,036
3.	Visit of Ship	Unit	14,915	15,467	15,459	15,399	15,064	14,198
		GRT	60,590,286	60,005,935	58,785,543	62,008,460	63,248,150	65,956,308

Source: Port Authority of Tanjung Perak Surabaya

Based on the above table, the flow of container and the visit of ship at Tanjung Perak Port generally shows the increase of trend during the period of 2005-2010 in general. With the growth, the demand on the increase of quality for the service of Port becomes higher. Besides, in order to anticipate the excessive increase of demand for shipping of goods through Tanjung Perak Port of Surabaya, the facilities of Port must be considered since they will directly determine the performance of the Port. Based on the previous study, the indication of sizeable waiting time was found and it causes the inoptimal performance of Port. The higher waiting time will cause higher cost and it has a direct effect on the price of goods at market. Therefore, the factors that influence the waiting time of ship at Tanjung Perak Port of Surabaya should be analyzed more comprehensively. The analysis is expected to anticipate the problems in the future.

1.2. Problem of Research

Tanjung Perak Port of Surabaya has an enormous potency to develop in the future and this statement is supported with the existing data that show the trend of increase on the flow of container and the coming of ship. This condition encourages the anxiousness that the growth in volume, without the improvement of quality that is adequate in terms of capacity of loading and discgarging of ship at quay, will increase the Waiting Time of ship at Port. Waiting time of ship at Tanjung Perak Port is a big problem that is faced by the businessmen on sailing sector, therefore the factors that can affect waiting time of ship need to be investigated and, furthermore, how to optimize them.

1.3. The Expected Contribution

This research is aimed to analyze the waiting time problems by examining the factors that can directly affect its length and in order to achieve solutions to optimize the waiting time. Therefore, the result of this research is expected to give the feedback for the stake holder of Tanjung Perak Port in Surabaya, especially on the management of facilities for the equipment of loading and discgarging at Port, in order to improve the operational performance in the future. Besides that, the result of the research is expected to give information on the users of Tanjung Perak Port of Surabaya on the condition of waiting time and to describe the existing problems of Port scientifically, especially the waiting time of ship, to the academician.

1.4. Scope of Discussion

1.4.1 Scope of Topic

The scope of topic is compiled to make the discussed topic suitable with the determined issue. The research focuses on one type of ship, the container ship, that comes to Tanjung Perak Port of Surabaya in Indonesia, including the ships for overseas routes or domestic routes.

1.4.2 Scope of Location

The research is conducted at the terminal of container at Tanjung Perak Port in Surabaya. The area of the research is limited only for two aspects as follows :

1. Sea aspect, when the ship is directed or delayed to enter the maritime area of Port or quay.
2. The quay aspect, during the ship berthing at quay, for loading and discgarging of goods. Meanwhile, the land aspect that includes the activities in the warehouse, the stacking of goods, and transportation from quay to the other places outside the Port does not belong to the scope of this research.

Chapter 2
LITERATURE REVIEW

2.1. Port

Port includes the land area and the maritime area around it with certain borders that are used as the place for ship for berthing and anchoring, terminal for passengers, loading and discgarging of goods that are supported by the facilities of safety for sailing and the activities to support the Port, and as a place for the shift of transportation modes (Soedjono, 2002).

In Indonesia, the regulation on Port is stated in :

1. Law of Indonesia No. 21 Year 1985 on Sailing.
2. Government Regulation No. 11 Year 1983 on Development of Port.
3. Government Regulation No. 6 Year 1985 on Public Company of Port III.
4. Government Regulation No. 69 Year 2001 on Port.
5. Decision of Minister of Communications No. KM9/A1.403 Phb-88 On 30 January 1988 on Criteria of Mandatory Pilotage Waters and Extraordinary Pilotage Waters.

Based on Government Regulation No. 11 Year 1983, the Port is defined as "the place for anchoring or the place where ship or other sea transportation vehicles load and unload the passengers, goods, and animal, the Port is a place for activity of economy." Therefore, the definition of Port includes the definition of infrastructure and transportation system, the Port itself, as the environment including the area of land and sea with the facility for anchoring and mooring of ship, in order to support loading and discgarging of goods and passenger from one mode of sea transportation to other modes of transportation.

As the definition of Port system stated in Government Regulation No. 11 Year 1983, the Port has some functions as follows :

a. Interface, the Port is the place where two systems of land transportation and sea transportation meet and the Port must provide several facilities and services that are needed for the loading of goods or passengers to the land transportation, or vice versa.
b. Link, the Port is the link of transportation systems and it really affects the whole activities of transportation.
c. Gateway, Port has a function as the gateway of a country/region and it has an important role for the economy of a country or region.
d. Industry entity, the development of industry with the orientation of export from one country or region.

Based on its function, the Port can be categorized into as follows :

a. Port of Goods. This Port has the quay that is supported with the facilities for loading and discgarging of goods.
b. Port of Passenger. This Port serves every activity that is related to the need for traveling and the back area of the Port has a function as the terminal for the passengers with the office of immigration, security, management of Port, enterprise of sailing, etc.
c. Mixed Port. The Port is used for the passenger and goods, but the pipe is used for distributing the oil. This Port is usually a small place or a place that is under the development.
d. Port of Oil. This Port handles the supplying of oil. The location of Port is usually far from the public place, in order to ensure its security. The Port does not usually need quay that must store the large loads since it only needs to make the scaffolding bridge or tether that is nearer to the sea, and it is supported with the pipes exactly under the bridge, except the pipe near the ship that must be placed on the bridge in order to make the connecting of pipe to the ship easier. The Port is also supported with additional tether in order to avoid the moving of the ship during the distribution of oil.
e. Port of Ship. This Port has a function to accommodate the fisherman. The Port is usually supported with auction market, tool for preservative, the

supply of fuel, and adequately large area for maintenance of fish-catching tool. The Port does not need the deep water since the mooring boat that is used by the fisherman is not big.

f. Military Port The Port tends to be used for military purposes. The Port has the maritime area that is large enough and the place for the separated place for loading and discgarging in which the distance is quite far. The Port is used to accommodate the activities of warship.

Based on the aspect of management, the Port can be categorized into two types as follows:

a. The managed Port. The Port is managed to give the needed facilities for every ship that enters the Port, with certain activities, such as loading and discgarging, the carrying of passenger, etc. The use of this Port usually requires the cost for service, such as the cost for anchoring, mooring, guidance, delaying, quay, stacking, etc.
b. The unmanaged Port. The Port is usually the place for anchoring the ship without the facility of customs, loading and discgarging, etc. The Port is subsidized by the government and it is managed by Technical Executive Unit of Director General of Sea Communications.

In order to realize the function, the Port is supported with the facilities as follows:

a. For the service of the ship, such as:
    1) Inflow of Port and system of navigation support for the sailing.
    2) Pool of Port.
    3) Wave breaker.
    4) Quay.
    5) Tug boat, assist tug, mooring boat, etc.
b. For the service for passengers and goods, such as:
    1) Apron of quay.
    2) Warehouse.
    3) Building of terminal for passenger, parking area.

4) Area of loading and discgarging for land transportation mode.
5) Access to land transportation system.
6) Facilities of debarkation and embarkation of passengers.
7) Tools for loading and discgarging, such as faucet, crane, forklift, etc.

2.2. Quay.

Quay is a building of Port that is used for anchoring the ship during the loading and discgarging of goods (Triatmodjo, 1996). Quay is the place where the ship is anchored at Port. At quay, there are several activities of loading and discgarging the goods as well as the passengers from the ship and toward the ship. At quay, there are several activities to fill the fuel for ship, drinking water, pure water, pipeline for dirty water or waste that will be processed at Port.

The quay can be categorized into three types as follows:

a. Quay/Wharf. This type of quay is located at shoreline and on a line with the beach.

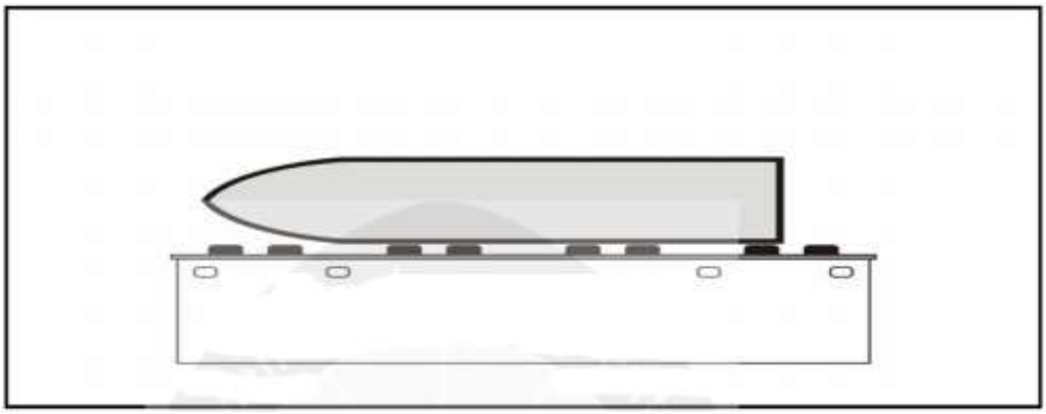


Figure 2.1 : Shape of Quay/Wharf

Source: Triatmodjo (1992)

b. Jetty/Pier. This type of quaf is perpendicular with the shoreline.

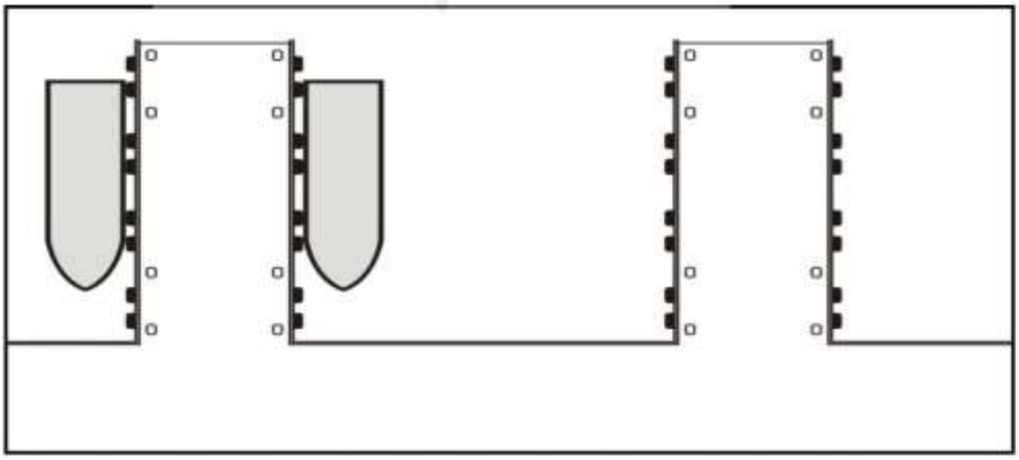


Figure 2.2 : Shape of Jetty/Pier

Source: Triatmodjo (1992)

c. Dolphin/Trestle. This type of Port is the place for anchoring the ship in form of dolphin on the pilling. It is usually at the sloping beach it needs the trestle bridge until the necessary depth.

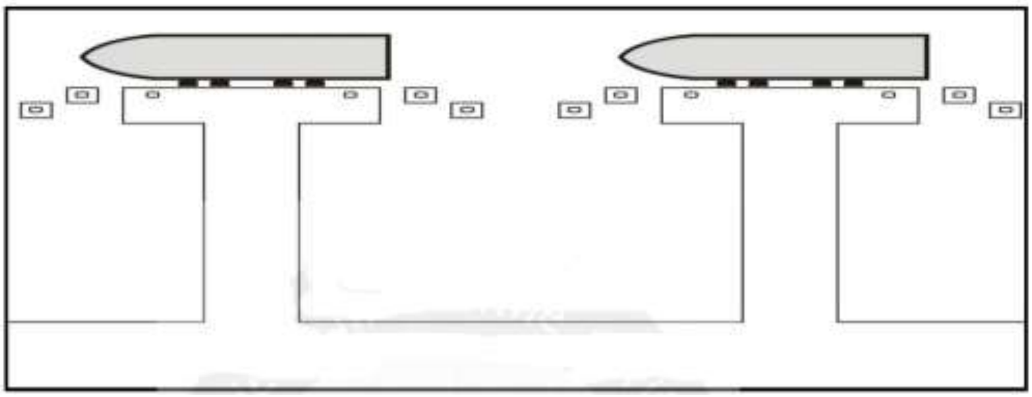


Figure 2.3 : Shape of Dolphin/Trestle

Source: Triatmodjo (1992)

2.3. Port Performance Indicator

A study on supply-chain shows that the effort to access the connecting Ports at regional area is not a proportional percentage of cost from the total cost of international transportation. Carana (2004) predicted around 20-50% from the cost of international transportation for the export was spent on the first 1,000 miles through the connecting Ports at regional level.

Indicators of Port performance has the different characteristic based on the aspects of activity as follows:

1. Approach Time (AT), the spent time for the moving of the ship from the location of release of anchor until the rope of tether.
2. Effective Time (ET), the effective time that is used for loading and discgarging when the ship is anchored.
3. Idle Time (IT) is the ineffective, unproductive, or wasted time when the ship is tethered (it can be caused by the weather, the broken tool for loading and discgarging, etc.).
4. Not Operation Time (NOT) is the gap of time, the time for anchoring that is planned when the ship is at Port (the preparation for loading and discgarging and the rest).
5. Berth Time (BT) the time of mooring since first line until last line.
6. Berth Occupancy Ratio (BOR) is the time ratio of the use at Port with the availability of time (the readiness of operation at Port) in a certain period of time that is stated in the percentage.
7. Turn Around Time (TRT) is the time when the ship is anchored at quay and the departure time of ship after the loading and discgarging of goods.

The recent data that can be used on the performance of Port is difficult to get. The latest available data that can be used to compare the performance of Ports in Indonesia at international level is the data of 2002, and it is limited on the main gate of trading, Jakarta. Although the data is acquired some years ago, the data still shows the lack of relative competence that is owned by the main Port of Indonesia. Based on the interview with some international sea transportation company, the condition apparently does not change. Port in Jakarta is still expensive and ineffective.

2.4. Waiting Time

Waiting Time is the time that is needed by the ship before the standard service at Port or quay for loading and discgarging of goods. Waiting Time can be said to be a wasted time (unproductive) that must be experienced by the crews of ship, the businessmen of sailing, or shippers who use the service of Port, due to certain factors at Port. The factors that influence the waiting time at a Port is related to the performance of service at Port itself that can be described in the following scheme.

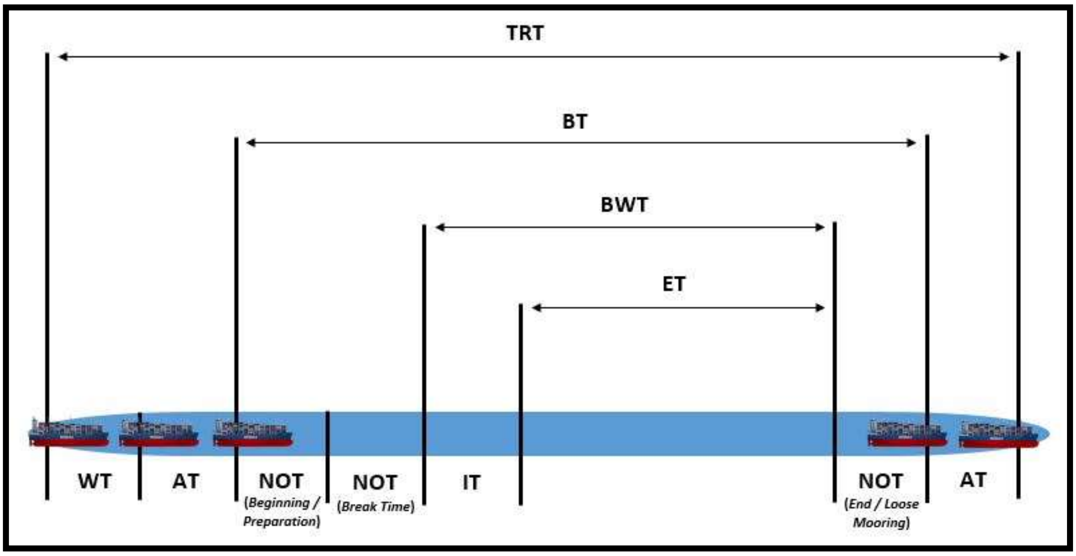


Figure 2.4 : Indicator on Performance of Service for Ship at Port

Source: Port Authority of Tanjung Perak in Surabaya

Based on the above figure, the waiting time of a ship is counted from when the ship is on the maritime area, not after when the ship is at Port or quay. So, the waiting time is the total time that is needed by the ship when it is at the maritime area of Tanjung Perak Port of Surabaya without getting any service.

Waiting Time at Port is a big problem for the businessmen on sea transportation. In 2002, the needed time for moving the container at Port in Jakarta is around 30-40 containers per hour. The improvement in technical and operational aspects shows the increase of productivity, in mid-2007, it reached 60 containers per hour. However, the increase on traffic of container and the traffic jam at Port with the problem that is related to the labour and the delay of tool booth cause the reduction of productivity until 40-45 containers per hour in the first semester of 2008.

The number is only a half of production level of Port at Singapore and other main transshipments in Malaysia with the productivity around 100-110 containers per hour. Due to the delay in handling the freight, the big companies of sea transportation report that they often have to leave the Port in Jakarta before the ship is completely loaded since they have to fulfill the promised schedule. This condition causes several costs for dignification besides the cost for getting the position on third party feeder as well as the loss since the place is not used on their own feeder. As the consequence, the businessmen of sea transportation reduce the planned capacity for the Port in Jakarta. International Sea of Indonesia enjoys very competitive service of transshipment in Singapore and Malaysia, but it has to pay expensive cost for service on loading and discgarging due to the expensive cost of Port in Indonesia.

2.5. Ship

In a modern sailing world, the ships that are used for the loading of goods and passengers are usually the types of ships that are supported by internal combustion engine with the solar fuel, while some of them are supported with steam from the steam turbine.

Based on the load, the types of ships can be categorized into as follows:

a. Passenger Ship

This ship is designed for carrying the passengers and their goods. Besides, this ship also carries the daily needs. This ship is built with many decks and there are rooms on every deck as the cabin for the passengers who travel with the ship The cabin is also made with different classes based on the type of facility and comfort that are provided.

b. General Cargo Ship

In a modern trade sailing world, there are some well-known ships as follows: General Cargo Carrier, Tanker, Log Carrier, Container Ship, and others have different characteristics. Besides, the characteristics of water that are different (tropical climate waters, river, and lake) also determine the need on trading ship. Based on the commercial aspects, the categorization of types of ships and the characteristics of load that must be loaded by the related ships can be managed.

General Cargo Ship, the ship that is built with the purpose to load the common goods, the load including several packaged goods in chest, bag, crate, etc. and the goods are shipped by many shippers for many consignees from several destinations.

c. Container Ship

This ship is made to load the container and it can have the tools for loading and discgarging and use shore crane and granty crane from land in order to load and unload the container. Therefore, the container is placed in the ship through several tracks and the ship for container is also named the cellular vessel. Due to high number of container that can be loaded, the cellular vessel can be categorized into several generations. The development of cellular vessel from the generation 1 to generation 5 is stated as follows :

Table 2.1: Types of Cellular Vessel

Generation	**Capacity TEU**	**Fixed Weight**	**Length (m)**	**Width (m)**	**Load (m)**
1	600 - 1,000	1,400	180	25	9
2	1,100 - 1,800	30,000	225	30	11

3	2,000 - 3,000	40,000	290	32	13
4	4,000	65,000			
5	> 4,000				

Note: 1 container 20 feet is 1 TEU (twenty-foot equivalent unit)

Source: Triatmodjo (1992)

2.6. Container

Container is specifically designed with certain size and it can be used several times, for storing and loading the load inside it. Philosophy behind the container is to cover or to bring the loads inside the same containers, to make every vehicle, including ship, train, truck, or other vehicles, able to load them as one unity, and to carry them quickly, safely, efficiently, and door to door whenever possible.

The operation of container can be done well when every involved party must agree that the sizes of container are the same to make it easier to load. Agency for International Standard Organization (ISO) has determined the sizes of containers as follows:

a. Container 20’ Dry Freight (20 feet). Size: length = 6.058 m, width =2.438 m, and height = 2.591 m.
b. Container 40’ Dry Freight (40 feet). Size: length = 12.192 m, width =2.438 m, and height = 2.591 m.
c. Container 40’ High Cube Dry. Size: length = 12.192 m, width =2.438 m, and height = 2.926 m.
d. Container 45' Size: length = 13.544 m, width =2.352 m, and height = 2.698 m.

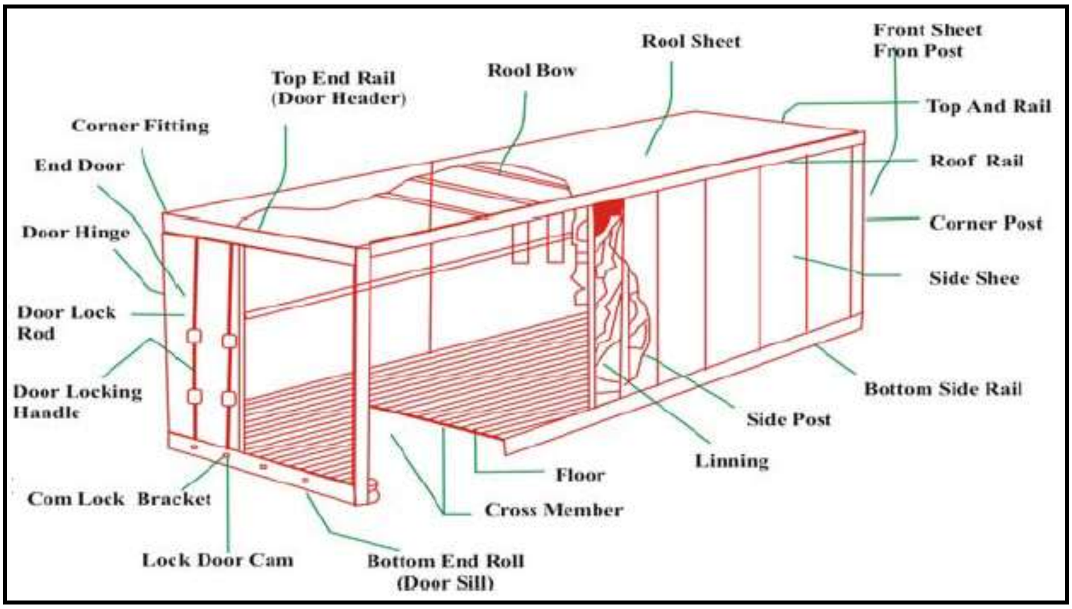


Figure 2.5 : Container

Source: Triatmodjo (1992)

International Standard Organization (ISO) determined the requirements on the freight container as follows:

1. Has a fixed shape and should be strong enough for use several times.
2. Made for loading the goods through several modes of transportation with one way transport.
3. Equipped with the operational equipment for quick use, especially for carrying from one mode of transportation to other modes of transportation.
4. Designed in a certain way to make it easier to load and unload.
5. Has the inner size 1 m3 (35,8 cu.ft) or more.

Container has several types as follows:

1. Dry Freight Container/General Cargo, used for loading the common loads.
2. Reefer Container, used for loading goods with low temperature from refrigerator, such as vegetables, meat, etc.
3. Bulk Container, used for loading the bulk load, such as rice, wheat, etc.

4. Open Side Container, used for loading with the size that is not possible to enter from the back door of container. So, every side of container must be opened. Such as, heavy equipment.
5. Soft Tof Container, used for loading the goods with a very large size.
6. Flat Rack Container, used for loading heavy loads, such as machine, spare part, etc.
7. Tank Container, the steel container that is built inside the shell of container for loading the tank with dangerous goods inside, such as gas, oil, and explosive chemicals.

Handling of container at Port includes the activities as follows:

1. Takes the container from ship and places it under the portal gantry crane.
2. Takes from the ship and quickly places it on the container of truck or trailer that is ready under the portal gantry, that will immediately load it outside the Port.
3. Moves the container from a place to be stacked at other places on the same container yard.
4. Shifts the container because the container at the lower position will be taken, so the upper container must be moved before that.
5. Unites some containers from one shipment to a location of stacking (initially dispersed to several locations).

Tools for loading and discgarging container can be described respectively as follows:

a. Gantry Crane

Gantry Crane is the tool for loading and discgarging the container in which the position at the side of the quay. The working procedure when the tool is not operated, the portal part that faces the sea is lifted so it will not block the maneuver of ship when approaching the quay or moving outside the quay. When it is operated, the part is lowered until the horizontal position.

During the operation of discgarging the container, after taking the container from the stacking at ship and it is lifted from an adequate height, the crane machine of gondola then takes it along the portal to the behind, toward the floor of quay. The work speed of loading and discgarging of container with that method is named the Hook Cycle and it can be done quickly enough, less than 2 until 3 minutes per box. Therefore, the productivity of hook cycle is around 20 to 25 boxes every hour. Hook Cycle is the time in the process of loading and discgarging the container since when the spreader is placed on the loads, lifted to a place in opposite direction at quay or ship.

b. Container Spreader

Is the tool for loading and discgarging the container including the square steel frame.

that is equipped with the lock at the lower part of four sides and

hung on the steel cable from gantry crane, transtainer, Straddler Loader, and the construction that is quite different on container forklift.

c. Straddler Loader

This vehicle is the same with straddler carrier type, but it is not supported with steering wheel, the movement is only forward and backward from the initial point. The function of this tool is to manage the container at the stacking area, to prepare the container that will be loaded by granty crane or to take the container that is unloaded from the ship, under the portal gantry, to move it to other places to avoid blocking other containers that are unloaded.

d. Transtainer / Rubber Tyred Gantry

This tool is also called RTG (Rabber Tayred Gantry) with the functions

To manage the stacking of container, to move the container from front and back directions. The procedure is to take the container at the lowest stacking by moving the upper container, shifting the container from one stacking to another.

e. Container Forklift

Forklift truck that is specifically used to lift this container (not for loading the loads in the stuffing frame) has a shape that is the same from other forklift trucks, but the lifting capacity is much larger, more than 20 ton with higher reach to take the container from (or to place it on) the structure of three, four, or five tiers.

g. Side Loader

This vehicle is the same with forklift, but it lifts and lowers the container from the sides, not from front direction. Side Loader is used to lower and lift the container from and on the trailer or chassis in which the trailers or chassises are brought to the side of loader for that purpose. The loading and discgarging of container with side loader takes a longer time since the leg of side loader (jack) must be fitted before lifting the container to avoid the tumbling of container.

h. Facilities and equipment for loading and dischraging the container

Besides the description of equipment for loading and dischraging the container mentioned above, the characteristics of facilities and equipment for loading and dischraging the container at quay of Tanjung Perak Port in Surabaya are shown in the table below:

Table 2.2 : Facilities and Equipments for Loading and Discgarging Container

Facility / Equipment	**Total**
Length Of Berth	1,450 Meter
Terminal (Depth of Draft)	-10.5 LWS
Container Yard	47 Acres
Container Freight Station	16,500 M 2
Quays Cranes	10 Units
Rabber Tayred Gantry	23 Units
Reach Stacker 40 Ton	3 Units
Side Container Loader 7.5 Ton	2 Units

Sky Stacker 8 Ton	2 Units
Electric Forklift 2.5 Ton	12 Units
Double Trailer	40 Units
Head Truck	54 Units
Chassis Of Truck 20 Ft	3 Units
Chassis Of Truck 40 Ft	45 Units
Chassis Of Truck 45 Ft	30 Units

Source: Port Authority Of Tanjung Perak, 2013

Terminal of container ship at the Port consists of some parts as follows:

1. Container Terminal Unit

Container Terminal Unit is the specific Port to manage the container with a wide yard and it is supported for loading, discgarging, and stacking the container that is unloaded or loaded to the ship. Container ship is not supported with the equipment for loading and discgarging, the loading or discgarging of container ship is done with gantry crane, the crane that can be used only for discgarging and loading the container with the capacity less than 50 ton. In order to load or unload a ship, a yard with certain width is needed for a ship for temporary storage of the unloaded containers or for stacking of containers that will be loaded since the container must be loaded based on the loads in the stacking in the ship.

2. Container Yard (CY)

Container yard is an area of Port that is used to store the FCL container that will be loaded or unloaded from the ship.

3. Container Freight Station (CFS)

Container freight station is the area that is used to store the container, loading or discgarging, and to store the break-bulk cargo that will be loaded to the container or unloaded from the container.

4. Inland Container Depot (ICD)

Inland container depot is the inner area or the outside area of Port that is under the supervision of customs for storing the container (FCL) that will be given to the consignee or received from shipper.

5. Watchtower

Watchtower is used for supervision of all places, managing, and controlling every activity at terminal, such as the operation of equipment and the notification on the direction of storage and the place of container.

6. Maintenance Workshop

The mechanism for loading and discgarging at the terminal of container encourages the need on maintenance and repair for the used equipment and for the repair of empty container that will be returned. The activities are done at the maintenance workshop. The damage of equipment and the delay of repair for equipment can cause the delay of all activities at terminal.

7. Apron

Apron of container terminal is larger compared with the apron for other terminals with a size 200 m until 50 m. The equipment for loading and discgarging the container, such as gantry crane, railway track, road for trailer truck, and the operation of equipment for loading and discgarging other containers.

8. Other Facilities

In the terminal of container, some public facilities are needed, such as power source for container with refrigerator, supply of fuel, supply of water, the lighting for the worker at night, and the security.

The moving of goods and container is started when the ship is anchored at quay, through the Gantry crane, the container is lifted from ship to quay (stevdoring), it is placed on truck trailer that is prepared, and it is brought to the container yard or to the consignee. This figure shows the flow of container from quay to the consignee:

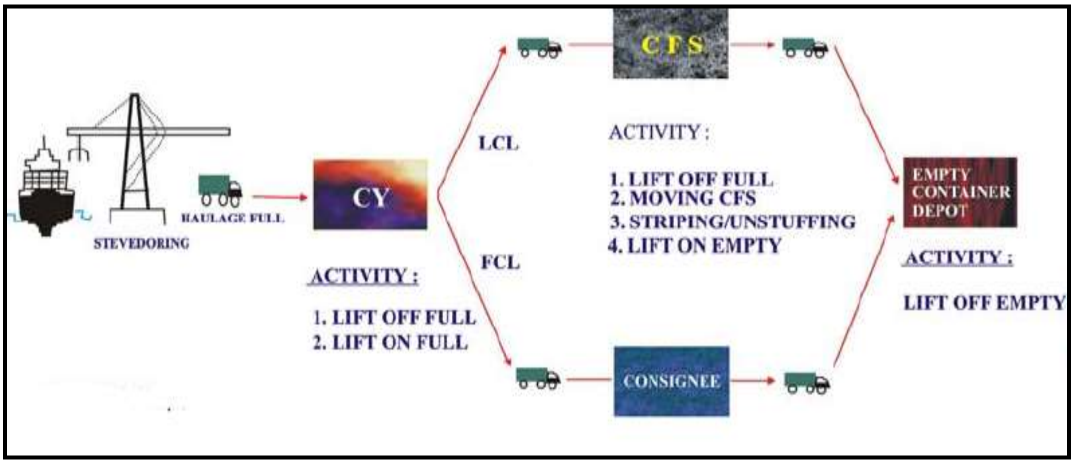


Figure 2.6 : Flow of Container at Quay

In the lifting of container from a country to another, there are two statuses that can be used :

1. Full Container Load (FCL)

This type of lifting has the characteristics as follows:

a. Contains the loads from one shipper for one Consignee
b. The stuffing of container is done by shipper (shipper load and count) and the loaded container is sent to container yard (CY) at Port for loading.
c. At discgarging port, the container is taken by consignee at CY and it is unloaded by consignee.
d. The sailing company is not responsible on the damage and the loss of goods inside the container.

2. Less Than Container Load (LCL)

The lifting of container has the characteristics as follows:

a. The container with the loads from some shippers is sent to some consignees.
b. The load is accepted in a break bulk condition and loaded at container freight station (CFS) by the sailing company.
c. At discgarging port, the container is unloaded at CFS by the sailing company and sent to some consignees in a break bulk condition.
d. The sailing company is not responsible on the damage and the loss of goods inside the container.

2.7. Fishbone Analysis

Fishbone diagram is often referred as Cause-and-Effect Diagram or Ishikawa Diagram by Dr. Kaoru Ishikawa, an expert on the quality control from Japan, as one of seven standards of quality (7 basic quality tools). Fishbone diagram is used for identification on the possibility of cause and when the team tends to consider the routine activity (Tague, 2005).

An effort and step for improvement will be easier to do when the problem and the cause are found. The advantage of fishbone diagram can help us to find the cause of problem with a user friendly way, tools that are user friendly are preferred by the people of manufacturing industry in which the process has many variables that potentially cause the problems (Purba, 2008).

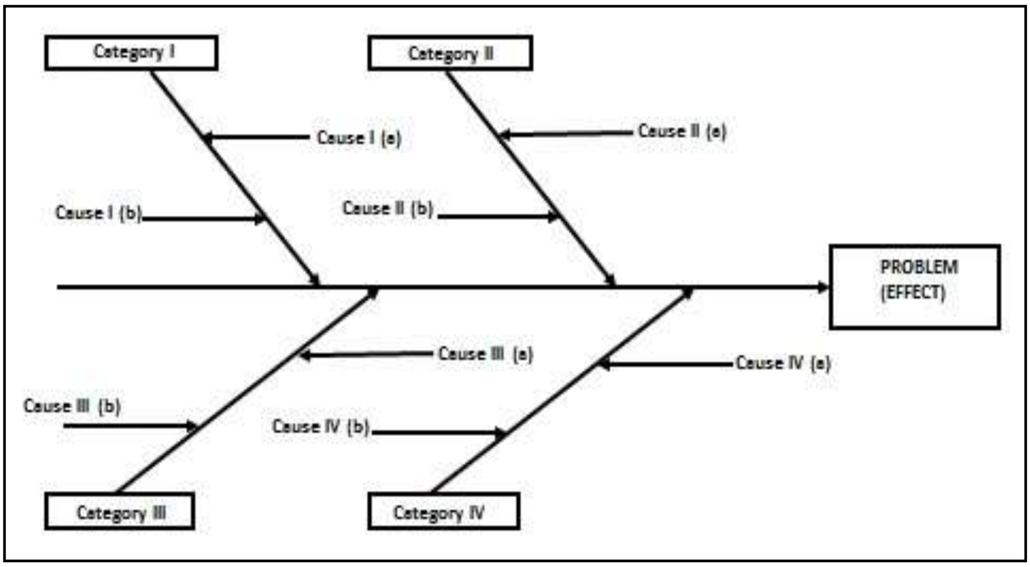


Figure 2.7 : Fishbone (Ishikawa) Diagram

The purpose of fishbone diagram is to find the causes of problem, the main cause or other causes. With the fishbone diagram, the related causes will be found. Therefore, there will be understanding from the existing problem in which the repair can be done by looking the problem and solving the problem itself. With the stair stepping method, starting from asking a question, "Why did it happen?" to the appearing main problems. After the answer is found, the same question can be repeated again to the answer. It is repeated again until ONE main cause that is the most fundamental is found.

Fishbone diagram will identify several potential causes from one effect or problem, and to analyze the problem through brainstorming session. The problem will be categorized into several categories that are related to each other, including human being, material, machine, procedure, policy, etc. Every category has the causes that need to explain through the brainstorming session.

2.8. Analysis of Regression

(Iriawan, 2006) noted that the analysis of regression is very useful in the research for: (1) the regression model can be used to measure the capacity of relation between the response variable and predictor variable, (2) regression model can be used to understand the effect of one or some predictor variables on response variable, (3) regression model has a function predict a variable or some predictor variables on response variable. Those two variables can be connected into a mathematical equality, the form of regression equality is usually stated as follows:

$Y = b_0 + b_1x_1 + b_2x_2 + ... + b_kx_k + \varepsilon$

b_0 = intercept (constanta)

$b_1...b_k$ = parameter of regression model for x1...xk

ε = error (residual = gap between the real value and the line of predicted model)

2.8.1 OLS Estimation Method

OLS Estimation Method is the method of estimation to get the smallest deviation/error. In order to get the parameter value with BLUE (Best Linear Unbiased Estimator) characteristics, the assumptions of OLS must be fulfilled. According to Nachrowi and Usman (2006), the assumptions or requirements that become the basic of regression coefficient estimation with the OLS method are as follows:

1. E(ui) = 0 or E(ui xi) = 0 or E(Yi) = β1 + β2 Xi, the effect of ui on Yi is neglected or ui does not affect E (Yi) systematically.
2. There is no correlation between ui and uj {cov (ui,uj) = 0}; i ≠ j 3. Homoskedasticity; the size of the same ui variance or var (ui) = σ2 for every i. In other words, the variance from the variable of ui disturbance is the same.
4. Covariance between ui and Xi is zero {cov (ui, Xi) = 0}. In other words, there is no free variable and disturbance variable.
5. The regression model is specified correctly.

2.8.2 Stationary Test

Before the regression with data time series, the stationarity test will be conducted. The stationarity test is conducted in order to know whether or not the used data time series is stationary. This is an important thing do, If the regression is done at the data time series that is not stationary, it will result in the spurious regression.

In order to know whether the used data time series is stationary or not, one of the methods that can be used is the use of unit roots test. The roots test is conducted with Augmented Dicky Fuller (ADF) method, with the following hypothesis:

H0: there is a unit root (the data are not stationary)

H1: there is no unit root (the data are stationary)

The result of estimation result on ADF method will be compared with critical value of McKinnon on the critical value of 1%, 5%, and 10%. If the value of t-statistic is smaller than the critical value of McKinnon, H0 is accepted, there is unit root on data or the data are not stationary. If the value of t-statistic is bigger than the critical value of McKinnon, H0 is refused, there is no unit root on data or the data are stationary.

2.8.3 Stability Test (Chow Test)

Chow test is the tool for test for equality of coefficients or
coefficient similarity test (Ghozali, 2005:131) If the result of observation that is analyzed can be categorized into two or more groups, the asked
question is whether two or more groups are the subjects or not.
the same process of economy. The used formula is:

$$F = \frac{(RSS1-RSS2) / (N-1)}{(RSS2) / (NT-N-K)}$$

Note:

ESS1 = Residual Sum Square the estimation result of pooled least square model

ESS2 = Residual Sum Square, the estimation result of model fixed effect

N = the number of data cross section

T = the number of data time series

K = the number of explanatory variable

The statistic of Chow Test follows the distribution of F-statistic with free degree when the value of CHOW statistic (F-stat) of test is higher than F-Table, there is enough evidence to accept the zero hypothesis, the used model is model fixed effect and vice versa. The test is called Chow Test due to its similarity with Chow Test for testing stability of parameter

2.8.4 Goodness of Fit of a Model

The accuracy of function of sample regression in predicting the actual value can be measured from goodness of fit of a regression similarity model. The measurement of goodness of fit can be done through the statistic value t, statistic value F, and determination coefficient. The statistic counting is considered significant statistically when the value of statistic test is on a critical area (the area where H0 is rejected). It is not considered significant when the value of statistic test is on the area where H0 is accepted.

2.8.4.1 Individual Parameter Significance Test (t-Test)

t-test is conducted in order to understand whether the independent variable influences the dependent variable or not. t-Test is conducted in order to compare the value of t statistic with t table. In this test, the two tail tests are conducted with the level of trust 95% or $\alpha = 5\%$ with the hypothesis Ho:$\beta0=\beta1=\beta2=0$ and Ha:$\beta0\neq\beta1\neq\beta1\neq0$

2.8.4.2 Simultaneous Significance Test (f-Test)

f-test is conducted in order to statistically analyze that the regression coefficient from independent variable gives a valuable influence by comparing the probability value (F-statistic) with F table, with the requirement when F-Statistic > F table, Ho is refused and Ha is accepted, it means that the independent variable significantly affects the dependent variable, with the following formulation of hypothesis :

Ho:$\beta0=\beta=\beta2=0$, independent variable does not have any effect on the dependent variable. Ha:$\beta0=\beta1=\beta2=0$, independent variable have effect on the dependent variable.

2.8.4.3 Determination Coefficient

Determination coefficient (R2) measures the capability of model in explaining the variance of dependent variable. The value of determination coefficient is between zero and one. The small value of R2 indicates that the capability of independent variables in explaining the variance of dependent variable is very limited. The value that is near to one indicates that the independent variables give almost all information that is needed to predict the dependent variables.

2.8.5 Model Test with Classic Assumption

Model test with classic assumption is conducted on the structural equality including the multicollinearity heteroskedasticity, and autocorrelation tests.

2.8.5.1 Multicollienarity Test

Multicollinearity, Frisch stated that a regression model is considered multicollinearity when there is perfect or exact linear connection between some or all free variables from a regression model. As the consequence, there will be difficulty to observe the influence of explaining variable on the explained variable. Multicollinearity that is quite sensitive on the regression model can be detected when R2 from auxiliary regression is higher than R2

The overall regression between unfree variable and free variable of the model is analyzed. Furthermore, if the value of variance inflation factor is higher than 10, the free variable can have the problem of multicollinearity.

2.8.5.2 Heteroskedasticity Test

The heteroskedasticity is a difference of variance among the data series. Heteroskedasticity happens when the value of variance from unfree variable (Yi) increases as the consequence of the increase of variance from free variable (Xi), the variance from Yi is not the same. The phenomenon of heteroskedasticity is often on data cross section rather than on the time series. Besides, it is often shown in the analysis with average data. In order to detect the existence of heteroskedasticity, the method of scatter plot graphic is used, White test, when the probability value (p value) of R2 observation is higher than the risk level of error that is taken ($\alpha = 5$ %), the residual is categorized into homoskedasticity

2.8.5.3 Autocorrelation Test

Autocorrelation is defined as the correlation between the parts of observation series that is sorted based on the time (like in a data time series) or the section (like in a data cross section).

Autocorrelation usually tends to happen on the data time series, but it can also happen on data cross section. In the data time series, the observation is ordered based on the time chronologically. Therefore, there is a possibility of the intercorrelation between the consecutive observation, especially when the interval between two observations is very short. In order to detect the autocorrelation Lagrange Multiplier (LM test) is done when the probability of observation is R2 > α (5 %), then it is free of autocorrelation.

2.8.5.4 Normality Test

Normality test is used to analyze the normality of distribution of residual factor. There are two ways to detect whether the residual has a normal distribution or not, by using the graphic analysis and statistic test. Graphic test is done with the histogram graphic and considering the normal probability plot, by comparing the cumulative distribution and normal distribution. Meanwhile, the statistic test is done by considering the curtosis and skewness values of residual.

2.9. Previous Research

2.9.1 General Literature Review on Port

Issues of economy, management, and policy at Port sectors have grown quickly since the mid1990s. In volume 25 of Maritime Policy and Management journal year 1998, Suykens and Van de Voorde (1998) conducted the literature study in the last twenty five years on the management of Ports in Europe. In their writing, the reference was taken from more than 24 international journal. Eight years later, Heaver et.al (2006) gave the literature review on evolution of economy at Port in the last 50 years. The reference includes 68 different journals, 51 journals of them were published in 1997. The journal related to the Port has been published for most of academic journal on maritime and transportation, and other relevant journals (Pallis, et. al., 2010).

This growth explains at least the partial development of Port industry that encourages the new questions on research, often with clear relevance (Heaver, et.al, 2006). The increase of world trading, new technology, and involvement of private sector in managing the industry of Port that is more complex. Port is a regionalization system (Notteboom and Robinson, 2005), that belongs to the part of transportation system that is wider on the chain of supply (Robinson, 2002). The Port is also developed as the activity of complex economy where other industries operate (De Langen, 2004). This tendency encourages the change of conventional organization and classification of Port (Bichou and Gray, 2005), and the questions on policy of Port. Privatization and liberalization has changed the management and ownership of traditional mode. The effort of European Union in determining the policy on supranational Port also encouraged many researches.

Table 2.3 : Port Research Sub-Fields

Category	Themes	Total Number of Papers	2007-2008	2002-2006	1997-2001
1. **Terminal studies**	• Performance measurement of terminals • Terminal operations • Description of (strategies of) TOCs	40	10	22	8
2. **Ports in transport & supply chains**	• Shipping (networks) & implications for ports • Supply chain trends and implications for ports & port authorities • Logistics activities in seaports • Information flows in supply chains; issues for ports • Hinterland chains	56	22	20	14
3. **Port governance**	• Port models and port reform • The role of the Port Authority • Industrial relations in ports • The port community, cooperation in seaports	61	15	23	23
4. **Port planning & development**	• Trends and developments • Descriptive (case) studies of ports & port development • Forecasting • (Economic) impact studies of ports and cost estimates • Port expansion projects • Tendering and concessions in ports	57	10	24	23
5. **Port policy & regulation**	• Port pricing, state aid, and national policicy • Environmental, safety & security regulations in ports • Anti-trust regulation; issues in ports • Supranational port policies	67	19	24	24
6. **Port competition & competitiveness**	• Port competition • Strategy analysis • Port Performance • Port Choice	74	22	43	9
7. **Spatial analysis of seaports**	• Spatial change in seaports • Spatial studies of port networks • Studies of spatial change of port cities & the port city interface • Analysis of port hinterlands	40	11	15	14
TOTAL		395	109	171	115

Source: Pallis, et. al. (2010)

Pallis et.al (2010) did the literature review that is related to the Port from some journals and papers published in 1997-2008. They classified the journals and papers to some different sub-fields, for identifying the main topic of research on Port. The following table summaries the classification. The related themes with the competence of Port (74 journals), the policy of Port and its regulation (67 journals) and the management of Port (61 journals) have made the community of research interested. The large imbalance is probably caused by the change of competence at Port in terms of the increase of complexity. The terminal study was often published in 2000s, with the development of organization, sophistication of technology, and the increase of traffic jam as the motivation on the increase of interest from researchers on this field. During 2007-2008 period, the published researches were more focused, rather than the past, on the examination of Port in terms of transportation and supply.

The researchers of Asian institutions focuses more on the terminal study, while the researchers in Belgia, Netherlands, Italy, and France are more interested to the theme of Port in the chain of transportation and supply. The management of Port is often learned by the researchers in England, Canada, and Australia, while the policy on Port and regulation is often learned by the researchers in United States of America. More specifically, almost half of all studies on Port during the 2007-2008 period focused on the container and terminal of container. Research community, especially in Asia, focuses on the industry of container. All other commodities (bulk, fruit, vehicles, cruise-ships, passenger-ships) are only discussed less than 5% of the total journals. It is proven that there is an opportunity to expand the scope of research (Pallis, et. al., 2010).

In the last years, the examination on Port in the chain of transportation and supply has developed very quickly. The interest in management, organization, and economy from terminal of Port has been expanded in the last years, like what is suggested by Slack and Fremont (2005), the commercialization of Port definitely results in orientation of big terminal in the study of Port.

2.9.2 The Literature Review on the Performance of Port

Until this time, there are only few published journal on research involving the performance of Port that is related to the influencing factors on waiting time of ship. Maloni and Jackson (2005a) discussed the problem on the capacity of Port and suggested the taxonomy based on the operational and strategic stake holders that are related to the flow of container. However, their review has one main limitation, the focus only on the stake holders (the involved parties) who influence the capacity, without the purpose to choose the influencing factors on capacity of Port directly and indirectly. Another journal by Maloni and Jackson (2005b) reviewed twenty five factors of capacity from the literature of academic and industry. However, they neglected some important factors that influence the train, truck, and capacity of dry port, and the performance of all systems starting from the problem of overall capacity at Port.

Unctad (1976) discussed some problems on the aspect of performance of a Port in 2 (two) groups, the financial group including the total tonnage worked, berth occupancy revenue per ton of cargo, cargo handling revenue per ton of cargo, labour expenditure per ton of cargo, capital equipment expenditure per ton of cargo, total contribution, contribution per ton of cargo. And the operational group including the arrival rate, waiting time, service time, turn around time, tonnage per ship, fraction of time berthed ship worked, number of gangs employed per ship per shift, tons per ship hour in port, tons per ship hour in berth, tons per gang hour, and fraction of time gangs idle. In the reality, some indicators really relate to the problems of waiting time of ship at a Port, but the there is no direct relation in the financial indicator that can influence the waiting time of ship at Port. On the other hand, Moon (2013) added the Quality Performance as one of the indicators for measuring the performance of a Port by considering how the capability solves the problems, such as the reliability (security), flexibility (working hours), implementation of a regulation that is valid and the used time for solving a conflict.

Due to trend of cheap price, the demand of transportation for container recently increases (Chung and Chiang, 2011). The shipping system of structured container is under the tight schedule. The reliability of schedule probably becomes the reference for the shipper when choosing the route for container sailing and the plan of their supply chain that is realistic from the time of shipping. So, the waiting time probably does not reduce the reliability of service for the ship, but it increases the logistic cost to the customers, like the additional cost for supply or additional production cost. The waiting time can cause several losses, such as the stopping of production due to the delay of shipping (Notteboom, 2006). Besides that, the waiting time of ship causes the knock-on effect on the supply chain. A more serious delay can cause the significant loss for the involve cargo, the loss of cargo (Vernimmen et al 2007), or the loss of potential customer. Majority of operators of ship really consider the reliability of their service, such as the reliability on the schedule. The schedule of ship that is not reliable also increases the operational cost for sailing company (Vernimmen et al., 2007). As the consequence, the reliability of schedule is important for the company when handling the activities of cargo. The on time shipping can reduce the time for storing at warehouse and the supply cost. It also supports the company to plan the pick up and the shipping at the beginning for reducing the resulted cost from the earlier shipping or the late shipping. Besides, it can help the company to maintain the integrity of supply chain by improving the flow of product supply.

Carey (1999) stated that the size of reliability and timeliness for the scheduled service is very important in planning, management, operation, and marketing of service. The schedule design is the strategic planning in the sailing route for container (Fagerholt, 2004), and it must fulfill the need of customers in terms of frequency, time of transit, and price (Notteboom, 2006). Vernimmen et al. (2007) showed that the low schedule reliability can be caused by many factors, the factors outside the control of container for sailing route. For example, the delay of ship due to the bad weather, traffic jam at Port, the labor strike, etc. Two steps of managing the schedule are the task for Port and navigation through the sea. Chung and Chiang (2011) explored the factors that influence the reliability of schedule, namely: (1) Operating strategy of shipping lines, (2) Staff in shipping lines, (3) Process management in the shipping lines, and (4) Port’s condition.

Chen and Huang (1999) analyzed the factors of mooring time for container ship based on three sub-periods, namely: (1) Preparation period, (2) Container handling period, and (3) Waiting for departure period. For every sub-period, the empirical model is predicted with samples of 77 ships that are observed from two Ports, Keelung and Taichung. The factors of Port and ship company belong the preparation period, and waiting for departure period, while the factors of Port, regulation, task of quay, the quantity of handled container belong to the model of container handling period. Although 93% of time for handling the container can be explained, other factors must be analyzed, such as the route of ship, the model system, etc., that can also influence the length of two sub-periods of mooring time. However, this finding is useful for the sailing company and the authority of Port in terms of giving the insight from several factors that influence the mooring time for the container ship.

Galor (2008) showed that the waiting time of a ship at Port is also influenced by the level of sea water surface. In many cases, the depth of Port area can limit the design of coming ship. With this method, the capacity of cargo ship cannot be used optimally. With this limitation, the Underkeel Clearance (UKC) is adopted as a constant value, but it is too big on many cases of value since it does not consider the external factors, especially the fluctuation of water surface. For that purpose, the Port can look for another way to increase the competence by reducing the UKC with certain limitation, such as the minimum navigation risk, and waiting time of ship. In this approach, the UKS is individually determined for every arrival or departure. The practice is used in many Ports around the world, especially from the research of Galor (2008) at Swinoujscie Port where UKC can be reduced until 50 cm.

Dachyar (2012) conducted the research with simulation method in order to get the description on condition of waiting time at Merak and Bakauheni Ports from several scenarios: number of ship, number of quay, the arrival of passenger, the sea wave, and the interval of ship arrival. The result of research shows that the waiting time of ship is around 10-30 minutes during the working days and the end of the week. On national holidays, waiting time increases until more than 10 hours. The simulation has been done in order to anticipate the queuing problems at Port that consumes the waiting time to the users. During the big wave, the big cargo ship must replace the small ships and the capacity of the shipment can be well maintained.

2.9.3 Literature Review on Performance of Tanjung Perak Port in Surabaya

In the study on the implementation of restructurization of management of Tanjung Perak Port in Surabaya, Giyantana (2013) stated that the resource factor is not quite supportive in the implementation of policy, for the Pelindo III Tanjung Perak that becomes the Port Enterprise or the Port Authority as the regulator. It is proven with the analysis of need that was done by Pelindo III of Tanjung Perak Port in Surabaya that needed the additional workers, 51 outsourcing workers and 20 full-time workers.

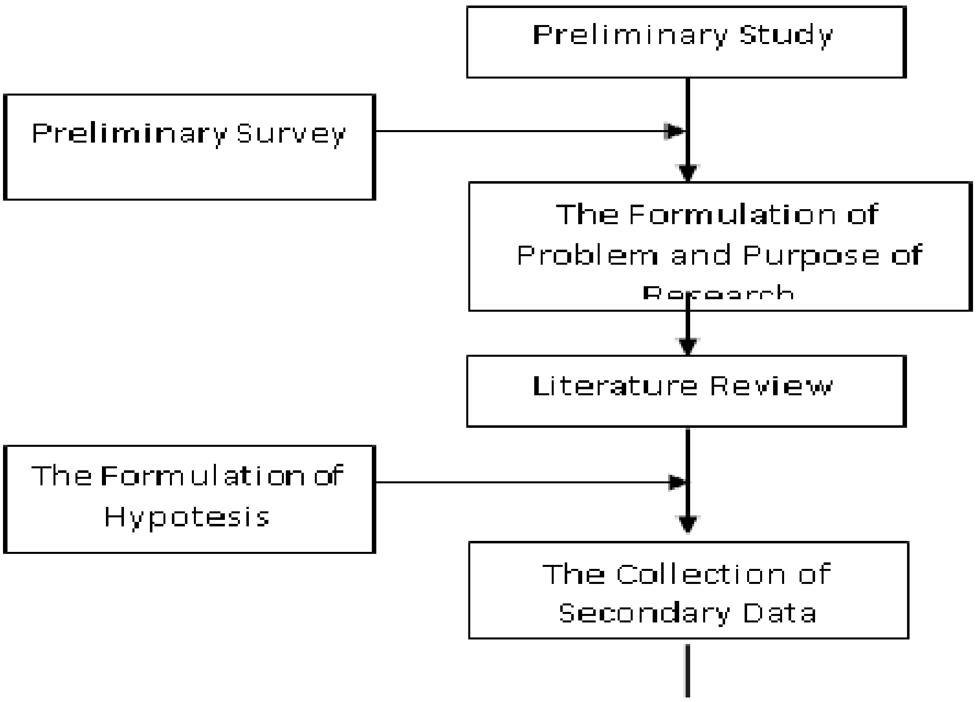
Anwar (2012) analyzed the performance of implemented tool at Tanjung Perak Port in Surabaya, in order to determine whether or not the improvement in management can be achieved when the efficiency level with a certain target as the consequence from the information that can be reliable in the Management of Contraction. They also analyzed the use of Balanced Scorecard that helped the authority office of Tanjung Perak Port for their strategic planning. The analysis of main factor shows that the knowledge on business and practice of HR, private skill, and the skill on management of competence for human resource are important in this field. In analyzing the management system of authority office at Tanjung Perak Port in Surabaya, a series of management tool is found for periodic use. Three selected management tools are Balanced Scorecard, Management of Competence (management of human resource), and Management Process (Improvement and Control).

Prasetyo and Nugroho (2012) conducted the research for understanding the level of service for ship at Tanjung Perak Port in Surabaya, on how the decision from the Port can allocate the anchoring of the ship that is still currently used. The result of counting showed that the Decision Support System (DSS) 1 as the old regulation must be used, while DSS 3 as the alternative DSS is quite good to use in the decision on allocation of ship anchoring since it is based on the analysis DSS 3 from the BOR side and the analysis of empty quay as well as the status of anchoring with the same value or almost the same with the value of DSS 1 and DSS 2. Meanwhile, DSS 1 still must be used since it is based on the analysis that DSS 1 has a same value or almost the same with DSS 2, especially on BOR side. The result of this research suggests that there should be the additional data such as the length of ship, length of quay, productivity, and policy from PELINDO III.

Supriyono (2010) analyzed the performance of container terminal based on the indicators that are needed for assessment of effectiveness for operational of container terminal at PT Terminal Petikemas Surabaya. Analysis of operational performance of Container Terminal will affect the effort for improving the service this time and in the future. The performance of container terminal as a system with many variables that influence it can be analyzed with the theory of queue and application of scenario model. The result of data analysis during the research with the field survey in 2009 shows the performance of TPS, such as BOR (performance of quay) 53.77& and BTP (number of container at quay) 1.61 box/meter of length of quay, YOR (performance of stacking field) for export 23.91% and import 55.12%. Through the analysis of scenario model, it is reported that: 1) Model Scenario A: The expansion on length of quay 500 m can reduce the density at quay that is shown with performance: BOR 43.02%, BTP 1.29 box/m, and YOR 51.96%, 2) Model Scenario B: The not operation time of ship can be reduced until 2 hours, so the berth time from 20.98 hours can be reduced into 18.98 hours by omitting the rest time between the shift and performance, BOR 48.64%, BTP 1.45 box/m, and YOR 43.30%, 3) Model Scenario C, applies the minimum type for service for all tools for loading and discgarging of container, with the result: BOR 39.72%, BTP 1.19 box/m and YOR 18.17%.

Chapter 3
METHODOLOGY OF RESEARCH

The research will be analyzed with the method of quantitative research with the approach of survey to the location of research. The initial survey is intended to understand the description of problem. Literature review is intended to discuss the relevant concepts and theories based on the topic of the research. The secondary data in this research are every monthly data during 2009 - 2013 related to the shipping and Port that are directly accumulated from the offices of governmental institutions with authority. The collected data are analyzed quantitatively in order for the hypothesis test. The technique of data analysis is used with the fishbone analysis and the multiple linear regression analysis. The steps of the research can be described in the following scheme:



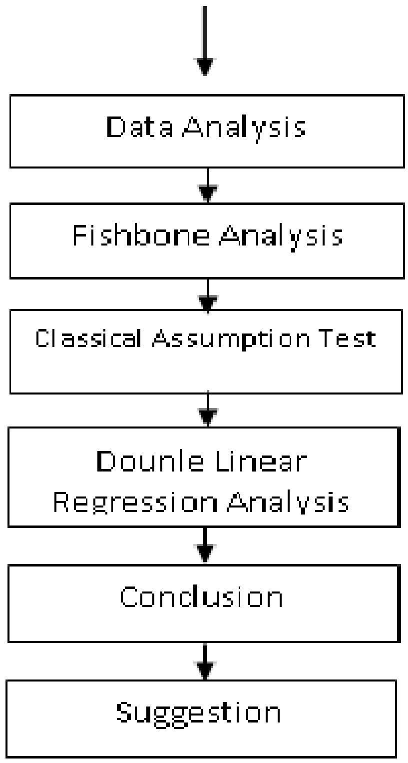


Figure 3.1 : Steps of Research

3.1 Research Method

The method research includes three main purposes as follows:

1. Analyzing the influencing factors on the waiting time of Tanjung Perak Port in Surabaya, the used technique of analysis is the fishbone analysis.
2. Analyzing the effect of every factor or variable that is resulted from the fishbone analysis on the waiting time of ship.
3. Determining the factors/variables with the highest effect on the waiting time of ship.

Based on three main purposes, the technique of data analysis in this research includes as follows:

1. The Fishbone Diagram from Ishikawa is used in identifying the causes of waiting time of ship at Tanjung Perak Port in Surabaya.

2. The statistical test for determining the validity of data and requirement of analysis (classical assumption test), such as Normality Test, Multicollinearity, Autocorrelation Test, and Heteroskedasticity Test.
3. Linear Regression Analysis is used to analyze the effect of every variable that is identified on the waiting time and to determine the most dominant variable on the waiting time.

3.2. The Required Data

The data that are required in this research is the arrival of ship at Tanjung Perak Port in Surabaya during 2009-2013 period. The analyzed data includes as follows:

1. Waiting Time (Y), is time for ship to wait when it is at the maritime area of Tanjung Perak Port.
2. Approach Time (X1) is the time that is used by the ship in a pilotage during the berthing or when the ship leaves port.
3. Effective Time (X2) is the effective time that is used for loading and discgarging when the ship is at quay.
4. Not Operation Time (X3) is the interval of time, the stopping time that is planned when the ship is at Tanjung Perak Port (the preparation for loading and discgarging and rest time).
5. Weather (X4) is the condition of weather at port when ship arrives at port and reports its arrival. This variable is measured with dummy in which: 0 value for the rainy weather and 1 value for sunny weather.
6. The Postpone Time (X5) is the time that is needed by the representation of ship in document processing of ship at port.
7. Idle Time (X6), is the ineffective, unproductive, or wasted time when the ship is at quay due to the weather, the broken facility for loading and discgarging the loads, the unreadiness of armada of lifting truck, and unreadiness of warehouse.

8. Berth Occupancy Ratio (X7) is the ratio between the time for the use of quay and the available time (the operation of quay) in a certain period of time that is stated in percentage.
9. Turn Around Time (X8) is the time when the ship is anchored at quay and the departure time of ship after the loading and discgarging of goods (Time Arrival-Time Departure).

Chapter 4

BUILDING SIMULATION OPTIMIZATION MODEL OF WAITING TIME

4.1 Fishbone Analysis

The searching of secondary data on the factors of waiting time was then conducted. The factors that cause waiting time at Tanjung Perak Port were found by brainstorming and they were grouped into Fishbone diagram (Ishikawa diagram) like what is shown on diagram 4.1.

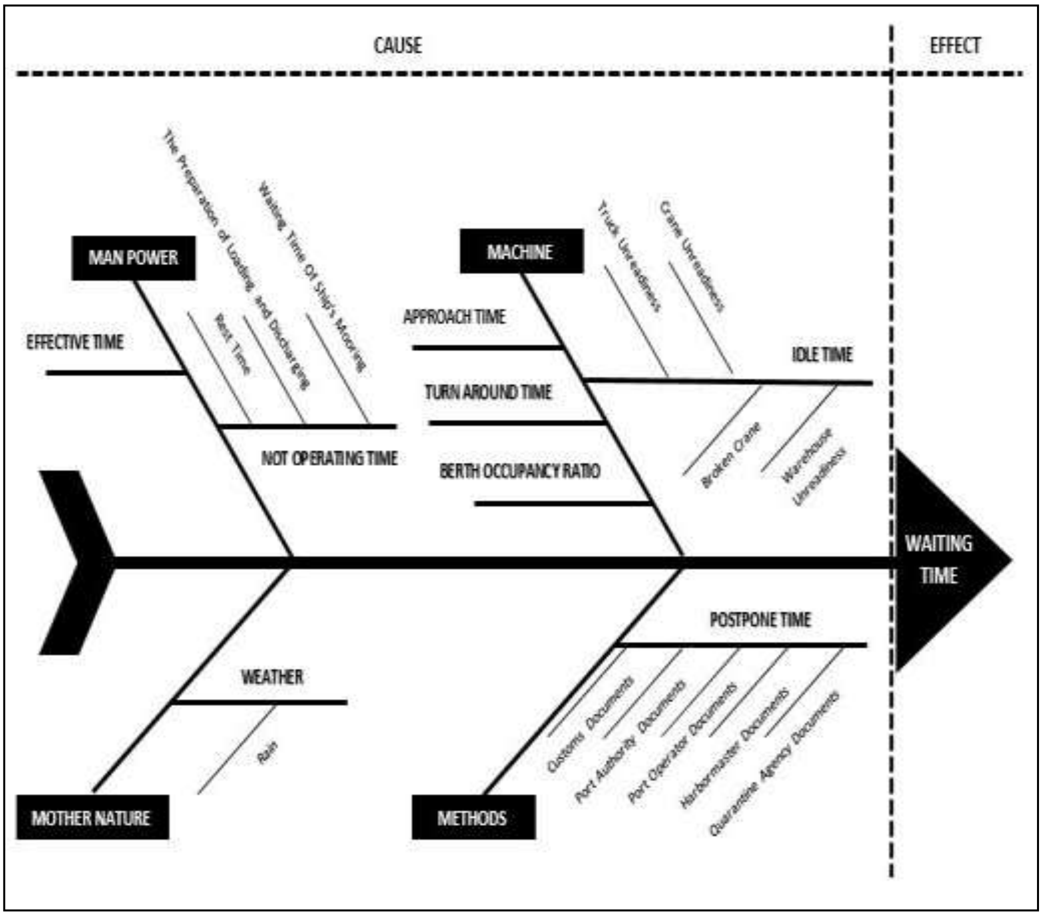


Figure 4.1 : Fishbone (Ishikawa) Diagram of Waiting Time

The factors that cause the waiting time are as follows :

1. Postpone Time

   The procedure of processing of document by ship or the agent that is appointed by the shipping company as the representation at port to prepare the required document, permission for ship to enter and leave port until ship berthing for loading and discharging of loads, and shipping of goods from port is still confusing and there is bureaucracy to pass. The agent of shipping company and the consignee of goods must submit many documents to many offices.

   There are custom clearance, permission to enter and leave port from harbormaster, the permission for berthing, loading, and discharging from port authority, the work related to the tool for loading and discharging from port operator and permission for loading animals and plants that must be received from Quarantine Agency. There are many required documents and the place of office of that institution is different, so the document processing needs longer time.

2. Weather

   The high rainfall is often followed by strong wind and high wave at sea. This condition affects the arrival of ship to port for loading and discharging since it may be swept away or hit coral. There are many corals at sea and they make ship difficult to move, especially during bad weather with strong wind and high wave.

   Rain also makes water flood the path to enter and exit the port, so many truck carrier cannot enter and exit the port easily.

3. Effective Time

   Time when the loading and discharging at ship is done is related to the effective work time that considers the operational time at port 24/7. In other words, the port must operate 24 hours a day in a week and there is also the reduction of time due to the work shift and rest time.

The lack of effectiveness of work time at Tanjung Perak Port causes the additional cost that is spent by ship operator and disturbance of the next route of ship.

4. Not Operating Time

   The cycle of loading and discharging by using the mechanical tools such as crane is operated by some people with different tasks and they belong to group. During their work, they will stop for the change of work shift and rest time, the interval is certain problem since they must wait for the workers to be ready to work and the waiting time for releasing and mooring of ship.

5. Idle Time

   One of the classical problems that often happen at every port is the wasted time to cause the high cost at port. There are some factors to contribute to the accumulation of idle time, namely unreadiness and damage of facility for loading and discharging that usually happen on crane, absence of truck to carry goods, unreadiness of warehouse to use as storage for the goods.

6. Approach Time

   Tanjung Perak Port of Surabaya is one of ports that require pilotage in Indonesia based on the regulation of Minister of Transportation number 53 Year 2011 on pilotage in which every ship that arrives and leaves the port must be with pilotage. The lost time due to the movement of ship in the pilotage when the ship arrives and leaves the port is counted since the guide boards the ship at the location of anchorage and the ship starts moving to quay until it binds the first rope at quay. It is also counted since ship releases the last robe at quay until it reaches the location of anchorage and the guide leaves.

7. Turn Around Time

   The time when the ship is at port, the duration of time at port in hour. The hour is counted since the ship arrives at anchorage area and it demands the guide to approach quay until the time when it arrives at anchorage area again and leaves the quay.

8. Berth Occupancy Ratio

   The indicator of the use of quay and availability of quay is the important factor in the performance of a port since it is directly related to the number and length of berth in accommodating a ship.

4.2. Data Analysis

The analysis is intended to ensure the factors that really influence the Waiting Time of ship at Tanjung Perak Port of Surabaya after the fishbone analysis is determined before. In the fishbone analysis by brainstorming, eight variables that can be used as the factors of waiting time of Tanjung Perak Port of Surabaya have been determined. This analysis uses the data of time series with the monthly data starting from 2009 until 2013 that were collected directly from Port Authority of Tanjung Perak Surabaya. This analysis was conducted by using software Statistical Package for the Social Sciences (SPSS) version 21.

4.2.1. Waiting Time (Y)

Waiting Time (Y) is the time when the ship waits at water area of Tanjung Perak Port. The description of Waiting Time is as follows :

Table 4.1 : Description of Waiting Time

	N	Minimum	Maximum	Mean	Std. Deviation
Waiting Time	60	1,03	2,22	1,5018	0.26798

Source : Processed data

During 2009-2013 period, the average *waiting time* was around 1.5018 hours with the deviation standard 0.26798 hour. *The lowest waiting time* was around 1.03 hour on December 2012 and the highest *waiting time*was 2.22 hours on November 2010.

Table 4.2 : Waiting Time Per Year

Year	N	Mean	Std. Deviation
2009	12	1.3750	0.19081
2010	12	1.5158	0.27437
2011	12	1.4350	0.15518
2012	12	1.3292	0.21305
2013	12	1.8542	0.11587
Total	60	1.5018	0.26798

Source : Processed data

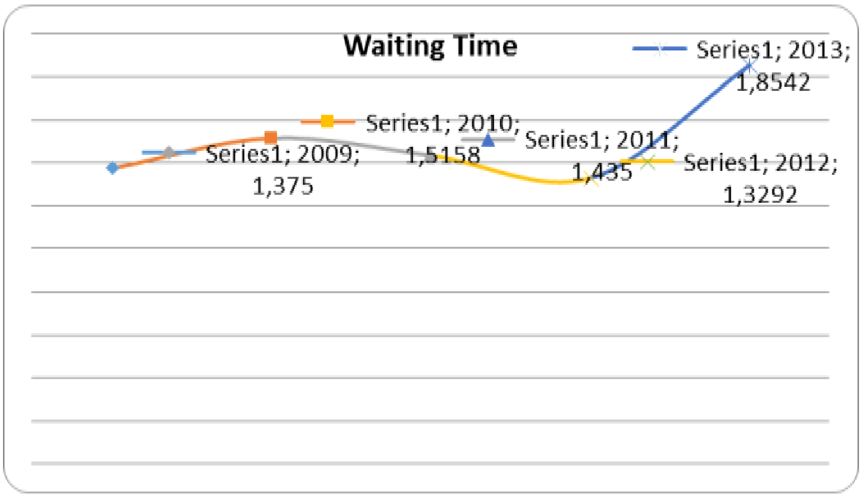


Chart 4.1 : Average Curve of Waiting Time Per Year

Based on Table 4.2 and Chart 4.1 above, it shows that the average waiting time increased in 2010, then it decreased two years later from 1.5158 hour in 2010 to

1.3292 hour in 2012. In 2013, the waiting time increased to 1.8542 hours.

4.2.2. Approach Time (X_1)

Approach Time (X1) is the time that is used by the ship in a pilotage during the berthing or when the ship leaves port. The description of Approach Time is as follows :

Table 4.3 : Description of Approach Time

	N	Minimum	Maximum	Mean	Std. Deviation
Approach Time	60	1.39	4,81	2,5438	1,09145

Source : Processed data

During 2009-2013 period, the average *approach time* was around 2.5438 hours with the deviation standard 1.09145 hours. *The lowest approach time* was around 1.39 hours on August 2009 and the highest *approach time*was 4.81 hours on June 2013.

Table 4.4 : Approach Time Per Year

Year	N	Mean	Std. Deviation
2009	12	1.7992	0.37720
2010	12	1.8683	0.19371
2011	12	2.1783	0.06250
2012	12	2.2717	0.41722
2013	12	4.6017	0.28774
Total	60	2.5438	1.09145

Source : Processed data

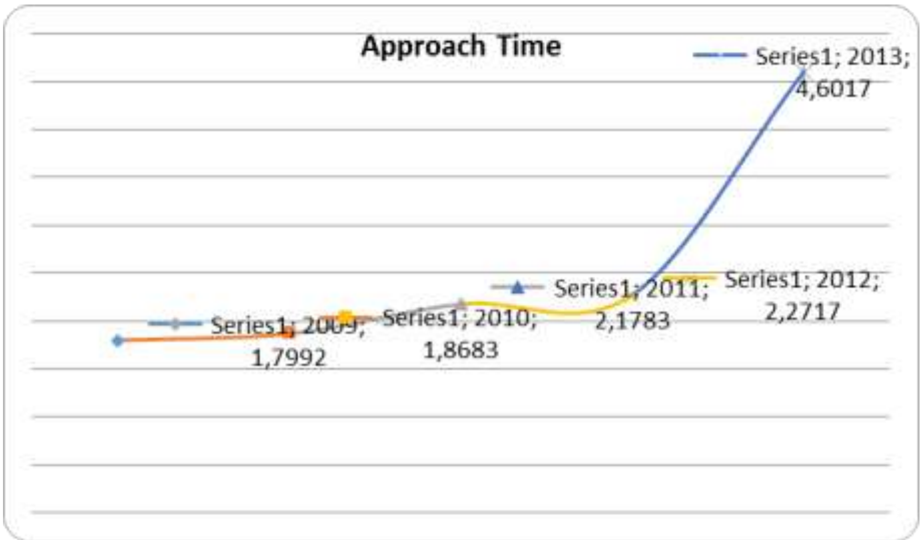


Chart 4.2 : Average Curve of Approach Time Per Year

Based on Table 4.4 and Chart 4.2 above, it shows the average approach time that increased since 2009 until 2013, in which the lowest average time was 1.7992 hours and the highest one was 4.6017 hours.

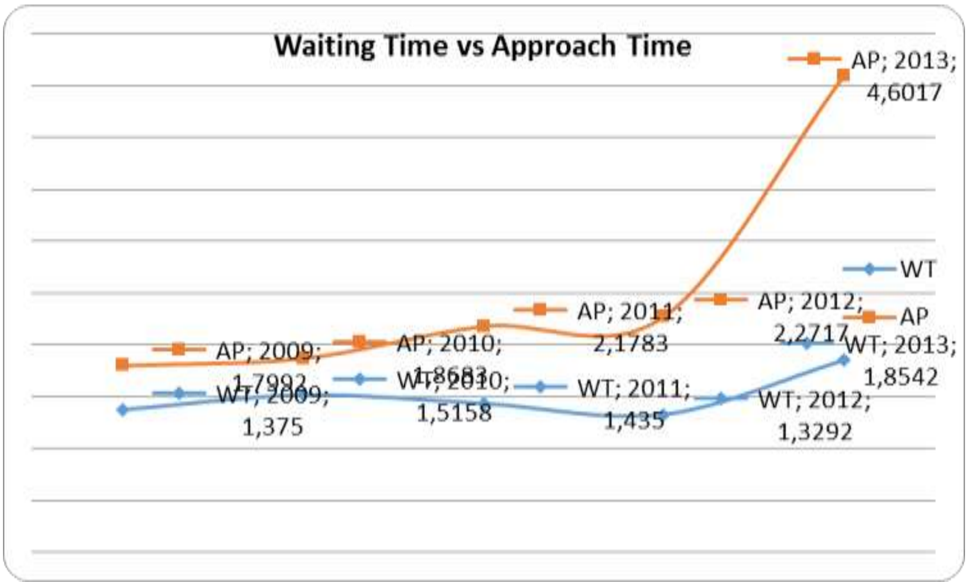


Chart 4.3 : Average Curve of WT and AP Per Year

Chart 4.3 shows the tendency that the increase of approach time is followed by waiting time, while the reduction of approach time also results in the reduction of waiting time.

4.2.3. Effective Time (X_2)

Effective Time (X_2) is the effective time that is used for loading and discharging when the ship is at quay. The description of Effective Time is as follows :

Table 4.5 : Description of Effective Time

	N	Minimum	Maximum	Mean	Std. Deviation
Effective Time	60	16,25	26,02	20,5308	1,90844

Source : Processed data

During 2009-2013 period, the average *effective time* was around 20.5308 hours with the deviation standard 1.90844 hours. *The lowest effective time* was around 16.25 hours on January 2009 and the highest *effective time*was 26.02 hours on December 2009.

Table 4.6 : Effective Time Per Year

Year	N	Mean	Std. Deviation
2009	12	20.9600	2.97957
2010	12	20.2008	1.66685
2011	12	20.1900	0.77159
2012	12	19.9333	1.28438
2013	12	21.3700	2.00745
Total	60	20.5308	1.90844

Source : Processed data

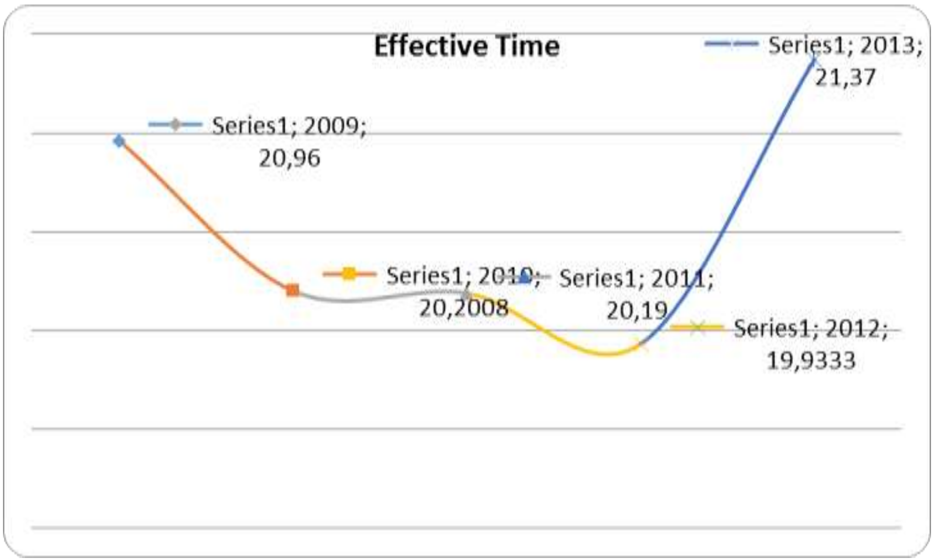


Chart 4.4 : Average Curve of Effective Time Per Year

Table 4.6 and Chart 4.4 above shows that the average effective time decreased since 2009 until 2012, while it increased in 2013 in which the lowest average time was 19.93333 hours and the highest one was 21.37 hours.

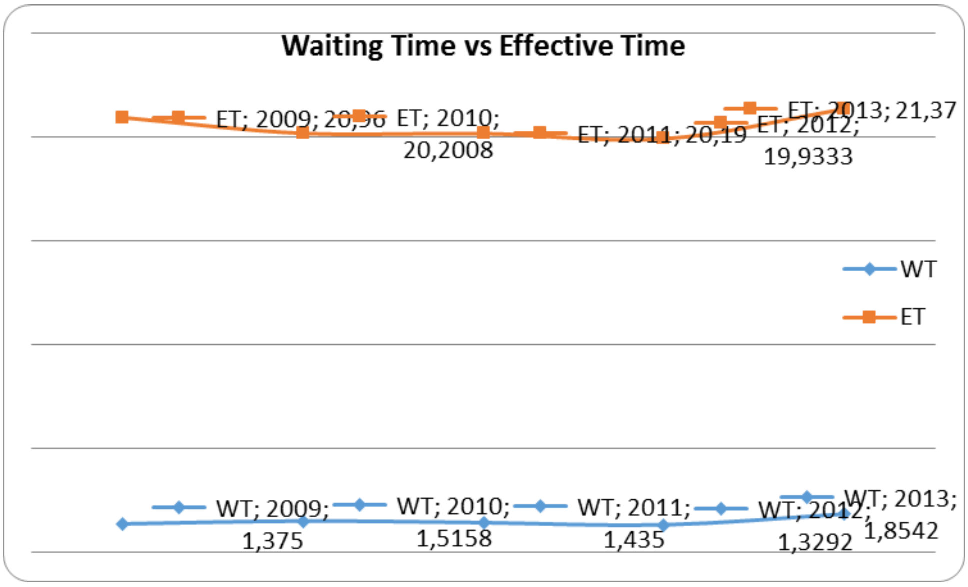


Chart 4.5 : Average Curve of WT and AP Per Year

Chart 4.5 shows the tendency that the increase of effective time is followed by waiting time, while the reduction of effective time also results in the reduction of waiting time.

4.2.4. Not Operation Time (X_3)

Not Operation Time (X_3) is the interval, the time when ship is at Tanjung Perak Port (preparation for loading and discharging and rest time). The description of Not Operation Time is as follows:

Table 4.7 : Description of Not Operation Time

	N	Minimum	Maximum	Mean	Std. Deviation
Not Operation Time	60	0.97	2,50	1,7282	0.40018

Source : Processed data

During 2009-2013 period, the average *Not Operation Time* was around 1.7282 hours with the deviation standard 0.40018 hour. *The lowest Not Operation Time* was around 0.97 hour on January 2009 and the highest *Not Operation Time*was 2.50 hours on July and November 2010.

Table 4.8 : Not Operation Time Per Year

Year	N	Mean	Std. Deviation
2009	12	1.6442	0.49550
2010	12	1.9783	0.44954
2011	12	1.5750	0.38935
2012	12	1.6325	0.30344
2013	12	1.8108	0.22064
Total	60	1.7282	0.40018

Source : Processed data

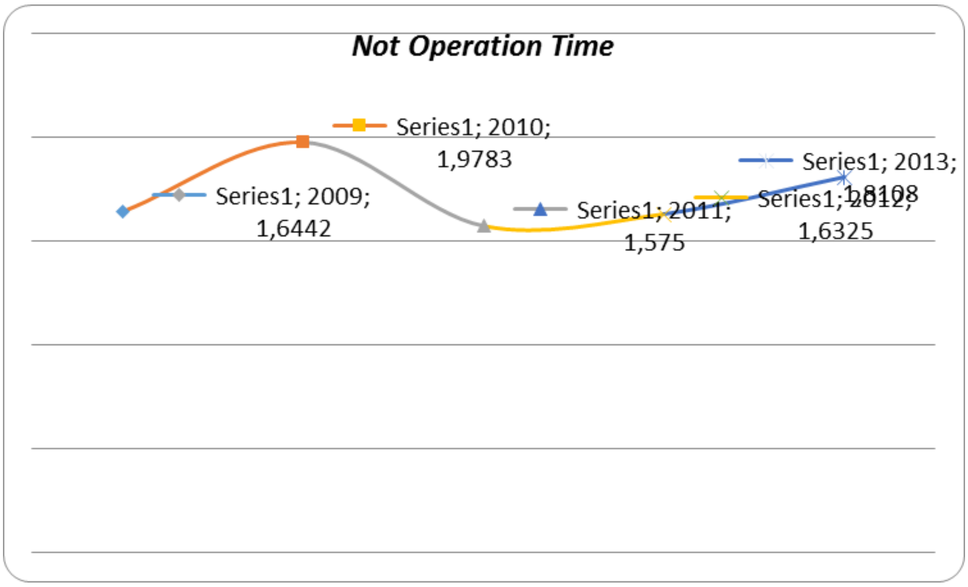


Chart 4.6 : Average Curve of Not Operation Time Per Year

Table 4.8 and Chart 4.6 above shows that the average Not Operation Time increased in 2010, but it decreased again in 2011. The average decline of Not Operation Time happened quickly since it increased again from 2012 until 2013. The lowest average Not Operation Time is 1.5750 hours and the highest one is 1.8108 hours.

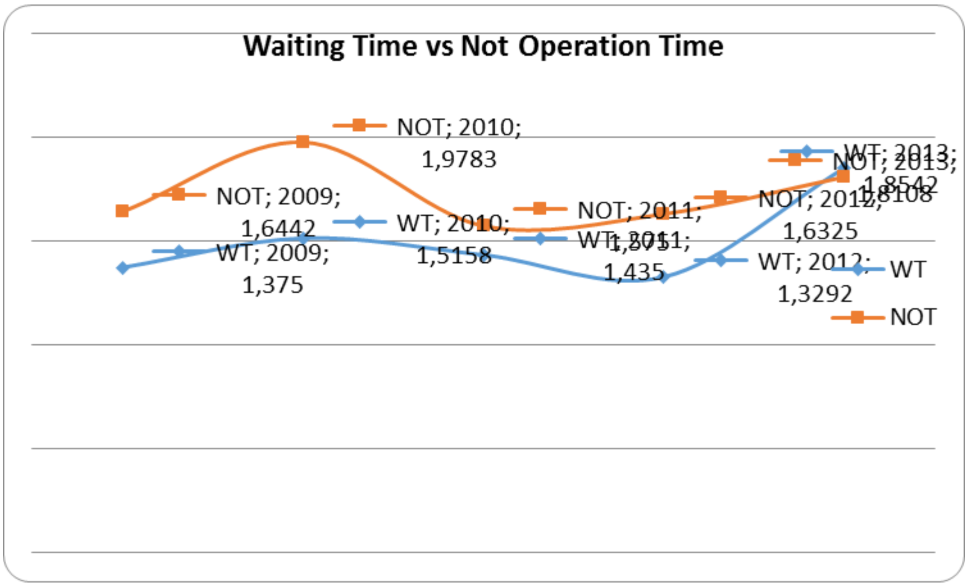


Chart 4.7 : Average Curve of WT and NOT Per Year

Chart 4.7 shows the tendency that the increase of Not Operation Time is followed by waiting time, while the reduction of Not Operation Time also results in the reduction of waiting time.

4.2.5. Weather (X_4)

Weather (X_4) is the condition of weather at port when ship arrives at port and reports its arrival. This variable is measured with dummy in which value 0 is for rain and value 1 is for fine weather. The description of weather is as follows :

Table 4.9 : Description of Weather

	Frequency	Percentage (%)
Rain	33	55
Fine	27	45
Total	60	100

Source : Processed data

During 2009-2013 period, the rain was 33 months (55%), while other 27 months was fine (45%).

4.2.6. Postpone Time (X_5)

Postpone Time (X_5) is the time that is needed by the representation of ship in document processing of ship at port. The description of Postpone Time is as follows :

Table 4.10 : Description of Postpone Time

	N	Minimum	Maximum	Mean	Std. Deviation
Postpone Time	60	2,65	8,11	5,0067	1,18222

Source : Processed data

During 2009-2013 period, the average Postpone Time was around 5.0067 hours with the deviation standard 1.18222 hours. The lowest Postpone Time was around 2.65 hours on May 2009 and the highest Postpone Time was 8.11 hours on February 2009.

Table 4.11 : Postpone Time Per Year

Year	N	Mean	Std. Deviation
2009	12	4.4767	1.53586
2010	12	4.8067	0.84774
2011	12	5.3092	1.36688
2012	12	5.3608	0.21923
2013	12	5.0800	1.38201
Total	60	5.0067	1.18222

Source : Processed data

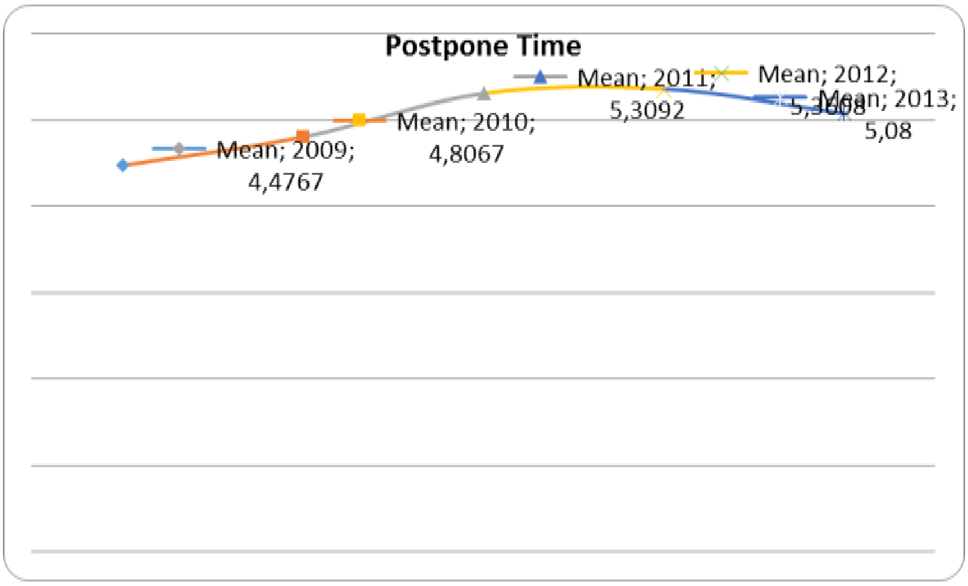


Chart 4.8 : Average Curve of Postpone Time Per Year

Table 4.11 and Chart 4.8 above shows that the average Postpone Time increased from 2009 until 2012, but it decreased again in 2013.

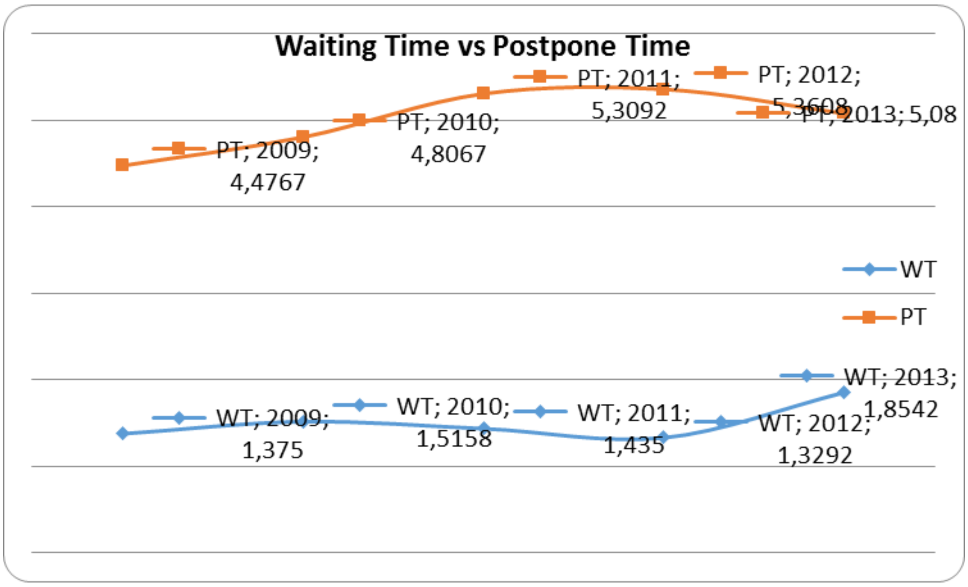


Chart 4.9 : Average Curve of WT and PT Per Year

Chart 4.9 shows the tendency that the increase of Postpone Time is followed by waiting time, while the reduction of Postpone Time also results in the reduction of waiting time.

4.2.7. Idle Time (X_6)

Idle Time (X6) is ineffective or unproductive time that is wasted when the ship is at quay due to the bad weather, broken facility for loading and discharging, unreadiness of armada of truck, and unreadiness of warehouse. The description of Idle Time is as follows :

Table 4.12 : Description of Idle Time

	N	Minimum	Maximum	Mean	Std. Deviation
Idle Time	60	2.00	6.95	4.4963	1.15009

Source : Processed data

During 2009-2013 period, the average *Idle Time* was around 4.4963 hours with the deviation standard 1.15009 hours. *The lowest Idle Time* was around 2 hours on

December 2009 and the highest Idle Time was 6.95 hours on May 2010.

Table 4.13 : Idle Time Per Year

Year	N	Mean	Std. Deviation
2009	12	4.1275	1.07803
2010	12	4.5025	1.52581
2011	12	4.1625	1.13960
2012	12	4.4392	0.58092
2013	12	5.2500	1.03673
Total	60	4.4963	1.15009

Source : Processed data

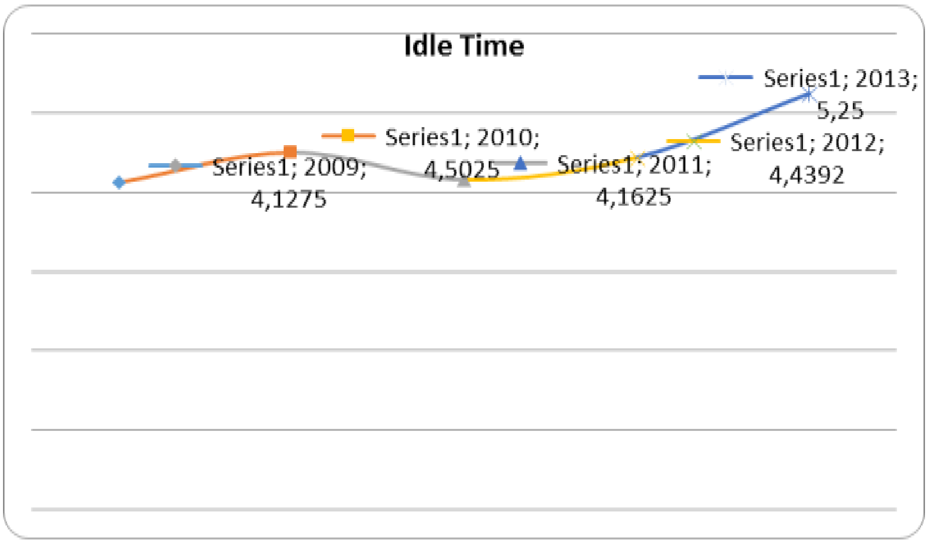


Chart 4.10 : Average Curve of Idle Time Per Year

Table 4.13 and Chart 4.10 above shows that the average Idle Time increased in 2010, 2012, and 2013, but it decreased in 2011.

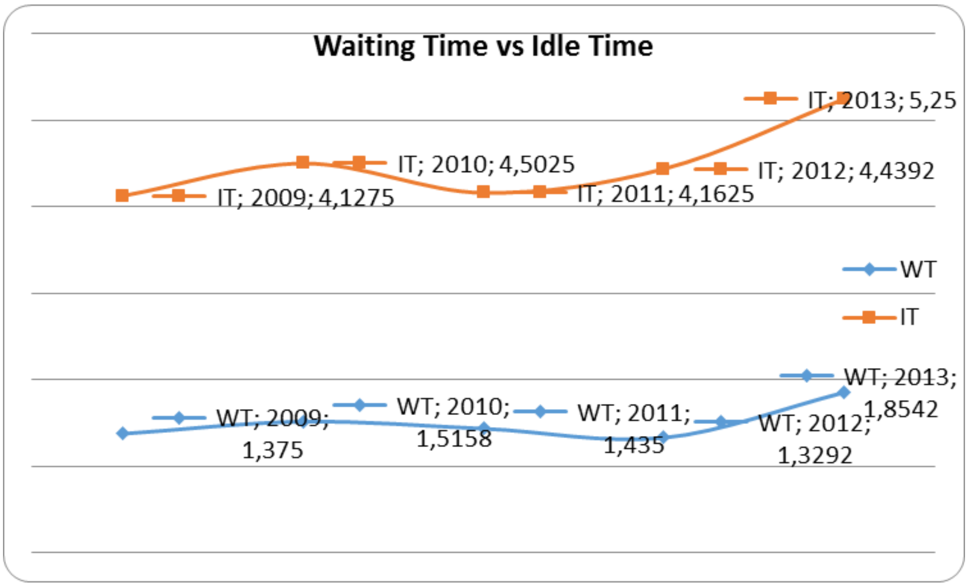


Chart 4.11 : Average Curve of WT and IT Per Year

Chart 4.11 shows the tendency that the increase of Idle Time is followed by waiting time, while the reduction of Idle Time also results in the reduction of waiting time.

4.2.8. Berth Occupancy Ratio (X_7)

Berth Occupancy Ratio (X_7) is the ratio between the use of quay and the available time (the readiness of quay to operate) in certain period that is stated in percentage. The description of Berth Occupancy Ratio is as follows :

Table 4.14 : Description of Berth Occupancy Ratio

	N	Minimum	Maximum	Mean	Std. Deviation
Berth Occupancy Ratio	60	39,22	76,39	55,6093	11,49797

Source : Processed data

During 2009-2013 period, the average Berth Occupancy Ratio was around 55.6093% with the deviation standard 11.49797%. The lowest Berth Occupancy

Ratio was around 39.22% on August 2009 and the highest Berth Occupancy Ratio was 76.39% on January 2013.

Table 4.15 : Berth Occupancy Ratio Per Year

Year	N	Mean	Std. Deviation
2009	12	47.7175	11.27698
2010	12	54.7108	11.50154
2011	12	53.2967	7.65142
2012	12	52.4967	5.24728
2013	12	69.8250	7.60740
Total	60	55.6093	11.49797

Source : Processed data

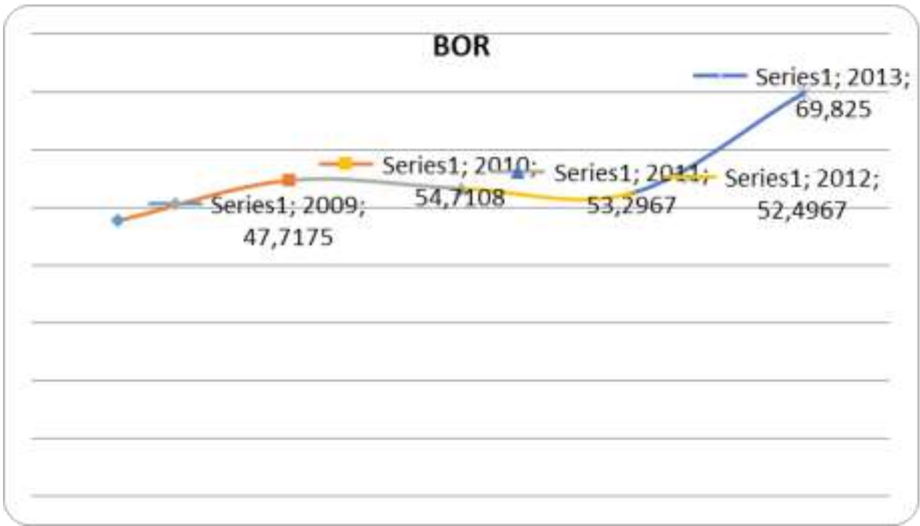


Chart 4.12 : Average Curve of BOR Per Year

Table 4.15 and Chart 4.12 above shows that the average Berth Occupancy Ratio increased in 2010, but it reduced in 2011 and 2012, then it increased again in 2013.

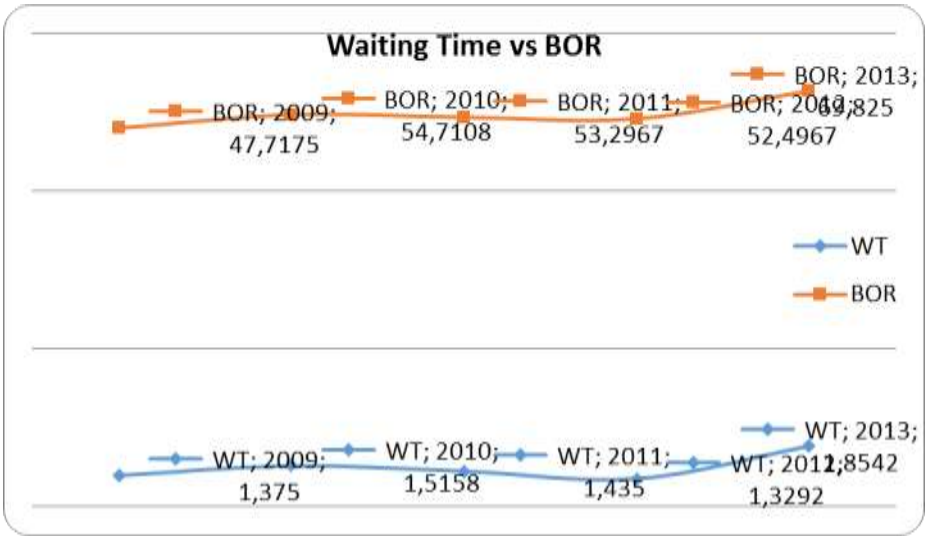


Chart 4.13 : Average Curve of WT and BOR Per Year

Chart 4.13 shows the tendency that the increase of Berth Occupancy Ratio is followed by waiting time, while the reduction of Berth Occupancy Ratio also results in the reduction of waiting time.

4.2.9. Turn Around Time (X_8)

Turn Around Time (X_8) is arrival time of ship for anchoring at quay and the arrival of ship for loading and discharging goods (Time Arrival - Time Departure). The description of Turn Around Time is as follows :

Table 4.16 : Description of Turn Around Time

	N	Minimum	Maximum	Mean	Std. Deviation
Turn Around Time	60	26.21	43.03	34.5317	4.49570

Source : Processed data

During 2009-2013 period, the average Turn Around Time was around 34.5317 hours with the deviation standard 4.49570 hours. The lowest Turn Around Time was around 26.21 hours on September 2009 and the highest Turn Around Time was 43.03 hours on June 2013.

Table 4.17 : Turn Around Time Per Year

Year	N	Mean	Std. Deviation
2009	12	31.4583	3.35869
2010	12	31.0908	4.25015
2011	12	35.0150	3.01525
2012	12	34.8425	1.54693
2013	12	40.2517	2.88168
Total	60	34.5317	4.49570

Source : Processed data

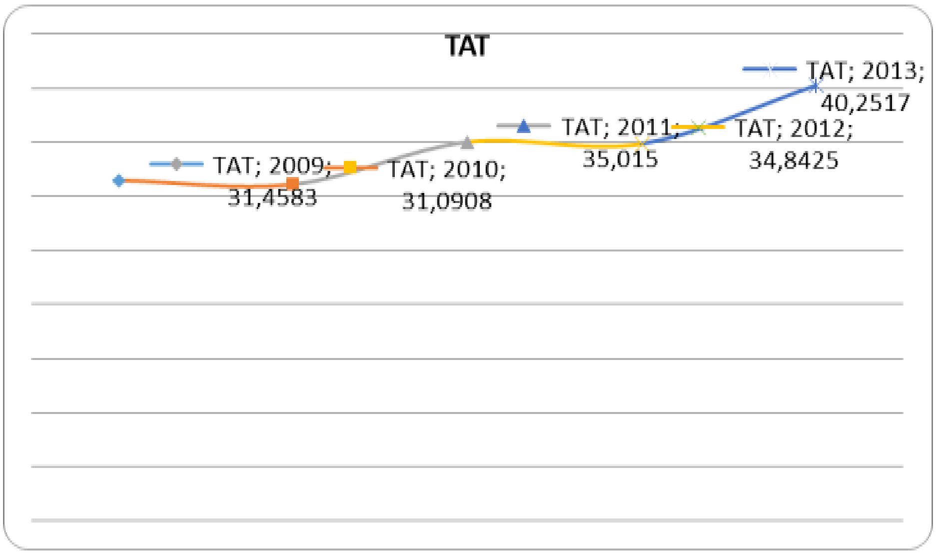


Chart 4.14 : Average Curve of TAT Per Year

Table 4.17 and Chart 4.14 above shows that the average Turn Around Time increased in 2011 and 2013, but it decreased in 2010 and 2012.

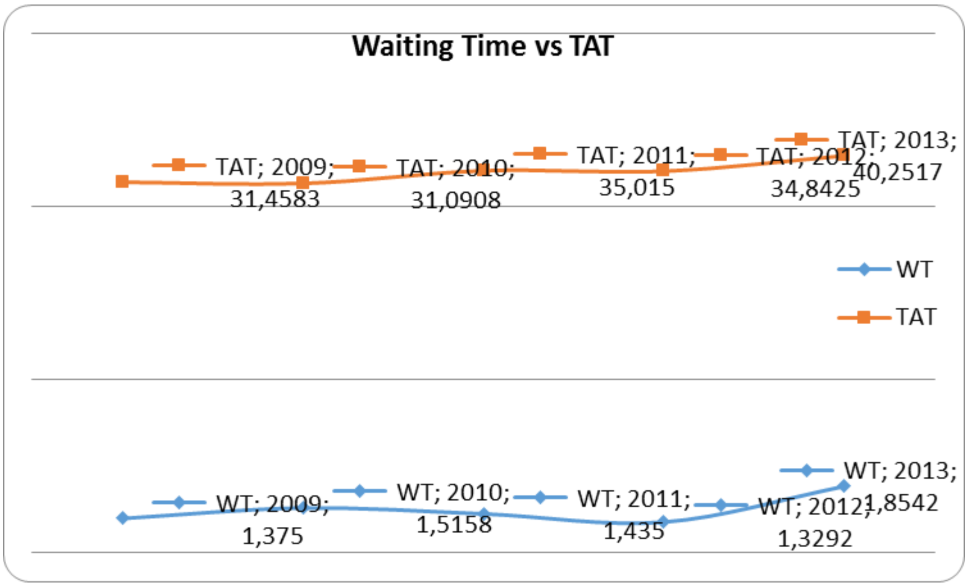


Chart 4.15 : Average Curve of WT and TAT Per Year

Chart 4.15 shows the tendency that the increase of Turn Around Time is followed by waiting time, while the reduction of Turn Around Time also results in the reduction of waiting time.

4.3. Classical Assumption Test

The classical assumption test is used to make the regression good. As the criteria for good model, there are some assumptions that must be fulfilled by data and variable. The assumption is that the variable must be normal, homoscedastic, without multicollinearity and autocorrelation. When those four requirements are fulfilled, the statistical procedure can be done by using parametric analysis.

4.3.1. Normality Test

The normality test is intended to analyze whether the tested variable has normal distribution or not. This test is conducted by considering the range of data. The data can be considered good when the distribution is normal and not too wide. In order to analyze normal distribution of data, there are some methods as follows:

1. P-P Plot

P-P plot is the used curve to analyze whether the variable is considered normal or not. Variable can fulfill the assumption of normality when P-P plot shows the relative data distribution that follows diagonal line or what is often called normal plot. Variable can fulfill the assumption of normality when P-P plot shows the relative data distribution that extends or avoids the line of normal plot.

2. Kolmogorov-Smirnov Test

Kolmogorov-Smirnov test is one of normality test that is often used due to its easiness and reliability compared than P-P plot. The method of Kolmogorov-Smirnov test is the use of SPSS in which the significance value from Kolmogorov-Smirnov table must be above standard error 0.05 or 5%. When the significance value is above standard error 0.05, it can be said that the data of a variable have the normal distribution.

This is the result of P-P plot and Kolmogorov-Smirnov test from the used variable in the research:

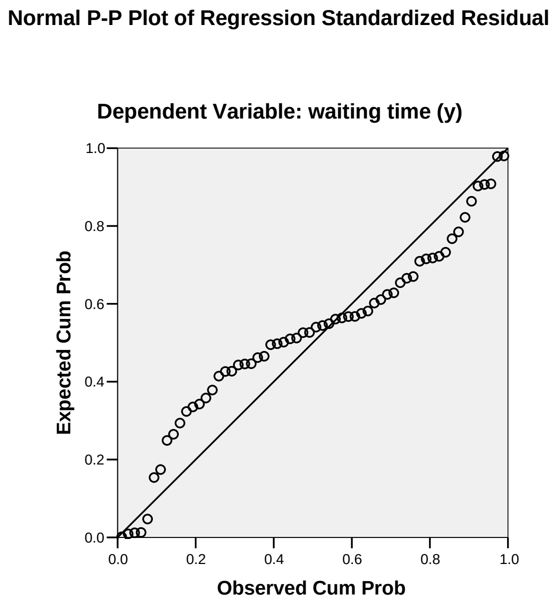


Chart 4.16 : P-P Plot

Chart 16 above shows that the graphic of normal plot shows the spreading spot around the diagonal line and the distribution follows the direction of diagonal line. Thus, the residual distributes normally and the variable of approach time, effective time, not operation time, weather, postpone time, idle time, BOR, turn around time, and waiting time distribute normally.

Table 4.18 : Result of Kolmogorov-Smirnov Test

Variable	*Kolmogorov Smirnov*	Sig
Residual	1,224	0,100

Source : Processed data

Kolmogorov-Smirnov test above shows the significance from all variables around 0.100 in which the value is above the limit_(standard error), 0.05 or 5%. It shows that the data of tested variable has the normal distribution and it can be continued for other classical assumption tests.

4.3.2. Heteroscedasticity Test

The purpose of heteroscedasticity is to analyze whether a linear model has difference of variance from residual of an observation to another observation or not. The indication of heteroscedasticity can be observed from the differences among the variance of residual from every free variable. In order to detect the indication of heteroscedasticity, rank spearman test and scatter plot graphic can be used.

Rank spearman test can be done by using SPSS with the regression of all free variables on residual value. If there is the effect of free variable that is significant (Sig < 0.05), it can be said that there is the problem of heterocedastisity. In order to analyze whether there is a signs of heterocedastisity or not, the significance of every variable can be used by regressing of variance of residual from every free variable. When the value of significance of table from every free variable is above 0.05, it can be said that there is no indication of heterocedastisity or homoscedastis. When the value of significance of table from every free variable is below 0.05, it can be said that there is indication of heteroscedastic.

Table 4.19 : Result of Rank Spearman Test

Free Variable	Correlation of Rank Spearman	Sig
Approach Time (X_1)	-0,119	0,366
Effective Time (X_2)	-0,098	0,455
Not Operation Time (X_3)	-0,053	0,690
Weather (X_4)	-0,103	0,431
Postpone Time (X_5)	0,039	0,770
Idle Time (X_6)	-0,100	0,445
BOR (X_7)	-0,106	0,419
Turn Around Time (X_8)	-0,019	0,888

Source : Processed data

Based on the table above, the value of significance from every free variable shows the value that is above 0.05 (5%). It shows that there is no sign of heteroscedastic among free variables that will be analyzed, so the data are homoscedastic. Another method to test heteroscedastic is scatter plot test in which the graphic of scatter plot is made by entering the dependent variable (zpred) on axis x and residual from every dependent variable (sresid) on axis y. When the distribution of data is random and it does not form specific pattern, it can be said that there is the sign of heteroscedastic in the analyzed free variable. When there is accumulating pattern of data during scatter plot test and it forms a specific pattern, it can be said that the data experience sign of heteroscedastic.

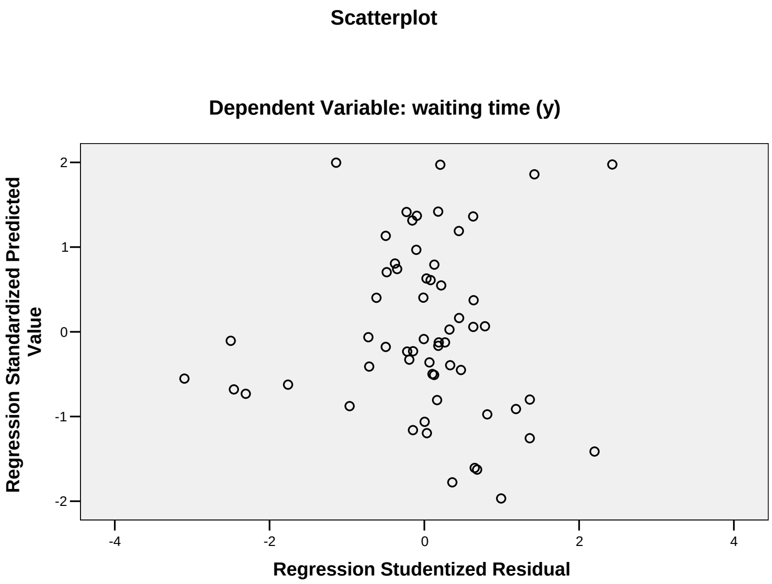


Chart 4.17 : Scatter

The Chart 17 above shows that the data of free variable that are analyzed spread randomly (between 0 on axis Y) and they do not form specific pattern. It can be said that there is indication of heteroscedastic in the free variable.

4.3.3. Multicollinearity Test

The multicollinearity test can be known by using Variance Inflating Factor (VIF) test. VIF test is one of easy methods of testing in analyzing the multicollinearity of data. In order to analyze the indication of multicollinearity, the t value and VIF can be observed when t value (tolerance) is above 0.1 and VIF value is below 10. It can be said that there is no multicollinearity among the analyzed variable and vice versa.

Table 4.20 : Result of Multicollinearity Test

Variable	VIF
Approach Time (X_1)	2,474
Effective Time (X_2)	1,176

Not Operation Time (X_3)	1,197
Weather (X_4)	1,450
Postpone Time (X_5)	1,195
Idle Time (X_6)	1,302
BOR (X_7)	2,375
Turn Around Time (X_8)	2,211

Source : Processed data

The multicollinearity test above shows that VIF of every variable is above 10, so every variable is free of multicollinearity.

4.3.4. Autocorrelation Test

The autocorrelation test is intended to analyze whether there is correlation between the error on t period and error on previous period (t-) in a regression model or not. The autocorrelation test is done by using Durbin-Watson test or D-W test. The result of Durbin Watson test is shown on table below:

Table 4.21 : Result of Durbin-Watson Test

Model Summary[b]

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Durbin-Watson
1	.921[a]	.848	.824	.11231	1.912

a. Predictors: (Constant), Turn Around Time (x8), cuaca (x4), postpone time (x5), effective time (x2), not operation time (x3), idle time (x6), BOR (x7), approach time (x1)

b. Dependent Variable: waiting time (y)

Source : Processed data

Value of dU and dL on Durbin Watson table is as follows:

n = 60

k = 8

dL = 1.2976 4-dL = 2.7024

dU = 1.8939 4-dU = 2.1061

Based on Table 4.21, it is known that the value of Durbin-Watson is 1.912. The value of DW is between 1.8939 and 2.1061, so there is no problem of autocorrelation on the regression model (the absence of autocorrelation).

4.4. Multiple Linear Regression Analysis

4.4.1. Equation of Multiple Linear Regression

Multiple linear regression test was conducted on the variables of *approach time* (X_1), *effective time* (X_2), *not operation time* (X_3), weather (X_4), *postpone time* (X_5), *idle time* (X_6), BOR (X_7) and *turn around time* (X_8) on*waiting time* (Y) that is presented in the table below :

Table 4.22 : Result of Multiple Linear Regression Test

Variable	Unstandardized coefficients	
	B	Std.error
Constant	-0,315	0,200
Approach Time (X_1)	0,058	0,021
Effective Time (X_2)	0,018	0,008
Not Operation Time (X_3)	0,134	0,040
Weather (X_4)	0,170	0,035
Postpone Time (X_5)	0,033	0,014
Idle Time (X_6)	0,038	0,015
BOR (X_7)	0,005	0,002
Turn Around Time (X_8)	0,011	0,005

Source: Appendix of SPSS

Based on the result of Table 4.22 above, the equation to form the linear regression model can be found on table of unstandarized coefficient on column B. Based on the result of analysis, the linear regression model can be formed as follows :

$$\mathbf{Y = -0.315 + 0.058\, X_1 + 0.018\, X_2 + 0.134\, X_3 + 0.170\, D_1 + 0.033\, X_5 + 0.038\, X_6 + 0.005\, X_7 + 0.011\, X_8}$$

Description :

X1 : approach time

X2 : effective time

X3 : not operation time

X4 : weather

X5 : postpone time

X6 : idle time

X7 : BOR

X8 : turn around time

Based on the result of multiple linear regression above, there are some aspects that must be explained as follows:

1. Value of regression coefficient of *approach time* (X_1) 0.058 has the definition that every increase of 1 hour from *approach time* (X_1) will influence the increase of *waiting time* (Y) 0.058 hour with the assumption that other variables are constant.
2. Value of regression coefficient of *effective time* (X_2) 0.018 has the definition that every increase of 1 hour from *effective time* (X_2) will influence the increase of waiting time (Y) 0.018 hour with the assumption that other variables are constant.
3. Value of regression coefficient of *not operation time* (X_3) 0.134 has the definition that every increase of 1 hour from *not operation time* (X_3) will influence the increase of waiting time (Y) 0.134 hour with the assumption that other variables are constant.

4. Value of regression coefficient of *postpone time* (X_5) 0.033 has the definition that every increase of 1 hour from *postpone time* (X_5) will influence the increase of waiting time (Y) 0.033 hour with the assumption that other variables are constant.
5. Value of regression coefficient of *idle time* (X_6) 0.038 has the definition that every increase of 1 hour from *idle time* (X_6) will influence the increase of waiting time (Y) 0.038 hour with the assumption that other variables are constant.
6. Value of regression coefficient of BOR (X_7) 0.005 has the definition that every increase of 1 hour from *BOR* (X7) will influence the increase of waiting time (Y) 0.005 hour with the assumption that other variables are constant.
7. Value of regression coefficient of *turn around time* (X_8) 0.011 has the definition that every increase of 1 hour from *turn around time* (X_8) will influence the increase of waiting time (Y) 0.011 hour with the assumption that other variables are constant.

4.4.2. Hypothesis Testing

In order to prove the effect of *approach time* (X_1), *effective time* (X_2), *not operation time* (X_3), weather (X_4), *postpone time* (X_5), *idle time* (X_6), BOR (X_7) and *turn around time* (X_8) on waiting time (Y) partially and simultaneously, the hypothesis test is conducted.

1. f-Test

This test was conducted by using distribution test of F by comparing the significance value of F-count with 0.05. If the result of sig. F-count is below (<) 0.05, it can be said that the free variable influences the bound variable together, the condition is different for sig. The F count above (>) 0.05 is determined as free variable simultaneously and it does not affect the bound variable. The result of F test is shown on table below :

Table 4.23 : Result of f-test

ANOVA[b]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	3.594	8	.449	35.612	.000[a]
	Residual	.643	51	.013		
	Total	4.237	59			

a. Predictors: (Constant), Turn Around Time (x8), cuaca (x4), postpone time (x5), effective time (x2), not operation time (x3), idle time (x6), BOR (x7), approach time (x1)

b. Dependent Variable: waiting time (y)

Source : Processed data

From the table above, it is known that the value of F count is 35.162 and sig. is 0.000 when it is compared with 0.005, it can be known that the variables of *approach time* (X_1), *effective time* (X_2), *not operation time* (X_3), weather (X_4), *postpone time* (X_5), *idle time* (X_6), BOR (X_7) and *turn around time* (X_8) affects the variable of *waiting time* (Y) simultaneously.

2. The value of determination coefficient (R^2)

Determination coefficient is used to analyze the ability of free variable to explain the bound variable. The determination coefficient has the value of 0 until 1. When the value of coefficient of determination is almost 1, it can be said that the free variable gives the information that can predict bound variable. The table below is the result of analysis of coefficient of determination.

Table 4.24 : The Result of Coefficient of Determination

Model Summary[b]

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Durbin-Watson
1	.921[a]	.848	.824	.11231	1.912

a. Predictors: (Constant), Turn Around Time (x8), cuaca (x4), postpone time (x5), effective time (x2), not operation time (x3), idle time (x6), BOR (x7), approach time (x1)

b. Dependent Variable: waiting time (y)

Source : Processed data

Based on the result of calculation of coefficient of determination, the value is 84.8%; it shows that the variables of *approach time* (X_1), *effective time* (X_2), *not operation time* (X_3), weather (X_4), *postpone time* (X_5), *idle time* (X_6), BOR (X_7) and *turn around time* (X_8) in explaining or affecting the variable of waiting time 84.8% and the rest is 15.2% is explained by other variables that are not discussed in this research.

3. t-Test

The purpose of this t test is to analyze the effect of free variable on bound variable partially. A free variable has partial effect on bound variable when it has the significance (<) 0.05, while the free variable does not have effect on bound variable partially when the significance value is higher than (>) 0.05. The result of t test is shown on table below :

Table 4.25 : Result of t-Test

Variable	t	Sig.
Approach Time (X_1)	2,760	0,008
Effective Time (X_2)	2,184	0,034
Not Operation Time (X_3)	3,356	0,001
Weather (X_4)	4,849	0,000
Postpone Time (X_5)	2,463	0,017
Idle Time (X_6)	2,614	0,012
BOR (X_7)	2,400	0,020
Turn Around Time (X_8)	2,334	0,024

Source : Processed data

The explanation of table above is as follows :

a. Approach Time (X_1)

Based on the table of t test above on column t, the value of t-count is 2.270 with the significance value 0.008. The significance value is less than 0.050 and its shows the positive effect that is significant between approach time and waiting time partially.

b. Effective Time (X_2)

Based on the table of t test above on column t, the value of t-count is 2.148 with the significance value 0.034. The significance value is less than 0.050 and its shows the positive effect that is significant between effective time and waiting time partially.

c. Not Operation Time (X_3)

Based on the table of t test above on column t, the value of t-count is 3.356 with the significance value 0.001. The significance value is less than 0.050 and its shows the positive effect that is significant between not operation time and waiting time partially.

d. Weather (X_4)

Based on the table of t-test above on column t, the value of t-count is 4.849 with the significance value 0.000. The significance value is less than 0.050 and its shows the positive effect that is significant between weather and waiting time partially.

e. Postpone Time (X_5)

Based on the table of t test above on column t, the value of t-count is 2.463 with the significance value 0.017. The significance value is less than 0.050 and its shows the positive effect that is significant between postpone time and waiting time partially.

f. Idle Time (X_6)

Based on the table of t test above on column t, the value of t-count is 2.614 with the significance value 0.012. The significance value is less than 0.050 and its shows the positive effect that is significant between idle time and waiting time partially.

g. Berth Occupancy Ratio (X_7)

Based on the table of t test above on column t, the value of t-count is 2.400 with the significance value 0.020. The significance value is less than 0.050 and its shows the positive effect that is significant between BOR and waiting time partially.

h. Turn Around Time (X_8)

Based on the table of t test above on column t, the value of t-count is 2.334 with the significance value 0.024. The significance value is less than 0.050 and its shows the positive effect that is significant between turn around time and waiting time partially.

4. Value of r^2partial

The value of r^2partial from every free variable is as follows :

Table 4.26 : Value of r^2partial

Variable	value of r-partial	value of r^2partial
Approach Time (X_1)	0,361	13,03%
Effective Time (X_2)	0,292	8.53%
Not Operation Time (X_3)	0,425	18,06%
Weather (D1)	0,562	31,58%
Postpone Time (X_5)	0,326	10.63%

Idle Time (X_6)	0,344	11,83%
BOR (X_7)	0,319	10.18%
Turn Around Time (X_8)	0,311	9,67%

Source : Processed data

Variable with value of the highest r^2partial is weather with the percentage 31.58%, while the variable with the lowest value of ^{2}partial is *effective time* with percentage 8.53%.

Chapter 5
SOLVING THE MODEL AND ANALYZING THE RESULT

5.1. The Effect of *Approach Time* toward *Waiting Time*

The result of the research on approach time showed that, in 2009, the mean of approach time was 1.7992 hours, while the mean of waiting time was 1.3750 hours. In 2010, the mean of approach time and waiting time increased, while, in 2011 and 2012, waiting time decreased and approach time increased. In the next year, the mean of approach time and waiting time showed another uplift; approach time increased to 4.6017 hours and waiting time increased to 1.8542 hours. In accordance with the current situation, almost all ports in Indonesia, especially major ports experience maritime pilot shortage. Surabaya's Tanjung Perak Port as the second biggest port in Indonesia is one of the examples of how the shortage automatically results in the overwork of the pilots by which each one of them have to guide too many ships. Of course, this will lead to a longer time for a ship to get a pilot. The other factors that contribute to the high value of approach time are the time needed by a pilot with his pilot boat to reach the designated ship, which needs to be guided, and the geographical conditions of Tanjung Perak Port, which has so many coral reefs and underwater power cables, making ships cannot maneuver freely and swiftly, so they need highly qualified and skilled pilots. The longer the berthing time, the longer the waiting time for each ship in a queue. It is, therefore, can be deduced that the increase of approach time will be followed by the increase of waiting time, or, conversely, the decrease of approach time will be followed by the decrease of waiting time.

From the above description that is supported by the result of t test (partial test), t-count resulted in value 2.270 with significance value 0.008 and r^2 partial value 13.03%. With significance value less than 0.050, it partially shows that there is a significant positive influence between approach time toward waiting time, which also means that the increase of approach time has real effect on the increase of waiting time.

5.2. The Effect of *Effective Time* toward *Waiting Time*

The result of the research on effective time showed that, in 2009, the mean of effective time was 1.7992 hours, while the mean of waiting time was 1.3750 hours. Since 2010 until 2012, the mean of effective time and waiting time decreased, while, in 2013, waiting time and effective time increased. The problem of time for (high value) loading and discharging time in Tanjung Perak Port is heavily caused by several factors, such as limited number of cranes and high congesty at port. Ideally, one ship should be served by two cranes. However, since the number of cranes is limited, one ship is only served by one crane, so the time for loading and discharging is longer. Moreover, high congesty at port hampers the circulation of trucks. Smooth circulation is needed, otherwise it will result in longer loading and discharging time and, furthermore, creates long queue and augmentation of waiting time value. Although effective time is the most insignificant factor among the other seven factors, it still has some effects toward the waiting time of ship in which the increase of effective time will be followed by the increase of waiting time, or, conversely, the decrease of effective time will tend to lead to the decrease of waiting time.

From the above description that is supported by the result of t test (partial test), t-count resulted in value of 2.184 with significance value of 0.034 and r^2 partial value of 8.53%. With significance value less than 0.05, it partially shows that there is a significance positive influence between effective time and waiting time, which also means that the increase of effective time has real impact on the increase of waiting time.

5.3. The Effect of *Not Operation Time* toward *Waiting Time*

The result of the research on not operation time showed that, in 2009, the mean of approach time was 1.6442 hours, while the mean of waiting time was 1.3750 hours. In 2010, the mean of not operation time and waiting time increased. In 2011 and 2012, waiting time decreased, while not operation time increased in 2012. In the next year, the mean of not operation time and waiting time increased. The total lost time caused by the preparation of loading and discharging or rest time commonly happened in all Indonesian ports, including in Tanjung Perak Port. This, of course, results in the increase of not operation time, which will be definitely entailed by the increase of waiting time at ports, or, conversely, every reduction of not operation time will be certainly followed by the reductions of waiting time.

From the above description that is supported by the result of t test (partial test), t-count resulted in value of 3.356 with significance value of 0.001 and r^2 partial value of 18.06%. With significance value less than 0.050, it partially showed that there is a significant positive effect between not operation time and waiting time, which also means that the increase of not operation time has real effect on the increase of waiting time.

5.4. The Effect of *Weather* toward *Waiting Time*

Since 2009 until 2013, the days were mostly rainy; about 33 months (55%), while the other 27 months (45%) were sunny days. As the most dominant factor among the other seven factors, weather condition will certainly affect the activities in ports, including loading and discharging activities especially the ones related to the problem of loading and discharging speed. In sunny days, generally, there are no significant constraints or obstacles in the loading and discharging activities. It will be different if the weather is not so good, e.g. rainy days, which is usually followed by storms and high tides. Bad weathers will make it difficult for ships to maneuver or move when berthing; this may endanger the loads, the crews, and the ships. Almost always, there will be delays if bad weathers strike, forcing many ships, which try to berthing, to re-anchorage until the weather goes back to normal. This condition will directly contribute to the increase of ships' waiting time in ports. Problems might also happen in the land around the port. Rainfall can make puddles around the main gate of the port that can hamper the circulation of trucks in and out of the ports, creating congesty both inside and outside. This can further contribute to truck shortage inside the ports because too many trucks are impeded outside the main gate. Loading and discharging activities will not run smoothly. It will also take more time for berthing, which at the end makes a longer waiting time for every ship.

The problems caused by weather factor take part in the high waiting time in the Tanjung Perak Ports. Supported by the result of multiple linear regression analysis, particularly on t test, the value of t-count was 4.849 with significance value 0.000 and r^2 partial value of 31.58%. With significant value less than 0.050, it partially shows that there is a significant positive effect between weather and waiting time. In other words, there is differences in waiting time between sunny days and rainy days where the mean of waiting time on rainy days is 1.3721 hours and the mean of waiting time on sunny days is 1.6604 hours.

5.5. The Effect of *Postpone Time* toward *Waiting Time*

The result of the research on postpone time shows that, in 2009, the mean of postpone time was 4.4767 hour, while the mean of waiting time was 1.3750 hour. Since 2010 until 2012, the mean of postpone time increased, while the mean of waiting time decreased in 2011 and 2012. In the next year, the mean of postpone time decreased and waiting time increased. A complete documents must be prepared by ships operators or assigned shipping companies (shipper). Long bureaucracy process at port, which involves so many port's jurisdictions (Port Authority, Quarantine Agency, Harbormaster, and Port Operator), is one of the main time-consuming causes and contributes to the longer waiting time needed by ships at ports. There is a tendency on how the increase of postpone time will lead to reduction of waiting time, or, conversely, if postpone time increases, then waiting time tends to increase.

From the above description that is supported by the result of t test (partial test), t-count resulted in value of 2.463 with significance value of 0.017 and r^2 partial value of 10.63%. With significance value less than 0.050, it partially shows that there is a significance positive influence between postpone time toward waiting time , which also means that the increase of postpone time has real impact on the increase of waiting time.

5.6. The Effect of *Idle Time* toward *Waiting Time*

The result of the research on idle time showed that, in 2009, the mean of idle time was 4.1275 hours, while the mean of waiting time was 1.3750 hours. In 2010, the mean of idle time and waiting time increased. In 2010 and 2012, the result showed another divergence in which the mean of waiting time decreased, while idle time increased. In the next year, the mean of idle time and waiting time increased. As what often happened at port, there are problems caused by the cranes in which its usage are often not well-prepared. The limited number of cranes -because some of them are old or broken, so there is high idle time at port. Another factor, which also contributes to high idle time in port, is the unprepared storage. It is often caused by its limited number and unprofessional consignees. Unprofessional consignees often do not prepare their storage earlier before the cargoes arrive, hampering the process of discharging. Moreover, there are often some fictitious reports about the availability of the storage, which cause more problems in the Tanjung Perak storage facility. Fictitious availability of storage and trucks represents how the facilities in port are managed in unprofessional ways, hindering smooth loading and discharging activities in which the loads cannot be moved immediately from the ships and carried to the storage.

The limited availability of trucks and congesty factors at port also disturbs the trucks' rotation inside the port. As showed by the result of the research, increase of idle time are always followed by the increase of waiting time. Conversely, if idle time decreases, it also happens on waiting time.

From the above description that is supported by the result of t test (partial test), t-count resulted in value of 2.614 with significance value of 0.012 and r^2 partial value of 11.83%. With significance value less than 0.050, it partially shows that there is a significant positive influence between idle time toward waiting time, which also means that the increase of idle time has real effect on the increase of waiting time.

5.7. The Effect of *Berth Occupancy Ratio* toward *Waiting Time*

The result of the research on berth occupancy ratio showed that, in 2009, the mean of berth occupancy ratio was 47.7175% and the mean of waiting time was 1.3750 hours. In 2010 and 2011, the mean of berth occupancy ratio increased. Its mean value decreased in 2012 and increased again in 2013. The mean of waiting time in 2010 and 2013 showed the increase, despite of its decline in 2011 and 2012. The goods and ships flow, which tends to increase every year in Tanjung Perak Port will create the increase of Berth Occupancy Ratio, thus it will result in long ships' queue to enter the port for berthing. Further consequence will be longer waiting time for each ship in the queue. The increase of berth occupancy ratio will almost certainly be followed by the increase of waiting time, or, conversely, the reduction of berth occupancy ratio will lead to the reduction of waiting time also.

From the above description that is supported by the result of t test (partial test), t-count resulted in value of 2.400 with significance value of 0.020 and r^2 partial value of 10.18%. With significance value less than 0.050, it partially shows that there is a significant positive effect between BOR and waiting time , which also means that the increase of BOR has real effect on the increase of waiting time.

5.8. The Effect of *Turnaround Time* toward *Waiting Time*

The result of the research on turn around time showed that, in 2009, the mean of turnaround time was 31.4583 hours, while the mean of waiting time was 1.3750 hours. In 2010 and 2012, the mean of turn around time decreased, while, in 2011 and 2013, the mean of turn around time increased. The mean of waiting time in 2010 and 2013 showed another increase, despite of its decline in 2011 and 2012. In general, the increase of turn around time tends to lead to the increase of waiting time. If the turn around time decreases, the waiting time tends to decline as well.

From the above description that is supported by the result of t test (partial test), t-count resulted in value of 2.334 with significance value of 0.024 and r^2 partial value of 9.67%. With significance value less than 0.050, it partially shows that there is a significant positive effect between turn around time and waiting time, which also means that the increase of turn around time has real effect on the increase of waiting time.

Chapter VI
CONCLUSION, SUGGESTION, AND RECOMMENDATION

6.1. Conclusion

Based on the multiple linear regression analysis, it can be concluded as follows :

1. The variables of Approach Time (X_1), Effective Time (X_2), Not Operation Time (X_3), Weather (X_4), Postpone Time (X_5), Idle Time (X_6), Berth Occupancy Ratio (X_7) and Turn Around Time (X_8) simultaneously and significantly influence the variable of Waiting Time (Y).

2. The ability of variables of Approach Time (X1), Effective Time (X2), Not Operation Time (X3), Weather (X4), Postpone Time (X5), Idle Time (X6), Berth Occupancy Ratio (X7) and Turn Around Time (X8) in explaining or giving influences on waiting time variable (Y) is 84.8% and the rest (about 15.2%) are explained by the other variables, which are not discussed in this research.

3. The variables of Approach Time (X1), Effective Time (X2), Not Operation Time (X3), Weather (X4), Postpone Time (X5), Idle Time (X6), Berth Occupancy Ratio (X7) and Turn Around Time (X8) partially give positive and significant affect the variable of waiting time (Y).

4. Variable that has the highest r^2 partial value is weather variable (31.58%), while variable that has the lowest r^2 partial value is effective time variable (8.53%).

6.2. Suggestion

1. The waiting time of ship is a common problem faced by ships for berthing at a port. This is especially true for ports with high intensity of ship arrivals and goods circulations. Tanjung Perak Port in Surabaya is one of the examples of busy port in Indonesia and actually the second biggest and busiest ports in the country after Tanjung Priok Port in Jakarta. This research is aimed to analyze the waiting time problems by examining the factors that can directly affect its length and in order to achieve solutions to optimize the waiting time. In reality, from the result of this research, it proves that many factors cause the waiting time of ship at port. They are: Approach Time, Effective Time, Not Operation Time, Weather, Postpone Time, Idle Time, Berth Occupancy Ratio, and Turn Around Time. Based on those factors, serious attention from the competent people is needed, particularly to continuously and specifically revamp the dominant factors that increase waiting time in Tanjung Perak Port. One of those most dominant factors is weather. As a natural factor, we cannot control the weather, but we can predict and take preventive actions to deal with direct and indirect impacts from bad weathers.

2. To optimize the solutions for the waiting time problems in Tanjung Perak Port, the first step should be to minimize or suppress its causal factors.

3. The lack of pilots and their service should be anticipated by establishing more vocational schools for pilot services and, at the same time, improving the quality of maritime pilots.

4. Port infrastructure should get more attention too, especially repairing the machines and building more complete facilities (such as storage, container yards, and berth areas inside and outside ports). The quality of path to the port should be improved to prevent problems caused by puddle and to reduce the congesty.

5. A review or more intensive research, however, is needed to qualitatively research the problems above, thus a more effective solutions can be found to reduce the problems at port, especially the ones related to the waiting time of ship.

6.3. Recommendation

1. Online One Stop Service and direct service are also needed at port to make the document handling process shorter, centralized, and straightforward; cutting the bureaucracy procedures and establishing good coordination between service users and stakeholders at ports.

2. The trucks traffic inside and outside the port can cause congesty. This may lead to problem in which trucks are stuck at port's gate. It, therefore, needs additional gates to expedite the truck movements in and out the port.

3. Loading and discharging equipment, such as crane, in ports are still limited and some of them are even old. This condition may provoke disturbance and possibly lower the productivity of cargo's loading and discharging activities at port. Thereby, rejuvenation of old equipment and addition of new port equipment are needed, including cranes.

4. Another means, which can help to eliminate obstacles for ship trying to anchor at a port for berthing, is by removing underwater power cables that lie on shipping line.

5. The government as the port regulator, in this case the Port Authority of Tanjung Perak Port in Surabaya, needs to make special regulations regarding Standard Operational Procedure (SOP), which regulate the loading and discharging activities. This should include the specific rules

to regulate the duration of rest time and work shift designed ideally for loading and discharging crews (gangs) and crane operators. The new set of rules should also regulate the assurance of storage readiness and available trucks to transport the loads. Direct or physical checking on storage and trucks readiness, in this case, is also needed to be done before granting permission to loading and discharging. An SOP is expected to reduce the time spent by the operators and crews in rest time and work shift and to improve the effectiveness of loading and discharging activities.

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Appendix 1

RAW DATA

	Month	Year	Y	X1	X2	X3
1	January	2009	1,38	1,72	16,25	0,97
2	February	2009	1,66	2,82	18,25	2,35
3	March	2009	1,49	1,89	24,36	2,11
4	April	2009	1,4	1,43	18,11	1,69
5	May	2009	1,17	1,58	23,66	1,01
6	June	2009	1,2	1,74	21,98	1,98
7	July	2009	1,65	1,72	22,24	1,89
8	August	2009	1,1	1,39	21,99	0,98
9	September	2009	1,12	1,58	19,35	1,11
10	Oktober	2009	1,44	2	17,95	1,68
11	November	2009	1,48	1,7	21,36	1,97
12	December	2009	1,41	2,02	26,02	1,99
13	January	2010	1,17	1,62	19,98	0,99
14	February	2010	1,44	1,79	18,52	2
15	March	2010	1,66	1,63	21,36	2,36
16	April	2010	1,6	1,81	21,33	2
17	May	2010	1,54	1,96	20,6	1,93
18	June	2010	1,63	1,61	21,13	2
19	July	2010	1,33	2,16	18,76	2,5
20	August	2010	1,21	1,75	17,25	1,54
21	September	2010	1,35	1,98	19,08	1,5
22	Oktober	2010	1,59	1,95	19,86	2,32
23	November	2010	2,22	2,05	23,56	2,5
24	December	2010	1,45	2,11	20,98	2,1
25	January	2011	1,6	2,15	20,51	1,25
26	February	2011	1,08	2,06	19,36	2
27	March	2011	1,66	2,18	21,98	2,15
28	April	2011	1,48	2,17	20,79	1,5
29	May	2011	1,32	2,19	19,13	2
30	June	2011	1,34	2,12	19,69	1,5
31	July	2011	1,41	2,14	19,92	1,5
32	August	2011	1,43	2,22	20,17	1,5
33	September	2011	1,54	2,19	20,68	1
34	Oktober	2011	1,39	2,19	20,29	1,5
35	November	2011	1,58	2,21	19,49	1
36	December	2011	1,39	2,32	20,27	2

	x4	x5	x6	X7	X8	RES_1
1	0	4,37	5	51,96	32,25	0,22705
2	0	8,11	5,7	70,25	30,22	0,00747
3	0	5,32	4	44,43	36,65	0,01913
4	0	6,11	4,06	40,23	36,09	0,12313
5	0	2,65	3,39	41,96	31,01	0,06472
6	0	2,98	3,46	39,33	31	-0,01538
7	1	3,54	6	70,21	35,21	-0,03473
8	0	4,38	3,67	39,22	26,4	0,03679
9	0	3,24	4	39,23	26,21	0,10375
10	1	4,17	4,5	49,09	30,31	0,03553
11	1	5,22	3,75	40,84	32,54	-0,00069
12	1	3,63	2	45,86	29,61	-0,0478
13	0	3,63	5,31	43,95	26,35	0,06965
14	1	4,26	3,35	55,8	26,24	0,04945
15	1	5,11	3,58	71,26	32,12	0,00283
16	1	5,11	3,98	59,87	33,98	-0,00138
17	1	4,58	6,95	46,46	32,35	-0,06096
18	1	5,91	6,5	71,36	26,29	-0,04556
19	1	3,98	2,38	42,25	28,62	-0,07053
20	0	3,9	5,65	47,92	29,35	0,00344
21	0	5,76	3,67	46,98	32,11	0,08863
22	1	5,01	3,5	50,98	32,16	0,0481
23	1	6,21	6,16	73,35	41,4	0,2307
24	0	4,22	3	46,35	32,12	0,14564
25	1	3,73	4,5	65,12	35,21	0,08199
26	0	2,98	4,5	55,87	33,45	-0,25401
27	0	6,46	6	51,65	36,31	0,06617
28	1	5,1	2,5	58,9	31,9	0,01903
29	0	5,81	2,5	43,4	33,95	0,0172
30	0	4,09	3,5	40,97	32,24	0,14827
31	1	4,7	2,95	64,12	33,17	-0,07607
32	0	4,91	5	52,33	41,22	-0,0152
33	0	8,06	5,5	54,56	40,19	0,03165
34	0	5,62	4	55,54	34,99	0,01384
35	1	6,16	5	53,23	35,44	0,064
36	0	6,09	4	43,87	32,11	0,01132

	Month	Year	Y	X1	X2	X3
37	January	2012	1,66	2,17	20,99	2
38	February	2012	1,5	3,15	19,99	2
39	March	2012	1,42	2,22	20,72	1,58
40	April	2012	1,16	2,16	20,99	1,25
41	May	2012	1,42	2,22	20,72	1,58
42	June	2012	1,66	2,17	20,99	2,3
43	July	2012	1,07	1,92	20,54	1,52
44	August	2012	1,24	2	16,98	1,51
45	September	2012	1,21	2	18,99	1,44
46	Oktober	2012	1,18	2	18,74	1,49
47	November	2012	1,4	3,13	20,8	1,44
48	December	2012	1,03	2,12	18,75	1,48
49	January	2013	2,11	4,77	20,8	1,98
50	February	2013	1,88	4,74	22,57	2
51	March	2013	1,84	4,67	20,76	2
52	April	2013	1,73	4,71	20,13	1,47
53	May	2013	1,73	4,81	21,93	1,64
54	June	2013	1,71	4,81	21,38	2,14
55	July	2013	1,83	4,78	20,45	1,83
56	August	2013	1,83	4,77	21,65	1,73
57	September	2013	1,9	4,77	16,92	1,72
58	Oktober	2013	2,01	4,18	24,82	1,73
59	November	2013	1,87	4,12	24,11	1,47
60	December	2013	1,81	4,09	20,92	2,02

	x4	x5	x6	X7	X8	RES_1
37	1	5,61	5,5	56,8	36,18	-0,04082
38	0	5,09	4,5	49,75	35,28	0,02903
39	0	5,5	5,33	54	35,76	-0,02431
40	0	5,56	3,5	57,26	35,62	-0,18782
41	0	5,5	4,33	55,34	35,76	0,0073
42	1	5,61	3,5	50,78	36,18	0,02308
43	0	5,48	4,49	42,65	35,02	-0,2513
44	0	5,08	4,34	50,43	31,65	0,00043
45	1	5,08	4,47	49,83	34,9	-0,26559
46	0	5,08	4,43	45,36	34,92	-0,10529
47	0	5,4	4,44	59,06	31,69	-0,02071
48	0	5,34	4,44	58,7	35,15	-0,33549
49	1	5,4	4,44	76,39	42,36	0,14938
50	1	7,34	4,44	71,83	38,62	-0,11462
51	0	7,27	4,44	74,41	38,45	0,04457
52	0	5,32	6,66	71,02	40,42	-0,01075
53	0	4,83	6,66	67,27	41,6	-0,05139
54	0	2,83	5,16	60,12	43,03	0,01247
55	1	3	4,84	71,55	41,7	-0,00976
56	1	5,05	6,73	50	38,58	-0,02089
57	1	4,07	5,72	74,83	41,1	0,06198
58	1	5,67	5,15	73,96	42,22	0,02139
59	1	5,34	3,44	71,75	42,29	0,01807
60	1	4,84	5,32	74,77	32,65	-0,01613

2. Appendix 2 OUTPUT SPSS

Regression

Descriptive Statistics

	Mean	Std. Deviation	N
waiting time (y)	1.5018	.26798	60
approach time (x1)	2.5438	1.09145	60
effective time (x2)	20.5308	1.90844	60
not operation time (x3)	1.7282	.40018	60
cuaca (x4)	.45	.502	60
postpone time (x5)	5.0067	1.18222	60
idle time (x6)	4.4963	1.15009	60
BOR (x7)	55.6093	11.49797	60
Turn Around Time (x8)	34.5317	4.49570	60

Correlations

		waiting time (y)	approach time (x1)	effective time (x2)	not operation time (x3)	cuaca (x4)	postpone time (x5)	idle time (x6)	BOR (x7)	Turn Around Time (x8)
Pearson Correlation	waiting time (y)	1.000	.669	.353	.447	.540	.319	.397	.751	.632
	approach time (x1)	.669	1.000	.165	.153	.153	.120	.341	.633	.687
	effective time (x2)	.353	.165	1.000	.194	.217	.014	-.065	.169	.267
	not operation time (x3)	.447	.153	.194	1.000	.333	.135	-.036	.232	.097
	cuaca (x4)	.540	.153	.217	.333	1.000	-.050	-.007	.411	.082
	postpone time (x5)	.319	.120	.014	.135	-.050	1.000	.184	.260	.257
	idle time (x6)	.397	.341	-.065	-.036	-.007	.184	1.000	.387	.349
	BOR (x7)	.751	.633	.169	.232	.411	.260	.387	1.000	.521
	Turn Around Time (x8)	.632	.687	.267	.097	.082	.257	.349	.521	1.000
Sig. (1-tailed)	waiting time (y)	.	.000	.003	.000	.000	.006	.001	.000	.000
	approach time (x1)	.000	.	.104	.121	.121	.180	.004	.000	.000
	effective time (x2)	.003	.104	.	.068	.048	.459	.310	.098	.019
	not operation time (x3)	.000	.121	.068	.	.005	.152	.393	.037	.230
	cuaca (x4)	.000	.121	.048	.005	.	.352	.478	.001	.266
	postpone time (x5)	.006	.180	.459	.152	.352	.	.080	.022	.024
	idle time (x6)	.001	.004	.310	.393	.478	.080	.	.001	.003
	BOR (x7)	.000	.000	.098	.037	.001	.022	.001	.	.000
	Turn Around Time (x8)	.000	.000	.019	.230	.266	.024	.003	.000	.
N	waiting time (y)	60	60	60	60	60	60	60	60	60
	approach time (x1)	60	60	60	60	60	60	60	60	60
	effective time (x2)	60	60	60	60	60	60	60	60	60
	not operation time (x3)	60	60	60	60	60	60	60	60	60
	cuaca (x4)	60	60	60	60	60	60	60	60	60
	postpone time (x5)	60	60	60	60	60	60	60	60	60
	idle time (x6)	60	60	60	60	60	60	60	60	60
	BOR (x7)	60	60	60	60	60	60	60	60	60
	Turn Around Time (x8)	60	60	60	60	60	60	60	60	60

Variables Entered/Removed[b]

Model	Variables Entered	Variables Removed	Method
1	Turn Around Time (x8), cuaca (x4), postpone time (x5), effective time (x2), not operation time (x3), idle time (x6), BOR (x7), approach time (x1)[a]	.	Enter

a. All requested variables entered.

b. Dependent Variable: waiting time (y)

Model Summary[b]

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Durbin-Watson
1	.921[a]	.848	.824	.11231	1.912

a. Predictors: (Constant), Turn Around Time (x8), cuaca (x4), postpone time (x5), effective time (x2), not operation time (x3), idle time (x6), BOR (x7), approach time (x1)

b. Dependent Variable: waiting time (y)

ANOVA[b]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	3.594	8	.449	35.612	.000[a]
	Residual	.643	51	.013		
	Total	4.237	59			

a. Predictors: (Constant), Turn Around Time (x8), cuaca (x4), postpone time (x5), effective time (x2), not operation time (x3), idle time (x6), BOR (x7), approach time (x1)

b. Dependent Variable: waiting time (y)

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.	Correlations			Collinearity Statistics	
		B	Std. Error	Beta			Zero-order	Partial	Part	Tolerance	VIF
1	(Constant)	-.315	.200		-1.580	.120					
	approach time (x1)	.058	.021	.237	2.760	.008	.669	.361	.151	.404	2.474
	effective time (x2)	.018	.008	.129	2.184	.034	.353	.292	.119	.850	1.176
	not operation time (x3)	.134	.040	.200	3.356	.001	.447	.425	.183	.836	1.197
	cuaca (x4)	.170	.035	.319	4.849	.000	.540	.562	.265	.690	1.450
	postpone time (x5)	.033	.014	.147	2.463	.017	.319	.326	.134	.837	1.195
	idle time (x6)	.038	.015	.163	2.614	.012	.397	.344	.143	.768	1.302
	BOR (x7)	.005	.002	.202	2.400	.020	.751	.319	.131	.421	2.375
	Turn Around Time (x8)	.011	.005	.189	2.334	.024	.632	.311	.127	.452	2.211

a. Dependent Variable: waiting time (y)

Coefficient Correlations[a]

Model			Turn Around Time (x8)	cuaca (x4)	postpone time (x5)	effective time (x2)	not operation time (x3)	idle time (x6)	BOR (x7)	approach time (x1)
1	Correlations	Turn Around Time (x8)	1.000	.072	-.200	-.254	.058	-.138	-.086	-.531
		cuaca (x4)	.072	1.000	.186	-.135	-.254	.100	-.430	.105
		postpone time (x5)	-.200	.186	1.000	.051	-.155	-.055	-.233	.194
		effective time (x2)	-.254	-.135	.051	1.000	-.118	.147	-.009	.044
		not operation time (x3)	.058	-.254	-.155	-.118	1.000	.086	-.039	-.085
		idle time (x6)	-.138	.100	-.055	.147	.086	1.000	-.246	-.039
		BOR (x7)	-.086	-.430	-.233	-.009	-.039	-.246	1.000	-.429
		approach time (x1)	-.531	.105	.194	.044	-.085	-.039	-.429	1.000
	Covariances	Turn Around Time (x8)	2.34E-005	1.21E-005	-1.31E-005	-1.0E-005	1.12E-005	-9.66E-006	-8.1E-007	-5.41E-005
		cuaca (x4)	1.21E-005	.001	8.84E-005	-3.9E-005	.000	5.11E-005	-3.0E-005	7.76E-005
		postpone time (x5)	-1.31E-005	8.84E-005	.000	5.76E-006	-8.39E-005	-1.09E-005	-6.2E-006	5.52E-005
		effective time (x2)	-1.02E-005	-3.9E-005	5.76E-006	6.90E-005	-3.92E-005	1.77E-005	-1.5E-007	7.79E-006
		not operation time (x3)	1.12E-005	.000	-8.39E-005	-3.9E-005	.002	5.01E-005	-3.1E-006	-7.16E-005
		idle time (x6)	-9.66E-006	5.11E-005	-1.09E-005	1.77E-005	5.01E-005	.000	-7.0E-006	-1.19E-005
		BOR (x7)	-8.12E-007	-3.0E-005	-6.18E-006	-1.5E-007	-3.08E-006	-6.98E-006	3.84E-006	-1.77E-005
		approach time (x1)	-5.41E-005	7.76E-005	5.52E-005	7.79E-006	-7.16E-005	-1.19E-005	-1.8E-005	.000

a. Dependent Variable: waiting time (y)

3. Appendix 3 NPar TESTS

One-Sample Kolmogorov-Smirnov Test

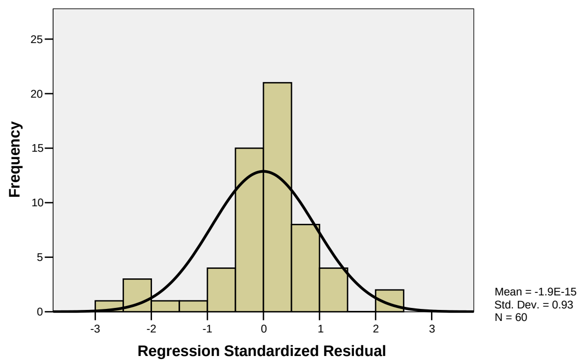
		Unstandardized Residual
N		60
Normal Parameters [a,b]	Mean	.0000000
	Std. Deviation	.10441932
Most Extreme Differences	Absolute	.158
	Positive	.102
	Negative	-.158
Kolmogorov-Smirnov Z		1.224
Asymp. Sig. (2-tailed)		.100

a. Test distribution is Normal.

b. Calculated from data.

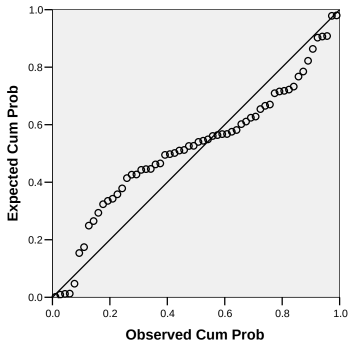
Histogram

Dependent Variable: waiting time (y)



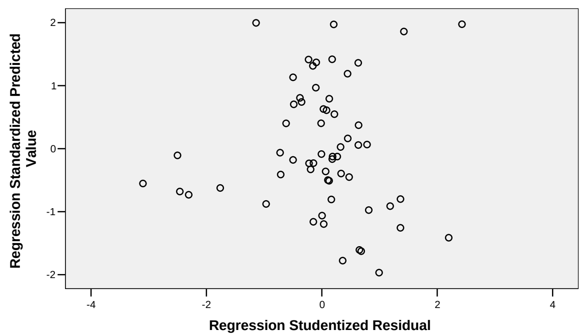
Normal P-P Plot of Regression Standardized Residual

Dependent Variable: waiting time (y)



Scatterplot

Dependent Variable: waiting time (y)



4. Appendix 4 NONPARAMETRIC CORRELATIONS

Correlations

			approach time (x1)	effective time (x2)	not operation time (x3)	cuaca (x4)	postpone time (x5)	idle time (x6)	BOR (x7)	Turn Around Time (x8)	Unstandardized Residual
Spearman's rho	approach time (x1)	Correlation Coefficient	1.000	.105	.142	.057	.270*	.286*	.567**	.660**	-.119
		Sig. (2-tailed)	.	.425	.280	.665	.037	.027	.000	.000	.366
		N	60	60	60	60	60	60	60	60	60
	effective time (x2)	Correlation Coefficient	.105	1.000	.236	.215	.090	-.015	.195	.309*	-.098
		Sig. (2-tailed)	.425	.	.069	.099	.494	.911	.136	.016	.455
		N	60	60	60	60	60	60	60	60	60
	not operation time (x3)	Correlation Coefficient	.142	.236	1.000	.282*	.145	-.014	.183	.074	-.053
		Sig. (2-tailed)	.280	.069	.	.029	.269	.914	.162	.573	.690
		N	60	60	60	60	60	60	60	60	60
	cuaca (x4)	Correlation Coefficient	.057	.215	.282*	1.000	-.056	.000	.398**	.087	-.103
		Sig. (2-tailed)	.665	.099	.029	.	.670	1.000	.002	.508	.431
		N	60	60	60	60	60	60	60	60	60
	postpone time (x5)	Correlation Coefficient	.270*	.090	.145	-.056	1.000	.125	.243	.324*	.039
		Sig. (2-tailed)	.037	.494	.269	.670	.	.340	.061	.011	.770
		N	60	60	60	60	60	60	60	60	60
	idle time (x6)	Correlation Coefficient	.286*	-.015	-.014	.000	.125	1.000	.386**	.383**	-.100
		Sig. (2-tailed)	.027	.911	.914	1.000	.340	.	.002	.003	.445
		N	60	60	60	60	60	60	60	60	60
	BOR (x7)	Correlation Coefficient	.567**	.195	.183	.398**	.243	.386**	1.000	.512**	-.106
		Sig. (2-tailed)	.000	.136	.162	.002	.061	.002	.	.000	.419
		N	60	60	60	60	60	60	60	60	60
	Turn Around Time (x8)	Correlation Coefficient	.660**	.309*	.074	.087	.324*	.383**	.512**	1.000	-.019
		Sig. (2-tailed)	.000	.016	.573	.508	.011	.003	.000	.	.888
		N	60	60	60	60	60	60	60	60	60
	Unstandardized Residual	Correlation Coefficient	-.119	-.098	-.053	-.103	.039	-.100	-.106	-.019	1.000
		Sig. (2-tailed)	.366	.455	.690	.431	.770	.445	.419	.888	.
		N	60	60	60	60	60	60	60	60	60

*. Correlation is significant at the 0.05 level (2-tailed).

**. Correlation is significant at the 0.01 level (2-tailed).