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Analysis of Model Loading and Unloading Time of Ships at Boom Baru Port, Palembang, Indonesia

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Abstract. Logistic transport passing through road transport in Palembang city has been very high. To support green Transport, it is recommended to convert some of land logistic transports to river transport. However, the river transport has not been ready in terms of dredging and maintaining water level of Musi River. Furthermore, Boombaru Port, which has been shallow, and has high tidal level difference, can cause the process of loading and unloading become longer. High dwelling time is one of many problems that happen in port's container terminal in Indonesia. This is commonly caused by longer loading and unloading time than those ports with high navigability and good handling equipment. Loading and unloading time depends on some factors, i.e ship size, limitation of equipment and stacking yard, a shallow port basin, tidal period and tidal magnitude. This paper aims to model the loading and unloading Time at Container Terminal of Boombaru Port, and analyze the effect of some factors on loading and unloading time. The model derived is Y = 0.501 X1 – 0.021 X2 – 2.63 X3 – 29.745, which X1 is Length Over All (m), X2 is Low Tide Elevation (cm) and X3 is duration of tidal period (hour).

1 Introduction

Sometimes, it was found the fact that transport problem is not derived from transport sector itself, but it is mostly come from other independent sectors, which is not connected one from another. For example the problems from unconnected supply chain of goods transport. Logistic transport passing through road transport in Palembang city has been very high. To support green Transport, it is recommended to convert some of land logistic transports to river transport. However, the river transport has not been ready in terms of dredging and maintaining water level of Musi River.

Furthermore, Boombaru Port, which has been shallow, and has high tidal level difference, can cause the process of loading and unloading become longer. High dwelling time is one of many problems that happen in port's container terminal in Indonesia. This is commonly caused by longer loading and unloading time than those ports with high navigability and good handling equipment. Loading and unloading time depends on some

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factors, i.e. ship size, limitation of equipment and stacking yard, and shallow port basin, tidal period and tidal magnitude.

Dwelling time is accumulated time from unloading and loading containers, until the containers leave the terminal trough the main gate [1]. There are many factors that affect dwelling time; among other things is the speed of handling process. In terms of berthing handling, the process of handling is mostly unloading time.

The speed of unloading process is affected by many factors, such as ship size, performance of the equipment, number of handling equipment, qualifications from the operator, the depth of post basin. In the case of river port, tidal level is also the main but neglected factor for time of handling process.

Since the time of handling process is very important factors, therefore this research will discuss about the factors which affect unloading time which include tidal level difference from sedimentation.

1.1 Problem Formulation

Problem Formulated are

1. How to model the loading and unloading time at Container Terminal of Boombaru Port, and
2. How to analyze the effect of some factors on loading and unloading time

1.2 The aims of the study

This paper is aimed to
1) Model the unloading Time at Container Terminal of Boombaru Port, and
2) Analyze the effect of some factors on unloading time

2 Literature Study

2.1 Dwelling Time

Dwelling time is accumulated time from unloading and loading containers, until the containers leave the terminal trough the main gate [1].
At Boombaru Port, Berth Occupancy Ratio is about 51.03%, which is above standard required services, has caused long time delay for ships berthing [2]. As a result the flow of containers at Container Ports Boombaru has been less than maximum required capacity, which gives impacts to lower productivity.
Further research has been done to get the model of productivity at container terminal, Boombaru. By the means of Multiple Linear Regression model with Stepwise method, the model derived is $Y=1,543\ X_1 + 47,253\ X_2 + 0,195\ X_3 – 162.964$. Y is containers flow in TEU per day; X1 Average length of All in m' (LOA); X2 is density of containers in ship in TEU's/m' and X3 is Berth troughput in TEU's per day **[3].** The constant -162.964 has been annoying results, which reflect unknown parameter. Therefore this study will see what other parameters that also affect berthing time. It is realized that some problems could come from Port Basin in front of Berth and sedimentation along the tidal river/canal approach. Further research has been set up to find out what other factors that affect the productivity and dwelling time in port terminal.

2.2 Tidal Basin

Tides are the rise and the fall of sea levels caused by the combined effects of the gravitational forces exerted by the moon, the sun and the rotation of earth**.** (Widyantoro, 2014). Tidal level are grouped to three main components, namely low tide, high tide, and tidal range. The tidal range is derived from the difference measure of high tide and succeeding low tide.

3 Research Method

The research Method are delineated as the following figure 1.

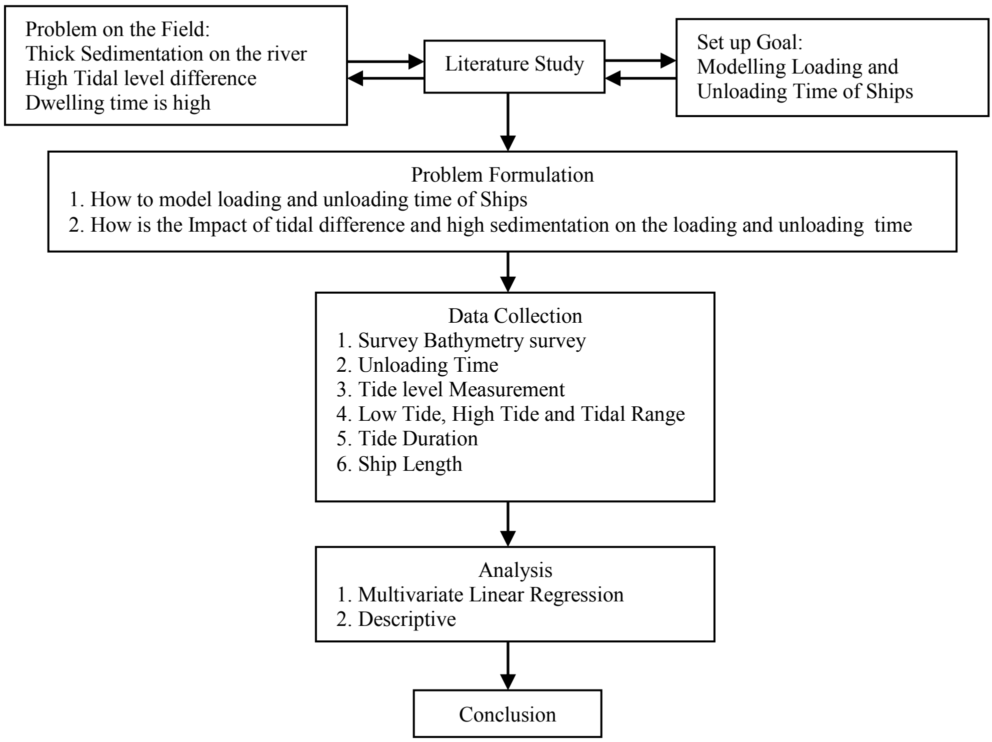

Figure 1 Flow chart of research

4. SURVEY RESULTS AND ANALYSIS

4.1 Survey Results

Data Variables

There are six variables that are predicted in finding productivity model, namely:

a. Average length of all (AvLOA)
b. Unloading Time
c. Low Tide
d. High Tide
e. Tidal Range
f. Duration of Tide

In order to find loading and unloading time model, some data collection had been done. The following **Table1** is presenting average length of all of ships for each month.

Table 1. Average Length of All Ships

No	Month	Average Length of All (m)
1	January	101.3
2	February	101.37
3	March	100.04
4	April	101.0
5	May	99.91
6	June	99.44
7	July	101.11
8	August	101.64
9	September	105.51
10	October	106.23
11	November	100.1
12	December	100.9
13	January	101.12
14	February	99.07
15	March	99.65

The following **table 2** is presenting average Loading and unloading time each month.

Table 2. Average Loading and unloading time each month

No	Month	Loading Unloading time each month (hour)
1	January	13.66
2	February	14.76
3	March	16.71
4	April	16.67
5	May	15.57
6	June	16.59
7	July	17.34
8	August	15.95
9	September	16.04
10	October	16.02

No	Month	Loading Unloading time each month (hour)
11	November	14.55
12	December	12.77
13	January	11.65
14	February	12.58
15	March	11.79

The following **Table 3** is presenting data of average Low Tide Elevation

Table 3. Average Low of Tide Elevation

No	Month	Low Tide Elevation (cm)
1	January	44.0
2	February	49.0
3	March	43.0
4	April	56.0
5	May	40.0
6	June	30.0
7	July	40.0
8	August	60.0
9	September	49.0
10	October	45.0
11	November	45.0
12	December	49.0
13	January	58.0
14	February	58.0
15	March	65.0

The following **Table 4** is presenting data of Average High Tide Elevation.

No	Month	High Tide Elevation **(cm)**
1	January	190.0
2	February	180.0
3	March	155.0

No	**Month**	High Tide Elevation **(cm)**
4	April	166.0
5	May	173.0
6	June	191.0
7	July	230.0
8	August	210.0
9	September	215.0
10	October	217.0
11	November	215.0
12	December	221.0
13	January	222.0
14	February	228.0
15	March	215.0

The following **table 5** is presenting data of Range of Tidal difference of fluctuation.

Table 5. Range of Tidal level

No	**Month**	**Fluctuation (cm)**
1	January	18.0
2	February	18.0
3	March	14.0
4	April	13.0
5	May	12.0
6	June	11.0
7	July	14.0
8	August	24.0
9	September	24.0
10	October	24.0
11	November	24.0
12	December	24.0
13	January	24.0
14	February	24.0
15	March	24.0

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The following **Table 6** is presenting data of Average Duration of Tide.

Table 6. Average Duration of Tide

No	**Month**	**Average duration**
1	January	18.0
2	February	18.0
3	March	14.0
4	April	13.0
5	May	12.0
6	June	11.0
7	July	14.0
8	August	24.0
9	September	24.0
10	October	24.0
11	November	24.0
12	December	24.0
13	January	24.0
14	February	24.0
15	March	24.0

4.2 Analysis of Model of Unloading Ships

Before doing regression process, data were tested and had to pass assumption test. Classical Assumption Method is used in order to verify research data, such as Normality Test, Multicollinearity Index, Heteroscedasticity Test, auto correlation Durbin-Watson, and Linearity Test.

After it is processed with MLR and Step Wise Method, summary model is derived as it is presented in the following table:

Table 7. Summary Model Analysis

Model Summary				
Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1		.665	.479	1.37916
2		.664	.530	1.30988
3		.663	.571	1.25106
4		.657	.600	1.20801
a. Predictors: (Constant), Tide duration, SC, Tide difference, LOWT, LOA				
b. Predictors: (Constant), Tide duration, SC, LOWT, LOA				
c. Predictors: (Constant), Tide duration, LOWT, LOA				
d. Predictors: (Constant), Tide duration, LOA				

While the result of FTest is presented in the following table 7.

Table 7. Table F test

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	33.991	5	6.798	3.574	.047[a]
	Residual	17.119	9	1.902		
	Total	51.110	14			
2	Regression	33.952	4	8.488	4.947	.018[b]
	Residual	17.158	10	1.716		
	Total	51.110	14			
3	Regression	33.893	3	11.298	7.218	.006[c]
	Residual	17.217	11	1.565		
	Total	51.110	14			
4	Regression	33.598	2	16.799	11.512	.002[d]
	Residual	17.511	12	1.459		
	Total	51.110	14			
a. Predictors: (Constant), Tide duration, SC, Tide Dif, LOWT, LOA						
b. Predictors: (Constant), Tide duration, SC, LOWT, LOA						
c. Predictors: (Constant), Tide duration, LOWT, LOA						
d. Predictors: (Constant), Tide duration, LOA						
e. Dependent Variable: Unloading Time						

After analysis having been done, some equation models which represent unloading time of ships in Container Port terminal Boom Baru, namely:

1) Y = -0.41 Ship Arrival +0.444 LOA -0.14 LOWT +0.003 Tide Dif -0.270 Tide duration -23.540
2) Y = -0.35 Ship Arrival +0.448 LOA -0.21 LOWT -0.257 Tide duration -23.617
3) Y = 0.501 LOA -0.21 LOWT -0.263 Tide duration -29.745

From those three models derived, Model three is more accurate, because all independent variables, such as LOA, LOWT and Tide duration has significant impact (Sig. < 0,05), so that the third model is considered best-fit model. This model then can be used to predict unloading time in Boombaru Port.

5 Conclusion

From the above analysis and discussion, it can be concluded as the following:

1) Model the unloading Time at Container Terminal of Boombaru Port is Y = 0.501 LOA -0.21 LOWT -0.263 Tide duration -29.745
2) Loading and unloading time are affected by length of all, Low Tide level, and tide duration

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