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# Berthing time in the port of Tanjung Priok, Jakarta, Indonesia

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This research aims to know and analyze the contribution of Truck Waiting Time and Crane Operator Waiting Time through Box Crane Hour to Berthing Time. The model of data analysis in this research uses the approach of the Path Analysis model. The research uses secondary data with time series from the data from the performance report of cargo ships berthed in Terminal 3. The samples used in this research are saturated samples in the form of the data of four variables for 36 months from 2016 to 2018 after the implementation of the Terminal Operating System (TOS). Some of the results of the hypothetical test state that the hypotheses having significant contributions are the variable of Truck Waiting Time to Berthing Time, Crane Operator Waiting Time to Berthing Time, and the variable of Crane Operator Waiting Time to Box Crane Hour. Whereas two hypotheses do not contribute, namely the variable of Truck Waiting Time to Box Crane Hour and the Box Crane Hour to Berthing Time. The Management is also expected to reduce the length of Berthing Time to give satisfaction to the shipping companies as the users by prioritizing the improvement of Truck Waiting Time and Crane Operator Waiting Time so that it will contribute directly to Box Crane Hour and Berthing Time.



## 1. Introduction

Container terminal operation is one of the important things to support activities at a port. In the container terminal operation, there are quite many problems such as lack of information, traffic, truck, waiting time, berthing window, unaccessible operator, and slow performance of the terminal. Many factors contribute to the Berthing Time in the port such as Box Crane Hour (BCH) or the productivity of container loading-discharging per crane, Truck Waiting Time, and Crane Operator Waiting Time. To shorten the Berthing Time of containers in the port, the Management of Pelabuhan Indonesia II 2013 has started implementing a Terminal Operating System (TOS) for international container loading-discharging activities at Terminal 3 in the area of oceangoing of the Port of Tanjung Priok. Based on the post-implementation data of the Terminal Operating System, every month from 2016 to 2018 there were still ships having the Berthing Time value under the company's target due to some obstacles such as low level of BCH, Truck Waiting Time, and Crane Operator Waiting Time in the field. With such a condition, it is necessary to analyze the contribution of Truck Waiting Time and operator crane obstacles to the Berthing Time with the intervening variable of Box Crane Hour.

Some of the main problems are found; (1) There are still failures in achieving the target of Berthing Time for some ships at Terminal 3 of the Port of Tanjung Priok after the implementation of the Terminal Operating System (TOS). Shipping lines want fast Berthing Time for cost efficiency and the ship can immediately sail to deliver the containers; (2) There are still low achievements of BCH in some ships at Terminal 3 of the port of Tanjung Priok after the implementation of TOS; (3) There is

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an obstacle of Truck Waiting Time toward the ships berthing at Terminal 3 of the Port of Tanjung Priok, and (4) There is an obstacle of Crane Operator Waiting Time toward the ships berthing at Terminal 3 of the Port of Tanjung Priok. Concerning TOS according to Min et al. (2017), terminal infrastructures can be utilized in better ways and can improve the efficiency of terminal operation. So, the terminal operating system must be integrated to be able to lower the burden of investment in equipment, and excessive labor, and terminal services must have good standards for loading-unloading activities. There are two basic characteristics of TOS advantages, namely features and benefits. Features, consisting of the aspects of privilege, characteristics, special services, and various benefits, are integrated into the TOS to make the operation of the container terminal more transparent to all stakeholders, and this is the core of the whole transformation operation (Azka et al., 2017). TOS according to Hervás-Peralta et al. (2019) also serves to manage sea container terminals, as well as a dry port, to improve the performance and contribute to reducing the congestion and the emission of greenhouse gases for higher sustainability.

## 2. Literature review

### *2.1 Berthing Time*

The container terminal can be divided into five areas, namely berth area, quay, transport, storage yard, and gate (Carlo et al., 2014). A good integration among the five areas is needed to achieve better performance (Karam et al., 2014). In the calculation of the terminal's operational performance, there are several indicators especially related to the shipping service at the wharf, one of them is Berthing Time. Berthing Time is the duration of a ship at the mooring since the first rope is tied at the pier until the last rope is released from the pier. In the previous research Najoan et al. (2017) explain that Berthing Time at the container terminal of the Port of Tanjung Emas, Semarang, achieves the highest percentage in August (12.15 %) and Berthing Time achieves the lowest value in July (-41.15%). At the container terminal of the Port of Tanjung Emas, Hanik (2021) explains the existence of obstacles in the process of ship's berthing such as the factors of the wharf, weather, and the availability of facilities and infrastructures provided by the port management unit. In the research of the Port of Tanjung Perak, Surabaya, the strategy of ship's berthing time optimization can also reduce the ship's waiting time (Ricardianto et al., 2022a; Ivana & Moetriono, 2021; Perdana et al., 2018). Another finding by Tan et al. (2020) mentions that the integration of the Berth Allocation Problem and Quay Crane Assignment Problem can help port operators to reach more optimal birthing time, which will increase the operational efficiency, and decrease operating costs, and generate economic benefits for the terminal operator.

In the studies of some other countries, the problem of long Berthing Time can be caused by the breakage of loading-discharging supporting equipment, manpower, the availability of warehouses, and the limited berth capacity in the berthing area (Monteiro et al., 2021). A study by Shahpanah et al. (2014) in Malaysia succeeded in reducing the waiting time of each ship at the container terminal in the port with an optimum waiting time of 50. Berthing Time scheduling model is also made by Mao et al. (2022) for the port's integrated energy system to take into account the operational flexibilities. Another research by Kim et al. (2021) says that wharf rescheduling, with the combined model of integer linear program, will reduce the cost and the postponed departure. The calculation of Berthing Time at a wharf has ever been made by Κατσέας (2020) in the container terminal of Thessaloniki, Greece using some problems of berthing place allocation, about the berthing time and berthing position of the coming ships, minimizing the average service time for the ships that stop by in the port.

### *2.2. Box Crane Hour*

In the operation of loading-discharging at the container port, there are obstacles of Truck Waiting Time and Crane Operator Waiting Time, which is the time needed for providing trucks and crane operators in the process of loading-discharging. The obstacles of Truck Waiting Time and Crane Operator Waiting Time have an impact on the decreasing productivity of loading-discharging of each crane operated, which is known as Box Crane Hour (BCH). BCH is the number of containers loaded-discharged in one working hour of each crane such as Container Crane, Ships Crane, and Shore Crane. The indicator of BCH is contributed by many factors that the terminal can and cannot control. High BCH makes the activities of loading-discharging quickly finished and has an impact on the decrease of Berthing Time. Idle Time is the time not used for loading-discharging activities or idle time, for example, the wasted time when the loading-discharging equipment is broken. The components of Idle Time are; (1) Weather obstacles, (2) Waiting for the truck, (3) Waiting for the cargo, (4) Broken loading-discharging equipment, (5) Occupational accidents, (6) Waiting for the manpower or operator, and (7) other obstacles for loading-discharging.

Based on the above formulation it is known that BCH or the productivity of container loading-discharging of one unit of crane is contributed by Idle Time where it can be said that Truck Waiting Time and Crane Operator Waiting Time have a direct influence on BCH. Based on the previous research by Najoan et al. (2017), the increase and decrease in the monthly productivity of BCH in one year indicate that the target of loading-discharging productivity set by the management of Pelabuhan Indonesia III Tanjung Emas Semarang branch has not been fully achieved yet. According to Agustin et al. (2020), the factors influencing the discrepancy of productivity processes in BCH are equipment and the deep pool in the berthing place factor. The estimated container traffic in Tanzania, according to Mwisila, (2018), indicates that the throughput of container terminals will increase, so fast terminal development and container handling automation are necessary.

### *2.3. Truck Waiting Time*

The lateness of trucks is a general matter in container terminals. Truck operation on the land side is evaluated using some factors such as truck turn time at the container terminal. Huynh (2009) offers a mathematical model to examine the contributions of truck arrival limitation at the turn time and crane utilization. In the drayage operation in the container terminal, the truck should be able to reduce the waiting time, and in the studies by Azab and Eltawil (2016), Fotuhi et al. (2013), and Huynh and Vidal, 2010) can determine the sequence of drayage trucks which will serve to minimize their waiting time. The method analyzed by Lange et al. (2017) to reduce the congestion in the port starts from optimizing the infrastructure up to controlling the truck arrival time. Truck congestion will give an impact on the other stakeholders in the port such as trucking companies, empty depots, or cargo stations. Azab and Eltawil (2016) show how the arrival pattern contributes to the truck turn time from the outside of the container terminal at Alexandria terminal, Egypt and the simulation suggests management of the arrival pattern. The impact of a long queue of trucks at the terminal causes' delays, emissions, congestion, and high cost for both the terminal and the customers (Gharehgozli et al., 2014). Huynh and Hutson (2008) study the source of truck lateness at the container terminal by using a decision tree as the tool of analysis. The model of truck optimization is also simulated by Zhang et al. (2013) so that it can reduce the congestion of heavy trucks at the terminal.

Sharif et al. (2011) use a simulation to minimize the congestion at the gate of the port terminal by utilizing the available information on the real-time congestion at the gate and simple logic to estimate the expected truck waiting time. In addition, Phan and Kim (2015) discuss the number of truck chassis needed, indicating the need for the additional fleet. The study of Angeloudis and Bell (2011) explains that it is quite difficult to predict the time of truck arrivals and the real number of arrivals so using a simulation will be very effective to predict it. Another finding by Im et al. (2020) is that the development of the Truck Appointment System (TAS) aims to reduce the truck congestion that occurs between the gate and container terminal yard. Such a collaboration model shows a higher efficiency because more forwarders and trucking jobs become segmented.

### *2.4. Crane Operator Waiting Time*

Berths and quay cranes are the main assets in the container terminal system (Duan et al., 2021). The operator must make a plan of crane utilization, to improve the service quality and reduce the operating cost of container terminals. Scheduling the crane waiting time at the wharf is one of the most complicated operations in the container terminal and it directly correlates with the ship's service and waiting time (Abou Kasm & Diabat, 2021). Today, most terminals have used gantry cranes for the container stacking operation, as the main key of modern terminal planning (Carlo et al., 2014). Quay crane scheduling is the main sea transportation management in a container terminal. It also correlates directly with the ship's service waiting time (Abou Kasm & Diabat, 2021). The result of their study indicates that the utilization of two to three modern cranes, in general, can reduce the service time of traditional cranes. The development of simulation tools according to the study by Huynh and Vidal (2012) is useful for making strategic planning which will optimize the crane waiting time. The research by Fotuhi et al. (2013) shows that the q-learning model is very effective in helping yard crane operators to choose the best next step. Based on some theories and the previous research that have been mentioned above, then this research aims to know and analyze the contribution of Truck Waiting Time through Box Crane Hour to Berthing Time and the contribution of Crane Operator Waiting Time through Box Crane Hour to Berthing Time. Thus, we propose Truck Waiting Time and Crane Operator Waiting Time to be the analysis tool that can improve the Berthing Time mediated by Box Crane Hour. Fig. 1 illustrates the conceptual model in this study which consists of seven research hypotheses based on the constellation of research, either directly or indirectly.

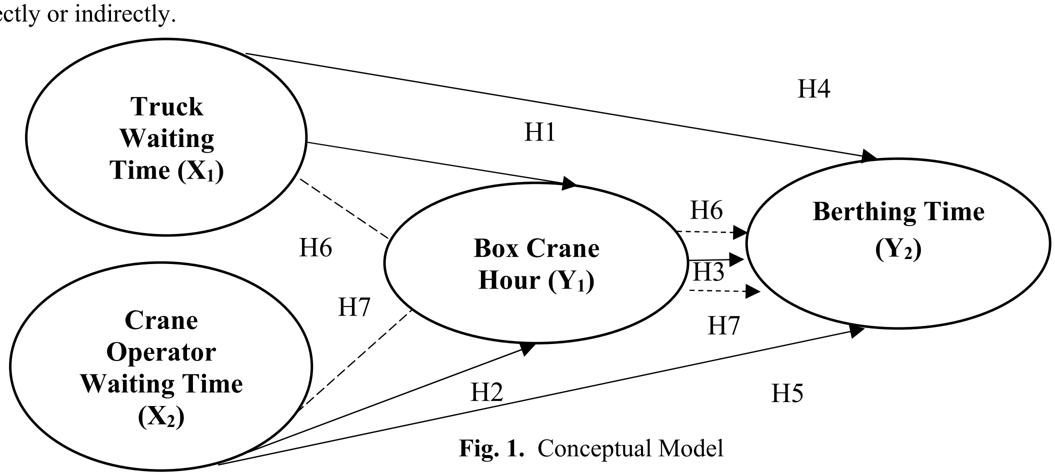


**Fig. 1.** Conceptual Model

**$H_1$.** *The direct contribution of Truck Waiting Time ($X_1$) on Box Crane Hour ($Y_1$)*
**$H_2$.** *The direct contribution of Crane Operator Waiting Time ($X_2$) on Box Crane Hour ($Y_1$)*
**$H_3$.** *The direct contribution of Box Crane Hour ($Y_1$) on Berthing Time ($Y_2$)*
**$H_4$.** *The direct contribution of Truck Waiting Time ($X_1$) on Berthing Time ($Y_2$)*
**$H_5$.** *The direct contribution of Crane Operator Waiting Time ($X_2$) on Berthing Time ($Y_2$)*
**$H_6$.** *Indirect contribution of Truck Waiting Time ($X_1$) through Box Crane Hour ($Y_1$) on Berthing Time ($Y_2$)*
**$H_7$.** *Indirect contribution of Crane Operator Waiting Time ($X_2$) through Box Crane Hour ($Y_1$) on Berthing Time ($Y_2$).*

## 3. Research Method

There are four latent variables in this research, namely Truck Waiting Time ($X_1$) and Crane Operator Waiting Time ($X_2$) as independent variables, Box Crane Hour ($Y_1$) as an intervening variable, and Berthing Time ($Y_2$) as the dependent variable. Each latent variable is measured using several variables and indicators being observed. This research is performed at Terminal 3 in the oceangoing area of Pelabuhan Indonesia II in the branch of Port of Tanjung Priok, Jakarta. The samples used in this research are saturated samples in the form of the data of Berthing Time, Box Crane Hour (BCH), Truck Waiting Time, and Crane Operator Waiting Time for 36 months from 2016 to 2018 after the implementation of the Terminal Operating System (TOS). The research uses secondary data with time series based on the data from the performance report of cargo ships berthing in Terminal 3. The cargo ships serve more than 2,400 boxes in each loading-unloading activity, such as; HS Chopin, Star River, MS Eage, NYK Daniela, ST Green, Arica Bridge, and Northern Diamond. The model of data analysis in this research uses the approach of the Path Analysis model. The hypothetical tests bring about the result of the first substructure test, namely the result of regression that affects the Box Crane Hour and the result of the F test on the variables of Truck Waiting Time and Crane Operator Waiting Time toward Box Crane Hour. The result of the second substructure test, namely the result of regression that affects Berthing Time and the result of the F test on the variables of Truck Waiting Time, Crane Operator Waiting Time, and Box Crane Hour, significantly affects the Berthing Time.

## 4. Results

### *4.1 Result of the First Sub Structure Test*

Statistical calculation shows that the result of the regression, R Square value, of Box Crane Hour is 0.228. Whereas the value of ANOVA in the F test is 4.865. Its significance is 0.014, so the variables of Truck Waiting Time and Crane Operator Waiting Time contribute significantly to Box Crane Hour. Based on the statistical calculation, the contributions of each variable are as follows; The coefficient value of Truck Waiting Time is -0.297. The significance of the Truck Waiting Time variable is 0.061 so that in partial the variable of Truck Waiting Time does not contribute to Box Crane Hour. The $t_{value}$ of Truck Waiting Time is -1.939. The value of $t_{he\ t\text{-}table}$ is 2.042 and $t_{\text{-}statistic}$ (-1.939) < $t_{\text{-}table}$ (2.042), so that Truck Waiting Time does not significantly contribute to Box Crane Hour. The coefficient value of Crane Operator Waiting Time is -0.359. The significance of the Crane Operator Waiting Time variable is 0.025, so the variable of Crane Operator Waiting Time partially negatively and significantly contributes to Box Crane Hour. The $t_{\text{-}value}$ of Crane Operator Waiting Time is -2.341. The value of $t_{table}$ is 2.042 and $t_{\text{-}statistic}$ (-2.341) > $t_{\text{-}table}$ (2.042), so that Crane Operator Waiting Time contributes significantly to Box Crane Hour. Sub Structure 1 Model with Path Coefficient (Fig. 2).

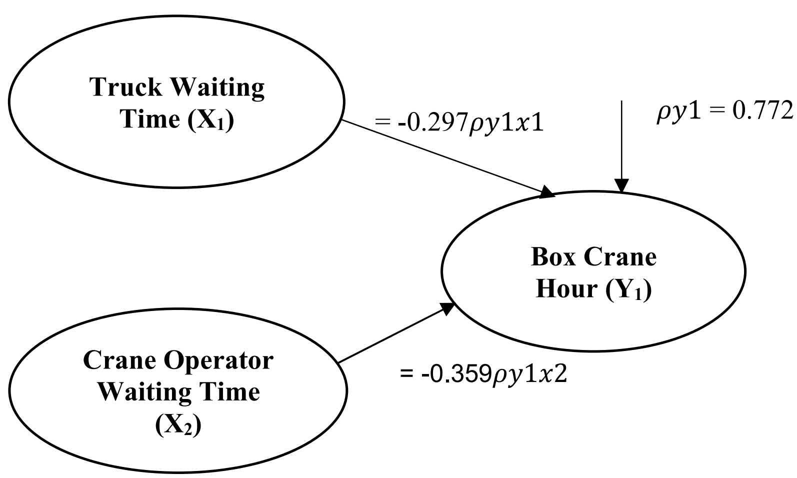


**Fig. 2.** Sub Structure 1

*4.2. Result of the Second Sub Structure Test*

Based on the statistical calculation, the value of R Square is 0.551. Whereas the value of ANOVA in the F test is 13.092. The intensities of Truck Waiting Time, Crane Operator Waiting Time, and Box Crane Hour contribute significantly to Berthing Time.

Based on the statistical calculation, the contributions of each variable are as follows:

The coefficient value of Truck Waiting Time is 0.601. The significance of the Truck Waiting Time variable is 0.000 so the variable of Truck Waiting Time partially contributes positively and significantly to Berthing Time. The $t_{\text{-value}}$ of Truck Waiting Time is 4.803. The value of $t_{\text{he t-table}}$ is 2.042. The value of $t_{\text{-statistic}}$ (4.803) > $t_{\text{-table}}$ (2.042) so that Truck Waiting Time contributes significantly to Berthing Time. The indirect contribution of Truck Waiting Time through Box Crane Hour to Berthing Time is 0.028. The coefficient value of the Crane Operator Waiting Time is 0.321. The significance of the Crane Operator Waiting Time variable is 0.017, so the variable of Crane Operator Waiting Time partially contributes positively and significantly to Berthing Time. The coefficient value of the Crane Operator Waiting Time is 2.506. The value of $t_{\text{he t-table}}$ is 2.042 and $t_{\text{statistic}}$ (2.506) > $t_{\text{-table}}$ (2.042), so that Crane Operator Waiting Time contributes significantly to Berthing Time. The indirect contribution of Crane Operator Waiting Time through Box Crane Hour to Berthing Time is 0.034. The total contribution of Crane Operator Waiting Time to Berthing Time is 0.355. So, the value of the direct contribution is bigger than the value of the indirect contribution.

The coefficient value of Box Crane Hour is -0.094. The significance of the Box Crane Hour variable is 0.493, so the variable of Box Crane Hour partial does not contribute to Berthing Time. The $t_{\text{-value}}$ of Box Crane Hour is -0.694. At the significance α 5%, it is quoted from the table that the value of $t_{\text{he t-table}}$ is 2.042 so that $t_{\text{-statistic}}$ (-0.694) < $t_{\text{-table}}$ (2.042). Thus, Box Crane Hour does not contribute significantly to Berthing Time.

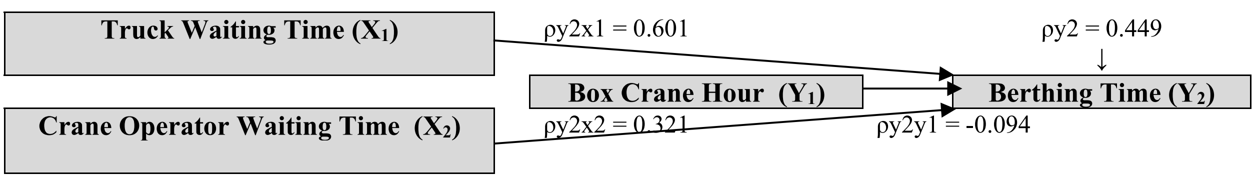


**Fig. 3.** Sub Structure 2

*4.3. Result of Path Analysis Model*

The variable of Box Crane Hour in partial does not significantly contribute to Berthing Time, causing indirect contribution in this research does not exist. Based on substructure 1 and substructure 2 models, the Path Analysis model with complete path structure (Fig. 4) is obtained.

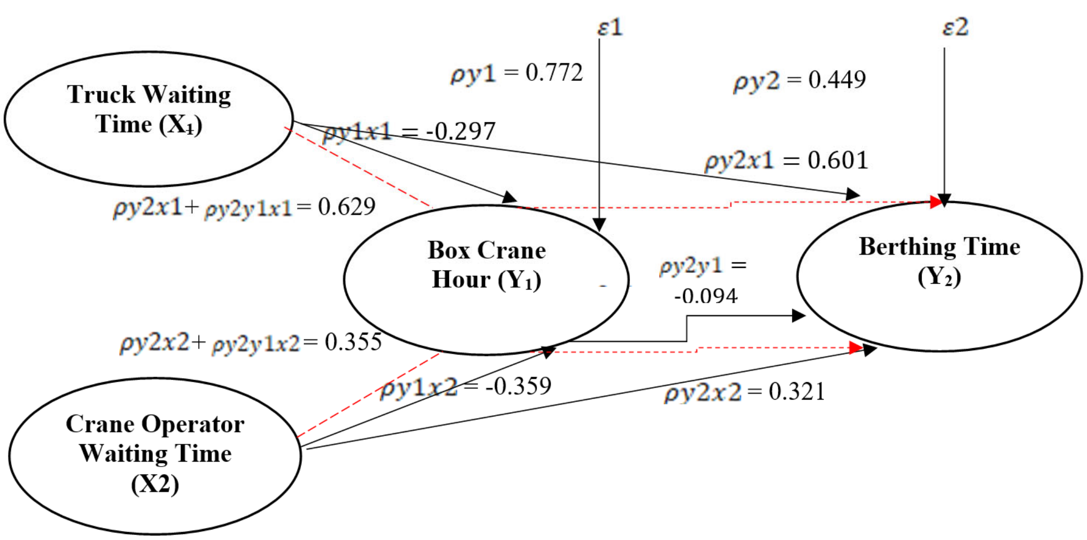


**Fig. 4.** Sub Structure 1 and 2

## 5. Discussion

### *5.1. Direct Contribution of Truck Waiting Time on Box Crane Hour*

Based on the calculation, partial Truck Waiting Time does not contribute significantly to Box Crane Hour and has a coefficient value of -0.297, so there will be a decrease of Box Crane Hour by 0.297 assuming that the other variables are considered constant. Some previous research in the Port of Tanjung Emas, Semarang found the relationship between the productivity of units on equipment like gantry cranes and the pattern of container stacking arrangement. In Pelabuhan Indonesia I Dumai, Riau, various obstacles frequently occur. Based on the survey result by Qi et al. (2019) in container terminals in the USA, an appropriate and cost-efficient strategy is needed to reduce truck congestion. To reduce external truck turning time, it is very necessary to pay attention to the factors that contribute to delay, especially the pattern of truck arrival (Azab & Eltawil, 2016). However, Huynh and Walton (2008), dan Huynh and Walton (2011) also study the impact that limits the truck arrivals, as well as the reduction of truck arrival that can interrupt the container delivery time. Therefore, the result of this research is not in line with the theoretical review and the results of previous studies, because some studies reveal that Truck Waiting Time has a significant contribution to the variable of Box Crane Hour. It means Truck Waiting Time contributes not significantly to Box Crane Hour.

### *5.2. Direct Contribution of Crane Operator Waiting Time on Box Crane Hour*

The test result of the variable of Crane Operator Waiting Time shows in part that the variable of Crane Operator Waiting Time contributes significantly to Box Crane Hour and has a coefficient value of -0.359 which shows a negative contribution. This is in line with the research by Najoan et al. (2017) stating that the increase and decrease of Box Crane Hour are caused by the factor of loading-discharging equipment operator's preparedness to work. The research by Abou Kasm and Diabat (2021) explains that generally, the utilization of two to three new-generation cranes can reduce the service time and average service time up to 65%. Therefore, the result of this research does not always support the theoretical study and the results of previous related research, because some research reveals that Crane Operator Waiting Time has a positive and significant contribution to the variable of Box Crane Hour. It means that Crane Operator Waiting Time partially contributes negatively and significantly to Box Crane Hour.

### *5.3. Direct Contribution of Box Crane Hour on Berthing Time*

Box Crane Hour has a significant value toward Berthing Time as big as 0.493. So, Box Crane Hour in partial does not affect the ship's berthing time and has a coefficient value of Box Crane Hour -0.094. This indicates that whenever the Box Crane Hour increases, Berthing Time will decrease by 0.094 with the assumption that the other variables are considered constant. This research does not support the research by Cahyadi and Sugiyono (2021) in the Teluk Bayur terminal, West Sumatera, Indonesia stating that Box Crane Hour and Berthing Time significantly contribute 71.3% to the wharf utility. The rest must be done to improve the Berthing Time to keep above 70% by reducing the waiting time and idle time. Whereas in the research by Darunanto et al. (2020) in Port of Tanjung Priok Jakarta, Box Crane Hour indicates a strong relationship with Berthing Time. Another research by Pang et al. (2011), asserts that cargo loading-discharging time is significant, and in every location, it is necessary to determine the time slot for each ship berthing. Additionally, the success of Berthing Time in the Port of Tanjung Priok is determined, among others, by the productivity of loading equipment and through the hypothetical analysis to contribute positively and significantly to Berthing Time (Angkoso & Setyawati, 2019). Therefore, the research of this research is not in line with the theoretical review and the results of previous related research, because some research reveals that Box Crane Hour has a significant contribution to the variable of Berthing Time. It means the variable of Box Crane Hour in partial does not contribute significantly to Berthing Time.

### *5.4. Direct Contribution of Truck Waiting Time on Berthing Time*

The coefficient value of Truck Waiting Time is 0.601, indicating that whenever there is an increase in Truck Waiting Time there will be an increase of Berthing Time by 0.601 with the assumption that the other variables are considered constant. So, the variable of Truck Waiting Time partially contributes positively and significantly to Berthing Time. This research supports the research by Azab and Eltawil (2016), that a long queue of trucks can also contribute to the port efficiency and cause congestion at the gate and yard, so it will contribute to Berthing Time. This research is in line with the previous research by Stojaković and Twrdy (2019) revealing that using a simulation approach to determine how different numbers of trucks assigned to one crane in the wharf can contribute to the productivities of the crane and all subsystems of the berthing area. Therefore, the result of this research is in line with the theoretical review and the results of previous related studies, because some research reveals that Truck Waiting Time has a significant contribution to the variable of Berthing Time. It means the variable of Truck Waiting Time partially contributes positively and significantly to Berthing Time.

### *5.5. Direct Contribution of Crane Operator Waiting Time on Berthing Time*

The coefficient value of Crane Operator Waiting Time is 0.321, indicating that whenever there is an increase in Crane Operator Waiting Time there will be an increase of Berthing Time by 0.321 with the assumption that the other variables are considered constant. So, the variable of Crane Operator Waiting Time partially contributes positively and significantly to Berthing Time. This research also supports the research by Imai et al. (2008) explaining that the allocation of berthing area should be planned to serve as many ships as possible in their terminal with the waiting time shorter than the determined deadline so that vessels can berth at the multi-user container terminal with a limited capacity of the wharf. Findings of Hu et al. (2014), and Zhou and Kang (2008) also indicate that berthing time and the strategy of Quay Crane (QC) allocation in association with the ship's arrival time will significantly increase the ship's fuel consumption and emission as well as the utilization of wharf and quay crane without undermining the service quality. In general, for container terminal systems, efficient berth and QC scheduling will have a great impact on the improvement of operational efficiency and customer satisfaction ( Ricardianto et al., 2022b; Pahala et al., 2021; Widiyanto et al., 2021; Lu & Xi, 2010). Therefore, the result of this research is in line with the theoretical review and the results of previous related studies, because some research reveals that Crane Operator Waiting Time has a significant contribution to the variable of Berthing Time. It means the variable of Crane Operator Waiting Time partially contributes positively and significantly to Berthing Time.

### *5.6. Indirect Contribution of Truck Waiting Time through Box Crane Hour on Berthing Time*

The total influence given by Truck Waiting Time to Berthing Time is the direct influence added by indirect influence as big as 0.629. If the value of direct influence is bigger than the value of indirect influence, then Box Crane Hour is not a good intervening variable. The result of this research is in line with the study of Chargui et al. (2021) stating that there is an obstacle in the truck parking distribution with the target to reduce the truck congestion in the relevant stacking yard by minimizing the ship departure time. Stojaković and Twrdy (2019) also explain the different number of trucks assigned to one crane at the wharf can contribute to the productivity of the crane and all subsystems in the berthing area. Thus, it proves that the variable of Box Crane Hour does not contribute directly to that study.

### *5.7. Indirect Contribution of Crane Operator Waiting Time through Box Crane Hour on Berthing Time*

The total influence given by Crane Operator Waiting Time to Berthing Time is the direct influence added by indirect influence as big as 0.355. If the value of direct influence is bigger than the value of indirect influence, then Box Crane Hour is not a good intervening variable. Based on the calculation it is known that the value of direct influence is bigger than the value of indirect influence. The result of this research is in line with the study of Chargui et al. (2021), stating that the allocation of quay cranes correlates with minimizing the ship's departure time. The study by Hu et al. (2014), and Zhou and Kang (2008) mentions that the berthing time and allocation strategy of Quay Crane (QC) contribute to the ship's departure time and will significantly increase the utilization of wharf and quay crane without lowering service quality. Thus, it proves that the variable of Box Crane Hour does not contribute directly to that study. Finally, based on the calculation through Path Analysis, Box Crane Hour as the intervening variable cannot mediate the relationship between Truck Waiting Time and Crane Operator Waiting Time to Berthing Time. Based on some discussions and by comparing some other research, it can be explained that the four variables in this research, namely; Truck Waiting Time, Crane Operator Waiting Time, Box Crane Hour, and Berthing Time can be regarded as a combination of variables as a novelty. As another novelty, the variable of Box Crane Hour cannot mediate the relationships with three other research variables.

## 6. Conclusion

Some results of the hypothetical test state that the significantly-contributing hypotheses are the variables of Truck Waiting Time to Berthing Time, Crane Operator Waiting Time to Berthing Time, and Crane Operator Waiting Time to Box Crane Hour. Whereas two hypotheses do not contribute, namely the variable of Truck Waiting Time to Box Crane Hour and the variable of Box Crane Hour to Berthing Time. The management of Pelabuhan Indonesia II as the port administrator is expected to shorten the Berthing Time to give satisfaction to the shipping companies as the users of Terminal 3 in the oceangoing area of the Port of Tanjung Priok by prioritizing the improvement of Truck Waiting Time and Crane Operator Waiting Time to contribute directly to the Box Crane Hour and the Berthing Time. To minimize the crane operator waiting time, policies from the Management of Pelabuhan Indonesia II are necessary to control the partner in terms of loading-discharging equipment to ensure the crane operator can be disciplined with the time for starting to work in the field and ask the partner in term of loading-discharging equipment to give warnings and sanctions to the crane operators who are frequently late to work.

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