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The Role of Effective Time in Relation to Equipment Utilization on Ship Service Performance

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Abstract: This research aims to determine the relationship and influence among factors affecting ship service performance. The research method in this study is quantitative regression analysis using Smart PLS 3.2.9 software. Employing regression analysis with the independent variables being ship service performance represented by Availability level and equipment usage time, the dependent variable being equipment utilization, and the mediating variable being effective time. The results of this research indicate that Availability level has a positive impact on effective time and employee performance, equipment usage time has a positive impact on ship service performance but not on effective time, and effective time has a positive impact on ship service performance.

Keywords: Effective time, Equipment Utilization, Service Performance

1. Introduction

As time progresses and the increasing flow of goods in Indonesia with all its dynamics, the rapid development of technology has had a very positive impact on the development of sea transportation due to the growing human need for efficient, practical, fast, and safe goods delivery, free from the risk of damage caused by weather or other factors (Rahayu, 2021).

Maritime transportation is a crucial component of the transportation system and contributes significantly to global trade (Fratila et al., 2021). Transportation is a crucial element in the economy of a country. Without transportation, the movement of goods and people would be hindered (Handoko et al., 2020). Effective maritime transportation should be complemented by efficient port operators, which are companies providing loading and unloading services, ultimately contributing to the smooth distribution of goods. Services are activities provided by one party to another (Koetler, 2008:83). Essentially, they are intangible and do not involve any ownership rights. The role of transportation services is particularly crucial in today's era of globalization, especially for companies operating in the field of logistics services. Ports and port management companies offering these services must deliver their services efficiently and effectively, meaning that the promised services are provided and meet the established standards within the specified time frame (Anggraeni & Alhempi, 2021).

Maritime transportation, particularly the shipment of goods, has undergone a highly beneficial systemic change with the emergence of containers, which have become an essential tool for sea freight and cargo transport (Kesaulya & Angwarmasse, 2023). A significant

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transformation has occurred in the system, primarily with the introduction of containers as a new mode of transportation. The incorporation of the container shipping sector is essential in the plan to enhance national competitive edge (Gena et al., 2020). Loading and unloading involve the transportation of goods from sea to land or vice versa (Defrianto & Purwasih, 2022). Over time, the increased usage of containers has led to issues at ports. The challenge at hand is the excessive stacking of containers at the port. There are numerous reasons why this problem arises, including ineffective loading and unloading systems, as well as inadequate equipment for transferring goods to or from ships.

Handling the loading and unloading of containers that can be managed by container terminals, using equipment designed for faster mobilization such as multipurpose cranes, gantry cranes, mobile cranes, and container cranes, is a desirable condition for the maritime transportation sector. The loading and unloading company is a partner or collaborator in the cargo loading and unloading process at the port (Rasidi et al., 2023). PT Mustika Alam Lestari is a company engaged in container loading and unloading services that operate using berths 214 and 300 at the Tanjung Priok port as partners of PT Multi Terminal Indonesia (MTI). To realize fast, safe, and smooth service for the management of cargo shipments, the cargo delivery process requires more efficient performance from the moment the ship berthing, the loading and unloading of cargo from the ship or onto the ship, to the management of various documents (Chrisnawati & Wiyanto, 2016).

Evaluating the seamless operation of a container terminal in serving cargo transportation activities and its future development requires the use of the container terminal's performance as an essential indicator (Junaid et al., 2020). The issues currently faced at Terminal 300 of PT Mustika Alam Lestari include inadequate Container Crane equipment, equipment utilization, unstable cargo loading and unloading productivity, and suboptimal ship service standards. Ship service time, cargo loading and unloading time, and equipment utility at the port are decisive factors for the port's success in providing services to port users. Especially in the loading and unloading activities, if the implementation of loading and unloading services at the port is not effective, it can lead to losses for various parties (Wiranata, et al., 2021). Chrisnawati & Wiyanto (2016) in their research discuss the impact of idle time on the loading and unloading productivity at PT Mustika Alam Lestari. They explain that changes in container loading and unloading performance are attributed to a 74% change in idle time percentage, with the remaining explained by other factors. This study aims to assess the ship service performance in mooring and cargo handling activities at the port. The findings are valuable for enhancing operational service performance, calculating the smoothness and sequence of these activities, and serve as a basis for consideration and calculation of port services.

2. Literature Review

2.1. *Effective Time*

Effective Time is the actual time (Real Time) used by the ship while berthed at the terminal for loading and unloading activities (Gurning et al., 2007). The research by Suyadi et al., (2010) states that there is a positive and significant relationship between effective time and ship service performance. This implies that the higher the value of effective working time, the higher the value of service performance.

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In accordance with the decision of the Director-General of Sea Transportation Number: Um.002/38/18/DJPL-2011 regarding the standard performance of operational services, for the operational performance of loading and unloading, only 2 points are considered effective in ship work at berth (ET:BT) because these two points have a significant impact on the loading and unloading during Berthing Time.

Effective Time (ET;BT) is the ratio between Effective Time and Berthing Time, which is an indicator related to berthing services. Effective Time is the total hours a ship is actually used for loading and unloading while at the berth/wharf, measured in hours. Berthing Time is the total time available for berth operation to serve the ship, also measured in hours. ET:BT is expressed as a percentage (%). The indicators of Effective Time, Berthing Time, loading and unloading performance, and equipment operational readiness are classified as good if they meet or exceed the standard, satisfactory if the achievement is between 90-100%, and less satisfactory if the achievement is less than 90%.

2.2. Equipment Utilization

Equipment utilization is a measure of the time during which a piece of equipment is actually engaged in activities according to its intended function, and it is expressed as a percentage. According to Lasse (2014:116), the word 'utilization' means the effective working time of the equipment, expressed in hours or as a percentage. The figures for effective working time are obtained from the equipment's logbook or its hour meter. The utility of equipment in this research consists of two dimensions: Availability and usage time.

Availability can help a company provide the best service to its customers. Availability is a measure of the working ability of loading and unloading equipment. Availability is the equipment's ability to lift cargo in each cycle; the cargo arriving at the terminal is the result of container loading and unloading, and the equipment used (Purnomo & Rumambi, 2016). Selasdini et al., (2018) state in their research that there is a relationship or influence between equipment availability and the productivity performance of terminal loading and unloading.

Usage time significantly affects its performance, especially when the equipment is limited, forcing it to work continuously (Umar, 2022). The usage time has a significant negative impact, both partially and simultaneously, meaning that the higher or older the equipment's age, the lower the effectiveness performance value (Sari, 2021). Machine operating hours are the total hours that machines/equipment operate during a specific period (month, year). Available hours represent the time provided for operators to use the equipment during a particular period (month, year). The figures for effective equipment working time are typically obtained from a logbook or from the equipment's hour meter.

$$Utilization = \frac{\text{Total Machine Operating Hours}}{\text{Available Hours}} \text{ x } 100\%$$

2.3. Service Performance

Performance is essentially the execution of tasks or the outcome of implementing work (Tanasale et al., 2023).Operational service performance is the measurable work output achieved by the port in providing services to ships, goods, and utility facilities and equipment during a specific time period and unit (Directorate General of Sea Transportation, 2011). Performance

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indicators for port services, commonly used nowadays, can be categorized into at least three groups: output indicators, service indicators, and utility indicators (Uguy, et al., 2015). The analysis of Ship Flow Performance is based on Service Indicators, which are closely related to information about the duration of ship service within the port's working environment (Uguy, et al., 2015).

a. Service time in waters is from the moment the ship is at anchor until it is tied up at the and vice versa.
   1) Waiting Time (WT)
      Waiting time here refers to the time a ship waits for mooring, pilot, or tugboat services.
   2) Postpone Time (PT)
      PT or delayed time that is unproductive while the ship is in the harbor waters between the anchorage location before/after performing activities, expressed in hours.
   3) Approach Time (AT)
      AT or the amount of time used during pilot service, from when the ship moves from the anchorage to tying up at the berth, and vice versa.
b. Service time at the berth is calculated from the time the ship is tied up at the berth until the lines are released, or the total number of hours the ship spends at the berth.
   1) Turn Round Time (TRT)
      TRT is the total hours a ship spends in the port, calculated from the ship's arrival at the anchorage location to its departure from the anchorage location, expressed in hours.
   2) Berthing Time (BT)
      BT is the total hours a ship spends at the berth, from the time the ship is tied up until the lines are released at the berth.
   3) Effective Time (ET) / Operation Time (OT)
      Effective time is the actual time used for loading and unloading activities, expressed in hours.
   4) Not Operation Time (NOT)
      NOT is the total hours when the ship is planned not to work while at the berth, including rest periods and waiting time for labor, as well as the time spent waiting to leave the berth, expressed in hours.
   5) Idle Time (IT)
      IT is the total hours of work that remain unused during the loading and unloading activities at the berth.

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2.4. Research Framework and Hypothesis

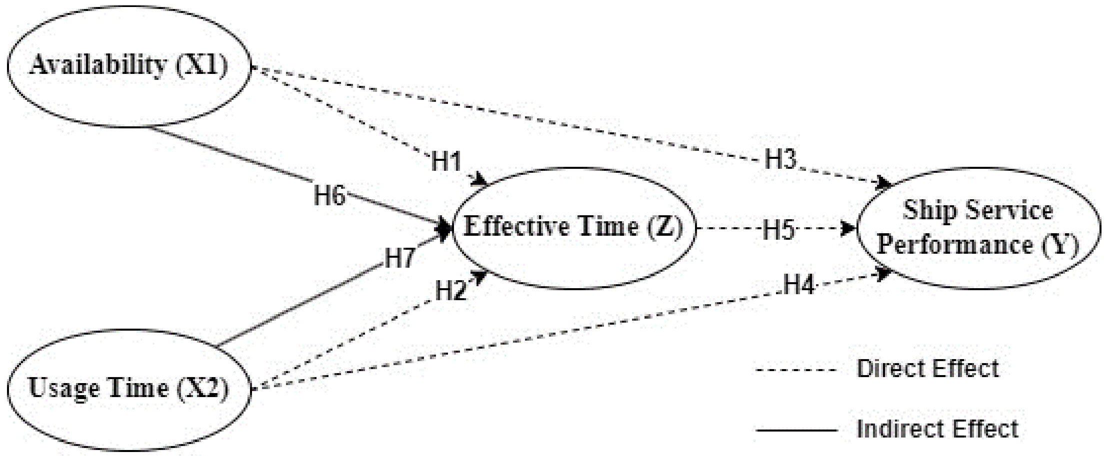

Figure 1. Research Framework

In quantitative research, hypotheses are a crucial component of a study. Sugiyono (2017: 63) states that hypotheses are provisional answers to research problem formulations, where the research problem is expressed in the form of question sentences. In this research, hypotheses are used as guidelines for the study to be conducted. The proposed hypotheses in this study are as follows:

H1: The Availability has a positive impact on Effective Time.

H2: Usage Time has a positive impact on Effective Time.

H3: The Availability has a positive impact on Ship Service Performance.

H4: Usage Time has a positive impact on Ship Service Performance.

H5: Effective Time has a positive impact on Ship Service Performance.

H6: The Availability has a positive impact on Ship Service Performance on through effective time.

H7: Usage Time has a positive impact on Ship Service Performance on through effective time.

3. Research Method

This research was conducted at Terminal Mustika Alam Lestari. The research approach used was quantitative, and using structural equation modelling analysis. The type of data utilized was secondary data, specifically the performance reports of the terminal for the year 2022. The data analysis technique employed was the mediation regression analysis using Smart PLS 3.2.9 software with the product of coefficient method, often referred to as the Sobel test. The dependent variable was ship service performance (Y), the independent variable was Availability (X), and the mediating variable was effective time (Z).

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4. Results and Discussions

4.1 Data Recaps

The following is a table of research questionnaire data recaps regarding the equipment ulitization (Availability 'X1' and Usage Time 'X2'), effective time (Z), and ship service performance (Y) of MV. Ever Order at Terminal PT. Mustika Alam Lestari 2022.

The table below shows the data recaps of equipment utilization (X) of MV. Ever Order at Terminal PT. Mustika Alam Lestari 2022.

Table 1
Data Recaps of Equiqment Utilization**.**

Ship	Month Period (2022)	Equipment Utilization (X)		
		Availability (X1)		*Usage Time (X2)*
		The total time equipment is ready for use (X1_1)	Operation time (X1_2)	Equipment operational readiness (X2_1)
MV. EVER ORDER	1	28	58	93
	2	37	65	89
	3	33	62	84
	4	30	51	86
	5	28	53	80
	6	31	51	78
	7	34	54	88
	8	34	48	92
	9	38	43	90
	10	34	52	89
	11	29	47	93
	12	30	58	96

Source : Performance Report of Terminal OP 2022 PT. Mustika Alam Lestari

The table below shows the data recaps of effective time (Z) of MV. Ever Order at Terminal PT. Mustika Alam Lestari 2022.

Table 2
Data Recaps of Effective Time.

Ship	Month Period (2022)	Effective Time (Z)			
		Operational Service Performance			
		The total time of ship berthing (Z1)	Ship resting time (Z2)	Time of releasing ropes - pilot descent (Z3)	Wasted time while berthed (Z4)
MV. EVER ORDER	1	44.30	1.00	0.13	2.17
	2	48.10	1.00	0.17	3.69
	3	54.76	1.00	0.17	4.88
	4	51.30	1.00	0.13	4.25

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	5	24.40	1.00	0.15	2.30
	6	49.30	1.00	0.17	3.90
	7	39.70	1.00	0.15	2.60
	8	46.70	1.00	0.13	2.94
	9	47.50	1.00	0.15	4.53
	10	33.40	1.00	0.13	1.10
	11	32.10	1.00	0.15	1.42
	12	31.90	1.00	0.13	1.14

Source: Ship Performance Report 2022 PT. Mustika Alam Lestari

The table below shows the data recaps of ship service performance (Y) of MV. Ever Order at Terminal PT. Mustika Alam Lestari 2022

Table 3
Data Recaps of Ship Service Performance.

Ship	Month Period (2022)	Ship Service Performance(Y)								
		WT (Y1)	PT (Y2)	AT (Y3)	NOT (Y4)	IT (Y5)	ET (Y6)	BWT (Y7)	BT (Y8)	TRT (Y9)
MV. EVER ORDER	1	0.70	8.15	1.00	3.80	2.17	38.30	40.50	44.30	46.00
	2	2.30	22.00	1.00	5.30	3.69	39.10	42.80	48.10	51.30
	3	0.60	4.17	1.00	1.43	4.88	48.45	53.33	54.76	56.36
	4	0.70	1.58	1.00	12.80	4.25	34.30	38.60	51.30	53.00
	5	0.80	5.33	1.00	4.00	2.30	35.20	37.60	24.40	43.40
	6	0.60	17.09	1.00	5.30	3.90	40.20	44.00	49.30	50.90
	7	0.70	25.46	1.00	4.10	2.60	33.00	35.60	39.70	41.30
	8	0.40	24.33	1.00	4.80	2.94	39.00	42.00	46.70	48.20
	9	0.50	27.41	1.00	5.20	4.53	37.80	42.30	47.50	49.00
	10	0.80	9.10	1.00	5.70	1.10	26.60	27.70	33.40	35.20
	11	0.60	8.92	1.00	6.20	1.42	24.40	25.80	32.10	33.70
	12	0.70	0.00	1.00	4.40	1.14	26.40	27.50	31.90	33.60

Source: Ship Performance Report 2022 PT. Mustika Alam Lestari

4.2 Measurement Model (Outer Model)

Validity & Reliability Test

In determining the convergent validity of an indicator, you can assess it based on the factor loading values (outer loading), which should exceed the minimum threshold. The values in this test should ideally be greater than 0.7 (Muhson, 2022). However, there is an exception for exploratory research; if the factor loading value is 0.6, it can still be considered acceptable (Yana et al., 2015).

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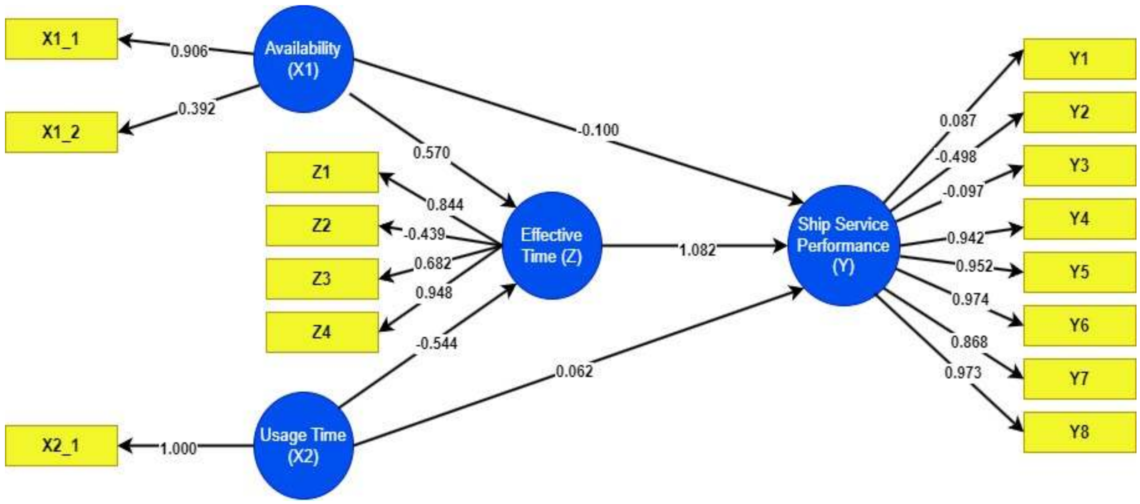

Fig. 2. Result of First Running PLS Algorithm

After identifying indicators with loading values below the threshold, the next step is to remove all of those indicators. The figure below illustrates the final outcome of the software after removing several indicators.

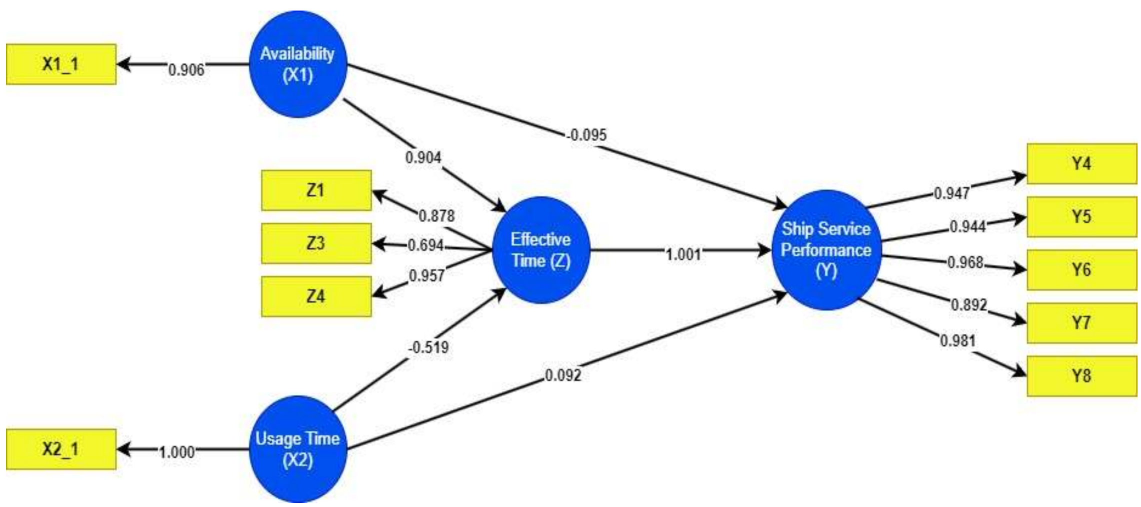

Fig. 3. Result of Final Running PLS Algorithm

As for testing the validity of a factor variable, it can be assessed by the Average Variance Extracted (AVE) value, which should be above 0.5. The table below shows the initial AVE values before removing some indicators.

Table 4
Result of Average Variance Extracted (AVE).

Variabel	Average Variance Extracted (AVE)
Availability (X1)	1.000
Usage Time (X2)	1.000
Effective Time (Z)	0.723
Ship Service Performance (Y)	0.897

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After removing several indicators that did not meet the criteria, it can be seen in the table above that the AVE values for all factors are now above 0.5. Therefore, based on both the outer loading values and AVE values meeting the criteria, it can be concluded that this research model is valid.

4.3 Structural Model (Inner Model)

Path Coefficient Analysis

Path coefficient signifies the influence of exogenous factor (X) values on the endogenous factor (Y), exogenous factor (X) on the mediating factor (Z), and mediating factor (Z) on the endogenous factor (Y). The value ranges between 0 and 1 and can be either positive or negative**.** The table below shows the factor that influence mediating factor (Z).

Table 5

Path Coefficient on Effective Time (Z).

Variable	Effective Time (Z)
Availability (X1)	0.504
Usage Time (X2)	-0.519

The path coefficient values for the combined data in this study are shown in the above table, which shows that the availability positively impact effective time and the usage time negatively impact effective time.

The table below shows the factor that influence endogenous factor (Y).

Table 6

Path Coefficient on Ship Service Performance (Y).

Variable	Ship Service Performance (Y)
Availability (X1)	-0.095
Usage Time (X2)	0.032
Effective Time (Z)	1.001

The path coefficient values for the combined data in this study are shown in the above table, which shows that the availability and effective time positively impact ship service performance. The usage time negatively impact Ship service performance.

R-Squared (R^2) Analysis

On the dependent construct is evaluated using R^2. The R^2 value is used to measure the degree of variation in the change of the independent variable to the variable (Jansen, 2019)

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Table 7
Result of R-Squared Analysis.

Variable	R-squared (R^2)
Effective Time (Z)	0.476
Ship Service Performance (Y)	0.853

Based on table 7, the effective time R-square value is 0.476, which means that the variability of 47.6% effective time can be explained by availability and usage time. Ship service pervormance R-square value is 0.853, which means that the variability of ship service performance explained by availability, usage time, and effective time is 85.3%. While the remaining 14.7% is explained by other variables not examined in this model.

4.4 Hypothesis Analysis

Next, hypothesis testing in SmartPLS can be carried out using bootstrapping. Hypothesis testing can use the values of T-statistics, the original sample values, and P-values. If P-values < 0.1, then the factor has a significant impact on courier performance. Furthermore, the T-statistic value should be greater (>) than the T-table (1.782). Regarding the original sample value, if (O) is positive, then the factor has a positive impact on ship service performance.

Table 8
Result of Hypothesis Analysis.

	Original Sample (O)	T Statistics	P Values
Availability (X1) -> Effective Time (Z)	0.504	1.831	0.068
Usage Time (X2) -> Effective Time (Z)	-0.519	2.097	0.036
Availability (X1) -> Ship Service Performance (Y)	-0.095	0.418	0.676
Usage Time (X2) -> Ship Service Performance (Y)	0.032	0.103	0.918
Effective Time (Z) -> Ship Service Performance (Y)	1.001	2.718	0.007
Availability (X1) -> Effective Time (Z) -> Ship Service Performance (Y)	0.504	1.562	0.119
Usage Time (X2) -> Effective Time (Z) -> Ship Service Performance (Y)	-0.519	1.338	0.181

Based on the table, for Availability (X1), it has a P-value of 0.068 (below 0.1) and a T-statistics value of 1.831, which is bigger than the T-table value of 1.782. Based on these two values, the availability factor significantly affects effective time. The original sample value (O) is positive, which indicates a positive relationship. Thus, it can be concluded that the first hypothesis for H1 is accepted, which is that Availability has a positive and significant effect on effective time.

For usage time (X2), it has a P-value of 0.036 (less than 0.1) and a T-statistics value of 2.097, which is bigger than the T-table value of 1.782. Based on these two values, usage time significantly affect effective time. The original sample value (O) is negative, indicating a positif

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relationship. Thus, it can be concluded that the second hypothesis for H2 is accepted, which is that usage time has a positive and significant effect on effective time.

Availability (X1) has a P-value of 0.676 (more than 0.1) and a T-statistics value of 0.418, which is smaller than the T-table value of 1.782. Based on these two values, availability does not significantly affect ship service performance. The original sample value (O) is negative, indicating a negative relationship. Thus, it can be concluded that the third hypothesis for H3 is rejected, which is that availability does not have a positive and not significant effect on ship service performance.

For usage time (X2), it has a P-value of 0.918 (more than 0.1) and a T-statistics value of 0.103, which is smaller than the T-table value of 1.782. Therefore, based on these two values, usage time does not significantly affect ship service performance. The original sample value (O) is positive, indicating a positive relationship. Thus, it can be concluded that the fourth hypothesis for H4 is accepted, which is that usage time has a positive but not significant effect on ship service performance.

Effective time (Z) has a P-value of 0.007 (less than 0.1) and a T-statistics value of 2.718, which is greater than the T-table value of 1.782. Based on these two values, effective time significantly affects ship service performance. The original sample value (O) is positive, indicating a positive relationship. Thus, it can be concluded that the fifth hypothesis for H5 is accepted, which is that effective time has a positive and significant effect on ship service performance.

Availability (X1) has a P-value of 0.181 (more than 0.1) and a T-statistics value of 1.338, which is smaller than the T-table value of 1.782. Based on these two values, availability does not significantly affect ship service performance on through effective time. The original sample value (O) is positif, indicating a positive relationship. Thus, it can be concluded that the sixth hypothesis for H6 is accepted, which is that availability has a positive but not significant effect on ship service performance on through effective time.

Usage Time (X2) has a P-value of 0.119 (more than 0.1) and a T-statistics value of 1.338, which is smaller than the T-table value of 1.782. Based on these two values, usage time does not significantly affect ship service performance on through effective time. The original sample value (O) is negative, indicating a negative relationship. Thus, it can be concluded that the seventh hypothesis for H7 is rejected, which is that usage time has a negative and not significant effect on ship service performance on through effective time.

Here is a table of the hypothesis testing results for the study.

Table 9
Hypothesis Results.

Hypothesis	Description	Act
H1	Availability has a positive impact on effective time.	Accepted
H2	Usage has a positive impact on effective time.	Accepted
H3	Availability has a positive impact on ship service performance.	Rejected

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H4	Usage time has a positive impact on ship service performance.	Accepted
H5	Effective time has a positive impact on ship service performance	Accepted
H6	Availability has a positive impact on Ship Service Performance on through effective time	Accepted
H7	Usage Time has a positive impact on Ship Service Performance on through effective time	Rejected

This research supports the earlier study by Suyadi et al., (2010), which states that there is a positive and significant relationship between effective time and ship service performance. The research by Selasdini et al., (2018) mentions a relationship or influence between equipment availability and performance, which contradicts the findings of this study, where equipment availability does not directly impact ship service performance. However, the results of this research can support Selasdini et al., (2018), where equipment availability has a positive relationship with equipment service performance through effective time. Research by Sari (2021), which states that the usage time of equipment has a significant negative impact, both partially and simultaneously, meaning that the higher or older the equipment's age, the lower the effectiveness performance value, contradicts the findings of this study. In this research, the usage time of equipment has a positive relationship with ship service performance. The results of this research can support Sari (2021), where the usage time of equipment has a negative relationship with service performance, meaning that the higher the usage time, the lower the ship service performance value.

5. Conclusion

Based on the conducted research, it is evident that there is a relationship among variables, including availability and usage time as independent variables (X), effective time as a mediating variable (Z), and ship service performance as the dependent variable (Y). Equipment utilization first dimension is Availability, has a positive influence on effective time, negative impact on ship service performance, and positive impact on ship service performance on through effective time. Equipment utilization second dimension is Usage time, has a positive influence on effective time, positive impact on ship service performance, and negative impact on ship service performance on through effective time.

6. Implication

Based on the results of this research, theoretical and practical implications can be presented as follows:

a. Theoretically, this research provides scientific justification regarding the Role of Effective Time, Level of Preparedness, and Equipment Utilization Time on Ship Service Performance at PT. Mustika Alam Lestari.
b. Practically, the results of this research are used as a solution for stakeholders involved in PT. Mustika Alam Lestari to maximize the standard ship performance service by minimizing Idle Time (IT) and Not Operation Time (NOT).

7. Research Limitations

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This research only explores factors influencing ship service performance specifically focusing on equipment utilization. Based on this, future research could examine ship service performance from other factors that have not been addressed. Furthermore, the researcher recommends that future studies analyze the overall performance of ships berthing at the terminal over a specific period.

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