

The Performance Level of Shipping Signs and the Depth of Shipping Channels Contribute to Integrated Port Time with the Number of Ship Visits as a Moderating Variable

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Abstract

In Indonesian seas, shipping signs' poor functionality might make it difficult for ships to navigate. Shipping accidents are more likely as a result, particularly when visibility is poor, like at night or in inclement weather. Analyzing the impact of shipping sign performance level and channel depth on the number of ship visits, the impact of shipping sign performance level, channel depth, and ship visitation on integrated port time, and the impact of shipping sign performance level and channel depth on integrated port time with the number of ship visits as a moderating variable are the goals of this study. The research methodology employed in this study is quantitative. A judgment sampling approach combined with a non-probability sampling technique was chosen by the researchers for this investigation. SPSS software was utilized by the researchers. The findings of the analysis indicate that both the channel depth and the level of performance of shipping signs have an impact on integrated port time. Additionally, the variable number of ship visits can moderate the relationship between the channel depth and integrated port time as well as the level of performance of shipping signs.

Keywords: *Level of Shipping Sign Performance, Integrated port time, Channel Dredging, Number of Ship Visits*

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INTRODUCTION

PT Pertamina (Persero) is an integrated national energy company, operating in the oil, gas, and renewable energy sectors. In 2021, Pertamina established six subholdings to help the company become a global energy player (CNBC, 2021). Pertamina as the parent company (Holding Company) is expected to integrate and optimize all logistics activities in the Pertamina Group from Upstream to Downstream to be able to provide optimal margins in a consolidated manner for the Pertamina Group. Meanwhile, various business activities that were previously managed as the company's core business will be carried out by related subholdings, where these subholdings are directly responsible for operating ports and ships in the energy distribution supply chain process throughout Indonesia. In its implementation, the Pertamina Group is required to optimize distribution costs and operate ships and ports excellently across all Pertamina operating units. This can be

achieved by scheduling cargo distribution through integrated sea transportation modes, superior ship operating performance and optimal management of port activities through achieving effective and efficient Integrated Port Time (IPT) (Pertamina Integrated Port Time Management Guidelines No. A3-001/L20000/2021-S9). Integrated port time (IPT) is a concept that refers to the time required for various processes occurring within a port, from ship arrival, loading and unloading, to ship departure. Integrated port time encompasses various aspects, including ship waiting time at the port before and after loading and unloading, the time required for administrative processes, and the time required for Performance Levels and other services. Integrated port time is an important indicator in evaluating the operational efficiency of a port, as it can reflect the overall performance of the logistics and management processes within it (Kurniawan et al., 2019). Integrated port time is influenced by various factors, including the shipping lane Performance Level and the number of ship calls (Aji et al., 2022).

Sub Holding Refining & Petrochemical (SH R&P) or known as PT Kilang Pertamina Internasional (PT KPI) is a Sub Holding that is responsible for managing refineries and producing fuel & petrochemicals. SH R&P has 6 (six) refineries, one of which is Refinery Unit IV (RU IV) Cilacap. PT Kilang Pertamina Internasional RU IV Cilacap is a Processing Unit that has the largest production capacity, namely 348,000 barrels/day, and the most complete facilities. This refinery has strategic value because it supplies 34% of national fuel needs or 60% of fuel needs on the island of Java (Nurul & Zulfiati, 2020). PT KPI RU IV Cilacap operates a Self-Service Terminal (TUKS) in Cilacap, a large TUKS with a high volume of ship traffic. TUKS Pertamina Cilacap plays a strategic role in supporting the distribution of energy throughout Indonesia, originating from PT KPI RU IV Cilacap.

As part of managing the safety and smoothness of shipping, TUKS Pertamina Cilacap is obligated to provide adequate port facilities and shipping signs. Based on Minister of Transportation Regulation (PM) Number 20 of 2017, each TUKS is required to provide clear and effective shipping signs to guide vessels passing through the area. The provision of these shipping signs aims to ensure the safety and smoothness of navigation in Indonesian waters, while also supporting the operational efficiency of the energy sector managed by Pertamina.

In fulfilling the TUKS obligation to provide the shipping signs, RU IV Cilacap requires assistance from PT Pertamina Trans Kontinental (PT PTK) Port Cilacap which comes from the Sub Holding Integrated Marine Logistic (SH IML) because PT PTK Port Cilacap acts as a Port Operator and has Visual Shipping Signs. The function of the Shipping Signs owned by PT Pertamina Trans Kontinental Port Cilacap itself is to support the Operation of Ships that carry out Loading and Unloading of Energy such as Fuel, Gas, Petrochemicals, and so on at TUKS PT Kilang Pertamina Internasional RU IV Cilacap. Shipping Navigation Aids or can also be called Shipping Signs according to Law Number 17 of 2008 concerning Shipping are Equipment or systems located outside the ship that are designed and operated to improve the safety and efficiency of ship navigation and/or ship traffic. Shipping Navigation Aids that are generally used in every Port are Visual Navigation Aids (Nurul & Zulfiati, 2020). Research on Shipping Signs and Water Navigation Aid

Systems (Shipping Signs) at TUKS Pertamina Cilacap is very important because it is one of the strategic ports in Indonesia that plays an important role in logistics and maritime transportation activities, so that the safety and smoothness of navigation in its waters are top priorities. Effective Shipping Signs and Shipping Signs can help direct and protect ships during sailing, reducing the risk of accidents that can cause material losses and environmental impacts (Almeida, 2023). In addition, there is a need to evaluate the condition and effectiveness of existing maritime signs, especially considering the frequently changing weather and ocean currents, which can affect the visibility and functionality of the signs. Suboptimal operation of navigational aids (navigational signs) due to a lack of Performance Levels can also be a potential cause of problems in the navigation of ships in these waters. When maritime signs do not function properly, such as drifting or missing buoys, or dead navigation lights, this can disrupt the navigation systems of ships passing through these waters (Nurul & Zulfiati, 2020).

According to PM No. 20 of 2017 concerning TUKS, In addition to the obligation to provide shipping signs, TUKS Pertamina Cilacap is also obliged to maintain shipping lanes in the TUKS area. Shipping Lane Maintenance according to the Regulation of the Minister of Transportation of the Republic of Indonesia Number: PM 129 of 2016 concerning Shipping Lanes at Sea and Buildings and/or Installations in Waters is a Performance Level carried out periodically which in terms of depth, width and freedom from other shipping obstacles is considered safe and secure for sea transport vessels to navigate. Shipping lane maintenance can also be done by maintaining the depth of the lane through the depth of the lane. Shipping lane depth is a very important activity in maintaining the security and smoothness of ship traffic in certain waters. At the Pertamina Cilacap Terminal, Shipping Lane Maintenance is a crucial aspect in ensuring that operating ships can sail safely and efficiently (Nasution & Kartohardjono, 2019).

The depth of a shipping channel is crucial because if it does not meet the operational needs of ships, it will cause delays in ship departures, disrupt operational schedules, and reduce overall port time efficiency. Dredging is carried out to maintain the depth of the shipping channel so that it meets the technical specifications of ships passing through the route. However, if dredging is not carried out routinely or is carried out too late, silting occurs, requiring ships to wait until certain tide conditions or until dredging is completed. This causes departure delays, disrupts operational schedules, and reduces the ideal turnaround time (Zhen et al., 2025). Disruptions in shipping channel depth can cause problems with integrated port time.

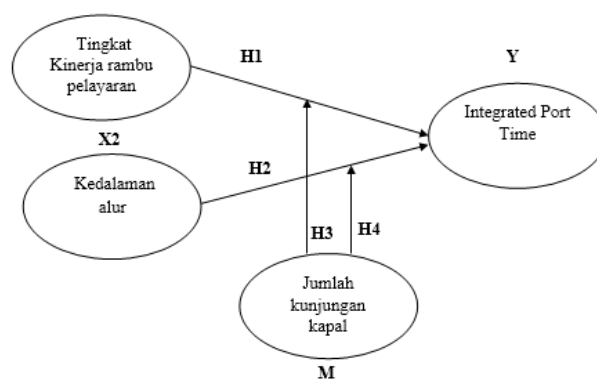
Inadequate channel depth hinders the smooth flow of ships entering and exiting the port, forcing vessels to wait for high tide or queuing for dredging. This prolongs integrated port time, reduces port efficiency, and impacts operational schedules and user satisfaction. If these disruptions persist, ship operators' confidence in the port will decline, ultimately leading to a decrease in ship calls (Zhen et al., 2025).

Delays due to this silting will impact port efficiency (Integrated Port Time), as ships must spend longer in port than planned. The long-term impact is a decline in ship operators' confidence in the port, ultimately reducing the number of ship

visits to the port (Sunitiyoso et al., 2023) shows that the availability and depth of optimal shipping channels through consistent dredging activities is one of the main indicators in port performance, and failure to maintain this aspect will directly impact ship traffic volume, service time, and port operational efficiency.

Ship traffic volume refers to a vessel's ability to operate efficiently and safely over a period of time, including under varying weather and environmental conditions. Ship traffic volume encompasses various factors, such as engine and propulsion system performance, the availability of navigation and safety equipment, and crew readiness to respond to emergency situations. Vessels operating at these terminals must be able to withstand various challenges, including navigating waters that may experience adverse weather conditions or changing shipping lanes due to port expansion and fluctuating performance levels. Disruptions in ship traffic volume can seriously impact operational efficiency, safety, and security at the port. For example, malfunctioning engines or navigation equipment can delay loading and unloading, increase the risk of accidents, and even cause significant economic losses for companies and related industries. (Asadabadi & Miller-Hooks, 2020).

The purpose of this study is to analyze the performance level of shipping signs that are suspected to contribute significantly to integrated port time at the Pertamina Cilacap Terminal. In addition, this study also aims to analyze the effect of channel depth on integrated port time at the terminal. Furthermore, this study focuses on analyzing the role of the number of ship calls as a moderating variable, both in the relationship between the performance level of shipping signs and channel depth on integrated port time at the Pertamina Cilacap Terminal. Thus, this study is expected to provide a comprehensive overview of the factors that influence port time efficiency and their contribution to smooth operations at the Pertamina Cilacap Terminal.



H1: The level of shipping sign performance contributes to integrated port time.

H2: Channel depth contributes to integrated port time.

H3: The level of shipping sign performance can contribute to integrated port time, with the number of ship calls as a moderating variable.

H4: Channel depth can contribute to integrated port time, with the number of ship calls as a moderating variable.

METHOD

Population

According to Sugiyono (2023), a population is a general area consisting of objects or people of a certain quantity and quality that are selected by the researcher to be studied and from which conclusions are drawn. The complete collection of individuals, events, or objects that the researcher wishes to study is called a population (Sekaran & Bougie, 2020). The population of this research is all data from all ship activities starting from the Cilacap Terminal operation.

Data Sources

The data sources for this research are secondary data. Secondary data is data obtained through reading, studying, and understanding other sources, such as company documents (Sugiyono, 2023).

Data Collection Method

The data collection method in this study was conducted through secondary data (Sugiyono, 2023). Secondary data obtained from Pertamina's reports and information related to its vessels provide in-depth insights into the company's operations and the maritime transportation involved. These reports cover various aspects such as the condition of Shipping Signs, implementation of shipping lane depths, achievement of ship Voyage Orders and reports on Integrated Port Time achievements from 2021 to 2024. This study uses percentage data for IPT, where a higher percentage indicates better performance because the visit time is shorter.

Data Analysis Method

In this study, the researcher used SPSS software. This method was designed to validate assumptions, identify the variables used in estimating results, and describe construct relationships and focus on defining the relationship's value. Data analysis is the process of collecting data from all respondents or other data sources (Sugiyono, 2023).

Data Analysis Techniques

Normality Test

The normality test aims to determine whether the dependent and independent variables in a regression model have a normal or non-normal distribution (Ghozali, 2021). The normality test in this study was carried out using the Kolmogorov-Smirnov test. Data is said to be normally distributed if it has a test probability value greater than 0.05. (Ghozali, 2021).

Multicollinearity Test

The multicollinearity test is used to determine whether there is a correlation between the independent variables in a regression model. A good regression model should have no correlation between the independent variables (Ghozali, 2021). So a low tolerance value is the same as a high VIF value ($VIF = 1/Tolerance$). The cutoff

value commonly used to indicate multicollinearity is a tolerance value ≤ 0.10 or equal to a VIF value ≥ 10 (Ghozali, 2021).

Heteroscedasticity Test

The heteroscedasticity test is used to determine whether there is inequality in the variance of residuals from one observation to another in a regression model. A good regression model is one that does not exhibit heteroscedasticity or homoscedasticity (Ghozali, 2021). This homogeneity test was conducted using the Homogeneity of Variation Test and Bartlett's Test. The homogeneity test was conducted to determine whether the data in variables X and Y were homogeneous. The homogeneity test was performed using SPSS version 25.0 for Windows.

Coefficient of Determination

According to Ghozali & Latan (2021) R-square can be seen in endogenous constructs, the R2 value is the coefficient of determination in endogenous constructs. An R2 value of more than 0.67 is interpreted as "good". An R-square value of 0.33 - 0.67 is interpreted as moderate, and an R-square value ≤ 0.33 is interpreted as "weak".

Moderated Regression Analysis (MRA)

This research was conducted using statistical analysis, namely the MRA regression analysis technique. MRA regression analysis is conducted to measure whether there is a relationship between more than one independent variable and the dependent variable with the moderating variable (Ghozali, 2021). The MRA regression analysis equation is as follows :

$$Y = a + \beta_1 X_1 + \beta_2 X_2 + \beta_3 M + \beta_4 M * X_1 + \beta_5 M * X_2 + e$$

Description:

Y: dependent variable

a: regression constant

βX : derived value or increase in independent variable

M: moderating variable

e: error

Hypothesis Testing

According to Ghozali & Latan (2021) research hypothesis testing is performed using probability values. The probability value for research hypothesis testing is a p-value ≤ 0.05 . Research hypothesis testing can be accepted or rejected based on the t-statistic and significance level (p-value). The significance level used in this study is 5% or 0.05. If the significance level is greater than 0.05, the hypothesis is rejected.

RESULTS AND DISCUSSION

Data Description

Descriptive statistics in the study can be seen in the following table :

	N	Minimum	Maximum	Mean	Std. Deviation
Integrated_Port_Time	48	0,93	1,31	1,1218	0,10724
Performance_Level_of_Shipping_Signs	48	0,63	0,98	0,8321	0,14154
Flow_Normalization	48	0,92	1,10	1,0185	0,04776
Ship_Visits	48	64,00	92,00	78,4375	6,48372
Valid N (listwise)	48				

Based on Table 6. above, it can be seen that the Integrated Port Time (IPT) variable has an average value of 1.1218 with a standard deviation of 0.10724. The minimum value of 0.93 and the maximum of 1.31 indicate variations in the efficiency of port visit times. Because IPT is measured as a percentage with the interpretation that a higher value indicates a shorter (more efficient) visit time, then a fairly high average IPT reflects relatively good port performance in managing ship visit times.

For the variable of the Performance Level of Shipping Signs, the minimum value recorded was 0.63 (63%) and the maximum value was 0.98 (98%), with an average value of 0.8321 (83.21%) and a standard deviation of 0.14154. This illustrates that the performance level of Shipping Signs is generally quite high, but experienced a downward trend from April 2023 to December 2024 due to lack of maintenance.

Meanwhile, the channel depth shows a minimum value of 0.92 (92%) and a maximum of 1.10 (110%), with an average of 1.0185 (102%) and a standard deviation of 0.04776. This value indicates that in general the condition of the shipping channel depth is in good condition, although there are still fluctuations during the observation period.

The Ship Visits index, which measures the number of times a ship successfully completes a Voyage Order, has a minimum value of 64.00 and a maximum value of 92.00. The average value of 78.4375 with a standard deviation of 6.48372 indicates that the number of ship visits is quite high, but there is significant variation from one month to another. The following is the research data :

Table 2. Research Data

No	Month	Performance					
		<i>Integrated port time</i>	Level of Shipping Signs	Groove depth	Ship Visits	TKR*KK	NA*KK
1	Jan-21	0,960	0,976	1,060	83	81,0246	87,98
2	Feb-21	1,091	0,976	1,060	69	67,3578	73,14

No	Month	<i>Integrated port time</i>	Performance				
			Level of Shipping Signs	Groove depth	Ship Visits	TKR*KK	NA*KK
3	Mar-21	0,936	0,980	1,060	85	83,3085	90,1
4	Apr-21	1,089	0,977	1,050	79	77,1751	82,95
5	Mei-21	1,051	0,976	1,050	79	77,1198	82,95
6	Jun-21	1,216	0,976	1,050	70	68,334	73,5
7	Jul-21	1,087	0,976	1,040	68	66,3816	70,72
8	Agust-21	1,159	0,952	1,040	80	76,192	83,2
9	Sep-21	1,008	0,953	1,040	77	73,3964	80,08
10	Okt-21	1,216	0,976	1,030	75	73,215	77,25
11	Nop-21	1,207	0,968	1,030	92	89,0836	94,76
12	Des-21	1,258	0,976	1,030	89	86,8818	91,67
13	Jan-22	1,014	0,976	1,030	83	81,0246	85,49
14	Feb-22	1,125	0,964	1,030	78	75,2154	80,34
15	Mar-22	1,093	0,976	1,030	85	82,977	87,55
16	Apr-22	1,075	0,976	1,020	79	77,1198	80,58
17	Mei-22	0,971	0,976	1,020	86	83,9532	87,72
18	Jun-22	0,931	0,976	1,020	77	75,1674	78,54
19	Jul-22	1,198	0,976	1,010	77	75,1674	77,77
20	Agust-22	1,044	0,948	1,010	79	74,8762	79,79
21	Sep-22	1,146	0,905	1,010	78	70,5744	78,78
22	Okt-22	1,121	0,905	1,000	85	76,908	85
23	Nop-22	1,112	0,905	1,000	81	73,2888	81
24	Des-22	1,162	0,905	1,000	85	76,908	85
25	Jan-23	1,102	0,932	0,990	80	74,592	79,2
26	Feb-23	0,973	0,857	0,990	70	59,997	69,3
27	Mar-23	1,031	0,833	0,990	64	53,3312	63,36
28	Apr-23	0,933	0,762	0,980	67	51,0473	65,66
29	Mei-23	0,932	0,762	0,980	71	54,0949	69,58
30	Jun-23	1,229	0,714	0,970	71	50,7153	68,87
31	Jul-23	1,184	0,667	0,970	68	45,3356	65,96
32	Agust-23	1,165	0,667	0,960	67	44,6689	64,32
33	Sep-23	1,158	0,625	0,960	80	50	76,8
34	Okt-23	1,283	0,700	0,950	83	58,1	78,85
35	Nop-23	1,295	0,700	0,940	76	53,2	71,44
36	Des-23	1,311	0,650	0,940	89	57,85	83,66
37	Jan-24	1,195	0,625	0,930	81	50,625	75,33
38	Feb-24	1,244	0,625	0,920	73	45,625	67,16
39	Mar-24	1,034	0,700	0,980	86	60,2	84,28
40	Apr-24	1,032	0,664	1,010	84	55,7928	84,84
41	Mei-24	1,151	0,675	1,040	83	56,025	86,32
42	Jun-24	1,122	0,650	1,080	79	51,35	85,32
43	Jul-24	1,098	0,650	1,090	79	51,35	86,11
44	Agust-24	1,097	0,700	1,100	82	57,4	90,2
45	Sep-24	1,255	0,710	1,100	78	55,3566	85,8
46	Okt-24	1,183	0,700	1,100	84	58,8	92,4
47	Nop-24	1,265	0,675	1,100	76	51,3	83,6
48	Des-24	1,303	0,650	1,100	75	48,75	82,5

Hypothesis Testing: Testing Against the Assumption Residuals Follow a Normal Distribution

Table 3. Normality Test Results
One-Sample Kolmogorov-Smirnov Test

		Unstandardized Residual
N		48
Normal Parameters ^{a,b}	Mean	,0000000
	Std. Deviation	,08939963
Most Extreme Differences	Absolute	,072
	Positive	,057
	Negative	-,072
Test Statistic		,072
Asymp. Sig. (2-tailed)		,200 ^{c,d}

a. Test distribution is Normal.

b. Calculated from data.

c. Lilliefors Significance Correction.

d. This is a lower bound of the true significance.

Based on Table 8, it is known that the results of the test for normality can be seen from the Kolmogorov-Smirnov sig. value of $0.200 > 0.05$, it can be said that this data is normally distributed (Ghozali & Latan, 2021).

Heteroscedasticity Test

Table 4. Heteroscedasticity Test Results
Coefficients^a

Model	Unstandardized Coefficients		Standardized Coefficients	t	Sig.
	B	Std. Error	Beta		
1 (Constant)	6,239	2,930		2,129	,039
Sign Performance Levels Shipping Groove depth	1,234	1,061	3,243	1,163	,251
Ship Visits	7,187	3,478	6,375	1,067	,450
TKR*KK	,077	,037	9,269	1,065	,451
NA*KK	,015	,013	3,685	1,146	,258
	,090	,044	13,192	1,033	,484

a. Dependent Variable: abs

Source: Processed Primary Data (2025)

Based on table 9, it can be seen that the results of the heteroscedasticity test for the independent variable have a significance value > 0.05 , so it can be said that heteroscedasticity does not occur (Ghozali & Latan, 2021).

Multicollinearity Test

The following table shows the multicollinearity results in this study :

Table 5. Multicollinearity Test Results

Model		Collinearity Statistics	
		Tolerance	VIF
1	(Constant)		
	Performance Level of Shipping Signs	,103	5,128
	Groove depth	,102	6,748
	Ship Visits	,201	5,643
	TKR*KK	,102	5,672
	NA*KK	,201	6,854

Source: Processed Primary Data (2025)

Based on Table 4.5, the Tolerance value is >0.1 and the VIF is <10 . Therefore, it can be concluded that the data in this study are free from multicollinearity. This means there is no correlation between the independent variables in this study.

Correlation Test

The following is a correlation test between variables in this study :

Table 6. Correlation Test Results

		Correlations			
		<i>Integrated port time</i>	Performance Level of Shipping Signs	Groove depth	Ship Visits
<i>Integrated port time</i>	Pearson Correlation	1	0,395**	0,096	0,094
	Sig. (2-tailed)		0,006	0,515	0,526
	N	48	48	48	48
Performance Level of Shipping Signs	Pearson Correlation	0,395**	1	0,230	0,113
	Sig. (2-tailed)	0,006		0,116	0,443
	N	48	48	48	48
Groove depth	Pearson Correlation	0,096	0,230	1	0,131
	Sig. (2-tailed)	0,515	0,116		0,374
	N	48	48	48	48
Ship Visits	Pearson Correlation	0,094	0,113	0,131	1
	Sig. (2-tailed)	0,526	0,443	0,374	
	N	48	48	48	48

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

Based on the results of the correlation test in Table 11, it can be seen that the Integrated port time (IPT) variable has a statistically significant relationship with the

Performance Level of Shipping Signs with a correlation coefficient value of 0.395 and a significance of 0.006 ($p < 0.01$). This indicates a fairly strong positive correlation, which means that the higher the performance of shipping signs, the better the IPT value, which in this context indicates a more efficient (shorter) ship visit time. Meanwhile, the relationship between IPT and the variables Channel Depth ($r = 0.096$; $p = 0.515$) and Ship Visits ($r = 0.094$; $p = 0.526$) is not statistically significant. This indicates that variations in dredging activities and the number of ship visits do not have a significant relationship to the efficiency of visit time at the port. The performance of shipping signs significantly contributes to increasing the efficiency of ship visit time (IPT).

Discussion of Research Results

Coefficient of Determination (R²)

Table 7. Results of the Coefficient of Determination (R²) Test

Model Summary ^b				
Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	,552 ^a	,305	,222	,09457

a. Predictors: (Constant), NA_KK, Shipping_Signs_Performance_Level, Channel_Normalization, TKR_KK, Ship Visits

b. Dependent Variable: Integrated_Port_Time

Source : Processed Primary Data (2025)

Based on Table 12, the R-square is 0.552, meaning that the independent variable influences the dependent variable by 55.2%, with the remaining 44.8% influenced by other variables.

F Test

Table 8. F Test Results

ANOVA ^a						
Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	,165	5	,033	3,686	,007 ^b
	Residual	,376	42	,009		
	Total	,540	47			

a. Dependent Variable: Integrated_Port_Time

b. Predictors: (Constant), NA_KK, Shipping_Signs_Performance_Level, Channel_Normalization, TKR_KK, Ship Visits

Source: Processed Primary Data (2025)

Based on Table 13, the sig.F value is $0.007 < 0.05$, which indicates a good model fit (Ghozali & Latan (2021)).

Analisis Regresi MRA (Moderated Regression Analysis)**Tabel 9.** Hasil Analisis Regresi MRA (Moderated Regression Analysis)

Model	Unstandardized Coefficients		Standardized Coefficients		t	Sig.
	B	Std. Error	Beta			
1 (Constant)	12,876	5,144			2,503	,016
Performance Level of Shipping Signs	3,910	1,862	5,161		2,100	,042
Groove depth	17,000	6,105	7,571		2,785	,008
Ship Visits	,182	,065	11,003		2,782	,008
TKR*KK	,045	,023	5,474		2,931	,006
NA*KK	,216	,077	15,994		2,796	,008

a. Dependent Variable : Integrated_Port_Time

Source : Processed Primary Data (2025)

The Moderated Regression Analysis (MRA) regression analysis equation is as follows: $IPT = 12.876 + 3.910 \text{ Shipping Sign Performance Level} + 17.000 \text{ Channel Depth} + 0.182 \text{ Ship Visits} + 0.045 \text{ TKR*KK} + 0.216 \text{ NA*KK}$

a.) First Hypothesis

Table 4.14 shows that the significance value for the Shipping Sign Performance Level variable is $0.042 < 0.05$, meaning the first hypothesis in this study is accepted (Ghozali & Latan, 2021). Therefore, there is an influence of the Level of Shipping Sign Performance on Integrated Port Time.

b.) Second Hypothesis

Table 4.14 shows that the significance value for channel depth is $0.008 < 0.05$, meaning the second hypothesis in this study is accepted (Ghozali & Latan, 2021). So there is an influence of flow depth on Integrated port time.

c.) Third Hypothesis

From Table 4.14, it is known that the significance value is $0.006 < 0.05$, meaning that the third hypothesis in this study is accepted (Ghozali & Latan, 2021). Therefore, the variable Number of Ship Visits is able to moderate the relationship between the Level of Shipping Sign Performance directly and Integrated Port Time.

d.) Fourth Hypothesis

Table 4.14 shows a significance value of $0.008 < 0.05$, meaning the fourth hypothesis in this study is accepted (Ghozali & Latan, 2021). So the variable number of ship visits is able to moderate the relationship between direct channel depth and integrated port time.

Tabel 10. Summary of Hypothesis Testing Results

No	Variabel	P-value	Hasil uji hipotesis
1	Performance Level of Shipping Signs	$0,042 <$	Accepted

No	Variabel	P-value	Hasil uji hipotesis
	on Integrated Port Time	0,05	
2	The depth of the flow contributes to the Integrated port time.	0,008 < 0,05	Accepted
3	The performance level of the shipping signs can contribute to integrated port time with the number of ship visits as a moderating variable.	0,006 < 0,05	Accepted
4	The depth of the channel can contribute to the integrated port time with the number of ship visits as a moderating variable.	0,008 < 0,05	Accepted

Discussion

The Level of Shipping Sign Performance on Integrated Port Time

The significance test result for the Shipping Sign Performance variable is $0.042 < 0.05$, meaning the first hypothesis in this study is accepted (Ghozali & Latan, 2021). Thus, the level of performance of shipping signs influences integrated port time. This efficiency can occur because good shipping sign performance, such as complete signs, beacons, and other navigation systems, can speed up the process of docking, loading, unloading, and departure of ships (Han et al., 2024). The condition that occurred at the Pertamina Cilacap Terminal was that the Shipping Sign Performance Level began to decline in the period from April 2023 to December 2024, affecting the IPT value which increased accordingly during that period.

The relationship between flow depth and integrated port time

The significance value test for flow depth is $0.008 < 0.05$, meaning the second hypothesis in this study is accepted (Ghozali & Latan, 2021). Thus, channel depth influences integrated port time. This means that the more optimal channel depth activities are carried out, the lower or shorter the integrated port time (IPT). This results in better port integrated time performance in handling ships from arrival to departure. This indicates that the continuity and depth of shipping channels play a crucial role in port operational efficiency. A channel that is clear of sediment allows ships to enter and exit smoothly without delays resulting from the risk of grounding or queuing during high tide. This directly reduces ship waiting time and speeds up the loading and unloading process and other port services (Pellegrini et al., 2020).

The performance level of shipping signs can contribute to integrated port time, with the number of ship visits as a moderating variable.

The significance value is $0.006 < 0.05$, meaning the third hypothesis in this study is accepted (Ghozali & Latan, 2021). So the Variable Number of Ship Visits is able to moderate the relationship between the Level of Shipping Sign Performance directly to Integrated Port Time. This opens up room for interpretation that the

contribution of Shipping Signs to the number of ship visits occurs indirectly through the moderating variable of the number of ship visits. The performance of Shipping Signs such as the reliability of beacons, navigation lights, and other auxiliary facilities plays an important role in facilitating and accelerating the loading and unloading process and ship traffic at the port. This has a direct impact on the efficiency of port service time which is reflected in the IPT. When IPT becomes more efficient due to the good performance of Shipping Signs, the port's competitiveness increases, and ultimately will encourage an increase in the number of ship visits (Lorenčić et al., 2021).

Channel Depth Can Contribute to Integrated Port Time, with the Number of Ship Visits as a Moderating Variable

The test results showed a significance value of $0.008 < 0.05$, meaning the fourth hypothesis in this study is accepted (Ghozali & Latan, 2021). Thus, the variable number of vessel visits is able to moderate the relationship between channel depth directly and integrated port time. In Port Performance Theory, port efficiency is greatly influenced by physical infrastructure, such as channel depth, navigation systems, and loading and unloading facilities. One key indicator in assessing port performance is integrated port time (IPT), which reflects the total time a vessel spends in port. Based on this theory, technical factors such as channel depth are included in the operational performance component, which directly impacts port productivity and efficiency (Halpe et al., 2025).

CONCLUSION

Based on the research results, it can be concluded that the level of performance of shipping signs with a significance value of $0.042 < 0.05$ has a significant effect on integrated port time, which means that the better the performance of shipping signs, the more effective the port time will be, although there is still a potential increase in the percentage of time when ships enter during the day. Channel depth is also proven to have a significant effect on integrated port time with a significance value of $0.008 < 0.05$, indicating that even though there are adjustments to the type of ship and the amount of cargo, the depth factor still affects time efficiency, because the less cargo loaded, the shorter the loading time. Furthermore, the number of ship visits acts as a moderating variable that strengthens the influence of the level of performance of shipping signs (sig. $0.006 < 0.05$) and channel depth (sig. $0.008 < 0.05$) on integrated port time. Thus, all research hypotheses are accepted and it can be concluded that both technical shipping factors and the intensity of ship activity contribute significantly to the effectiveness of integrated port time at the Pertamina Cilacap Terminal.

THANK-YOU NOTE

With gratitude, the author would like to thank all parties who have provided support, direction and assistance in the preparation of this journal, both directly and indirectly, so that this research can be completed well.

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