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The Effectiveness of Vessel Traffic Service (VTS) in Monitoring Ship Movement Order and Docking Areas in Surabaya's West Shipping Channel

[1*] Rizky Cahyaningrum, [1]Muhammad Dahri, [1]Diyah Purwitasari, [1]Indah Ayu Johanda Putri

[1]Maritime Polytechnic of Surabaya, Surabaya, Indonesia

*email: hyarzkychy@gmail.com

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ABSTRACT

Vessel Traffic Service (VTS) serves a critical function in maintaining maritime safety and regulating ship traffic order, particularly in congested waterways such as Surabaya's West Shipping Channel. This system is designed to facilitate organized vessel movements, thereby minimizing accident risks and regulatory violations. However, the effectiveness of VTS in supporting the monitoring of ship movement order and berthing areas requires further investigation. This study analyzes the effectiveness of Vessel Traffic Service (VTS) in supporting the monitoring of ship movement order and berthing areas within Surabaya's West Shipping Channel. The research employs a quantitative methodology utilizing simple linear regression analysis. Data collection was conducted through observation and secondary data analysis, subsequently processed using SPSS 22 software. The findings demonstrate that VTS effectiveness significantly influences order monitoring, with a significance value of 0.001 ($p < 0.05$). The coefficient of determination indicates a value of 29.1%, signifying that VTS effectiveness contributes to the orderliness of ship movements and berthing areas. The regression equation reveals that each unit increase in VTS effectiveness results in a 0.470 unit improvement in order monitoring.

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1. INTRODUCTION

The implementation of shipping channels is essential for ensuring maritime safety during port entry and exit operations, as well as facilitating ship movement processing. To achieve shipping safety objectives, collaborative efforts are required from all stakeholders: government entities as regulators, private enterprises as operators, and the maritime community as service users [1]. These channels must maintain safety standards regarding depth, width, and remain free from navigational obstacles. Efficient shipping flow management is crucial for enabling smooth and safe vessel navigation while avoiding hazards. This study focuses specifically on Surabaya's West Shipping Channel.

The Surabaya West Shipping Channel operates under the regulatory framework established by the Decree of the Minister of Transportation of the Republic of Indonesia Number KP 455 of 2016, which determines shipping flows, route systems, traffic procedures, and shipyard areas in accordance with interests in the Surabaya West Shipping Channel (APBS). This channel utilizes a two-way route system with a width of 150 meters, comprising two designated routes: the new channel and the old channel. The new channel maintains a minimum depth of -13 meters LWS

with a length of 39.65 Nautical Miles, while the old channel has a depth of -8.4 meters LWS and extends 4.2 Nautical Miles. Vessels with a minimum draft of 8.5 meters are required to transit through the new shipping channel.

Maritime safety represents a fundamental aspect of shipping operations. Safety and security arrangements in shipping have evolved alongside technological advances and international conventions, incorporating modern safety equipment. Law Number 17 of 2008 also governs shipping security systems. Information management is critical for ship captains, requiring effective information management and communication systems for ship traffic, including vessel movement guidance and alert systems.

The Vessel Traffic Service (VTS) at Tanjung Perak Port has been operational since 2015, aimed at enhancing safety and efficiency while protecting the maritime environment. VTS systems can interact with vessels and provide real-time information regarding traffic conditions within the VTS coverage area. In Surabaya, VTS provides services for vessels operating in both the Surabaya West Shipping Channel (APBS) and the Surabaya East Shipping Channel (APTS).

Currently, Surabaya experiences high shipping channel density. In 2023, the port recorded 14,966 incoming vessels and 15,435 outgoing vessels, with a total of 16,337 ships utilizing docking areas. VTS maintains responsibility for monitoring vessel movements and berthing areas.

Analysis of available data indicates that VTS performance in monitoring vessels through communication systems has not achieved optimal effectiveness. Numerous vessels have reported inactive Automatic Identification Systems (AIS), preventing VTS operators from performing their duties optimally. Essential VTS functions, including the provision of shipping safety information, navigation guidance, and ship traffic organization, are consequently affected and do not comply with established regulations.

Based on previous research findings, the authors identified significant information regarding Vessel Traffic Service (VTS) implementation in port facilities. Research indicates that while VTS improves shipping safety and operational efficiency, service constraints persist. Therefore, this study aims to determine the relationship and influence of Vessel Traffic Service (VTS) effectiveness on order monitoring within the designated area.

2. METHODOLOGY

This research employs simple linear regression analysis within a quantitative research framework. The study utilizes two data sources: primary data obtained directly through questionnaires administered to VTS Surabaya respondents, and secondary data derived from books, journals, and other scholarly sources to complement primary data collection. The quantitative survey methodology is employed to gather data on beliefs, opinions, and variable relationships. This research was conducted at the Type A Navigation District Office Class I Surabaya, specifically within the Vessel Traffic Service (VTS) office.

The independent variable in this study is the Effectiveness of Vessel Traffic Service (VTS). Effectiveness encompasses not only end results but also includes the success of processes required to achieve desired outcomes [2]. The dependent variable is the monitoring of ship movement order and berthing areas, which is influenced by the existing variable of Vessel Traffic Service effectiveness, enabling measurement of the impact provided.

The study population consists of service users in Surabaya's West Shipping Channel, specifically 35 ship agents utilizing Surabaya Vessel Traffic Service facilities. Samples were drawn from all 35 agents transiting through the 39.65 NM APBS at Tanjung Perak Port.

Data collection techniques employed in this study include questionnaires, observations, and literature reviews. Questionnaires were utilized to obtain measurable responses from respondents, field observations were conducted, and literature studies provided theoretical foundations. Data analysis techniques include item validity testing to measure questionnaire validity, reliability testing to assess questionnaire consistency, classical assumption testing to prevent regression analysis problems, simple linear regression analysis to measure variable impact, and Paired Sample T-tests for hypothesis testing.

3. RESULTS AND DISCUSSION

Data collection was conducted through questionnaires administered to respondents, specifically ship agencies operating within the Type A Class I Navigation District of Surabaya and Tanjung Perak Port. Questionnaire distribution was conducted through online surveys using Google Forms, where respondents evaluated each question item. Independent variables were measured through indicators of Vessel Traffic Service role effectiveness, including information quality, traffic management, and navigation assistance. Dependent variables were measured through order monitoring indicators and observation system availability in accordance with P2TL regulations.

3.1 Validity Test

Table 1. SPSS Data Processing Results for Variable X and Y Validity

Statement	Result	R Table	Information
The Effectiveness of the Role of Vessel Traffic Service			
X1	0.712	0.43	Valid
X2	0.819		Valid
X3	0.737		Valid
X4	0.708		Valid
X5	0.503		Valid
X6	0.629		Valid
X7	0.649		Valid
X8	0.706		Valid
X9	0.691		Valid
X10	0.667		Valid
Monitoring of Movement Order and Anchorage Area			
Y1	0.642	0.43	Valid
Y2	0.627		Valid
Y3	0.812		Valid
Y4	0.712		Valid
Y5	0.522		Valid
Y6	0.619		Valid
Y7	0.714		Valid
Y8	0.692		Valid
Y9	0.589		Valid
Y10	0.51		Valid

Source: SPSS 22 Output

The validity test results demonstrate that the calculated r-values for each questionnaire statement component exceed the r-table value of 0.430. These results confirm that the questionnaire data possesses valid results, as all values exceed the 0.430 threshold.

3.2 Reliability Test

The reliability test results indicate that questionnaire variable X (effectiveness of Vessel Traffic Service role) achieved a Cronbach's alpha value of 0.682, which exceeds the reference value of 0.872, confirming that the variable X questionnaire data is reliable. Similarly, the reliability test for variable Y (monitoring movement order and anchorage area) yielded a Cronbach's alpha value of 0.846, confirming that the variable Y questionnaire data from respondents is reliable.

3.3 Classical Assumption Tests

3.3.1 Normality Test

Table 2. Kolmogorov-Smirnov Normality Test Results

One-Sample Kolmogorov-Smirnov Test		Unstandardized Residual
N		35
Normal Parameters^a,b^	Mean	0.0000000
	Std. Deviation	2.73341243
Most Extreme Differences	Absolute	0.101
	Positive	0.078
	Negative	-0.101
Test Statistic		0.101
Asymp. Sig. (2-tailed)		0.200^c,d^

Source: SPSS 22 Output

The normality test results indicate an Asymp. Sig. (2-tailed) value of 0.200. According to normality test requirements, data is considered normally distributed when Asymp. Significance (2-tailed) > 0.05. Therefore, the data is confirmed as normally distributed since the Asymp. Significance (2-tailed) value of 0.200 exceeds 0.05.

3.3.2 Linearity Test

Table 3. Linearity Test Results

ANOVA Table			Sum of Squares	df	Mean Square	F	Sig.
Monitoring * Effectiveness	Between Groups	(Combined)	188.171	9	20.908	3.075	0.013
		Linearity	104.139	1	104.139	15.315	0.001
		Deviation from Linearity	84.032	8	10.504	1.545	0.192
	Within Groups		170.000	25	6.800		
	Total		358.171	34			

Source: SPSS 22 Output

The ANOVA table shows a Deviation from Linearity value of 0.192. The linearity test decision-making criterion states that if the significance value > 0.05, a linear relationship exists between variables X and Y. Therefore, the linear relationship between variables X and Y is confirmed as significant since 0.192 > 0.05.

3.3.3 Heteroscedasticity Test

Table 4. Heteroscedasticity Test Results

Coefficients^a^						
Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	9.424	2.686		3.509	0.001
	Effectiveness	-0.207	0.075	-0.433	-2.763	0.009

a. Dependent Variable: ABS_Res

Source: SPSS 22 Output

The heteroscedasticity test was conducted by regressing the absolute residual value (ABS_Res) against the independent variable. The regression results showed that the effectiveness variable had a significance value of 0.009, indicating heteroscedasticity presence in the model. This test reveals that the homoscedasticity assumption is not met, which may cause inefficient regression parameter estimation.

3.4 Simple Linear Regression Test

The correlation coefficient (R) value is 0.539, indicating a strong relationship between the two research variables. The R-square or Coefficient of Determination (KD) value demonstrates the quality of the regression model formed by independent and dependent variable interaction. The determination coefficient value obtained was 29.1%, indicating that the independent variable (X) contributes 29.1% effect on the dependent variable (Y).

The significance test determines the degree of significance or regression linearity. The criteria are determined based on the significance value test (Sig.), with the requirement that the significance value < 0.05. The significance value obtained was 0.001, meaning the significance is less than the 0.05 criterion. Therefore, the regression equation model based on research data is significant and meets the established criteria.

Table 5. Simple Regression Coefficients

Coefficients^a^						
Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	20.057	4.569		4.390	0.000
	Effectiveness	0.470	0.128	0.539	3.678	0.001

Source: SPSS 22 Output

The simple linear regression coefficient calculation results show a constant coefficient value of 20.057 and a free variable coefficient (X) of 0.470, yielding the regression equation: Y = 20.057 + 0.470X. The constant value of 20.057 indicates that when the effectiveness variable equals zero, the monitoring value is 20.057. The positive value (0.470) in the regression coefficient of the independent variable (effectiveness) illustrates a unidirectional relationship between the independent variable (effectiveness) and the dependent variable (monitoring), meaning each unit increase in the effectiveness variable causes a 0.470 unit increase in monitoring.

3.5 Paired Sample T-Test

The partial t-test results demonstrate that the significance value of Vessel Traffic Service role effectiveness (X) on monitoring ship movement order and berthing area (Y) was 0.001 < 0.05, with a t-calculated value of 3.678 > t-table value of 1.690. Therefore, H_0 is rejected and H_a is accepted, indicating significant effectiveness of Vessel Traffic Service role in monitoring movement order and berthing areas.

3.6 Discussion

This research was conducted to determine and test Vessel Traffic Service role effectiveness in monitoring ship movement and berthing areas in Surabaya's West Shipping Channel using SPSS 22 software. The paired T-test results show a t-calculated value of 3.678 > t-table value of 1.690, with a significance value of Vessel Traffic Service role effectiveness (X) on monitoring ship movement order and berthing area (Y) of 0.001 < 0.05. Based on these results, H_a is accepted and H_0 is rejected, confirming that Vessel Traffic Service role effectiveness significantly affects monitoring of ship movement order and berthing areas in Surabaya's West Shipping Channel, with a determination coefficient value of 29.1% (R-square = 0.290).

The R-square result indicates the ability of Vessel Traffic Service role effectiveness variable to influence monitoring variables of ship movement order and berthing areas. The remaining 70.9% (0.709) represents other variables that can affect monitoring variables of ship movement order and berthing areas in Surabaya's West Shipping Channel. These other variables include harbormaster supervisory roles, inadequate navigation aids, inappropriate guidance officer handling, human resources not implementing regulations properly, and insufficient regulatory frameworks governing resources directly related to berthing area order and ship movement.

The simple linear regression test yielded the equation Y = 20.057 + 0.470X, conforming to the simple linear regression formula Y = a + bX, where X represents the independent variable, Y represents the

dependent variable, a represents the constant, and b represents the regression coefficient.

This equation indicates that each 1% increase in Vessel Traffic Service role effectiveness value results in a 0.470 increase in monitoring ship movement order and berthing area value. The constant of 20.057 means that if Vessel Traffic Service role effectiveness (X) equals zero, then monitoring ship movement order and berthing area (Y) equals 20.057. The regression coefficient of 0.470 for the monitoring ship movement order and berthing area variable indicates a positive relationship between variables X and Y: greater role effectiveness leads to increased order monitoring. The paired sample T-test results confirm significant influence between independent variables (X) and dependent variables (Y), evidenced by the paired T-test result of 3.678 compared to the table value of 1.690 at a 0.05 significance level, confirming H_a acceptance.

4. CONCLUSION

Based on the study entitled "The Effectiveness of Vessel Traffic Service Role in Monitoring Ship Movement Order and Docking Areas in Surabaya's West Shipping Channel," it is concluded that a positive and significant influence exists between Vessel Traffic Service role and ship order monitoring. The paired sample T-test demonstrated significant results between Vessel Traffic Service effectiveness and order monitoring with a significance value of 0.001. The effectiveness contributed 29.1% to movement order and berthing area management in Surabaya's West Shipping Channel, while other variables influenced the remainder. Recommendations for increasing Vessel Traffic Service role effectiveness in Surabaya's West Shipping Channel include implementing e-pilotage services and conducting more comprehensive research.

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