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The Influence of Effective Time: Berthing Time on Berth Occupancy Ratio at Mirah Port, Tanjung Perak.

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Abstract

Objective – This research aims to analyze the impact of Effective Time : Berthing Time on the Berth Occupancy Ratio at Mirah Port, Tanjung Perak, by assessing its efficiency and compliance with operational standards.

Design/methodology/approach – The research applies a quantitative method with simple linear regression analysis. The data were obtained from monthly Performance Standards Reports of KSOP Utama Tanjung Perak from 2020 to 2024. The analysis was conducted using SPSS version 26 to determine the statistical significance of Effective Time : Berthing Time's impact on Berth Occupancy Ratio.

Findings – The analysis shows that the Effective Time to Berthing Time ratio for both 2023 and 2024 consistently falls below the required minimum standard. Despite this, the Berth Occupancy Ratio remains within a safe range and does not surpass the established threshold. Further hypothesis testing demonstrates that there is a significant relationship between the Effective Time to Berthing Time ratio and the Berth Occupancy Ratio. However, this ratio only explains a small portion of the variation in Berth Occupancy Ratio, suggesting that most of the changes are influenced by other factors not covered in this study.

Research limitations/implications – The research is limited to Terminal Mirah and covers only the period from 2020 to 2024. Future research should consider expanding the dataset and including other performance factors.

Practical implications – Terminal Mirah should enhance operational effectiveness through infrastructure optimization, workforce training, and improved cargo handling efficiency to raise Effective Time : Berthing Time values, ensuring optimal Berth Occupancy Ratio utilization.

Originality/value – This research contributes to port management studies by establishing the relationship between Effective Time : Berthing Time and Berth Occupancy Ratio, highlighting the need for improved operational efficiency to meet regulatory standards.

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INTRODUCTION

The rapid advancement of the present era has brought significant changes across various fields of human life. In particular, in the transportation sector, to support the mobility of goods and services in Indonesia. The dynamics of maritime transportation have become a key factor in connecting the thousands of islands in Indonesia, facilitating the more efficient movement of goods and people, and contributing to the nation's economic growth. Ports, as the core of the maritime transportation network, play a vital role in managing and accommodating these movements.

Ports serve as essential elements in ensuring the smooth flow of goods, particularly during the processes of loading and unloading on maritime vessels (Rahayu et al., 2021). The importance of ports in global trade has a significant impact on regions, areas, and even countries (Sianturi et al., 2021)

Indonesia, as an archipelagic country, relies heavily on maritime transportation for the movement of goods between its thousands of islands. Efficient port operations are thus critical for ensuring the seamless flow of national and international trade. Tanjung Perak Port, the second busiest port in Indonesia after Tanjung Priok, plays a vital role in supporting economic activities in the eastern part of the country.

Terminal Mirah, located within the Tanjung Perak Port area, is a multipurpose terminal that handles various types of cargo, including containers, dry bulk, and general cargo. Under the supervision of KSOP Utama Tanjung Perak, the terminal is subject to operational performance standards designed to maintain high service levels and minimize delays. Among these standards are the Effective Time: Berthing Time (ET:BT) and the Berth Occupancy Ratio (BOR), two key performance indicators used to evaluate terminal efficiency.

To ensure the efficiency of port operations, the Indonesian Directorate General of Sea Transportation has issued performance standards, including regulations such as KP-KSOPU.Tpr 1 Tahun 2024 and Peraturan Direktur Jenderal Perhubungan Laut Nomor : HK.103/2/18/DJPL-16. These regulations stipulate that the Effective Time: Berthing Time (ET:BT) should not fall below 65%, while the Berth Occupancy Ratio (BOR) should not exceed 70%. ET:BT measures the proportion of effective working time compared to the total berthing time of a vessel, reflecting how efficiently port operations are carried out. Meanwhile, BOR indicates the percentage of time a berth is occupied, which directly relates to berth availability and capacity management.

Despite these regulations, recent observations at Terminal Mirah show a decline in ET:BT values, particularly in 2023 and 2024, raising concerns about operational efficiency. Although BOR remains within acceptable limits, a low ET:BT indicates suboptimal port performance standards due to inefficiencies in vessel loading and unloading times at the berth.

This study aims to investigate the implementation of port performance standards, particularly focusing on the ET:BT and BOR metrics. Specifically, it seeks to analyze whether there is a significant relationship between ET:BT and BOR at Terminal Mirah, Tanjung Perak. Understanding this relationship is crucial for improving operational strategies, optimizing resource usage, and aligning terminal performance with national maritime regulations.

This study investigates the application of these port performance standards at Terminal Mirah, particularly focusing on how ET:BT influences BOR. By analyzing performance data from 2020 to 2024, the study seeks to identify trends, uncover potential inefficiencies, and provide recommendations for enhancing terminal productivity.

The significance of this research lies in its potential to contribute to port performance management strategies. The findings are expected to help port authorities and terminal operators align operational practices with national regulatory standards and global best practices, ensuring that the port remains competitive in an increasingly globalized trade environment.

THEORETICAL BACKGROUND AND RESEARCH MODEL

Ports are strategic infrastructure that support economic development by enabling the efficient movement of goods and people across regions and countries. According to (Triatmodjo, 2010), port performance is a critical determinant of national and regional economic productivity, particularly for archipelagic countries such as Indonesia. As logistics and supply chain networks become increasingly complex, port efficiency becomes a fundamental factor in maintaining competitiveness in global trade.

Port Performance Standards

According to DJPL Regulation Number: HK 103/2/2/DJPL-17 Concerning Guidelines for Port Operational Service Performance, Operational Service Performance Standards are the work result standards of each service that must be achieved by the Terminal/Port operator in implementing port service, including in the provision of port facilities and equipment. Operational Service Performance is the measurable work result the Port achieves in implementing ship, goods facility, and equipment utilization services within a specific period and unit.

Operational Service Performance Indicators are service variables, such as the use of port facilities and equipment. Guidelines for Calculating Port Operational Service Performance are guidelines for calculating port operational service performance.

Guidelines for Calculating Port Operational Service Performance apply as guidelines in calculating port operational service performance as determined by the Port Operator. Calculation of port operational service performance is used as evaluation material to monitor the effectiveness of port service operations and a benchmark for the quality of port facility usage and port service time. The service performance standards of the Mirah Tanjung Perak Terminal are regulated by the Decree of the Head of the Harbor Master's Office and the Main Port Authority of Tanjung Perak Number: KP-KSOPU.Tpr 1 of 2024 concerning the Operational Service Performance Standards of Tanjung Perak Port in 2024..

Effective : Berthing Time (ET : BT)

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 (%) (Barasa et al., 2019). During loading and unloading process of ships it is crucial of being on time especially ini maritime industry. Effective Time : Berthing Time is a parameter that used to evaluate the efficiency of ships during docked at the pier. This parameter reflects the ratio of time required by the ships during unloading process. Effective Time : Berthing Time can be stated.

Effective Time : Berthing Time (*ET : BT*) = $\frac{Effective\ Time}{Berthing\ Time}$……(1)

Effective Time (ET) is the total effective time of a ship spends during on loading and unloading process at the piers, excluding any disruptions to its process except break time. As it can be stated like this.

Effective Time (ET) = *Berth Working Time* (BWT) - *Idle Time* (IT)……(2)

Berthing Time (BT) other hand is the total time of a ship since the first line was tied at the pier until the last line was released from the pier which can be stated.
Berthing Time (BT) = *Berth Working Time* (BWT) + *Not Operation Time* (NOT) ……(3)

Berth Occupancy Ratio (BOR)

Utilization of conventional piers is used to measure the extent to which conventional pier facilities are used intensively. The level of use of the pier or so-called berth occupancy ratio (BOR) (Hutauruk et al., 2023) Berth Occupancy Ratio (BOR) is a measure of dock efficiency. It is calculated by comparing dock use time with available time in a period and expressed as a percentage. BOR shows how optimally the dock is used for loading and unloading ships.

According to Triatmodjo (2010), BOR is influenced by several factors, including the type of goods handled, ship size, loading and unloading productivity, number of workers (gangs), working hours and shifts, dock length, effective working days, and reserve time when the ship is docked but not carrying out loading and unloading activities.

The calculation of BOR differs depending on the type of dock. For docks with several separate berths, BOR is calculated based on the ship's mooring time compared to the available time. Meanwhile, for docks without berth divisions (continues berth), such as the Mirah Terminal, which has six berths, the BOR calculation considers the length of the ship plus the safety factor, multiplied by the mooring time, then divided by the length of the dock and the available time.

BOR is an important indicator in assessing port performance and the efficiency of dock use, so understanding the factors that influence it is crucial to improve port operational services.

$$BOR = \frac{(n\ Call\ x(\ x\ LOA + 5))x\ (n\ Berthing\ Time)}{Berth\ Length\ x\ availaible\ time\ in\ certain\ period} \ldots\ldots\ldots\ldots\ldots\ldots (4)$$

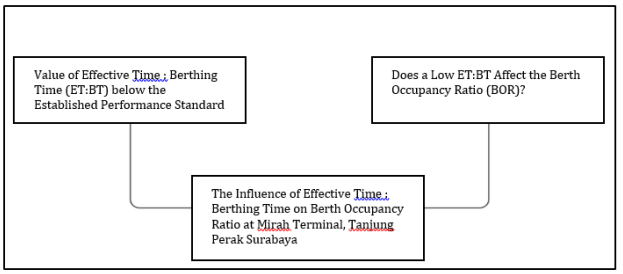
Previous studies, such as those by Fadiansyah et al. (2022) and Putri & Rahmawati (2022), have explored factors influencing Berth Occupancy Ratio, including waiting time and berth throughput. However, limited research has specifically investigated the relationship between Effective Time : Berthing Time on Berth Occupancy Ratio, particularly in Indonesia's major ports. Previous studies used two independent variables, namely Waiting Time and Berth Occupancy Ratio, to influence the dependent variable, Integrated Port Time, while my study only discusses one independent variable, namely the ratio of Effective Time to Berthing Time (ET: BT), which influences the Berth Occupancy Ratio (BOR). In addition, previous studies discussed Yard Occupancy Ratio (YOR) and BOR with qualitative methods, while my study focuses only on BOR with a quantitative approach. Previous studies also examined the relationship between Idle Time and Berth Output on BOR, while my study only examines the effect of ET:BT on BOR.

H_a: Effective Time : Berthing Time significantly influences Berth Occupancy Ratio at Terminal Mirah, Tanjung Perak.

H_0: There is no significant influence of Effective Time: Berthing Time on the Berth Occupancy Ratio at Terminal Mirah, Tanjung Perak.

RESEARCH METHODS

This study employs a quantitative research approach using a simple linear regression model. The population consist of operational performance reports from Terminal Mirah, covering the period 2020 -2024. The sample was selected using purposive sampling, focusing on Effective Time : Berthing Time and Berth Occupancy Ratio values. Data collection methods including document analysis of monthly performance reports and statistical data processing using SPSS version 26.



Source: Author
Figure 1. Conceptual Framework

ANALYSIS AND RESEARCH RESULTS

According to KP-KSOPU.Tpr 1 Tahun 2024, the minimum standards for Effective Time : Berthing Time at Terminal Mirah is set at 65%. However, finding indicate that Effective Time : Berthing Time performance in Terminal Mirah fell below this threshold, with an average of 55.99% in 2023 and 53.39% in 2024. These figures reflect suboptimal operational efficiency. In contrast, the Berth Occupancy Ratio remains within the acceptable range, not exceeding the maximum limit of 70% established by the same regulation.

Table 1.
EFFECTIVE TIME : BERTHING TIME DATA FROM 2020 – 2024

ET : BT	2024	2023	2022	2021	2020
JAN	51,56	55,65	69	48,96	61,33
FEB	52,47	59,65	70,61	62,24	40,93
MAR	51,06	67,86	74,38	60,26	51,87
APR	50,23	63,04	75,38	72,55	51,87
MAY	51,11	60,78	77,18	69,74	65,79
JUN	54,68	56,60	78,28	68,27	69,14
JUL	55,03	56,34	72	75,58	47,48
AUG	52,53	53,73	67,94	76,94	56,34
SEP	55,61	50,01	68,47	75,44	61,19
OCT	55,88	47,06	76,27	62,95	56,02
NOV	56,01	50,30	65,72	80,44	47,48
DES	54,55	51,19	59,28	76,18	56,87

Source: Tanjung Perak Port Performance Standards Monthly Report

Table 2.
BERTH OCCUPANCY RATIO FROM 2020 – 2024

BOR	2024	2023	2022	2021	2020
JAN	49	54,85	26	43	37
FEB	45	58,00	44	46	53
MAR	49	50,97	29	49	74
APR	61	55,13	41	47	47
MAY	45	52,99	65	55	25

BOR	2024	2023	2022	2021	2020
JUN	56	55,51	51	43	48
JUL	73	50,16	26	43	36
AUG	54	58,60	49	39	25
SEP	46	49,70	33	43	25
OCT	55	55,19	44	36	43
NOV	39	62,23	42	46	36
DES	64	45,84	42	44	40

Source: Tanjung Perak Port Performance Standards Monthly Report

Table 1 & 2 presents the Effective Time : Berthing Time and Berth Occupancy Ratio values from 2020 to 2024 which also will be used as the data analysis material and then will be processed in the research.

Table 3.
DESCRIPTIVE STATISTICS FOR EFFECTIVE TIME : BERTHING TIME AND BERTH OCCUPANCY RATIO

Variable	Minimum	Maximum	Mean	Std. Deviation
ET:BT (%)	40.93	80.44	61.05	9.93
BOR (%)	25.00	74.00	46.67	10.94

Source: Data processed by the author using SPSS 26 Regression Analysis

Table 3 presents the Descriptive Statistics for Effective Time : Berthing Time and Berth Occupancy Ratio values from 2020 to 2024. Based on Table 3, the highest Effective Time : Berthing Time is on November 2021 with 80.44%. While the highest Berth Occupancy Ratio is on March 2020 with 74.00%. Whereas the lowest the lowest Effective Time : Berthing Time is on October 2020 with 40.93%. While the lowest Berth Occupancy Ratio is on May, August, and September 2020 with 40.93%.

The hypothesis testing results are as follow.

Table 4.
R-Test

Model Summary[b]

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.279[a]	0,078	0,062	10,59291

a. Predictors: (Constant), ET : BT
b. Dependent Variable: BOR

Source: Data processed by the author using SPSS 26

The result:
R^2 (R Square)= 0.078, indicating that Effective Time : Berthing Time explains 7.8% of the variance in Berth Occupancy Ratio. R = 0.279, indicates a very low level of correlation between variables, its following correlation table Sugiyono, 2017.

The following are the results of the hypothesis testing that was carried out using the t-test at a significance level of 0.05 or α = 5%.

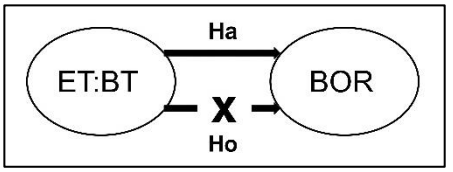
Table 5.
T-Test

Coefficients[a]

Model				Standardized Coefficients Beta	T	Sig.
1	(Constant)	65,433	8,590		7,617	0,000
	ET : BT	-0,307	0,139	-0,279	-2,212	0,031

a. Dependent Variable: BOR

Source: Data processed by the author using SPSS 26



Source: Author
Figure 1. HYPOTHESIS

The result:
T-Value = -2,212, with significance of 0.031 < 0.05, confirming a significant influence of Effective Time : Berthing Time on Berth Occupancy Ratio. The negative coefficient suggests that higher Effective Time :
Berthing Time values correlate with lower Berth Occupancy Ratio. The regression analysis results indicate a statistically significant influence of Effective Time : Berthing Time on Berth Occupancy Ratio at Terminal Mirah, Tanjung Perak. But with weak relationship only 7.8% and negative correlation.

DISCUSSION

This research is grounded in the theoretical framework of port operational performance, focusing on two primary indicators: Effective Time : Berthing Time (ET:BT) and Berth Occupancy Ratio (BOR). ET:BT, as defined by the Regulation of the Director General of Sea Transportation Number HK 103/2/2/DJPL-17, measures the proportion of a ship's berthing time that is used productively for loading and unloading operations. A higher ET:BT ratio signifies greater operational efficiency, as it indicates that less time is wasted while the vessel is docked, thus minimizing idle periods and maximizing the effectiveness of port services.

BOR, on the other hand, reflects the level of utilization of dock facilities, calculated by dividing the total time the berth is occupied by the total available time within a given period. According to national and international standards—including those outlined in Port Development: A Handbook for Planners in Developing Countries (UNCTAD)—the ideal BOR should not exceed 70%. This threshold is established to prevent congestion, ensure smooth cargo flow, and maintain operational flexibility. Theoretically, there is a close relationship between ET:BT and BOR: when ET:BT is low, ships spend more unproductive time at berth, extending total berthing duration and potentially pushing BOR above optimal limits. Conversely, higher ET:BT ratios reduce ship turnaround times, thereby keeping BOR within acceptable boundaries and enabling the port to serve more vessels efficiently.

Empirical findings from the Mirah Tanjung Perak Terminal reveal that ET:BT values in 2023 and 2024 were 55.99% and 53.39%, respectively—both below the minimum standard of 65%. This

shortfall points to ongoing inefficiencies in ship time utilization at berth, likely stemming from factors such as limited cargo handling equipment, suboptimal coordination among stakeholders, and various technical constraints. Despite these inefficiencies, the BOR at Mirah Terminal remained within the safe threshold, not exceeding the 70% maximum as stipulated by international guidelines.

Statistical analysis confirms a significant relationship between ET:BT and BOR, with a significance value of 0.031 (<0.05) and a t-count exceeding the critical value, thereby supporting the alternative hypothesis. However, the coefficient of determination (R^2) is only 0.078, indicating that ET:BT accounts for just 7.8% of the variance in BOR. The remaining 92.2% is influenced by other operational factors—such as vessel arrival patterns, cargo volumes, equipment capacity, and terminal management practices—not directly addressed in this study.

Conceptually, these results reinforce theoretical expectations: improving the efficiency of ship working time (ET:BT) does contribute to optimizing berth utilization (BOR). However, the relatively low explanatory power of ET:BT alone highlights the need for a holistic approach to port performance management. Effective BOR control requires not just improvements in ET:BT, but also enhancements in infrastructure, workforce capabilities, scheduling systems, and inter-organizational coordination.

This study underscores the necessity of consistently applying port performance standards. For Mirah Terminal, recommendations include optimizing infrastructure, investing in workforce training, and streamlining cargo handling processes to boost ET:BT values. These measures are essential for maintaining BOR within ideal limits, thereby supporting efficient cargo flow and enhancing the port's national and international competitiveness.

Comparative research by Hijah et al. (2023) at Lembar Seaport demonstrated consistently high ET:BT values from 2019 to 2022, meeting established performance benchmarks. This contrast with Mirah Terminal illustrates the variability of operational standards and outcomes across different ports, as regulated by the Director General of Sea Transportation Regulation No. HK.103/2/18/DJPL-16. Factors such as traffic density, cargo characteristics, infrastructure quality, and port functions play significant roles in shaping these benchmarks and operational realities.

Further, Rahmawan et al. (2025) identified a much stronger relationship between Effective Time and BOR at the Semen Indonesia Group Tuban area, with ET:BT explaining 43.8% of BOR variation. This finding highlights that the influence of ET:BT on BOR is highly context-dependent, affected by local operational conditions and management practices.

The primary contribution of this research lies in its nuanced analysis of how ET:BT ratios affect BOR within the specific operational context of Mirah Terminal. The study provides empirical evidence that can inform port management strategies, suggesting that authorities should prioritize optimizing Effective Time through operational improvements, infrastructure investments, and workforce development to achieve better berth utilization. At the same time, recognizing the limited impact of ET:BT alone encourages a more integrated approach to performance enhancement, incorporating vessel scheduling, cargo handling systems, and broader logistical considerations

CONCLUSIONS

Based on the findings and data analysis regarding Effective Time : Berthing Time and Berth Occupancy Ratio at Terminal Mirah, Tanjung Perak, from January 2020 to December 2024, the following conclusions can be drawn :

The implementation of port performance standards at Terminal Mirah complies with KP-KSOPU.Tpr 1 Tahun 2024. However, Effective Time : Berthing Time performance in 2023 and 2024 fell below the minimum threshold of 65%, with average values of 55.99% and 53.39%, respectively. These figures indicate suboptimal operational performance, necessitating further evaluation and improvements. In contrast, the Berth Occupancy Ratio values remain within the acceptable threshold, not exceeding the maximum limit of 70%, as regulated by KP-KSOPU.Tpr 1 Tahun 2024. Hypothesis testing results confirm that Effective Time : Berthing Time significantly influences Berth

Occupancy Ratio, as evidenced by a significance value of 0.031 < 0.05 and a t-value of -2.212, which exceeds the critical t-value of 2.000 in absolute terms (|-2.212| > 2.000). The negative t-value suggests an inverse relationship, meaning that an increase in Effective Time : Berthing Time corresponds to a decrease in Berth Occupancy Ratio. This relationship implies that improving operational efficiency by increasing Effective Time : Berthing Time could enhance berth availability and reduce congestion. However the correlation coefficient (R) of 0.279 indicates a very weak relationship between the two variables. The coefficient of determination (R^2) is 0.078, suggesting that Effective Time : Berthing Time explains only 7.8% of the variance in Berth Occupancy Ratio, while the remaining 92.2% is influenced by other factors not covered in this study

To address these challenges, Terminal Mirah should consider investing in infrastructure, enhancing workforce training, and optimizing operational processes to improve Effective Time : Berthing Time performance in the coming years. Additionally, strategic berth utilization planning could further increase efficiency and reduce unnecessary delays. Given the weak correlation observed in this study, future research should explore additional variables such as weather conditions, workforce efficiency, and equipment availability to gain a more comprehensive understanding of the factors affecting Berth Occupancy Ratio. Strengthening these aspects will not only improve Effective Time : Berthing Time performance but also contribute to the overall effectiveness of port operations at Terminal Mirah, Tanjung Perak.

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