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Enhancing Port Efficiency: A Case Study at Mangole Timber Producers' Terminal in North Maluku, Indonesia

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ABSTRACT

This paper investigates the operational efficiency of the MV Green Raccoon V. 028 during its inaugural service at the Mangole Timber Producers' Special Self-Interest Terminal (TUKS) in North Maluku, Indonesia. The study employs a qualitative case study approach to analyze the planning, execution, and evaluation of the vessel's loading and unloading activities. The research highlights the challenges and successes of the operation, mainly focusing on the impact of natural factors such as heavy rain, which contributed to significant idle time. Despite these challenges, the operation exceeded its efficiency targets, achieving a loading capacity of 9501 tons in less than the planned five days. The paper concludes with recommendations for improving operational strategies to reduce idle time further and enhance overall terminal efficiency. .

1. Introduction.

Ports support industrial and trade activities by distributing, producing, and consolidating cargo or goods (Budimawan, Ganding Sitepu, Rini, 2021). In this context, the main focus of the Mangole Timber Producers (MTP) Special Self-Interest Terminal (TUKS) (Zhuhendrik, Kurnianingsih and Okparizan, 2023) in North Maluku is an operational collaboration between Sampoerna Kayoe and Meratus Group. This Terminal, managed by PT Multi Sarana Pelabuhan Indonesia (MSPI) (Jagadsea, 2023), needs to improve operational efficiency and effectiveness, especially in loading and unloading activities (Koloay, Kairupan and Tumbel, 2024).

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Planning and evaluating the activities (Widyastuti and Riantisari, 2024) of the inaugural ship MV Green Raccoon V. 028 at this terminal is a critical case to examine, considering the need to map company operations and operating patterns and answer problems, including traffic flow, work personal readiness, and loading and unloading equipment (He et al., 2019; Tafia and Islam, 2023). In addition, the resolution of general TKBM (Eka Cempaka Putri, Mukhlas Sumartanto and Billy Afrilian Nurreja, 2024) rejection of loading and unloading operations at TUKS is a critical issue that requires strategic solutions.

This research topic is essential because it provides insight into how planning and evaluating ship operational activities can improve efficiency and effectiveness at specialized port terminals, focusing on related to the MV case Green Raccoon V. 028 at TUKS Mangole of Timber Producers. This research contributes to a better understanding the challenges and solutions in exceptional port management. It is also relevant in the context of port infrastructure development in Indonesia, where improving port performance can support regional and national economic growth (Munim and Schramm, 2018; Osadume and University, 2020).

In addition, this study's results can be used as a reference for managing other ports facing similar challenges. They also provide recommendations for improving subsequent ship operational activities to reduce waiting times and increase the use, reliability, and readiness (LAKHMAS and SEDQUI, 2018).

The main objective of this study is to plan and evaluate the operational activities of the MV inaugural ship, Green Raccoon V. 028, at the Mangole Timber Producers (MTP) Special Self-Interest Terminal (TUKS) in North Maluku. This study aims to identify and analyze factors affecting ships' and terminals' effectiveness and operational efficiency and propose improvement strategies to improve operational performance in the future (Iris and Lam, 2021; Hardianto et al., 2023).

The importance of port operational efficiency and effectiveness is multifaceted, impacting various aspects of maritime logistics, trade, and the broader economy (Edih, Faghawari and Agboro, 2023). Ports underscore this significance as critical nodes in global supply chains, where improvements in port operations can lead to substantial benefits, including enhanced economic performance, reduced environmental impact (Safuan, Ramadian and Selasdini, 2023), and increased competitiveness of seaports (Moon and Woo, 2014).

Port operational efficiency directly influences the economic performance of the regions they serve (Edih, Faghawari and Agboro, 2023). Efficient ports facilitate faster turnaround times for ships, reducing operational costs for shipping companies (Wang et al., 2023), as well as the entire supply chain. This efficiency can lower transportation costs, making goods more competitive in the global market and stimulating trade volumes (Kutin, Nguyen and Vallée, 2017). A study highlighted a significant positive association between port efficiency and economic growth. However, no significant impact of seaborne trade on economic growth was noted (Munim and Schramm, 2018).
Efficient port operations also have a significant environmental dimension. Thanks to high-quality port operations, port time can be reduced, improving the operational efficiency of liner services by reducing fuel consumption and emissions demands of international trade and contributing positively to the global economy (Safuan, 2023).

2. Methodology

2.1. Research Design.

The research design used is qualitative (Bernard, Wutich and Ryan, 2016), with a case study approach (Rashid et al., 2019; Priya, 2021).

It analyzes documents related to vessel and terminal operations, such as operational reports, vessel schedules, and records of loading and unloading activities.

2.2. Operational Simulation.

Operational simulation is used to observe and calculate the exact cycle and timing of vessel operations including the movement of trucks from the storage warehouse to the jetty.

2.3. Data Analysis.

Data collected from direct observation, documentation, and operational simulations were then analyzed to evaluate the effectiveness and efficiency of MV. Green Raccoon V. 028.

Using this approach, the research aims to provide a comprehensive overview of the maiden vessel to operations at Mangole Timber Producers' TUKS and identify areas that require improvement to enhance operational efficiency and effectiveness.

3. Result & Discussion.

3.1. MV Green Raccoon V. 028 Prime Ship Activity Planning.

The planning of MV Green Raccoon V. 028's inaugural ship activities at the Mangole Timber Producers (MTP) Special Self Interest Terminal (TUKS) includes ship activities, terminal (Jetty) activities, and conducting operational simulations. Ship activities include pre-berthing, berthing, and post berthing. As for what is done in ship planning, as follows;

Table 1: Ship Planning.

PRE-BERTHING	BERTHING	POST BERTHING
➢ Coordination: Meratus - MTP Team, Port Of Authority, imigration, custom Port of Health & Pilotage ➢To Prepare Document; Vessel Berthing Meeting (RKK), RPKOP (Inaportnet), Manifest, Discharge List & DG information ➢Vessel Monitoring (Ships Particullar, ETA ETB) By email	➢Coordination on Process between Pilotage, Captain & Port Site (MTP-Meratus) ➢Channel Communication ➢ISPS Implementation; Establish PAN Document by SSO & Dos Document by Port/Terminal ➢Document ; Sof, Tally Sheet, Time Sheet, Stowage/BayPlan, Loading-Unloading List	➢Coordination to Pilotage, Port Authority, Departure Report (Sof) ➢ Document; Loading List, DG Info ➢Draught Survey - (Independent Surveyor) ➢RBM - Invoice

Source: Meratus Group.

Table 1 outlines the procedures and coordination activities involved in the berthing of ships. It is divided into three main sections: Pre-Berthing, Berthing, and Post-Berthing, each detailing specific tasks and coordination efforts.

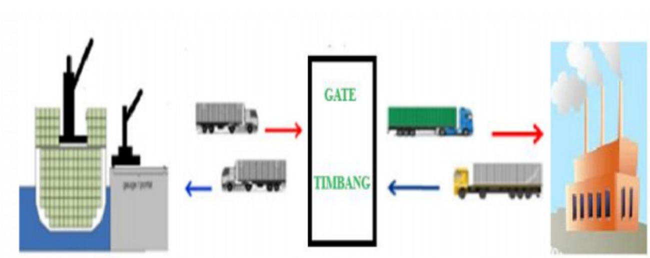
Pre-berthing coordination involves close collaboration with stakeholders, including the Marine Traffic Planning (MTP) team, port health authorities (Grenfell et al., 2008) and pilotage services (Uğurlu et al., 2017) to ensure seamless preparation for the ship's arrival. This coordination ensures that all relevant parties are adequately informed and ready to facilitate the berthing process (Prasaja, Priadi and Batu, 2023). Additionally, meticulous Documentation is essential, encompassing the preparation of crucial paperwork such as the Vessel Berthing Request (VBR), Pilotage Request and Clearance (PRC/CP), and the Discharge List. These documents are vital in streamlining the berthing process and ensuring compliance with port regulations. Furthermore, Vessel Monitoring activities are conducted, tracking the ship's particulars and Estimated Time of Arrival (ETA) (Veenstra and Harmelink, 2021), along with communication via email to ensure effective coordination and timely berthing.

Berthing entails a comprehensive process involving coordination and communication among cargo handlers, the ship's captain, and the port site, particularly the Marine Traffic Planning (MTP) team. Effective channels of communication are paramount to ensure a seamless berthing process. Additionally, adherence to security protocols, including implementing a Port Arrival Notification (PAN)(Osman et al., 2021), and compliance with the International Ship and Port Facility Security (ISPS) Code (Wardani, 2021), is crucial for maintaining port security. Furthermore, meticulous documentation plays a pivotal role, with the preparation of essential paperwork such as the Statement of Facts (SOF), Tally Sheet, Time Sheet, Stowage/Bay Plan, and Loading/Unloading List being necessary for tracking and managing cargo handling operations effectively.

Post-Berthing activities encompass several essential tasks to ensure the vessel's efficient departure. This includes coordinating departure logistics by preparing the Departure Report (SDR) and liaising with the port authority for necessary clearances. Documentation remains a priority, with meticulous attention to compiling loading lists and documenting Dangerous Goods (DG) (Lei and Ok, 2020) information to ensure compliance and safety. Additionally, conducting a Draught Survey independently measures the ship's draught and verifies the quantity of cargo loaded or unloaded, providing crucial data for maritime operations. Furthermore, issuing the RBM - Invoice for the berthing services rendered concludes the post-berthing process, facilitating financial transactions and administrative closure.

While terminal activities (Jetty) include meeting operational targets exceeding 2000 tons per day, ships are served for less than five days using six Trucks and two Forklift units, as shown in the picture below.

Figure 1: Operation Pola.



Operation Pola Of Composition			
Operation Type	:	Direct Loading	
Loading Capacity	:	10.000	Tonage
Crane Use	:	2	Units
Target	:	≥2000	Tonage Per Days
		5	Vessel Call Max. Days
Forklift	:	2	Units
Headtruck	:	6	Units
Working Hours	:	24 Hours	Days
		12 Hours	Per Shift

Source: Meratus Group.

Figure 1 is likely used for internal purposes to provide an overview of the equipment, processes, and key metrics related to cargo handling operations at a port or similar facility. It outlines the capacity and resources involved, such as the number of cranes and forklifts and the operational targets for daily tonnage. The 24-hour operation suggests a continuous workflow to accommodate high cargo volumes and meet shipping schedules. Overall, the image serves as a simplified guide to the operational structure and capacity of a cargo handling operation, which could be helpful in training, planning, or improving efficiency within the facility (Luna et al., 2018).

Conducting operational simulations (Dragović, Tzannatos and Park, 2017) is a direct conservation using trucks that operate from the wood pellet storage warehouse through the weighing gate to the jetty. This aims to get the proper cycle and time to calculate the ship's operational time and departure.

Figure 2: Port Operation Cycle.

Source: Meratus Group.

Figure 2 is a visual port operation cycle representation of the time required for various tasks related to the operation of a truck within a specific cycle. It breaks down the cycle into distinct stages, each with an associated duration, and provides a total time for the entire cycle process (Saini, Efimova and Chromjaková, 2021) that typically requires approximately 3 minutes. The accompanying image depicts a truck positioned at what seems to be a weighing station, with the gate visible in the background, highlighting this crucial step in the logistical operation. The comprehensive duration for one truck to execute the entire cycle amounts to 33 minutes, consolidating the time spent across all the individual stages detailed above. This total time encompasses each step of the process, including loading, haulage to storage, transport to the jetty and weighing at the gate, providing a holistic perspective on the efficiency and timeline of the logistical operation for each truck.

Figure 2 uses arrows to indicate the sequence of operations and the flow from one stage to the next. It also employs visual cues such as pictures of trucks at various stages and icons representing movement and weighing to enhance understanding. Overall, the image serves as an infographic to communicate. (Widyasari and Yani, 2020) The efficiency and time management of a truck's operations, likely within a logistics or transportation-related business. It provides a clear and concise overview of the time allocation for each part of the operation cycle, which can be helpful in planning, scheduling, and identifying potential areas for optimization (Zhang et al., 2022).

3.2. MV Green Raccoon V. 028 Prime Ship Activity Evaluation.

MV Green Raccoon V. 028's inaugural Ship Service can be implemented in about 4.6 days, faster than the planned target of about five days. In addition, 9501 tons of cargo were loaded using two ships' cranes. The table below shows ship service performance.

Table 2: Ship Service Performance.

MSPI	TERMINAL DEPARTURE REPORT PT. MULTI SARANA PELABUHAN INDONESIA PELABUHAN MANGOLE TIMBER PRODUCERS		
ACTIVITIES	LOADING	Breakbulk	Wood Pellet
	Status RRO :	Realization	
VESSE NAME/VOYAGE	MV. GREEN ROCCON/ 028		
BERTH SIDE	PORT SIDE		
BERTH NO.	MTP-JETTY 1		
LOA/BITT NO.	120 / 80 - 200		
ATA	24/02/2024 05:00		
CLOSING TIME	1/3/2024 23:00		
BERTHING TIME	27/02/2024 16:18		
WORKING HOURS	28/02/2024 00:01 sd 4/3/2024 14:42:00		
ETD	4/3/2024 2:18		
LABOUR GANG			
DAYS	DATE	SHIFT Pagi	SHIFT Malam
1st Day	28/02/2024	13	13
2nd Day	29/02/2024	13	13
3rd Day	1/3/2024	13	13
4th Day	2/3/2024	13	13
5th Day	3/3/2024	13	13
EQUIPMENT			
FC/SC	2	Units	SC
Headtruck	6	Units	
Folklift	4	Units	
MOVEMENT			
Activities		Tonnages	
Discharge		0	
Loading		9501	
Remarks :			
Waiting Truck Heavy rain Open/Closed Hacth Cover			
Admin Planner		Site Manager	
ttd HALIFA UMASANGAJI		ttd Surento	

ATA	24/02/2024 21:06
CLOSING TIME	1/3/2024 23:00
BERTHING TIME	27/02/2024 16:18
WORKING HOURS	28/02/2024 00:01 sd 3/3/2024 14:42:00
ATD	4/3/2024 2:18

Source: Meratus Group.

Based on the above realization, the effectiveness of TUKS in Mangole Timber Producers is served for 3.6 days (because it is reduced by idle time caused by natural factors, namely heavy rain for one day) so that activities stop.

The unloading handling performance at TUKS Mangole Timber Producers is 107.66 Per Ton Per Shift Per Ship (2 units of crane ships). This shows that the achievement of unloading service performance at TUKS at TUKS Mangole Timber Producers is 2260 Tons Per day, exceeding the planned target of around 2000 Tons Per day.

Figure 3 appears to be a performance report or datasheet related to a loading or shipping operation. It contains numerical values and calculations that measure the efficiency and productivity of the operation in question. The operation's performance metrics are detailed as follows: The Total Tonnage amounted to 1,503,402 tons, representing the cumulative weight of cargo

Figure 3: Operational Performance.

Source: Meratus Group.

loaded or shipped. Working Hours totaled 110.25 hours, indicating the duration of active work. Berthing Time, measuring 129.24 hours encompasses the total duration the ship was docked at the port, encompassing loading, unloading, and idle periods. Idle Time accounted for 22 hours, signifying periods when no work was conducted despite the ship being berthed. The Performance Calculation section evaluates operational efficiency, employing the formula Ton/gang/Hours to determine performance metrics. Specifically, the Performance (Nett) calculation yields 53.83 tons per gang per hour and 107.66 tons per ship, reflecting the operation's productivity and effectiveness.

The net performance is calculated by dividing the total tonnage by the product of the practical working hours (which seems to be 88.25 hours, although this number is not explicitly detailed in the image) and the number of gangs (2 in this case). The result gives two figures: one for the tonnage per gang and one for the tonnage per ship.

The factors contributing to the total idle time of 22 hours during the inaugural MV Green Raccoon V. 028 service can be categorized into internal factors of 2 hours, external factors of 2 hours, and natural factors (rain) for 18 hours. The details below are illustrated from each hatch.

The waiting time entries, including "Waiting Truck Operator," "Waiting Truck," and "Waiting Port Helper (TKBM)," signify various reasons causing delays, indicating that ship crane operations are sometimes halted due to the absence of necessary personnel or equipment (Budipriyanto et al., 2017). Fluctuating numbers suggest inconsistency influenced by external factors or operational effectiveness. Weather conditions like "Rainy" and "Cloudy" are monitored as they impact crane operations, with significant idle time on adverse weather days, potentially due to safety concerns or reduced visibility (Christiansen and Fagerholt, 2002). Operational activities such as "Excavator Pick Up's

Table 3: Idle Time Crane No. 1.

Iddle Time Ship Crane No. 1						
No	Remarks	Date				
		28	29	01	02	03
1	Waiting Truck Operator	24	-	24	-	-
2	Waiting Truck	36	48	-	60	18
3	Waiting Port helper (TKBM)	12	-	-	-	-
4	Rainy	-	75	-	216	-
5	Cloudy	18	-	300	149	-
6	Excavator Pick Up to under hacth cover	-	-	84	-	-
7	Draft Survey	-	-	-	-	54
8	Timing Process	-	-	12	-	-
9	Triming	-	-	24	-	-
10	Open Hacthcover	-	24	12	24	6
11	Closed Hatchcover	18	-	6	12	6
12	Equipment support Checking	30	24	-	-	-
Total (Minutes)		138	171	462	461	84
Converse to Hours		2,30	2,85	7,70	7,68	1,40
Average Time Total (Hours)		22				

Source: Data Analysis.

Table 4: Idle Time Crane No. 2.

Iddle Time on Ships Crane 2						
No	Remarks	Date				
		28	29	01	02	03
1	Cargo Change to berth side	18	-	-	-	-
2	waiting Truck	24	42	-	18	36
3	Equipment support Checking	54	12	-	-	12
4	Rainy	-	-	165	179	-
5	Cloudy	-	105	120	189	-
6	Jumbo Bag Cleaning	-	-	30	-	-
7	To Open Jumbo Bag node	-	-	-	24	-
8	Excavator Pick Up to under hacth cover	-	-	84	-	-
9	Draft Survey	-	-		-	54
10	Ceremony	-	-			24
11	Prepare to Triming Process	-	-	36	-	-
12	Triming Process	-	-	24	-	-
13	Open Hacthcover	6	18	-	8	-
14	Closed Hatchcover	24	6	-	-	-
		-	-	-	-	-
Total (Minutes)		126	183	459	418	126
Convertion to Hours		2,1	3,05	7,7	7,0	2,1
Average Time Total (Hours)		22				

Source: Data Analysis.

under hatch cover," "Draft Survey," and "Turning Propeller" denote specific tasks involving the crane, with idle time indicating either delays or scheduled non-operational periods. "Equipment support Checking" suggests routine maintenance activities for crane safety and efficiency (Zhang et al., 2020), with idle time likely scheduled for checks. The "Average Time Total (Hours)" row provides an overview of idle time across dates, aiding in assessing overall operational efficiency.

In conclusion, the data provides a detailed account of the factors contributing to the idle time of Ship Crane No. 1. By analyzing this data, stakeholders can identify inefficiencies and potential improvements in crane operation scheduling, safety protocols, and maintenance practices (Suprata, Natalia and Sugioko, 2020). The data also highlights the significant impact of weather conditions on crane operations, which is a critical factor for planning and risk management (Valdeza et al., 2023).

The table documents data spanning five days, encompassing the 28th, 29th, 1st, 2nd, and 3rd of unspecified months, providing the total idle time for each day. These figures, ranging from 126 to 459 minutes, shed light on the operational dynamics of Ships Crane 2. The table further delineates 14 distinct activities or conditions contributing to idle time, encompassing both operational tasks like "Cargo Change to berth side" and environmental factors such as "Rainy" and "Cloudy" conditions. Notably, each activity exhibits variable idle times across different dates, suggesting fluctuations in operational efficiency. Additionally, converting idle minutes into hours facilitates a standardized measurement of idle time, with an average idle time of 22 hours calculated across the recorded days. Observations from the data pinpoint the 1st as experiencing the highest idle time, potentially indicative of significant delays or operational issues. Unique entries like "Draft Survey" and "Ceremony" underscore the occasional nature of specific tasks or events, informing strategic operational planning. Ultimately, this comprehensive dataset offers valuable insights (Jawad and Balázs, 2024) for assessing operational efficiency, managing environmental impacts, and optimizing resource allocation in maritime logistics.

Conclusions.

The inaugural operation of MV Green Raccoon V. 028 into the Mangole Timber Producers' TUKS demonstrated significant operational efficiency achievements, surpassing the target loading capacity within a reduced timeframe.

However, the operation also faced challenges, primarily due to natural factors like heavy rain, which caused considerable idle time. This study suggests that future operations could benefit from enhanced weather preparedness and more robust contingency planning. The terminal can improve its resilience and efficiency by addressing these issues, potentially setting a benchmark for similar regional operations. This case study provides insights into the specific operational dynamics at TUKS and contributes to broader discussions on improving efficiency in port operations under varying environmental conditions.

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