Analysis of Ship Operational Performance Evaluation Using the Day in the Life of (DILO) Method at PT. Firaya Trans Marine

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ABSTRACT

Ship operational efficiency is a crucial factor in the shipping industry because it directly affects costs and timeliness. PT. Firaya Trans Marine faces obstacles in the form of the dominance of Non-Value Added (NVA) activities such as waiting for documents, idle time, and engine breakdowns, which reduce productivity. This study uses the Day in The Life Of (DILO) method to comprehensively evaluate ship operational performance. The study was conducted on three Self Propelled Oil Barge (SPOB) vessels, namely Kelly Baid, Sibenua Baru Kaltara, and Tersus Alfa 02. Observations were made during two voyages on each vessel with detailed daily activity records. The data were then categorized into Value Added (VA) and NVA activities and analyzed in terms of operational time distribution and fuel consumption (BBM) as cost indicators. The results show a high proportion of NVA: Kelly Baid 37.02%, Sibenua Baru Kaltara 67.91%, and Tersus Alfa 02 86.38%. The dominant NVA activities are waiting for documents, idle time, and breakdowns. Actual fuel consumption also exceeded theoretical standards, with the highest wastage on the Kelly Baid (7,947 liters or Rp. 119.2 million). This indicates a link between high NVA activity and energy waste and operational costs. The DILO method has proven effective in identifying the roots of inefficiencies, both technically and administratively. Recommended improvement strategies include document digitization, improved real-time communication, preventive maintenance, and crew training. This study confirms that DILO can be a strategic tool for identifying wasteful time and energy, while providing a basis for managerial improvements to enhance ship operational efficiency.

Keywords: operational efficiency, DILO, value added, non-value added, fuel consumption.

INTRODUCTION

The shipping industry plays a strategic role in supporting the global economy [1]. For Indonesia, an archipelagic nation with over 17,000 islands, shipping not only serves as a link between regions, but also serves as a major driver of resource distribution, trade, and economic activity across various sectors [2]. Indonesia's strategic geographic location and abundant natural resources make operational efficiency in the shipping industry a critical factor in maintaining economic stability and environmental sustainability. Data [3] shows that maritime transportation accounts for over 80% of global trade volume. This confirms that shipping is a vital component of the global supply chain, despite facing challenges in efficiency, cost, and environmental risks [4], [5], [6].

PT. Firaya Trans Marine, one of the shipping companies in Indonesia, faces classic problems in the form of long ship waiting times and high operational costs. Non-value-added (NVA) operational activities still dominate the shipping process, thus increasing cost waste, especially fuel consumption. Therefore, operational performance evaluation is important to distinguish between value-added (VA) activities and non-value-added (NVA) activities, so that the company can develop an appropriate efficiency improvement strategy.

The Day in The Life Of (DILO) method was chosen as an analysis tool because it can provide a detailed picture of the daily activities of the ship and crew. By observing activities chronologically over a certain period, this method can identify VA and NVA activities more accurately [7]. Previous studies have shown that ship crew involvement in energy efficiency activities plays a crucial role in

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operational success [8]. The DILO method allows management to conduct time-based evaluations systematically and practically, using simple instruments such as activity tables, stopwatches, and work logs [9].

In addition to focusing on time usage, this study also links NVA activities to financial impacts in the form of wasted fuel consumption. Thus, DILO analysis not only measures productivity but also links inefficiencies to cost consequences. Expected optimization efforts include improving shipping schedules, streamlining administrative procedures, increasing preventative maintenance, and training crew members to reduce the duration of NVA activities [7].

On the other hand, port infrastructure also influences operational efficiency. Docks, loading and unloading facilities, and limited port accessibility can increase vessel waiting times, ultimately increasing the proportion of NVA. Adequate infrastructure has been proven to accelerate the loading and unloading process and reduce operational costs [10]. Therefore, the application of the DILO method is also useful for analyzing the relationship between port infrastructure conditions and vessel efficiency [11], [12].

Based on this background, this study focuses on two main problems: (1) how to measure the amount of ship operational time including VA and NVA in the operations of PT. Firaya Trans Marine, and (2) how the application of the DILO method affects the calculation of ship operational costs. The final objective is to develop practical recommendations that can improve ship operational efficiency and reduce costs, especially those related to fuel consumption.

RESEARCH METHODS

Research Design

This research is a case study at PT. Firaya Trans Marine using the Day in The Life Of (DILO) method to analyze the operational performance of ship shipping in depth. One ship from each fleet category was selected as the observation subject. DILO implementation was carried out by following the ship's crew throughout a full operational cycle from preparation for departure to returning to berth and recording all activities chronologically to distinguish value-added (VA), semi-value-added (SVA), and non-value-added (NVA) activities.

Data were analyzed to identify areas for improvement, efficiency opportunities, and cost reductions through: (i) transcription of notes and interviews, (ii) categorization of themes, and (iii) descriptive statistics to measure the proportion of VA–SVA–NVA time. Qualitative analysis explored the context of the causes of inefficiencies and work process optimization options. This design aims to generate practical, evidence-based recommendations that would be impactful and sustainable for improving operational performance.

Research Location

The research was conducted at PT. Firaya Trans Marine, Jl. Teluk Kumai Barat No. 83, Perak Utara, Pabean Cantikan, Surabaya – East Java, with an operational observation route of Gresik (East Java) – Kuala Samboja (East Kalimantan) on-board the ship.

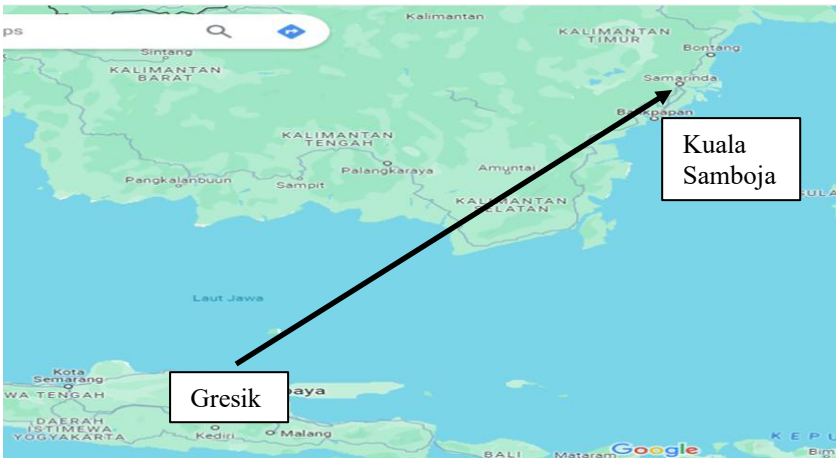

Figure 1. Location of the Gresik – Kuala Samboja shipping route

The selected vessel served as the primary setting for DILO's daily observations to capture authentic operational conditions along the route.

Population and Sample

According to [13], population is the entire object or subject that has certain qualities and characteristics that are determined by the researcher to be studied and drawn conclusions. In this study, the population includes 3 ships and 36 people, consisting of 30 ship crews and 6 administrative staff of PT. Firaya Trans Marine. Considering that the population is less than 100, this study uses a saturated sampling technique, namely the entire population is sampled without any reduction in the number of respondents. Thus, the research sample includes crews and operational staff working on three ships operated by the company, namely Kelly Baid 01, Sibenua Baru Kaltara, and Tarsus Alfa 2, so that it can provide a comprehensive and representative picture of the daily operational activities of ships and employee performance at PT. Firaya Trans Marine.

Data Collection and Analysis

This study uses the Day in The Life Of (DILO) method to observe the activities of ship crew and operational staff during one operational cycle, with the aim of identifying value-added and non-value-added activities. Data are analyzed descriptively to describe the characteristics of respondents and the distribution of working time, and visualized through diagrams. Furthermore, correlation and regression analyses are conducted to measure the relationship between operational variables (daily activities, time efficiency, procedures, K3) and ship performance. Qualitative data from observations and interviews are analyzed using thematic analysis. Using saturated sampling techniques and integrated analysis, this study provides comprehensive insights and practical recommendations for improving operational efficiency at PT. Firaya Trans Marine.

Research Variables

Research variables are attributes, characteristics, or values of individuals, objects, or activities that have certain variations, which are determined by researchers to be studied and conclusions drawn [14].

- Independent variables: (1) Daily operational activities; (2) Efficiency of time use; (3) Operational procedures; (4) Occupational Health & Safety (K3).
- Dependent variable: Ship operational performance (efficiency, productivity, fuel consumption, punctuality, overall effectiveness).

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Research Instruments

There are several types of research instruments that are usually used by researchers:

1. DILO Observation Sheet: records start/finish time, activity type (VA/SVA/NVA), resources, obstacles.
2. Interview Guide: crew, administrative staff, and PKBM to enrich the context of observation data.

Method of collecting data

This data collection method is carried out in 2 (two) ways, namely:
Primary data

- Site & facility survey: dock, loading & unloading equipment, operational patterns.
- On-board observation: following crew during shift; verifying with logbook & timesheet.
- Face-to-face interviews: exploring motives/procedures, constraints, and opportunities for improvement.

Secondary data

- Internal operational documents and supporting literature.

All data is recorded and archived digitally to facilitate tracking and auditability.

Data Processing and Analysis Method (Use of DILO Method)

DILO Steps:

1. Observation & recording of daily activities during one operating cycle.
2. Activity grouping:
    - VA: contributes directly to operational objectives.
    - NVA: does not add value/is wasteful.
    - NB-NVA (necessary but non-value added): must be done but does not add direct value.
3. Analysis of activity duration & frequency and quantification of NVA costs (time costs, operational costs, especially fuel, and opportunity costs).
4. Synthesis of findings & cost implications: prioritization of root causes and NVA reduction recommendations to reduce fuel waste and improve on-time delivery.

The steps in the data processing and analysis method used in this research to ensure that the results obtained can provide effective and practical recommendations according to [15]:

- Identification–categorization of activities (based on job description & interview).
- Non-intrusive observation: record descriptions, timestamps, duration.
- Classify VA/SVA/NVA and calculate proportions.
- Improvement plan: communicate individual & unit results; set targets; plan implementation (document digitization, schedule improvement, preventive maintenance, crew training); monitor–evaluate periodically.

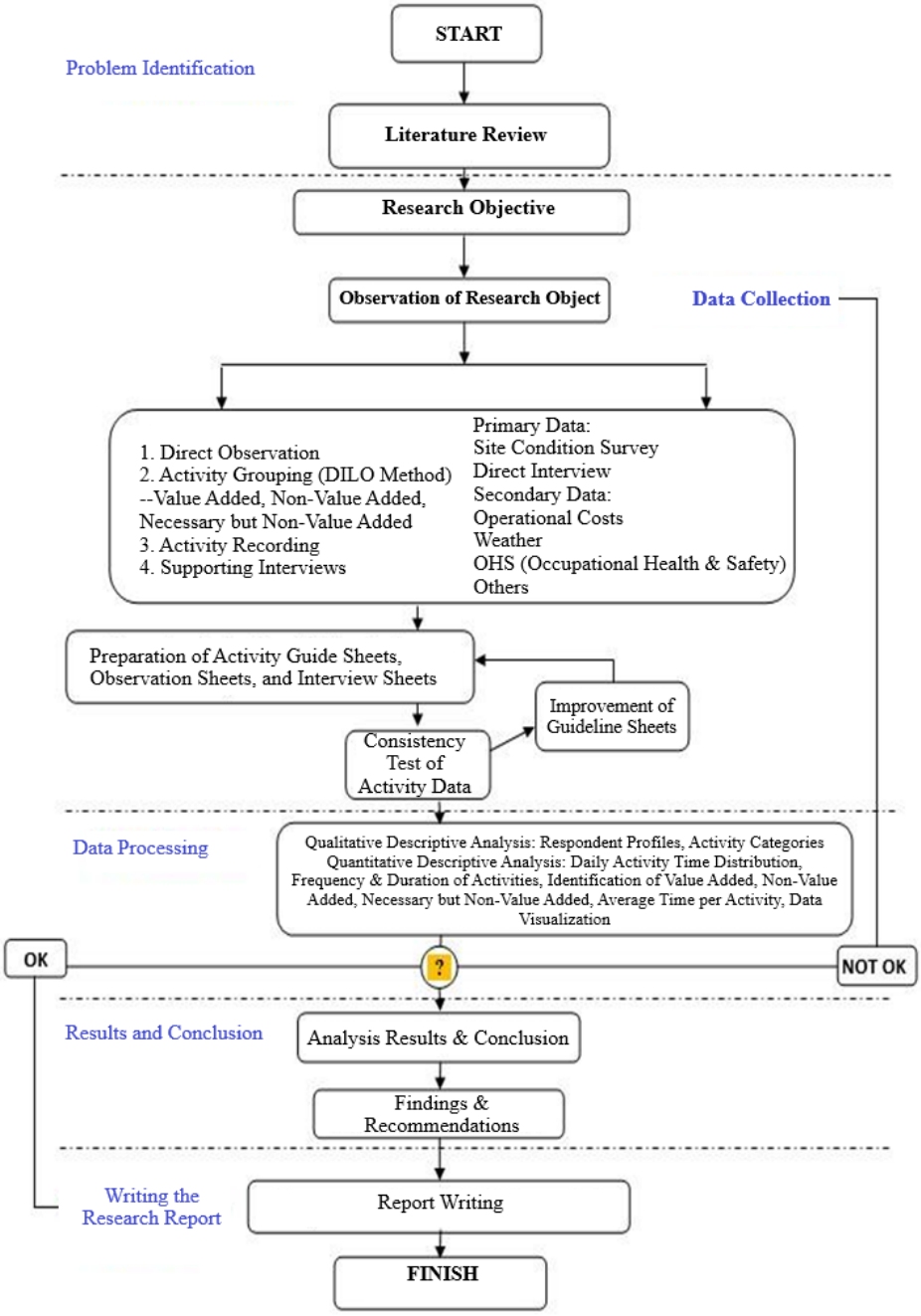

Figure 2. Research flowchart

RESULTS AND DISCUSSION

General Description of Research Location

The research was conducted at PT. Firaya Trans Marine, a local shipping operator on the Gresik-Kuala Samboja route. Three vessels were observed during two trips each: Kelly Baid 01, Sibenua Baru Kaltara, and Tersus Alfa 02 (both multi-port/circle). Using the DILO approach, all daily activities were classified into Value Added (VA) and Non-Value Added (NVA).

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Table 1. Operational activities

No	Activity categories	Information
1	Sailing	Ship journey from port of origin to destination
2	Shifting	Change of ship position in the port area
3	Breakdown/Stop	Unproductive conditions such as waiting for documents, waiting for loads, machine breakdowns
4	Loading	Cargo loading process (fuel)
5	Unloading	Cargo unloading process (fuel)
6	Maneuvering	The activity of maneuvering a ship to dock or leave a port

Observation Results per Ship

Kelly Baid 01

The total duration of the two shipments was 736.55 hours. The VA component was dominated by sailing (50.59%), followed by loading (5.32%), unloading (4.86%), maneuvering (1.03%), and shifting (1.16%). The largest non-performing asset (NVA) was breakdown/stoppage (37.02%) due to document clearance, jetty queues, and engine failures.

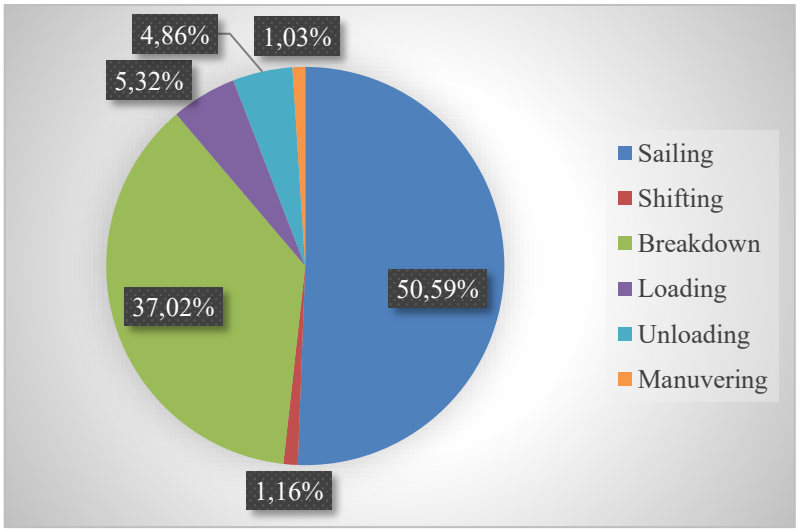

Figure 3. Percentage of time per activity category of kelly baid ship

New Continent of North Kalimantan

Total duration 466:10 hours. Sailing 26.22%; Loading 2.57%; Unloading 2.24%; Maneuvering 1.07%. Breakdown/Stop reached 67.91% (NVA), indicating a bottleneck in documents/permits and technical readiness.

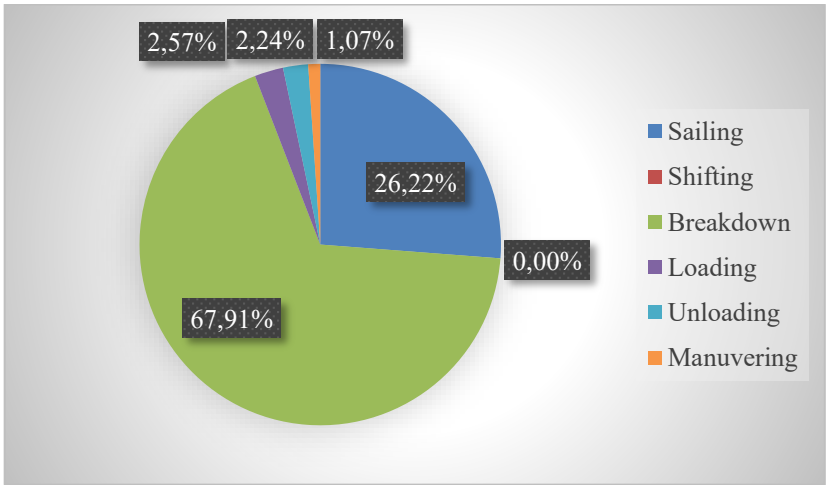

Figure 4. Percentage of Time per Activity Category of the SPOB Sibenua Baru Kaltara Ship

Tersus Alfa 02

Total duration 761:00 hours. Breakdown/Stop 86.38% (NVA) dominated; Sailing only 9.81%; Loading 1.27%; Unloading 1.82%; Maneuvering 0.72%. Strong indication of weak preventive maintenance and operational coordination.

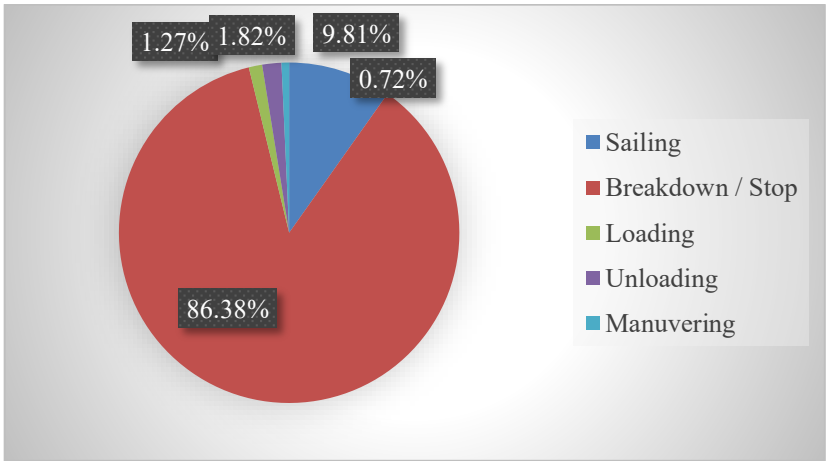

Figure 5. Percentage of Time per Activity Category of Tersus Vessel Alfa 02

Operational Time Analysis: VA vs NVA

The recapitulation of VA–NVA proportions is shown in Table 2 and Figure 6.

- Kelly Baid: VA 62.86% vs NVA 37.01% (ratio 1.69) → relatively efficient.
- Sibenua Baru Kaltara: VA 32.40%, NVA 67.91% (ratio 0.48) → dominant inefficiency.
- Tersus Alfa 02: VA 13.62%, NVA 86.38% (ratio 0.16) → most critical condition.

Table 2. Comparison of VA and NVA time proportions between ships

Boat	Total time (hours)	VA (O'clock)	NVA (hours)	VA (%)	NVA (%)	VA/NVA ratio
Kelly Baid	736:55	463:21	272:54	62.86%	37.01%	1.69
New Continent of North Kalimantan	466:10	151:05	316:35	32.40%	67.91%	0.48
Tersus Alfa 02	761:00	103:35	657:25	13.62%	86.38%	0.16

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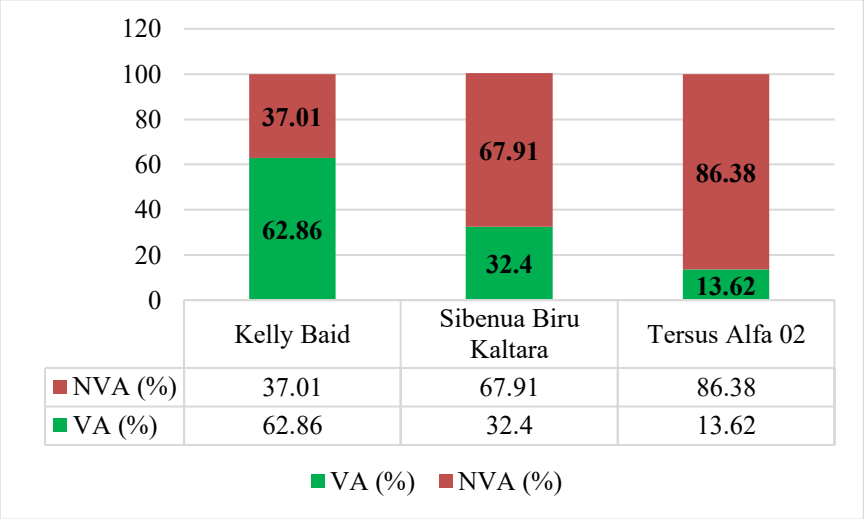

Figure 6. Comparison of VA and NVA proportions between ships

Only Kelly Baid found VA >60%. Two multi-port vessels exhibited high NVA (particularly waiting/breakdown), indicating port/clearance processes and technical readiness as the primary drivers of inefficiency.

NVA Salient Point (Kelly Baid Case)

Table 3 (Trip-1 & Trip-2) shows the largest NVA pattern:

- Trip-1: Mealtime (34.85%), Waiting Information (23.83%), Waiting Document (21.52%).
- Trip-2: Waiting Document (34.30%), Maintenance (15.09%), Mealtime (12.82%), Waiting Crew (11.69%).

Table 3. Non-Value Added Activities (NVA) on the Kelly Baid ship (trips 1 and 2)

Trip 1

No	Delay	Time	%
1	Waiting Information	31:00:00	23.83%
2	Waiting Crew	16:10:00	12.43%
3	Prepare Loading/Unloading	3:10:00	2.43%
4	Bunkering	3:00:00	2.31%
5	Maintenance	3:25:00	2.63%
6	Mealtime	45:20:00	34.85%
7	Waiting Document	28:00:00	21.52%
	Total Observation Time	130:05:00	100.00%

Trip 2

No	Delay	Time	%
1	Waiting Information	06:00:00	1.55%
2	Waiting Crew	06:00:00	11.69%
3	Prepare Loading/Unloading	02:48:00	5.45%
4	Bunkering	04:48:00	9.35%
5	Maintenance	07:45:00	15.09%
6	Mealtime	06:35:00	12.82%
7	Waiting Document	17:37:00	34.30%
8	Cleaning	05:00:00	9.75%
	Total Observation Time	50:33:00	100.00%

The crux of the problem lies in communication and documentation are not yet real-time, meal/work schedules are not synchronized, and maintenance is not structured. Most NVAs are avoidable if e-clearance, proper job sequencing, and preventive maintenance are implemented.

Energy Efficiency (BBM) and its Relation to NVA

The comparison of Real vs Theoretical Fuel (KPI) in Table 4.7 is visualized in Figure 4.7.

- Kelly Baid: Real 25,880 L vs Theoretical 17,933 L → difference 7,947 L (Rp. 119,204,730).
- Tersus Alfa 02: difference 4,663.55 L (Rp. 69,948,240).
- Sibenua Baru Kaltara: difference of 2,420.60 L (Rp. 36,309,000).

Table 4. Fuel consumption efficiency

Information	Volume (Liters)	Fee (IDR)
Real consumption (2 Trips)	25,880	388,195,500
Theoretical consumption (KPI)	17,933	268,990,770
Difference in waste	7,947	119,204,730

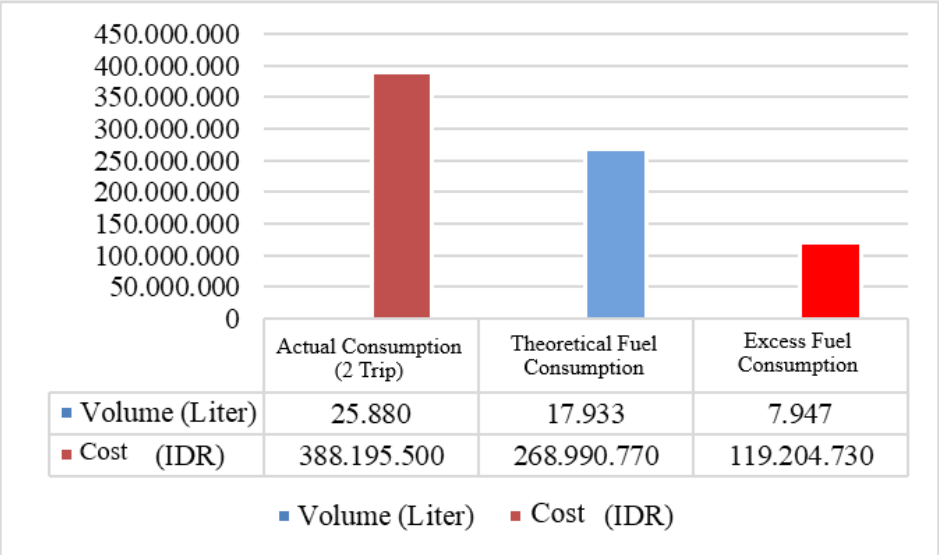

Figure 7. Fuel consumption efficiency

Fuel consumption is correlated with NVA-especially idling with the engine running while waiting. Interestingly, a good VA ratio (Kelly Baid) doesn't automatically translate to fuel economy if engine idle control is weak.

Comparison of Performance Between Ships & Implications

Qualitative evaluations of the ships' operational performance were also conducted to identify the specific strengths and weaknesses of each unit. These evaluations focused on aspects of operational behavior that are not always reflected in numbers but significantly impact overall efficiency. The following table summarizes the results of the qualitative evaluation of the strengths (VA) and challenges (NVA) of each ship (see Table 5).

Table 5. Operational qualitative evaluation

Boat	Power (VA)	Weaknesses (NVAs)
Kelly Baid	Consistent sailing speed, effective sailing time	Too long idle when document is not ready
New Continent of North Kalimantan	The crew is quite disciplined in loading and unloading.	The Shifting and Waiting process is too long
Tersus Alfa 02	Stable in VA time distribution	Lots of technical breakdowns and loading delays

Key managerial implications:

1. Digitalization of administration (e-clearance, real-time comms ship–jetty–office).
2. Structured scheduling (mealtime synchronization, jetty slots, work sequence).
3. Preventive maintenance based on engine operating hours + near real-time fuel monitoring.
4. Crew training (time efficiency, fuel management, K3) and VA-based incentives.
5. Standardization of SOPs (shifting, maneuvering, bunkering) and periodic audits.

Synthesis of Discussion

1. DILO Effectiveness. DILO provides granular time allocation data (VA/SVA/NVA) so that waste is clearly visible and improvement priorities can be established based on evidence.
2. NVA–Cost Relationship. NVA (waiting, breakdown, idle) drives fuel waste. The Kelly Baid case highlights that high VA remains wasteful if engine idle is not controlled.
3. Directions for Improvement. For multi-port operations (Sibenua, Tersus), port coordination and technical readiness are key. For port-to-port operations (Kelly Baid), documentation and idle control are crucial. Quick wins: e-clearance, crew discipline, and scheduled PMs.

CONCLUSION

Based on field observations on three vessels, the Kelly Baid, Sibenua Baru Kaltara, and Tersus Alfa 02, this study factually describes the operational conditions of shipping while providing a basis for recommendations for improving time and cost efficiency. Activity mapping using the DILO method shows a still high portion of Non-Value Added (NVA) with details of 37.02% (Kelly Baid), 67.91% (Sibenua Baru Kaltara), and 86.38% (Tersus Alfa 02), respectively. The most dominant forms of NVA include waiting for documents/clearance, idle time while waiting for instructions or jetty availability, and technical breakdowns due to reactive maintenance. These findings confirm the significant potential for waste reduction through strengthening port coordination, digitalizing the licensing/document process, and strengthening the technical readiness of ships. From a cost perspective, the difference between actual and theoretical fuel consumption (KPI) indicates material waste of approximately Rp. 119,204,730 for Kelly Baid, ± Rp. 36.3 million on Sibenua Baru Kaltara, and approximately Rp. 70 million on Tersus Alfa 02, which correlates with the duration of NVA, particularly idling with the engine running. This confirms the effectiveness of DILO as a diagnostic tool to link time to costs, so that the root of waste can be intervened in a targeted manner. However, this study has limitations: the coverage of only three vessels and two trips does not represent variations in other routes/commodities; fuel data is not real-time (still relying on manual records) so it has the potential to cause deviations; and the short observation horizon does not capture seasonal factors (extreme weather, port congestion). Therefore, further studies with broader coverage, real-time fuel sensorization, and a longer observation period are needed to strengthen the validity and generalizability of the findings. Overall, this study successfully presents a comprehensive picture of the causes of operational inefficiencies and provides a concrete activity-based approach for their improvement.

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