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Analysis of Operational Performance in Container Loading and Unloading at PT Jakarta International Container Terminal (JICT)

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Abstract: This study is entitled "Analysis of Container Loading and Unloading Operational Performance at PT Jakarta International Container Terminal (JICT)". The research object is the container loading and unloading operations conducted at PT Jakarta International Container Terminal (JICT), located at Tanjung Priok Port in North Jakarta. The objectives of this study are to analyze the operational performance of container handling activities based on Quay Crane productivity, identify the factors causing the failure to achieve the company's Gross Crane Rate (GCR) target of 30 boxes per crane per hour, and formulate recommendations to improve terminal operational productivity. This research employed a qualitative approach using observation, interviews, documentation, and literature review as data collection methods. Informants were selected through purposive sampling and consisted of operational supervisors, berth planners, ship planners, yard planners, Quay Crane operators, RTGC operators, chassis truck drivers, and terminal operational staff. Data were analyzed using the Miles and Huberman model, including data reduction, data display, and conclusion drawing, supported by source, technique, and time triangulation to ensure data credibility. The findings indicate that Quay Crane productivity has not consistently met the company target due to insufficient chassis availability, limited RTGC capacity, and a high container-shuffling rate in the Container Yard, averaging approximately 30%. These factors contribute to delays in container flow, increased equipment waiting time, and reduced overall loading and unloading efficiency.

Keyword: Operational Performance, Container Handling, Quay Crane, RTGC, Chassis Truck, Gross Crane Rate, JICT.

INTRODUCTION

Maritime transport is the backbone of international trade because it can transport large volumes of goods at a relatively lower cost compared to other modes of transportation (Dwiguna et al., 2024). As global trade flows increase and export-import activities grow, the need for efficient port and container terminal services becomes increasingly critical. Ports, as

key nodes in the logistics chain, serve to connect production, distribution, and consumption processes; thus, port operational performance is crucial to the smooth flow of goods (Faturrahman, 2024). PT Jakarta International Container Terminal (JICT), as one of the largest container terminals in Indonesia, plays a strategic role in supporting national logistics activities (Dewi & Fakhrurrozi, 2021). The high volume of containers handled daily requires the company to maintain loading and unloading productivity at an optimal level. One of the key indicators used to measure vessel service productivity is the Gross Crane Rate (GCR), which is the number of containers that can be loaded or unloaded by a single quay crane unit in one hour of operation. However, actual productivity remains below the company's target, indicating operational constraints that warrant in-depth analysis.

Theoretically, the operational performance of a container terminal is influenced by the effective utilization of resources, the availability of equipment, and coordination among operational units. Performance theory states that the achievement of work outcomes is a function of capability, resource support, and the effectiveness of the work system. In the context of container terminals, loading and unloading productivity is determined not only by the capacity of quay cranes but also by the availability of supporting equipment such as Rubber-Tired Gantry Cranes (RTGCs) and truck chassis, as well as by container yard management. Furthermore, the theory of container terminal operations explains that loading and unloading activities constitute an integrated system, in which each component is interconnected and influences the terminal's overall performance (Auliyah et al., 2026). High levels of container shuffling, limited supporting equipment, and suboptimal operational coordination can create bottlenecks, reducing productivity and increasing vessel turnaround times.

Based on these conditions, this study aims to analyze the operational performance of container loading and unloading at PT Jakarta International Container Terminal (JICT), identify the factors causing the failure to meet quay crane productivity targets, and analyze the impact of the availability of truck chassis, RTGCs, and container shuffling rates on loading and unloading productivity. In addition, this study aims to provide actionable recommendations to improve the operational efficiency of the container terminal, thereby expediting vessel services, increasing productivity, and strengthening the competitiveness of Indonesian ports in support of international trade.

METHOD

This study employs a descriptive qualitative approach to gain an in-depth understanding of the operational performance of container loading and unloading at PT Jakarta International Container Terminal (JICT). A qualitative approach was chosen because this study focuses on identifying and analyzing the factors that influence container loading and unloading productivity based on actual operational conditions in the field (Wiryawan, 2024). The research was conducted at PT Jakarta International Container Terminal (JICT), Tanjung Priok Port, North Jakarta, from January through March 2019. This location was chosen because JICT is one of the largest container terminals in Indonesia, with a high cargo-handling volume and a crucial role in supporting national logistics activities.

The research subjects consisted of parties directly involved in the operational activities of the container terminal, namely the Operations Supervisor, Berth Planner, Ship Planner, Yard Planner, Quay Crane Operator, Rubber-Tired Gantry Crane (RTGC) Operator, Chassis Truck Driver, field operations control officers, and operations division staff. Informants were selected using purposive sampling, which involves selecting individuals based on their knowledge and experience relevant to the research focus. The research scope includes container loading and unloading activities, the use of Quay Cranes, RTGCs, and Chassis Trucks, as well as container yard management related to achieving loading and unloading productivity.

The primary instrument in this study was the researcher himself (human instrument), supported by interview guidelines, observation sheets, documentation tools, and the company's

operational data obtained from the New Enterprise Data Repository (NEDR) system. Data collection was conducted through direct observation of container loading and unloading activities, in-depth interviews with informants, a review of the company's operational reports, and a literature review of books, scientific journals, and documents related to container terminal operations. The research procedure began with problem identification, a literature review, field data collection, data analysis, and culminated in the formulation of conclusions and research recommendations.

The data analysis technique uses the Miles and Huberman model, which consists of three stages: data reduction, data presentation, and drawing conclusions or verification (Qomaruddin & Sa'diyah, 2024). Data reduction is carried out by selecting and simplifying data relevant to the research objectives. Next, the data are presented in the form of descriptive narratives to facilitate understanding of the phenomena under study. The final stage involves drawing conclusions based on the patterns and relationships identified during the analysis process. To ensure the credibility and validity of the data, this study employs source, methodological, and temporal triangulation by comparing information obtained from various informants, data collection methods, and different time periods. Through this approach, it is hoped that a comprehensive picture of the factors influencing container loading and unloading productivity at PT Jakarta International Container Terminal will be obtained.

RESULTS AND DISCUSSION

This study was conducted at PT Jakarta International Container Terminal (JICT), located at Tanjung Priok Port in North Jakarta. JICT is one of the largest container terminals in Indonesia and plays a strategic role in supporting both national and international logistics flows. As a major container terminal, JICT handles the loading and unloading of export, import, and transshipment containers at very high volumes every day. In carrying out its operations, JICT is supported by various modern facilities and equipment, such as Quay Cranes (QC), Rubber-Tired Gantry Cranes (RTGC), Chassis Trucks, Reach Stackers, and a Terminal Operating System (TOS) that controls and monitors container movements in an integrated manner. The operational success of a container terminal is heavily influenced by the coordination between equipment and the human resources involved in loading and unloading. One indicator used to measure the operational success of a container terminal is the Gross Crane Rate (GCR), defined as the number of containers that can be unloaded or loaded by a single Quay Crane in one hour. PT Jakarta International Container Terminal has set a productivity target of 30 boxes per crane per hour. However, based on the company's operational data, actual productivity remains in the range of 22–30 boxes per crane per hour, indicating a gap between the target and actual performance that requires further analysis.

The study was conducted on three container ships selected as research samples: the CMA CGM Swordfish, the Wan Hai 512, and the Cosco Durban. These three ships were observed during three arrival periods between January and March 2019. These vessels were selected because they represent the characteristics of container ships regularly served by JICT, with relatively similar loading and unloading volumes—approximately 2,500 containers per port call.

Table 1 Operational Data on Container Loading and Unloading

Vessel Name	Loading/Unloading Volume (Boxes)	Quay Crane	RTGC	Chassis Truck	Shuffling (%)	VOR
CMA CGM Swordfish	2.500	4	4	12	30	22
Wan Hai 512	2.500	4	4	10	30	30

Cosco Durban	2.500	4	4	12	30	30
CMA CGM Swordfish	2.500	4	4	10	30	22
Wan Hai 512	2.500	4	4	8	30	30
Cosco Durban	2.500	4	4	12	30	30
CMA CGM Swordfish	2.500	4	4	10	30	22
Wan Hai 512	2.500	4	4	12	30	30
Cosco Durban	2.500	4	4	12	30	30

Based on the table above, it can be seen that all ships have the same workload, namely 2,500 containers, supported by four quay cranes and four RTGCs. However, there are differences in the productivity achieved. The CMA CGM Swordfish achieved a VOR of only 22 boxes/crane/hour, while the Wan Hai 512 and Cosco Durban were able to achieve a VOR of 30 boxes/crane/hour. These results indicate that loading and unloading productivity is influenced not only by the number of quay cranes but also by other operational factors, such as the number of chassis trucks, the availability of RTGCs, and the condition of the container yard.

Analysis of Research Results

Analysis of Chassis Truck Availability

Observations show that the number of chassis trucks used during the study ranged from 8 to 12 units to support four quay cranes. Theoretically, this number is considered sufficient to support loading and unloading operations. However, in practice, this number has not ensured a smooth flow of containers from the pier to the container yard, or vice versa. When several large ships are being served simultaneously, some chassis trucks must be allocated for receiving and delivery activities, thereby reducing the number available for ship service. Consequently, delays in vehicle movement cycles occur, increasing waiting times for the quay cranes.

Based on an interview with the Operations Supervisor, a shortage of truck chassis often causes vehicle queues under the crane. This situation prevents the quay crane from operating continuously, as it must wait for vehicles to receive unloaded containers or to transport loaded containers to be loaded onto the ship. Operationally, a delay involving a single truck chassis can disrupt the entire loading and unloading cycle. If this situation occurs repeatedly during a single work shift, a significant amount of idle time will accumulate, leading to a decline in the Quay Crane's productivity.

RTGC Availability Analysis

The Rubber-Tired Gantry Crane (RTGC) is one of the primary pieces of equipment used to stack and unstack containers in the container yard. Research has shown that four RTGCs are used for each ship service. Although this number is relatively adequate, RTGCs are not used solely to support ship loading and unloading operations. RTGCs must also handle various other activities such as receiving, delivery, marshalling, container housekeeping, and container repositioning. The high workload of RTGCs often leads to job queues, especially as yard density increases. Under such conditions, RTGC operators must handle multiple requests simultaneously, resulting in longer service times.

Furthermore, observations show that RTGCs are frequently used to reshuffle containers due to high yard density. This situation results in a portion of the RTGC's capacity being diverted to additional tasks that do not directly enhance loading and unloading productivity.

Consequently, container deliveries to the pier are delayed, causing chassis trucks to wait longer. These delays ultimately lead to a decrease in quay crane productivity.

Analysis of Container Shuffling Rates

One of the key findings of this study is the high rate of container shuffling in the Container Yard. Based on the company's operational data, the shuffling rate averages 30%. This percentage is significantly higher than the ideal standard for container terminals, which generally ranges from 10–15%. The high shuffling rate indicates that the container placement system is not yet operating optimally. Shuffling occurs when a container to be loaded onto a ship is blocked by other containers, forcing the RTGC operator to move several containers first before retrieving the target container. Observations show that in some cases, RTGC operators must move three to five containers to retrieve a single container for loading onto a ship. This additional activity results in longer service times and reduces equipment utilization efficiency. The higher the shuffling rate, the longer it takes to complete loading and unloading operations. This situation causes delays in delivering containers to the pier, thereby reducing Quay Crane productivity.

The Integration of Operational Systems and Loading/Unloading Productivity

Container loading and unloading operations at modern container terminals are essentially an integrated system comprising equipment, human resources, information systems, and operational management. Loading and unloading productivity is determined not only by the capabilities of a single type of equipment, but by the ability of all subsystems to work in harmony. This study found that the quay crane, as the primary loading and unloading equipment, actually possesses sufficient technical capabilities to meet the company's targets. However, these capabilities cannot be optimally utilized due to constraints in other subsystems, such as limitations of the chassis trucks, limitations of the RTGCs, and the high rate of container shuffling in the container yard.

These findings show that the concept of bottlenecks remains a major challenge in container terminal operations. A bottleneck occurs when one component of the system has a lower capacity than the others, thereby hindering the overall process flow. In the context of this study, the limited capacity of RTGCs and chassis trucks prevented quay cranes from operating continuously, resulting in productivity levels falling below the company's targets. This situation indicates that productivity cannot be improved in isolation simply by increasing the number of quay cranes; rather, it must be achieved by enhancing the capacity of all subsystems that support the loading and unloading process.

Furthermore, the research findings indicate that coordination among operational units significantly affects the smoothness of the loading and unloading process. The activities carried out by the Berth Planner, Ship Planner, Yard Planner, Operations Supervisor, Quay Crane Operator, RTGC Operator, and Chassis Truck Driver must proceed in sync to prevent delays in container movement. If any one unit experiences a delay in performing its duties, the impact will be felt throughout the entire terminal's operational chain.

Efficiency in Quay Crane Utilization

Quay cranes are the primary equipment that determines the speed of ship service at container terminals. Based on the research findings, all sample ships were served using four quay cranes, with a workload of approximately 2,500 containers per ship. However, the productivity achieved showed significant differences. The CMA CGM Swordfish achieved a Vessel Operating Rate (VOR) of only 22 containers per crane per hour, while the Wan Hai 512 and Cosco Durban were able to reach 30 containers per crane per hour. This difference indicates that quay crane productivity is influenced not only by the number of units used but also by supporting operational conditions.

Under ideal conditions, the quay crane should be able to operate continuously without any downtime. However, observations show that there are periods when the quay crane must halt operations because no truck chassis is available to receive containers or because the containers to be loaded are not yet available at the dock area. These conditions result in idle time, which directly reduces the gross crane rate. From an operational management perspective, idle time is a form of waste that must be minimized because it increases the company's operating costs. The longer the Quay Crane remains idle, the lower the utilization rate of the company's equipment. Therefore, improving the Quay Crane's productivity requires a systemic approach that involves all operational components of the terminal.

The Role of the Container Yard in Supporting Container Terminal Performance

The container yard is a strategic area within a container terminal because it serves as temporary storage for containers before they are loaded onto ships and after they are unloaded. The effectiveness of container yard management is crucial to the smooth flow of containers within the terminal. Research findings indicate that a high rate of container shuffling is one indicator that container yard management is not yet operating optimally. A shuffling rate of around 30% suggests that many container-moving activities still do not add value to operational processes.

High shuffling not only results in longer RTGC turnaround times but also increases fuel consumption, operator working hours, and equipment wear and tear. In addition, high shuffling activity can increase the risk of workplace accidents and container damage due to excessive movement. Therefore, companies need to implement a more systematic container arrangement strategy by considering vessel arrival schedules, loading sequences, container types, and shipping destinations. Applying the "first planned, first loaded" principle can be an effective way to reduce shuffling rates. With this approach, containers to be loaded first are placed in easily accessible locations, so no additional movement is required during loading.

The Importance of Digitalization and Terminal Operating Systems (TOS)

Advances in information technology offer significant opportunities for container terminals to improve operational efficiency. One technology widely implemented in modern container terminals is the Terminal Operating System (TOS). This system integrates all operational activities, ranging from vessel scheduling and container placement to equipment management and real-time productivity monitoring. A range of modern facilities and integrated operational systems support JICT. By making optimal use of the TOS, the company can plan container placement more accurately, thereby reducing shuffling.

Additionally, this system allows management to directly monitor the movements of chassis trucks and RTGCs, enabling faster operational decisions during disruptions. Digitization also enables the company to implement predictive operations the ability to forecast equipment and resource needs based on historical operational data. Consequently, the company can plan more effectively and reduce the likelihood of bottlenecks during loading and unloading operations.

The Impact of Increased Productivity on Port Competitiveness

High cargo-handling productivity not only benefits container terminal operators but also enhances the port's overall competitiveness. The higher the cargo-handling productivity, the shorter the time ships spend at berth at the port. This benefits shipping companies by reducing the operational costs of their vessels while they are in port. For ports, increased productivity will boost service capacity without the need for infrastructure expansion in the short term. Ports capable of providing fast and efficient service will be more attractive to international shipping companies, thereby potentially increasing the annual volume of container traffic handled.

In the context of national logistics, increased loading and unloading productivity also contributes to a reduction in national logistics costs. As the movement of goods through ports accelerates, the supply chain will become more efficient and better able to support Indonesia's global economic competitiveness. The findings of this study indicate that optimizing truck chassis, RTGCs, and container yard management are strategic steps JICT can take to improve operational productivity while strengthening Tanjung Priok Port's position as Indonesia's main gateway for international trade.

Analysis of Loading and Unloading Productivity from a Systems Theory Perspective

Systems theory states that an organization is a collection of subsystems that interact and cooperate to achieve specific goals. In container terminal operations, the quay crane, RTGC, chassis truck, container yard, and human resources are subsystems that together form a comprehensive ship-servicing system. Research findings indicate that loading and unloading productivity at JICT is influenced by the interactions among these subsystems. Although Quay Cranes possess high technical capabilities, productivity cannot meet targets if supporting equipment cannot keep pace with the Quay Cranes' work pace. This situation indicates that system performance is determined not by the strongest component but by the weakest.

The Relationship Between Operational Performance and Vessel Berthing Time

One of the key indicators in port services is vessel berthing time, or port stay. The higher the cargo-handling productivity achieved, the shorter the time required for a vessel to complete its cargo-handling activities at the port. Research findings indicate that low quay crane productivity—due to limitations in supporting equipment—results in longer vessel turnaround times. This situation not only harms container terminals but also has economic implications for shipping companies. Vessels that remain in port longer incur additional costs, including crew operational expenses, fuel for vessel support, port fees, and opportunity costs from delays in proceeding to the next port. In the modern shipping industry, time efficiency is one of the key factors determining a shipping company's competitiveness. Therefore, container terminals capable of providing fast service will be preferred by shipping companies over those with low productivity.

The Importance of Effective Yard Planning

The container yard is one of the areas that significantly impacts container terminal productivity. Research findings indicate that high levels of container shuffling suggest that the yard planning process is not yet operating optimally. Effective yard planning must take into account various operational aspects, including vessel arrival schedules, the sequence of loading and unloading activities, container types, container sizes, and shipment destinations. By taking these factors into account, companies can reduce reshuffling activities that do not add value to operational processes. Additionally, implementing data-driven yard planning strategies can help companies optimize the use of available storage space. Through the use of information technology, companies can determine the most efficient storage locations for containers, thereby minimizing the time spent searching for and retrieving them.

Strategies for Optimizing Truck Chassis and RTGCs

Based on research findings, one way to improve loading and unloading productivity is by optimizing the number and operational patterns of truck chassis and RTGCs. This optimization can be achieved through more effective operational scheduling, the redistribution of equipment to areas requiring additional capacity, and the implementation of technology-based monitoring systems. Companies can also implement an automated dispatching system to manage the movement of truck chassis in real time. With such a system, vehicles can be directed to locations requiring service, thereby minimizing wait times. Additionally, companies need to perform

scheduled preventive maintenance to maintain equipment reliability. Equipment that frequently breaks down reduces the terminal's operational capacity and increases the risk of bottlenecks in the loading and unloading process.

Research Contributions to the Development of Port Science

This study makes an academic contribution to the development of port management and maritime logistics, particularly regarding container loading and unloading productivity. The results show that container terminal productivity is the result of the interaction of various interrelated operational factors. The findings of this study reinforce systems theory and bottleneck theory in the operational context of container terminals in Indonesia. Furthermore, this study provides empirical evidence that productivity gains cannot be achieved solely by adding primary equipment but must be accompanied by increased capacity in supporting equipment, improvements in container yard management, and strengthened operational coordination. From a practical perspective, the research results can serve as a basis for container terminal management in formulating policies to improve productivity, develop infrastructure, and plan future equipment investments. Thus, this study is expected to benefit not only PT Jakarta International Container Terminal but also other container terminal operators in Indonesia.

CONCLUSION

Based on the results of a study on the Operational Performance Analysis of Container Loading and Unloading at PT Jakarta International Container Terminal (JICT), it can be concluded that the operational performance of container loading and unloading at JICT has not yet fully met the productivity targets set by the company, particularly the Gross Crane Rate (GCR) target of 30 boxes per crane per hour. The study's findings indicate that loading and unloading productivity results from the integration of the entire container terminal operational system, which involves Quay Cranes, Chassis Trucks, Rubber-Tired Gantry Cranes (RTGCs), and Container Yard management. Therefore, loading and unloading performance is not only determined by the capabilities of the Quay Crane as the primary loading and unloading equipment but is also significantly influenced by the readiness and effectiveness of supporting equipment, as well as coordination among operational units.

Based on the first research question, this study concludes that the number of truck chassis supporting a single quay crane does not yet fully meet the company's operational needs. Although there are between 8 and 12 truck chassis available to support loading and unloading, under certain conditions, this number is insufficient to keep pace with the quay crane's operating speed, particularly when container volumes increase or multiple ships are being served simultaneously. This situation results in idle time for the quay crane, which directly impacts the productivity of container loading and unloading operations.

Based on the second research question, this study concludes that the number of RTGCs supporting loading and unloading operations does not yet fully meet the container terminal's operational needs. RTGCs are used not only to support ship loading and unloading operations but also to handle container receiving, delivery, marshalling, and housekeeping activities. The high workload of the RTGCs causes service queues in the Container Yard, thereby slowing the movement of containers to and from the pier. As a result, the smooth operation of loading and unloading is disrupted, and vessel service productivity cannot meet expected targets.

Furthermore, based on the third research question, this study concludes that the high percentage of container shuffling in the Container Yard significantly affects container loading and unloading productivity at PT Jakarta International Container Terminal. A shuffling rate of approximately 30% indicates that many container relocation activities still do not add value to the loading and unloading process. The high level of reshuffling causes an increase in RTGC operating time, longer waiting times for chassis trucks, and delays in the provision of containers

for ship loading operations. These conditions directly reduce Quay Crane productivity and hinder the Company's ability to achieve its operational targets.

Overall, this study successfully achieved its research objectives, namely to identify and analyze the factors contributing to the failure to meet container loading and unloading productivity targets at PT Jakarta International Container Terminal. The results show that the main factors affecting container loading and unloading operational performance are the suboptimal availability of chassis trucks, the limited capacity of RTGCs in support yard stacking activities, and the high rate of container shuffling in the container yard. These three factors are interrelated and create operational bottlenecks that result in low quay crane productivity.

Thus, it can be concluded that the operational performance of container loading and unloading at PT Jakarta International Container Terminal will improve if the company can optimize the number and utilization of chassis trucks, increase the capacity and effectiveness of RTGC usage, and reduce the shuffling rate through more planned and integrated management of the container yard. Improvements in these areas are expected to increase the Gross Crane Rate, expedite vessel service, reduce vessel berthing time at the port, and support increased efficiency and competitiveness of the container terminal as a whole.

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