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A Study of Port Facilities in Supporting Throughput at Sunda Kelapa Port

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***Abstract*— Sunda Kelapa Port is a collector port that plays an important role in inter-island goods distribution, yet it still faces facility limitations and low operational efficiency. Although the number of loading and unloading activities increases each month, the predominantly manual operational processes indicate the need for facility modernization. This study aims to analyze the condition of facilities at Sunda Kelapa Port and evaluate throughput values to determine their relationship with port performance. A qualitative descriptive method was employed through an assessment of primary and functional port facilities as well as throughput calculations based on loading and unloading data from August to October 2025. This analysis was conducted to assess the capacity of the existing facilities to support increased cargo flow. The results show that the 54 percent decrease in general cargo throughput in September, followed by a limited increase in October, was influenced by inadequate conditions of the public pier, storage yard, and warehouse. For container cargo, the significant 90 percent decline in throughput was caused by the limited capacity of the container yard, insufficient stuffing– stripping areas, and the absence of modern container-handling equipment. Overall, the study concludes that the existing facilities at Sunda Kelapa Port are not yet optimal in supporting throughput growth. Modernizing port facilities is essential to improve efficiency and strengthen the port's role within the national logistics system.**

Keywords— Port Facilities, Sunda Kelapa Port, Throughput.

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I. INTRODUCTION

Sunda Kelapa Port is one of the ports with a long history in Indonesian maritime trade. According to the Pelindo website (2020), Sunda Kelapa Port was an international shipping port built in 1527 during the Portuguese rule. In the early 17th century, the VOC (Vereenigde Oost- Indische Compagnie) used Sunda Kelapa as its main port before building Tanjung Priok Port to accommodate larger ships. Today, Sunda Kelapa Port is a cargo and container port. It is visited by inter-island ships and traditional vessels such as Phinisi or Bugis Schooners with their distinctive shapes. In addition to timber, the commodities transported include basic necessities, general goods, and building materials.

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Sunda Kelapa Port is classified as a collection port according to the port hierarchy in the 2016 National Port Master Plan. Law No. 17 of 2008 explains that a collection port is a port that serves maritime transportation activities in relatively small quantities and is also the point of origin and destination for passengers and/or goods and inter-provincial ferry transportation. Sunda Kelapa Port is one of the active Class III ports in Jakarta that handles the loading and unloading of various commodities in a multipurpose capacity [1].

TABLE 1.
NUMBER OF LOADING AND UNLOADING ACTIVITIES

Bulan	Total Kegiatan
Oktober	2327
September	2548
Agustus	1921

Source: Internal Company Data, processed by researchers (2025)

Based on the data in Table 1 regarding the number of loading and unloading activities at Sunda Kelapa Port, there has been an increase every month, which means that this port has great potential for development. The large number of loading and unloading activities is closely related to one of the port's performance indicators, namely throughput. According to Riyanti (2024), throughput is the amount of cargo that passes through the terminal, or the amount of cargo that is successfully handled by the port in tons or meters, or boxes in a certain period. The amount of throughput is closely related to the facilities owned by the port. Unfortunately, there are several challenges faced by this port, such as limited facilities and the need for increased efficiency in management and operations. The loading and unloading process is still carried out manually, where loading and unloading workers need to move

goods into sacks and then attach them to cranes made by the ship owners themselves, as shown in Figure 1. This results in low operational efficiency and longer ship service times compared to ports that are managed in the form of terminals. This shows the need for modernization and improvement of facilities so that logistics activities can be more optimal and competitive. According to Affiat et al. (2021), who also researched the Sunda Kelapa port, port managers have made adjustments to facilities to accommodate container

Based on observations conducted by the research team at the Sunda Kelapa multipurpose port on September 22, 2025, various obstacles were still found that affected the smooth running of port operations. The main problem lies in the limited facilities, particularly the condition of the roads around the pier, which are damaged as shown in Figures 2 and 3, thereby hampering vehicle mobility and slowing down the truck lossing and non-truck lossing processes ( ), which ultimately hinders an increase in throughput at the port. The longer the turnover of goods at a port, the smaller the throughput value.

In line with the fifth point of Asta Cita, which emphasizes downstreaming and industrialization to increase domestic added value, strengthening the national logistics sector is key to equitable development and increasing industrial competitiveness [3]. Sunda Kelapa Port, as the oldest and most strategic port, plays an important role in the distribution of industrial products, downstream products, and basic necessities between islands [4]. Improving its operational efficiency and effectiveness is crucial to streamlining the national supply chain, supporting downstreaming, and providing economic added value to the community. This effort is also in line with the Sustainable Development Goals (SDGs) points 8 (Decent Work and Economic Growth) and 9 (Industry, Innovation, and Infrastructure), where improving port efficiency drives labor productivity, strengthens sustainable logistics facilities, and contributes to inclusive and sustainable economic development in line with the global SDGs agenda [5].

This study focuses on the assessment of Sunda Kelapa port facilities and throughput based on loading and unloading data at Sunda Kelapa port. This study will describe the condition of port facilities that support loading and unloading activities, analyze throughput based on loading and unloading volume data, and analyze port facilities in supporting the increase in throughput at Sunda Kelapa Port. The results of the analysis are expected to provide recommendations for improvements or developments to the facilities to increase throughput at Sunda Kelapa Port, in order to support the smooth flow of inter-island logistics and strengthen the role of multipurpose ports in the national maritime transportation system.

Figure 1. Loading process at the People's Port using sacks attached to a ship crane
Source: Author's documentation (2025)

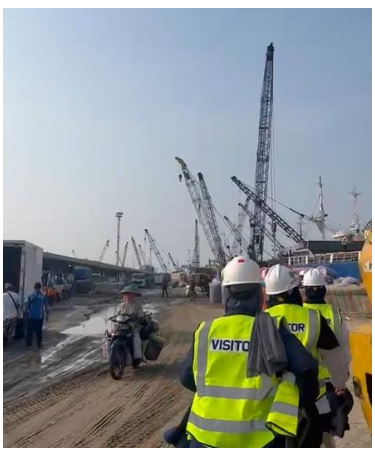

Figure. 2. Road Conditions at the Port
Source: Author's documentation (2025

II. METHOD

The method used in this study is a qualitative descriptive method. Based on the definition provided by Arikunto (2005:234), descriptive research is research intended to collect information about the status of existing phenomena, meaning that it analyzes something based on the conditions of the phenomena as they occur in the field/research location at the time the research is conducted. In addition, Arikunto also explains that descriptive research is not intended to test specific hypotheses, but only to describe a variable, phenomenon, or condition as it is. Similarly, this study does not aim to prove a hypothesis, but rather to examine the existing conditions of facilities in increasing throughput at the Port of Sunda Kelapa.

The types and sources of data in this study consist of primary and secondary data. Primary data collection techniques were carried out through direct observation of the Sunda Kelapa port and interviews with the Operations Manager and the operational team at this port. Meanwhile, secondary data was obtained by conducting a literature study and documentation on theories regarding ports, port performance, and loading and unloading data at Sunda Kelapa Port. The data collection period was from August to October 2025.

The flow of this study adopts the research flow conducted by Chairunnisa and Sunarto (2012), which consists of five stages of qualitative research. However, this study made adjustments, particularly in the fourth stage, which was not conducted in this study [6]. The following are the details of the stages/flow of the research conducted:

1. Orientation Stage: This stage aims to determine the research problem and the information needed for the research.
2. Exploration Stage: At this stage, the research team needs to read various sources such as books, news, and papers published in reputable journals, then discuss them with the team and determine the information that is relevant to the research objectives. Next, they need to create the observation guidelines and interview guidelines needed for the next stage.
3. Checking stage: at this stage, the research team conducts direct observation in the field to ensure that all information obtained from the previous stage is accurate and to discover new information in the field. In addition, the research team also interviews informants as specified in the interview guidelines, in this case managers and employees involved in port operations.
4. Data analysis stage: all observation and interview data is then collected and grouped according to each research objective. In this study, data on port facilities and loading and unloading was obtained, which will then be analyzed into throughput data.

In this data analysis stage, two data analysis techniques were used, namely descriptive data analysis of port facilities and throughput calculations based on loading and unloading data.

Port throughput measurements reflect the amount of cargo or number of ships handled by the port over time. These measurements are influenced by many variables beyond physical capacity [7]. In the context of this study, this definition will be adopted into the following two equations:

1. The first equation is used to determine general non-containerized cargo throughput: Throughput = Total weight of cargo unloaded + loaded in a given period
2. The second equation is used to determine container throughput: Throughput = Number of 20 ft containers + (2 × Number of 40 ft containers)

According to Riyanti (2024), the use of the above equation is based on the definition that container throughput is a measure of the number of containers handled during a certain period of time, and is a standard measure of seaport productivity. A 20-foot container can be referred to as 1 box, 1 TEU, while a 40-feat container can be referred to as 1 box, 2 TEUs. For general cargo, the unit used is tons, while for containerized cargo, the unit is TEUs.

III. RESULT AND DISCUSSION

Sunda Kelapa Port is a multipurpose port. In general, multipurpose ports handle various types of cargo, such as general cargo, dry bulk, liquid bulk, and containers. Therefore, adequate port infrastructure is very important to support smooth loading and unloading activities. The main infrastructure includes docks, harbor basins, shipping lanes, warehouses, and storage yards. Docks serve as places for ships to berth and are the main point of for the transfer of goods. According to Baird (1999) in Maritime Policy & Management, dock capacity greatly determines a port's ability to handle throughput and avoid operational congestion [7]. Meanwhile, inadequate basin depth and navigation channels can hinder ships from entering and docking. Sunaryo et al. (2019) in the Journal of Civil Engineering emphasize that the depth of the basin must be in accordance with the draft of the ships served so that the loading and unloading process can take place optimally [8].

In addition to infrastructure, port facilities or loading and unloading equipment have a major impact on the productivity of multipurpose ports. Equipment such as Mobile Harbor Cranes (MHCs), forklifts, reachstackers, and internal transport equipment such as trucks and trailers are used to move various types of goods. Baskara & Setiawan (2021) in the Indonesian Journal of Marine Engineering show that MHCs can increase loading and unloading productivity due to their flexibility for various types of cargo [9]. For bulk cargo, facilities such as grab buckets, hoppers, and conveyor systems are needed to make the cargo transfer process.

faster and safer. Mahardika (2017) in the Journal of Infrastructure Engineering states that the use of conveyor systems significantly increases the efficiency of bulk cargo handling compared to manual methods [10].

In addition, multipurpose ports are usually equipped with pipelines to handle liquid bulk cargo such as fuel or vegetable oil. Darmawan et al. (2016) in the Journal of Maritime Technology found that the use of pipelines can reduce ship berthing time and increase

liquid cargo throughput. Thus, complete and efficient facilities and infrastructure are key factors that determine the performance of multipurpose ports in handling various types of cargo and achieving optimal throughput [11].

Port facilities and infrastructure are divided into three types of port facilities. According to Triatmodjo in his book Port Planning (1996), the three types of port facilities consist of [12]:

1. Basic (primary) facilities are facilities that a port must have to enable ships to enter, anchor, and carry out loading and unloading activities, such as port basins, shipping lanes, and docks.
2. Functional facilities are facilities that directly support operational activities at the port, especially loading and unloading and cargo handling. These facilities include warehouses (transit sheds), storage yards (container yards/open storage), loading and unloading equipment such as cranes, forklifts, reachstackers, conveyors, grabs, hoppers, and internal transportation equipment such as trucks, head trucks, and trailers.
3. Supporting facilities: additional facilities that are not directly involved in loading and unloading activities, but are very important to ensure that port operations run smoothly, safely, and efficiently. Some supporting facilities include administrative offices, security posts, dock lighting, internal access roads, clean water, electricity, work safety equipment, CCTV, vehicle parking, and facilities for workers such as prayer rooms and rest areas.

At PT. Pelindo Regional 2, Sunda Kelapa Port also has the three types of port facilities as described above. Based on the results of observations, interviews with operational managers, and a study of documentation from the PSPP Report (Rizky, et al., 2024), data was obtained regarding the port facilities at Sunda Kelapa, as shown in Table 2 (Main Facilities), Table 3 (Functional Facilities), and Table 4 (Supporting Facilities) below:

Based on the data in Tables 2, 3, and 4, which discuss the facilities at Sunda Kelapa Port, it can be seen that, in general, most of the facilities are in good condition and are being utilized. However, there are several key facilities that are in poor condition, which could potentially hamper the port's operational efficiency.

The main facilities, namely the shipping channel, water area, harbor basin, basin depth, and breakwater, are in good condition and functioning optimally. This indicates that ship accessibility to the port is not a major obstacle, given that the shipping channel is 2,212 meters long, 60 meters wide, and has a depth of -6 meters LWS. The basin depth of -4 meters LWS is also sufficient to serve small to medium-sized domestic vessels and traditional ships. However, the wharf facilities, which are the main point of loading and unloading activities, are in varying conditions. The People's Port Wharf, which is 1,200 meters long and functions as a multipurpose cargo facility, is in poor condition. This condition has the potential to affect the smoothness of the loading and unloading process, especially for wooden ships or traditional ships, which are the dominant users of the port. In contrast, the 1,005-meter Domestic Pier is in good condition and can still support optimal operational activities. Meanwhile, the 3,936-meter road facility in the port area is in poor condition. Damage to road access greatly affects the speed of mobilizing goods from the pier to the storage area and out of the port, thereby increasing waiting times and reducing overall logistics efficiency.

The functional facilities at Sunda Kelapa Port based on the available data, facilities such as the Pelindo branch office, container yard, and heavy loading and unloading equipment (harbor cranes, reach stackers, forklifts, head trucks, fixed jib cranes, and top loaders) are all in good condition and have been utilized. The presence of these various types of heavy equipment indicates that Sunda Kelapa Port has relatively adequate equipment support for multipurpose loading and unloading activities, although not all of these tools are specifically designed for more advanced container handling. However, several other important facilities are in poor condition, namely the stacking yard (36,212 m^2), the stuffing & stripping yard (37,512 m^2), and the warehouse with a capacity of 10,807 tons. The poor condition of these facilities indicates limitations in terms of physical quality or functional capacity, which can affect the cargo handling process. The stacking yard and warehouse are vital components in the goods flow system; if their condition is not optimal, this can result in goods accumulation, delivery delays, and increased logistics costs. Thus, although the basic port facilities are adequate, the functional capacity of the port does not yet fully support high-volume cargo handling activities.

The supporting facilities at Sunda Kelapa Port. Several facilities are available, such as firefighting equipment, security posts, lighthouses, KSOP offices, Customs offices, electrical installations, PDAM, waste disposal sites, places of worship, and parking areas for loading and unloading equipment, all of which are in good condition and have been fully utilized. The availability of these facilities reflects that the port has a fairly complete operational support system, especially in terms of regulations, safety, and services to port users. The presence of other supporting facilities such as canteens, minimarkets, banks, and security posts also plays a role in supporting the comfort of workers, ship crews, and other port service users. With well-maintained supporting facilities, the port can ensure the stability of non- technical services that remain important in the daily operational ecosystem.

Understanding the condition of port facilities is very important in relation to the port's ability to produce optimal throughput. Key facilities such as docks, harbor basins, and road access are components that directly affect the smooth operation of loading and unloading. When these facilities are in poor condition, such as the public docks and road access at Sunda Kelapa Port, operational processes are hampered and throughput tends to decline. Therefore, knowing the periodic throughput value is important as a performance indicator that can show the extent to which port facilities are able to accommodate the flow of goods.

The cargo loading and unloading data collected during the research period was then processed using the equation presented in the methods section to obtain throughput calculations for general cargo, both containerized and non-containerized.

Based on the results of calculations of general non-containerized cargo throughput at Sunda Kelapa Port collected during the period from August to October 2025, there were fluctuations in the amount of cargo unloaded and loaded during those three months. General cargo throughput at Sunda Kelapa Port in August 2025 recorded a value of 877,330 tons. This value then decreased to 404,341 tons in September 2025. The recorded decrease was 472,989 tons, equivalent to 54%, which means that the volume of goods handled by the port fell by more than half compared to the previous period. In October 2025, general cargo throughput was recorded at 413,556 tons, representing an increase of 9,215 tons compared to the previous month. This increase indicates that in October 2025, Sunda Kelapa Port handled 2% more cargo volume than before. However, this increase was insignificant when compared to the decline that occurred in September 2025.

The calculation of container throughput at Sunda Kelapa Port for the period August to October 2025 shows slightly different results from non-container throughput. The calculation results indicate a significant decrease in cargo volume at the time of the study. Container throughput at Sunda Kelapa Port in August 2025 was 63,077 TEUs. Then, in September 2025, the recorded throughput value was only 6,504 TEUs. The throughput value decreased by 56,573 TEUs or 90%, which means that the volume of containers handled by the port was almost completely lost compared to the previous period. In October 2025, the container throughput at was 6,258 TEUs. This data illustrates that container throughput at Sunda Kelapa Port again experienced a decline of 9,215 tons compared to the previous month. In other words, the volume of containers handled by Sunda Kelapa Port in October 2025 was 4% less than in September. Thus, during the three months of the study, container throughput continued to decline.

The decline in general cargo and container throughput was significant. General cargo throughput recorded a 54% decline, while container throughput recorded an even greater decline of 90%. A decline of this magnitude is usually considered critical, as throughput is a key indicator of port productivity. The decline in throughput at Sunda Kelapa Port may be caused by factors directly and indirectly related to the port. Factors directly related to the port include port facilities, while factors not directly related to the port include global economic conditions.

There has been a decline in the global economy, particularly in terms of trade activity and supply chain disruptions. This is in line with the UNCTAD report on the Review of Maritime Transport 2025, which states that the overall condition of maritime trade in 2025 will experience stagnation due to geopolitical uncertainty and supply chain disruptions. Geopolitical uncertainties such as the war in Ukraine, conflicts in the Red Sea, and risks in the Strait of Hormuz have caused disruptions to the global supply chain, which in turn have impacted the entire supply chain network. This report is reinforced by a study conducted by Faradilah and Bahar (2023) on the Makassar New Port. The results of the study show the need for risk mitigation to maintain the sustainability of the national supply chain, as global disruptions have an impact on loading and unloading volumes and port throughput. However, these global economic factors will not be discussed in detail in this study, as the focus of this study is on the relationship between port facilities and port throughput value.

Low throughput is an indication of suboptimal use of port facilities. Riyanti's (2024) research shows that the decline in throughput at the Makassar Container Terminal is related to limitations in equipment and dock capacity [13]. The lower the throughput, the lower the level of facility utilization, which means that operational performance declines. Finally, Indrianti (2023) conducted a study on the operational performance of Tengkayu I Port (Tarakan) and found that despite good service times, loading and unloading performance did not meet standards due to low throughput. This has an impact on port operational efficiency [13].

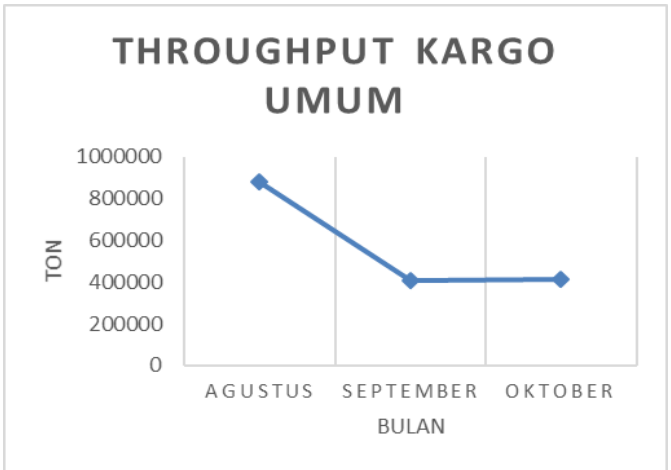

Figure 4. General Non-Container Cargo Throughput at Sunda Kelapa Port August-October 2025
Source: Author's documentation (2025)

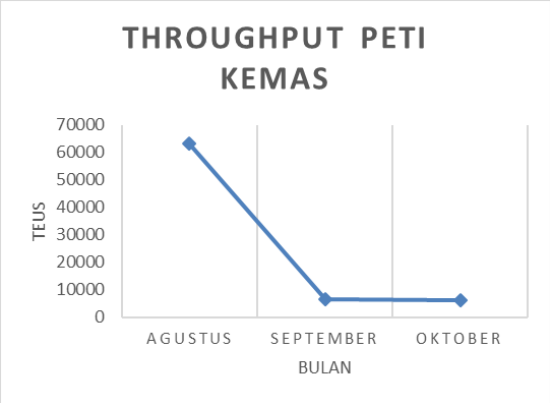

Figure 5. Container Throughput at Sunda Kelapa Port August-October 2025
Source: Data processed by researchers, 2025

Based on the results of an analysis of the condition of the Sunda Kelapa Port facilities and data on general cargo and container throughput for the period August to October 2025, it appears that fluctuations in port performance are closely related to the capacity and condition of the available facilities. The main facilities, namely the public port docks, which are the main point of general cargo loading and unloading activities, are in poor condition, while functional facilities such as the stacking yard, stuffing and stripping yard, and warehouses are in similar condition. The suboptimal condition of these facilities has the potential to cause bottlenecks in the loading and unloading process, prolonging ship waiting times and reducing the port's ability to handle the flow of goods. This is reflected in a significant decline in general cargo throughput, from 877,330 tons in August to 404,341 tons in September 2025, or a 54 percent drop. In October 2025, general cargo throughput increased slightly to 413,556 tons, but this 2 percent increase was not enough to restore handling volumes to their previous levels because storage capacity and cargo mobility in the port area were still limited by inadequate facilities.

Meanwhile, container throughput showed a much more drastic decline than general cargo. Although certain facilities such as container yards were in good condition, their capacity of only 1,664 TEUs was unable to keep up with the container volume, which reached 63,077 TEUs in August 2025. This imbalance in capacity, coupled with poor stuffing and stripping conditions and the lack of modern standard container loading and unloading equipment, has severely hampered the container handling process. As a result, container throughput dropped dramatically by 90 percent in September 2025 to 6,504 TEUs, and declined again by 4 percent in October 2025 to 6,258 TEUs. This continuous decline indicates that Sunda Kelapa Port does not yet have adequate infrastructure and functional facilities to maintain large-volume container services, raising the possibility of container traffic being diverted to alternative ports with more complete and efficient facilities. Overall, the suboptimal condition of port facilities, including public docks, stacking yards, warehouses, and container handling support facilities, is the main factor affecting the decline in throughput during the study period.

Based on the results of the analysis and discussion, there are several facility improvements that can be considered by port managers, the government, and relevant stakeholders to improve the performance of Sunda Kelapa Port:

1. Rehabilitation of Key Port Facilities
   The improvement of public docks should be a top priority given their role as a center for general cargo loading and unloading. Rehabilitation includes structural repairs, increasing the depth of the docks, and reorganizing the work area to make the loading and unloading process more efficient.
2. Improvement of Storage and Warehouse Facilities
   The stacking yard and warehouse, which are currently in poor condition, need to be expanded and physically upgraded. Modernization of the warehouse management system, such as the application of information technology for tracking goods, is also necessary to reduce bottlenecks.
3. Development of Container Infrastructure
   In order to regain competitiveness in container services, Sunda Kelapa Port needs to increase the capacity of its container yard, build more adequate stuffing and stripping yards, and procure special container loading and unloading equipment such as top-loaders and mobile cranes that meet modern terminal port standards.
4. Improving Accessibility and Mobility Within the Port
   The poor condition of roads in the port area causes delays in the mobilization of goods. Therefore, road repairs and traffic flow reorganization need to be carried out immediately to support increased distribution efficiency.

IV. CONCLUSION

Based on the results of research on the condition of Sunda Kelapa Port facilities and the value of general cargo and container throughput for the period August to October 2025, it can be concluded that the decline in port operational performance is strongly related to suboptimal facility conditions. In general cargo, a 54 percent decline in throughput from August to September 2025 shows

that the capacity of public docks, stacking yards, and warehouses, which are in poor condition, are unable to support the increase in goods flow. Although there was a 2 percent increase in throughput in October 2025, this was not enough to restore the port's performance to its original condition because facility limitations remain the main obstacle to the smooth flow of logistics.

Meanwhile, container throughput experienced a much more significant decline, namely 90 percent in September and a further decline of 4 percent in October 2025. This condition indicates that the container yard capacity of only 1,664 TEUs, coupled with poor stuffing and stripping fields, was unable to meet the container operation needs, which reached 63,077 TEUs in August. The absence of special container loading and unloading facilities also meant that the port was unable to compete with other ports that had more modern facilities. Overall, these findings indicate that the capacity and quality of Sunda Kelapa Port's facilities are inadequate to support high-volume operations, directly impacting throughput during the study period. Therefore, improving the port's performance in the future requires comprehensive facility upgrades to accommodate the dynamic flow of goods sustainably.

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