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The Influence of Loading and Unloading Operations and Dockworker Performance on Container Handling at the General Cargo Terminal of Tanjung Priok Port

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ABSTRACT

Container handling at the general cargo terminal of Tanjung Priok Port faces operational challenges, including limited space and infrastructure, delayed cargo arrivals, and uneven workloads among dockworkers. These conditions can reduce the effectiveness and efficiency of loading and unloading operations, highlighting the need to examine the factors influencing container handling performance. This study aimed to analyze the influence of loading and unloading activities and dockworker performance on container handling at the terminal. A descriptive qualitative research design was employed, using primary data collected through interviews and Focus Group Discussions (FGDs) involving a cooperative official and dockworkers, as well as secondary data obtained from relevant literature. Data validity was ensured through source triangulation, while the collected information was analyzed descriptively to identify operational patterns and challenges. The findings revealed that container handling was closely associated with the effectiveness and efficiency of loading and unloading activities. Operations conducted according to established plans resulted in more effective container handling, whereas operational obstacles negatively affected service quality. Furthermore, dockworker performance was influenced by skills and competencies developed through certification and training programs, particularly in adapting to modernized handling equipment. These competencies contributed positively to loading and unloading activities and overall container handling performance. This study highlights the importance of coordinated operational planning, continuous workforce development, and competency-based training in improving port terminal efficiency. The findings provide practical insights for port management and relevant stakeholders in optimizing cargo handling operations and strengthening dockworker capabilities.

1. Introduction

Ports Ports play a strategic role in national and international logistics systems by connecting cargo distribution networks with domestic and global trade. Their operational effectiveness directly affects supply chain continuity, logistics costs, and economic competitiveness through improved connectivity, reduced trade barriers, and efficient commercial activities (Benedecti et al., 2026; Chen & Hasan, 2023; Gattuso et al., 2023; Mlambo, 2021; Mthembu & Chasomeris, 2023; Tovar & Wall, 2022; Verschuur et al., 2021). In this context, port performance depends not only on infrastructure availability but also on the effectiveness of cargo handling activities and the capabilities of the workforce responsible for port operations. Tanjung Priok Port in Jakarta, Indonesia, represents a particularly important setting because it is the country's largest and busiest seaport and serves as a major gateway for export and import activities, with an annual container throughput capacity of approximately 6.5 million twenty-foot equivalent units (TEUs). According to Statistics Indonesia, the volume of unloaded cargo increased from 10,179,891 metric tons in 2020 to 16,028,588 metric tons in 2023, while loaded cargo increased from 11,950,492 to 14,754,923 metric tons during the same period. Furthermore, container throughput reached 17.7

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million TEUs in 2023, representing a 3% increase compared with 2022. These developments demonstrate the growing operational demands placed on port infrastructure and human resources.

Despite the increasing volume of cargo, container handling operations at Tanjung Priok Port continue to encounter operational constraints. Container dwell time remained above two days throughout several periods in 2023, reaching 2.64 days in January, 2.57 days in February, and 2.48 days in August. These figures indicate persistent challenges in cargo movement and storage management. Several factors contribute to these conditions, including incomplete administrative documentation, congestion involving vehicles entering and leaving the port, and inspection procedures conducted by multiple government agencies. In response to these challenges, the government introduced revised procedures for *overbrengen* services on November 1, 2023. Under these procedures, approval for the relocation of cargo to another storage facility (*Pindah Lokasi Penumpukan*, PLP) may be granted when the yard occupancy ratio or shed occupancy ratio reaches at least 65%. Although these measures are intended to improve storage management, operational efficiency also depends on the coordination of loading and unloading activities and the availability of competent dockworkers.

At the general cargo terminal, several operational issues require particular attention, including limited storage space and supporting infrastructure, delays in cargo arrivals, and imbalances between cargo volumes and the number of available dockworkers (*tenaga kerja bongkar muat*, TKBM). Delayed cargo arrivals can disrupt operational schedules and interfere with previously established loading and unloading plans. Meanwhile, unequal workload distribution may reduce labor productivity and operational efficiency. Another important concern involves the competency and occupational readiness of TKBM personnel. Previous research identified inadequate compliance with personal protective equipment requirements and limited access to training among dockworkers as significant workforce-related concerns (Hadi & Putri, 2016). Furthermore, a substantial gap between expected and actual dockworker performance has been reported (Sukmawati et al., 2020). These challenges are particularly relevant given the size of the workforce at Tanjung Priok Port, which comprised 2,213 workers affiliated with the Karya Sejahtera TKBM Cooperative and 822 workers affiliated with the Kalibaru Cooperative (Noor, 2023). This situation highlights the importance of examining both operational activities and workforce capabilities in achieving effective container handling.

Conceptually, loading and unloading activities encompass the transfer of cargo to and from vessels through stevedoring, cargodoring, and receiving and delivery operations, as stipulated in the Minister of Transportation Decree No. KM. 14 of 2002 concerning the implementation and operation of loading and unloading activities for goods to and from ships (2002). TKBM performance refers to the work outcomes and behaviors demonstrated by dockworkers in performing tasks within their assigned authority and responsibilities. Container handling involves the movement of cargo from the quay to the storage yard and subsequently onto trucks, or in the reverse direction, together with container storage and maintenance activities. Meanwhile, a general cargo terminal is a conventional port facility that handles general cargo using shipboard cranes or mobile cranes (Triatmodjo, 2010). These concepts demonstrate that container handling is an operational process involving the integration of equipment, work procedures, storage facilities, and human resources.

Previous studies have examined several factors associated with port operational performance. Supandri et al. (2022) reported that the effectiveness of loading and unloading operations in facilitating container flows at PT Pelindo's Lembar Branch depended on the availability of modern equipment and the contribution of TKBM personnel. Similarly, Suryantoro et al. (2020) demonstrated that equipment availability and labor resources influenced loading and unloading productivity. From a workforce perspective, Pratama (2015) identified knowledge as the characteristic most strongly associated with unsafe work practices. Jamil et al. also reported that the use of manual equipment reduced the efficiency of loading and unloading operations. These findings collectively indicate that operational equipment, workforce competency, and loading and unloading procedures are important considerations in improving port performance. However, the existing studies primarily discuss equipment effectiveness, labor productivity,

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occupational safety, or individual operational factors. The relationship between loading and unloading activities and TKBM performance in the specific context of container handling at a general cargo terminal remains insufficiently examined, particularly regarding workforce certification and training in response to equipment modernization.

Based on these conditions, the central research problem concerns how loading and unloading activities and TKBM performance contribute to container handling effectiveness at the general cargo terminal of Tanjung Priok Port. Accordingly, this study aims to analyze the role of loading and unloading activities in container handling and examine how TKBM performance supports the effectiveness of these operations. Particular attention is given to dockworker competencies developed through certification and training programs, especially in adapting to modernized cargo-handling equipment. This study adopts a descriptive qualitative approach to explore operational conditions and workforce-related challenges through interviews and focus group discussions.

This study contributes to the understanding of port operational management by examining the interconnected roles of loading and unloading activities and dockworker performance in container handling. Its theoretical contribution lies in extending the discussion of port operational effectiveness beyond equipment and infrastructure considerations to include workforce competency and operational coordination. Practically, the findings are expected to provide insights for port management, TKBM cooperatives, and other relevant stakeholders in improving operational planning, optimizing workforce distribution, strengthening certification and training programs, and supporting adaptation to equipment modernization. The novelty of this study lies in its integrated examination of loading and unloading activities and TKBM performance as interrelated aspects of container handling at the general cargo terminal of Tanjung Priok Port.

2. Literature Review

2.1. Conceptual and Theoretical Foundations

Port operational effectiveness is determined by the coordination of loading and unloading activities, workforce capabilities, and cargo-handling equipment. Loading and unloading operations consist of three interconnected stages: stevedoring, cargodoring, and receiving and delivery, which collectively facilitate the movement of cargo between vessels, storage areas, and land transportation (Minister of Transportation Decree No. KM. 14 of 2002, 2002). These activities require effective operational planning, adequate equipment, and coordination among personnel to ensure continuous cargo flows. Rahman et al. (2024) emphasized the importance of optimizing loading and unloading processes, while Wang and Wang (2023) demonstrated that interactions among operational factors influence the reliability of port logistics systems. Similarly, Yu and He (2025) highlighted the importance of collaborative scheduling among yard cranes and transportation equipment in supporting container operations.

Dockworker performance, particularly that of *Tenaga Kerja Bongkar Muat* (TKBM), represents another important component of port operational effectiveness. It encompasses workers' competencies, technical skills, and ability to perform assigned responsibilities safely and efficiently. Hadi and Putri (2016) identified the need to improve TKBM competencies through training, while Sukmawati et al. (2020) emphasized the importance of revitalizing dockworker competencies to respond to changing operational requirements. In addition, Raidurrasyid et al. (2023) highlighted workforce allocation and workload management as important considerations in logistics operations. As port equipment becomes increasingly modernized, certification and technical training are essential for enabling workers to operate equipment effectively and adapt to changing operational demands (Moros-Daza, 2024).

Container handling refers to the movement, storage, and distribution of containers between vessels, terminal yards, and land transportation. Its effectiveness depends on the integration of loading and unloading operations, equipment availability, workforce competencies, and operational coordination. Li et al. (2015) discussed the importance of selecting appropriate loading clusters in container terminals, while Supandri et al. (2022) demonstrated the relevance of modern equipment and TKBM involvement in facilitating container flows. Therefore, effective container handling requires not only adequate infrastructure but also coordinated operational procedures and competent human resources.

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2.2. Review of Empirical Studies

Previous empirical studies have established the importance of operational equipment and workforce capabilities in port performance. Supandri et al. (2022) found that modern equipment and TKBM involvement contributed to the effectiveness of loading and unloading operations and the smooth movement of containers. Similarly, Suryantoro et al. (2020) demonstrated that labor availability and loading and unloading equipment influenced container-handling productivity. From an operational perspective, Carlan et al. (2023) and Ezzahra et al. (2023) discussed the benefits of automation, process synchronization, and improved equipment utilization in cargo-handling activities. Moros-Daza (2024) further highlighted the importance of effective labor force management in maritime ports. These studies indicate that port efficiency depends on the interaction between technological resources, operational processes, and human resources. However, differences in terminal characteristics, equipment availability, and workforce competencies may produce different operational outcomes across port environments.

2.3. Identification of the Research Gap

Although previous studies have examined loading and unloading productivity, equipment modernization, workforce management, and container-handling efficiency, these aspects have generally been discussed separately or within different operational contexts. Supandri et al. (2022) focused on the effectiveness of loading and unloading activities in facilitating container flows, whereas Suryantoro et al. (2020) examined the relationship between labor, equipment, and container-handling productivity. Meanwhile, Moros-Daza (2024) emphasized labor force management in maritime ports. Limited attention has been given to the interconnected relationship between loading and unloading operations and TKBM performance in container handling at a general cargo terminal, particularly regarding certification, technical training, and adaptation to modernized equipment. This study addresses this gap by examining these operational and workforce dimensions together through a descriptive qualitative investigation at the general cargo terminal of Tanjung Priok Port.

2.4. Development of the Conceptual Framework

This study conceptualizes container handling as an operational outcome influenced by the effectiveness of loading and unloading activities and TKBM performance. Loading and unloading operations are assessed through the implementation of operational plans, coordination among handling stages, equipment availability, and the management of operational constraints. TKBM performance is examined through workforce competencies, certification, technical training, and the ability to adapt to modern handling equipment. Container handling is understood through the effectiveness and efficiency of cargo movement, storage, and distribution within the terminal.

The conceptual relationship assumes that effective loading and unloading operations directly support container handling, while competent TKBM personnel contribute to operational effectiveness through their involvement in cargo-handling activities. TKBM performance also supports container handling through the effectiveness of loading and unloading operations. These relationships are influenced by supporting conditions, including equipment availability, weather, truck availability, and operational scheduling.

2.5. Hypotheses or Research Propositions

Based on the theoretical foundations, previous empirical findings, and conceptual framework, this qualitative study develops the following research propositions:

Proposition 1: Effective and efficiently coordinated loading and unloading operations contribute to more effective container handling at the general cargo terminal of Tanjung Priok Port.

Proposition 2: TKBM performance, particularly competencies developed through certification and technical training, supports the effectiveness of loading and unloading operations and overall container handling.

Proposition 3: The relationship between loading and unloading operations, TKBM performance, and container handling is influenced by operational conditions, including equipment availability, weather, truck availability, and workforce allocation.

These propositions provide an analytical basis for examining the operational relationships and workforce-related factors influencing container handling. They are explored through interviews, focus group discussions, and descriptive qualitative

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analysis rather than statistical hypothesis testing.

3. Research Methods

3.1. Research Design

This study employed a descriptive qualitative research design to examine the relationship between loading and unloading operations, dockworker (TKBM) performance, and container handling at the general cargo terminal of Tanjung Priok Port. This approach was selected because it enables an in-depth understanding of operational activities, workforce competencies, and constraints encountered in cargo-handling processes. The research focused on describing actual operational conditions and interpreting participants' experiences rather than testing statistical relationships.

3.2. Research Context and Setting

The research was conducted at Tanjung Priok Port, a major seaport located in North Jakarta and managed by PT Pelabuhan Indonesia (Persero). The port covers a land area of 604 hectares and a water area of 424 hectares. This location was selected because of its strategic role in national logistics activities and the operational challenges associated with loading and unloading activities, workforce management, and container handling, particularly at the general cargo terminal.

3.3. Population and Sample / Research Participants

The study population comprised 2,168 TKBM workers affiliated with the Karya Sejahtera TKBM Cooperative. The workforce eligibility criteria included an age range of 18–55 years, a minimum educational qualification of primary school or equivalent, physical and mental fitness, and possession of competency certificates. Participants were selected using purposive sampling based on their relevance to the research objectives and knowledge of port operations. The research participants consisted of one cooperative representative responsible for managing TKBM workers and dockworkers from one work gang. The selection of participants was informed by Creswell (2009), who indicated that qualitative research generally involves approximately 5–10 participants. The participants provided information regarding workforce management, operational procedures, competencies, and challenges in loading and unloading activities.

3.4. Data Sources and Data Collection

This study used primary and secondary data. Primary data were collected through direct observation, semi-structured interviews, and focus group discussions (FGDs). Secondary data were obtained from documentary sources, Statistics Indonesia, relevant legislation, and previous scholarly publications concerning loading and unloading operations, TKBM performance, and container handling. Data collection was conducted on Tuesday, December 10, 2024, in the vicinity of Tanjung Priok Port. The interview with the cooperative representative was conducted at 10:00 Western Indonesian Time (WIB), followed by an FGD with TKBM workers at 14:00 WIB. The interview covered the cooperative's activities, membership structure, workforce recruitment, worker allocation, qualifications, and employment termination procedures. Meanwhile, the FGD explored workers' responsibilities, work schedules, previous training experiences, and operational constraints. Responses were initially documented in written notes and subsequently converted into digital transcripts for analysis.

3.5 Measurement of Variables and Research Instruments

As a qualitative study, this research did not employ numerical measurement scales or standardized questionnaires. Instead, the main research concepts were explored through observation guidelines, interview questions, and FGD discussion topics developed according to the research objectives and relevant literature. Loading and unloading operations were examined through operational planning, coordination of stevedoring, cargodoring, and receiving and delivery activities, equipment availability, and operational constraints. TKBM performance was explored through workforce competencies, certification, technical training, work responsibilities, and the ability to operate modernized handling equipment. Container handling was examined in terms of cargo movement, storage, distribution, and the effectiveness and efficiency of handling operations. These conceptual indicators provided the analytical basis for organizing and interpreting the qualitative data.

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3.6. Data Analysis Techniques

Data were analyzed using descriptive qualitative analysis. The interview and FGD transcripts were examined, organized, and compared with the conceptual indicators established in the literature review. The analysis focused on identifying recurring information concerning loading and unloading activities, TKBM competencies, operational constraints, and container-handling effectiveness. Information obtained from participants was subsequently compared with relevant documentary evidence and previous empirical findings to identify similarities, differences, and relationships among the research concepts. The findings were interpreted descriptively to address the research objectives and research propositions.

3.7. Validity, Reliability, and Trustworthiness

Research trustworthiness was established through persistent observation and source triangulation. Source triangulation involved comparing responses obtained from different informants regarding the same research questions to identify consistency in the information provided. Responses expressing similar underlying meanings were treated as mutually supporting evidence. The interview findings were also compared with FGD information, field observations, documentary sources, and relevant literature. These procedures were applied to strengthen the credibility and consistency of the research findings.

3.8. Ethical Considerations

The study maintained participant confidentiality by anonymizing participants' identities during data documentation and reporting. Interviews and FGDs were conducted separately to maintain the organization of data collection and protect participants' identities. Information obtained from participants was used for research purposes and presented in a manner that did not disclose their personal identities. Formal ethical approval and specific informed-consent procedures were not detailed in the available research documentation.

3.9. Research Procedure

The research was conducted through several stages. First, the research problem and relevant literature concerning loading and unloading operations, TKBM performance, and container handling were identified. Second, the research setting and participant selection criteria were established using purposive sampling. Third, primary data were collected through field observations, an interview with a cooperative representative, and an FGD with TKBM workers on December 10, 2024. Fourth, the collected information was documented and converted into digital transcripts. Fifth, the data were organized and analyzed by comparing participants' responses with the conceptual indicators and previous research findings. Finally, source triangulation was conducted to assess information consistency, and the findings were interpreted in relation to the research objectives and propositions.

3.10. Methodological Limitations

This study has several methodological limitations. First, the qualitative approach and limited number of participants, particularly the involvement of workers from only one work gang, restrict the extent to which the findings can represent the entire TKBM workforce at Tanjung Priok Port. Second, the findings are based primarily on interviews, FGDs, observations, and documentary evidence rather than statistical measurements. Consequently, the magnitude of the relationships between loading and unloading operations, TKBM performance, and container handling cannot be quantified. Third, the study focuses on one general cargo terminal, which may limit the applicability of its findings to other port settings with different operational characteristics. Future research could employ a quantitative or mixed-method approach involving a larger and more diverse sample to examine these relationships and assess the contribution of additional operational factors.

4. Results and Discussion

4.1. Research Results

4.1.1. Sample Description and Descriptive Findings

The study involved four informants, comprising one representative of the Karya Sejahtera TKBM Cooperative and three dockworkers from one work gang at Tanjung Priok Port. The informants provided information concerning workforce management, operational arrangements, training, and constraints in loading and unloading activities. The research was conducted on December 10, 2024, through interviews and a focus group discussion (FGD).

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Tanjung Priok Port operates three terminals with a combined quay length of 7,102.5 meters. General cargo activities are primarily handled at Operating Terminal 1, which has a quay length of 1,490 meters. Its facilities include transit sheds, open storage yards, cranes, warehouses, and a 25-meter-wide apron. The terminal uses cranes, shore-based derricks, forklifts, and handcarts to support cargo-handling activities.

Table 1. Operating Terminals at Tanjung Priok Port

Terminal	Quay Length (m)	Main Operations
Operating Terminal 1	1,490	Bulk cargo, heavy equipment or vehicles, and general cargo
Operating Terminal 2	3,592.5	Domestic containers, breakbulk, dry bulk, liquid bulk, domestic vehicle traffic, and passengers
Operating Terminal 3	2,020	International and domestic containers, and international breakbulk

Source: PT Pelabuhan Tanjung Priok (2016).

4.1.2. Data Quality and Preliminary Analysis

Because this study employed a descriptive qualitative approach, statistical tests of normality, multicollinearity, reliability coefficients, and model fit were not applicable. Data quality was examined through persistent observation and source triangulation. Information obtained from the cooperative representative was compared with responses from TKBM workers participating in the FGD. The comparison indicated consistency regarding the gang structure, work schedules, training arrangements, and operational constraints. The findings were subsequently compared with documentary sources and relevant literature.

4.1.3. Main Analytical Results

a. Loading and Unloading Operations

Loading and unloading activities at the general cargo terminal consist of three sequential stages: stevedoring, cargodoring, and receiving and delivery. Before a vessel arrives, operational planning covers the stowage plan, potential overstow, floating crane requirements, the number of work gangs, hazardous cargo, and equipment requirements. Once the vessel is berthed, the cargo hatches are opened, cargo conditions are inspected by ship officers and surveyors, and cargo is transferred onto trucks or the quay. At the receiving and delivery stage, cargo owners, through freight forwarding companies (EMKL), must provide complete documentation, including D/O, OPP/OPT, SPPB, and SPB, before goods can be released from the warehouse.

Table 2. Stages of Loading and Unloading Operations at the General Cargo Terminal

Stage	Main Activities	Personnel
Stevedoring	Loading or unloading cargo between the ship and the quay, barges, or trucks	One stevedore assisted by a foreman; 12 workers per gang
Cargodoring	Transporting cargo by truck from the ship's side and stacking it in the storage area using tango equipment	Truck and tango equipment operators
Receiving/delivery	Delivering or receiving containers to or from the port area	Six workers: one tango equipment operator, two assistants, two truck helpers, and one administrator

Source: Compiled from the research findings and literature.

The findings indicate that the three operational stages are sequential and interdependent. When trucks are unavailable or warehouses are not ready, cargo lifted by cranes may remain suspended in slings, potentially extending vessel berthing time. Other operational constraints include adverse weather, inadequate equipment, vessel delays, crane breakdowns, waiting times for trucks, and occupational safety and health (OSH) concerns when workers rush to position slings. TKBM informants specifically identified heavy rain and strong winds as major obstacles. Requests for extensions of vessel berthing periods must be submitted no later than eight hours before the existing period expires.

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b. TKBM Performance

TKBM workers operate in gangs across three daily shifts. According to all four informants, each gang consists of 12 workers: one gang leader, one crane operator, and ten gang members. The stakeholder and TKBM informants provided consistent information regarding the gang structure and three-shift working system, as presented in Table 3.

Table 3. Summary of Data Source Triangulation

Aspect	Stakeholder	TKBM
Work system	12 workers per gang; three shifts	12 workers per gang; three shifts
Qualifications	Aged 18–55; primary school diploma; physically and mentally fit	Not discussed
Training	OSH and stevedoring training after joining	OSH and some technical training
Constraints	Not discussed	Weather; limited proficiency with new equipment

Source: Interviews and FGD, December 10, 2024.

The findings also indicate that TKBM workers are cooperative members rather than cooperative employees. They receive piece-rate payments when work is available and do not have fixed working hours or attendance registers. Consequently, their attendance depends on the availability of assignments. Regarding performance, the study focused on competencies acquired through training and certification rather than attendance. Not all workers had received technical training on modern handling equipment, while the training provided had primarily covered OSH and basic technical activities.

c. Container Handling

Container-handling procedures differ according to the type of container flow. Export containers enter through the port gate, undergo document verification, are temporarily stored using yard cranes, and are subsequently loaded onto vessels using quay cranes. Import containers are unloaded using quay cranes, transported to the storage yard by prime movers, temporarily stored, and then dispatched to their final destinations. Transshipment containers are unloaded from incoming vessels, stored in the yard, and subsequently loaded onto vessels bound for their next destinations.

These processes demonstrate that loading and unloading activities are integral to container handling. Delays in cargo movement can increase container dwell time and disrupt container flows. The study also identified the importance of workforce availability. During the COVID-19 pandemic in 2020–2021, reductions in the number of TKBM workers constrained loading and unloading activities. Following 2022, port productivity tended to increase alongside the expansion of the TKBM workforce.

4.1.4. Hypothesis Testing Results / Key Findings

The analysis identified three principal findings. First, loading and unloading operations require coordinated implementation of stevedoring, cargodoring, and receiving and delivery activities. Second, TKBM performance is supported by technical competencies, certification, and training, particularly in adapting to modernized equipment. Third, container handling depends on the integration of operational planning, workforce availability, and equipment readiness.

The findings further indicate that TKBM performance contributes to container handling through loading and unloading operations. However, equipment availability, weather conditions, truck availability, vessel arrivals, and workforce allocation also influence operational outcomes. These findings provide qualitative support for the three research propositions concerning operational effectiveness, workforce competency, and the role of external operational conditions.

4.1.5. Visual Presentation of Results

Tables 1–3 present the principal empirical findings. Table 1 describes the terminal structure and operational characteristics of Tanjung Priok Port. Table 2 illustrates the sequential stages of loading and unloading activities and their personnel requirements. Table 3 presents the triangulation of information obtained from the cooperative representative and TKBM workers. Together, these tables provide an overview of the operational

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environment, workforce arrangements, and data consistency.

4.2. Research Discussion

4.2.1. Interpretation of Key Findings

The findings demonstrate that container handling at the general cargo terminal depends on the effective coordination of loading and unloading activities. Stevedoring, cargodoring, and receiving and delivery constitute an interconnected operational sequence in which disruption at one stage can affect subsequent activities. The unavailability of trucks, inadequate warehouse readiness, equipment breakdowns, and unfavorable weather conditions can interrupt cargo movement and extend vessel berthing time. Therefore, operational planning must consider equipment readiness, workforce availability, and flexible scheduling to maintain operational continuity.

The findings also demonstrate that TKBM performance is closely related to workforce competencies rather than attendance alone. Certification and technical training enable workers to perform operational tasks and adapt to modernized handling equipment. However, limited technical training may create difficulties when workers are required to operate more advanced equipment. Thus, TKBM performance contributes to container handling through the effectiveness of loading and unloading activities.

4.2.2. Comparison with Previous Studies

The findings are consistent with Supandri et al. (2022), who demonstrated that modern equipment and TKBM involvement contribute to the effectiveness of loading and unloading operations and the smooth movement of containers. Similarly, Suryantoro et al. (2020) found that labor availability and loading and unloading equipment influence container-handling productivity. These studies support the present finding that workforce capabilities and equipment readiness are essential components of port operational effectiveness.

Regarding operational coordination, the findings are consistent with Rahman et al. (2024), Wang and Wang (2023), and Yu and He (2025), who emphasized the importance of coordinated cargo-handling processes and operational scheduling. The present study further illustrates how disruptions involving trucks, warehouses, cranes, and weather conditions can affect the continuity of loading and unloading activities at a general cargo terminal.

In terms of workforce competency, the findings are consistent with Hadi and Putri (2016), who identified limitations in TKBM training, particularly training focused on sling attachment. Sukmawati et al. (2020) also emphasized the need to revitalize dockworker competencies in response to changes in port operations. Furthermore, Raidurrasyid et al. (2023) highlighted the importance of workload management and workforce allocation. These findings reinforce the importance of continuous training and competency development as port equipment and operational requirements evolve.

The findings also support the studies of Carlan et al. (2023), Ezzahra et al. (2023), Hong et al. (2026), and Moros-Daza (2024), which discussed automation, operational efficiency, and workforce management in cargo and maritime operations. More manual processes may require greater labor input and increase nonproductive time compared with automated handling systems. In addition, Pratama (2015) identified worker knowledge as the characteristic most strongly associated with unsafe work practices, reinforcing the importance of competency development and occupational safety.

The container-flow findings are also related to Li et al. (2015), who examined loading cluster selection in container terminals. The present study extends this operational perspective by describing the movement of export, import, and transshipment containers and the role of loading and unloading activities in each process.

4.2.3. Theoretical Contributions

This study contributes to port operational management literature by illustrating the interconnected relationship between loading and unloading operations, TKBM performance, and container handling. The findings extend the discussion of port efficiency beyond infrastructure and equipment availability by emphasizing workforce competency, operational coordination, and the continuity of cargo-handling processes.

The study also provides a qualitative explanation of how TKBM performance contributes to container handling through loading and unloading operations. In this context, operational activities function as an intermediate process connecting workforce competencies with container-handling

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effectiveness. This perspective enriches the understanding of port operations by highlighting the interdependence of human resources, equipment, and operational procedures.

4.2.4. Practical and Policy Implications

The findings have several implications for port management and TKBM cooperatives. First, operational planning should incorporate backup equipment and additional workforce arrangements to anticipate foreseeable disruptions, including equipment breakdowns, worker shortages, and overweight cargo. Second, flexible scheduling should be implemented to accommodate unpredictable conditions, particularly adverse weather and vessel arrival delays.

Third, TKBM cooperatives and port management should strengthen certification and technical training programs to ensure that workers can operate modernized handling equipment. Training should extend beyond basic sling attachment and occupational safety to include technical competencies relevant to contemporary cargo-handling operations. Fourth, workforce allocation should be adjusted to operational requirements to minimize workload imbalances associated with equipment modernization. These measures can support safer, more efficient, and more coordinated container-handling activities.

4.2.5. Integration with the Research Gap

The research addresses the identified gap concerning the limited integration of loading and unloading activities and TKBM performance in studies of container handling at general cargo terminals. Previous studies examined equipment effectiveness, labor productivity, workforce competency, and automation from different perspectives. This study brings these dimensions together by explaining how workforce competencies contribute to operational effectiveness and how loading and unloading activities support container handling at Tanjung Priok Port.

The findings also highlight the importance of certification and technical training in the context of equipment modernization, an aspect that requires attention when examining the relationship between workforce performance and terminal operations. Therefore, the study provides contextual evidence from a general cargo terminal and contributes to a more integrated understanding of port operational effectiveness.

4.2.6. Acknowledgement of Study Limitations

The findings should be interpreted within the context of the research setting and qualitative evidence. The study involved a limited number of informants and focused on one general cargo terminal and one TKBM work gang. Furthermore, the relationships identified were derived from interviews, FGDs, observations, and relevant literature rather than statistical testing. Consequently, the magnitude of the contribution of each factor cannot be established. Other operational conditions, including equipment, weather, and truck availability, also influence container handling and should be considered in further investigations.

5. Conclusion

5.1. Summary of Key Findings

This study examined the relationship between loading and unloading operations, TKBM performance, and container handling at the general cargo terminal of Tanjung Priok Port. The findings demonstrate that effective container handling depends on the coordination of loading and unloading activities, particularly the integration of stevedoring, cargodoring, and receiving and delivery operations. Operational disruptions, including equipment breakdowns, truck unavailability, warehouse constraints, vessel delays, and adverse weather conditions, can interrupt cargo flows and reduce operational efficiency.

The study also found that TKBM performance is supported by competencies acquired through certification and technical training, particularly in adapting to modernized handling equipment. Competent workers contribute to effective loading and unloading activities, which subsequently support container-handling efficiency. However, workforce competency is not the only determining factor, as equipment availability, weather conditions, truck readiness, and workforce allocation also influence operational outcomes.

5.2. Theoretical Contributions

This study contributes to the literature on port operational management by demonstrating the interconnected roles of loading and unloading operations and dockworker performance in

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container handling. It extends the understanding of operational effectiveness beyond infrastructure and equipment availability by incorporating workforce competencies, operational coordination, and the continuity of cargo-handling processes. The findings also provide a qualitative explanation of how TKBM performance contributes to container handling through loading and unloading activities, offering a more integrated perspective on the relationship between human resources and port operational performance.

5.3. Practical and Policy Implications

The findings emphasize the importance of improving operational planning and workforce development at the general cargo terminal. Port management should ensure the availability of backup equipment and TKBM personnel to anticipate foreseeable operational disruptions. Flexible scheduling is also necessary to respond to unpredictable conditions, particularly weather disturbances and vessel arrival delays.

Furthermore, TKBM cooperatives and port management should strengthen certification and technical training programs to improve workers' competencies in operating modernized handling equipment. Training programs should cover technical equipment operation, occupational safety, and adaptation to changing port technologies. Workforce allocation should also be adjusted to operational requirements to reduce workload imbalances and support more efficient cargo-handling activities.

5.4. Limitations of the Study

This study is limited by its descriptive qualitative approach, the small number of informants, and its focus on one general cargo terminal at Tanjung Priok Port. The findings reflect the experiences and operational conditions reported by the cooperative representative and TKBM workers from one work gang. Furthermore, the relationships among loading and unloading operations, TKBM performance, and container handling were explored descriptively rather than measured statistically. Therefore, the findings cannot establish the magnitude of each factor's contribution or be generalized to all port terminals without further investigation.

5.5. Directions for Future Research

Future research should employ quantitative or mixed-method approaches involving larger and more diverse samples of TKBM workers across different terminals to examine the relationships identified in this study. Further investigations could measure the contribution of loading and unloading operations, TKBM competencies, certification, technical training, and cargo-handling equipment to container-handling efficiency. Additional factors, including weather conditions, truck availability, equipment readiness, and workforce allocation, should also be incorporated to provide a more comprehensive understanding of port operational performance. Comparative studies across general cargo and container terminals could further explain differences in operational requirements and workforce competencies in response to port modernization.

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