



DIJDBM:
**Dinasti International Journal of Digital
Business Management**

E-ISSN: 2715-4203
P-ISSN: 2715-419X

<https://dinastipub.org/DIJDBM> ✉ dinasti.info@gmail.com ☎ +62 811 7404 455

DOI: <https://doi.org/10.38035/dijdbm.v6i6>
<https://creativecommons.org/licenses/by/4.0/>

Analysis of the Operational Performance of Quay Crane Loading and Unloading at Pt. Jakarta International Container Terminal

Erichi Alfonso Febricardo¹, M. Thamrin², Euis Saribanon³.

¹Institut Transportasi dan Logistik Trisakti, Jakarta, Indonesia, erichihasibuan@gmail.com.

²Institut Transportasi dan Logistik Trisakti, Jakarta, Indonesia, thamrinaroba7@gmail.com.

³Institut Transportasi dan Logistik Trisakti, Jakarta, Indonesia, nengnonon04@gmail.com.

Corresponding Author: erichihasibuan@gmail.com¹

Abstract: PT. Pelabuhan Indonesia II (Pelindo II) is a state-owned enterprise (BUMN) that manages 12 ports in Indonesia. PT. Jakarta International Container Terminal is a subsidiary of Pelindo II. As an international terminal, PT. Jakarta International Container Terminal provides container loading and unloading services at a standart speed of 28 boxes per hour per quay crane. PT. Jakarta International Container Terminal has two docks: the west dock, with a dock length of 890 meters, a depth of 11 meters, and eight quay cranes; and the north dock, with a dock length of 720 meters, a depth of 14.5 meters, and eight quay cranes. The special case study aims to analyze and compare the performance of West Dock and North Dock based on berth occupancy ratio (BOR), gross crane rate (GCR), and vessel operation rate (VOR) per month, using secondary data from PT. Jakarta International Container Terminal with population data from September 2018 to March 2019, and vessel calls and container volumes from 2014 to 2018. The results of the data obtained from PT. Jakarta International Container Terminal describes the differences in achieving BOR, GCR, and VOR between the west dock and the north dock. The west dock has a BOR, GCR, and VOR score that is lower than the north dock, based on data from September 2018 to March 2019.

Keyword: BOR, VOR, GCR, Loading, Unloading, Container.

INTRODUCTION

Maritime transportation is one of the main modes of transportation, playing a strategic role in supporting global and domestic trade. Compared to land and air transportation, maritime transportation has a much greater capacity to transport goods and passengers with high load capacity and relatively lower operational costs, especially for long-distance shipments. In the context of globalization and world economic integration, maritime transportation has become the backbone of the international logistics system, as most of the world's trade—over 80% of the volume of goods—is carried by sea. In this global goods distribution mechanism, container ships serve as the primary means of efficient international goods transportation, while container terminals are essential hubs in the worldwide supply chain. Container terminals not only serve as loading and unloading points but also as integrated logistics management centers that connect

sea, land, and, in some cases, air modes of transportation through an efficient intermodal system.

Container terminals are equipped with various vital facilities, including storage yards, berths, and advanced loading and unloading equipment (quay cranes, rubber-tyred gantry cranes, forklifts, reach stackers, and straddle carriers), as well as an internal truck-and-trailer network connecting the berths to the storage areas. All of these facilities are integrated to ensure that container movement from ship to shore, or vice versa, is fast, safe, and efficient. The success of container terminal management can be measured through key performance indicators such as throughput, gross crane rate (GCR), vessel operation rate (VOR), and berth occupation ratio (BOR). These indicators describe the extent to which the terminal can optimize the use of facilities and equipment to support smooth ship operations.

One of the main ports in Indonesia's logistics system is PT. Pelabuhan Indonesia II (Pelindo II) or Indonesia Port Corporation (IPC). As a strategic state-owned enterprise, IPC manages 12 major ports throughout Indonesia, with Tanjung Priok Port as the main port, which is the center of national export-import activities. Under the IPC, there are several subsidiaries, including PT. Jakarta International Container Terminal (JICT), which is a joint venture between PT. Pelindo II and Hutchison Port Holding Hong Kong since April 1, 1999. Before this partnership, the terminal facility was known as Unit Terminal Peti Kemas I (UTPK I) and was fully managed by Pelindo II. In terms of ownership structure, Hutchison Port Holding holds a 51% stake, while Pelindo II and the Maritime Employees Cooperative control 49%. Since then, PT. JICT has become the leading operator of Container Terminals I and II at Tanjung Priok Port and has grown to become the largest container terminal in Indonesia.

Based on 2019 data, PT. JICT has a stacking yard capacity of 41,204 TEUs and has seen year-over-year increases in loading and unloading volumes, in line with the growing scale of trade and the size of ships in operation. With the rise in large vessels measuring more than 200 meters in length and more than 12 meters in draft, the demands on terminal operational efficiency are also increasing. Port performance, in this case, is highly dependent on the effectiveness of human resource management, equipment, and supporting infrastructure. According to Kasypi and Shah (2006), one of the dominant factors affecting operational performance is the effectiveness of planning and utilization of loading and unloading equipment, particularly quay cranes. Quay cranes are the primary tools in the container loading and unloading process, and their productivity directly determines the speed of ship operational cycles at the port.

PT. JICT operates two main docks, namely the West Dock and the North Dock. The West Dock is 890 meters long with a depth of 11 meters and is equipped with eight quay cranes (QC 01–QC 09), while the North Dock is 720 meters long with a depth of 14.5 meters and eight quay cranes (QC 11–QC 18). The differences in depth and technical specifications between the two docks affect the types of ships that can berth and the level of operational productivity of each. Initial analysis shows significant differences in BOR, GCR, and VOR values between the two, with the North Dock performing better than the West Dock.

This study, entitled “Analysis of the Operational Performance of Quay Crane Loading and Unloading between the West Pier and North Pier at PT. Jakarta International Container Terminal,” aims to compare, analyze, and evaluate differences in operational productivity between the West and North piers using BOR, GCR, and VOR indicators. The main objective of this study is to determine which pier has higher operational efficiency and to identify the technical and managerial factors that influence these results. The results of this study are expected to make a real contribution to the management of PT. JICT is working to optimize resources, schedule ships, maintain and renew equipment, and plan future investments. Thus, this study is expected to provide strategic benefits to increase the competitiveness of Tanjung Priok Port as a high-standard international port in Southeast Asia..

METHOD

The research method used in this study is a qualitative case study. This method was chosen because it can explore operational phenomena in depth through the contextual and interpretive analysis of empirical data. According to Lincoln (2009), qualitative research is reflective and dynamic because it seeks to understand the meaning behind observed behaviors or processes rather than simply measuring relationships between variables. This study focuses on the phenomenon of quay crane operational performance at PT. JICT, so a qualitative approach is highly relevant for comprehensively describing the complexity of field conditions. Creswell (2008) adds that qualitative research emphasizes the collection of data in the form of words, narratives, and descriptions rather than numbers, to understand the perceptions, views, and experiences of informants directly involved in the phenomenon being studied. Data was collected through in-depth interviews, direct observation of the loading and unloading process, and documentation of port operational reports. Secondary data, including productivity reports, BOR, VOR, and GCR data from September 2018 to March 2019, were also used to strengthen the analysis.

The case study approach, as described by Yin (2011), allows researchers to intensively examine a single unit of analysis in a real-life context. Through this approach, researchers can explore the processes taking place at PT. JICT, analyze the relationships between operational variables, and identify the factors causing the performance differences between the West Pier and the North Pier. Informants were selected using purposive sampling, which involves choosing respondents based on specific criteria relevant to the research objectives. The informants were crane operators, operations managers, field supervisors, and equipment technicians. In addition, this study used a descriptive-comparative analysis to compare data from both docks and systematically identify productivity gaps. Data validity was tested using source and method triangulation, combining interview, observation, and documentation results to ensure the analysis was objective and scientifically accountable. With this approach, the study is expected to provide an in-depth understanding of the technical and managerial factors that influence productivity differences at PT. JICT, as well as to produce applicable strategic recommendations for improving terminal operational efficiency.

RESULTS AND DISCUSSION

In this case study, “Analysis Of The Operational Performance Of Quay Crane Loading And Unloading Between The West And North Piers At Pt. Jakarta International Container Terminal,” the researcher selected data on berth occupancy ratios from September 2018 to March 2019, with the following data:

PRODUKTIVITTY PT. JAKARTA INTERNATIONAL PERIOD SEPTEMBER 2018 - APRIL 2019

No	Month	PRODUCTIVITY					
		BOR (%)		VOR (%)		GCR (%)	
		West	North	West	North	West	North
1	Sep-18	40.53	67.62	48.1	68.7	24.0	26.7
2	Okt-18	31.60	58.29	53.1	75.9	25.8	28.6
3	Nov-18	37.10	67.53	47.8	68.3	23.6	26.2
4	Des-18	44.58	70.29	49.2	70.2	23.9	26.6
5	Jan-19	29.36	54.05	53.7	76.7	25.1	27.8
6	Feb-19	28.84	59.51	53.0	75.8	24.5	27.2
7	Mar-19	29.15	56.39	52.4	74.9	24.5	27.3
Average		34.45	61.95	51.0	72.9	24.5	27.2

Figure 1 Produktivty PT JICT 2018 - 2019

Source: PT. JICT

Looking at the table above, there is a difference in productivity between the west pier and the north pier, as shown in the Berth Occupation Ratio (BOR) column, and a difference in quay crane productivity between the west pier and the north pier, as shown in the Gross Crane rate productivity column and the average productivity difference – average vessel per arrival at the west dock and north dock at PT. Jakarta International Container Terminal, as seen in the Vessel Operation ratio productivity column. Berth Occupation Ratio (BOR), also known as the dock utilization rate, is the ratio of the total time each available dock is used to the total available time during a period (month/year), expressed as a percentage.

$$BOR = (\text{number(LOA + 5) x berth time}) : (\text{berth length x 24 x calendar days}) \times 100\%$$

Researchers collected BOR data monthly from September 2018 to March 2019. The data shows that the BOR at the north pier was always higher than the BOR at the west pier. In September 2018, the BOR at the west pier was 40.53%, while at the north pier it was 67.62%. In October 2018, the BOR for the west pier was 31.60% while the north pier was 58.29%. In November 2018, the BOR for the west pier was 37.10%, while the north pier was 67.53%. In December 2018, the BOR for the west dock was 37.10%, while the north dock was 67.53%. In December 2018, the BOR for the west dock was 44.58% while the north dock was 70.29%. In January 2019, the BOR for the west dock was 29.36% while the North Terminal was 54.05%. In February 2019, the BOR for the West Terminal was 28.84% while the North Terminal was 59.51%. In March 2019, the BOR for the West Terminal was 29.15% while the North Terminal was 56.39%.

The comparison of the advantages of the north dock over the west dock at PT. Jakarta International Container Terminal can also be seen in the Vessel Operation Ratio (VOR), which is the ratio of container boxes unloaded and/or loaded to the hours the ship is docked. It can be seen that, in terms of ship operations, the north dock is better than the west dock. This can also be seen in the Gross Crane Rate (GCR), which is the ratio of the number of container boxes unloaded and/or loaded to the time the crane is used. The north dock is better than the west dock. This is supported by data on crane strength in the north, which uses super panamak cranes, while the west still uses panamak cranes. Cranes at the north dock can use a twin-lift system, which allows them to load or unload two containers at once. Regarding the year of manufacture, the cranes at the western dock have the following data: crane no. 01 in 1984, crane no. 02 and no. 03 in 1978, crane no. 04, no. 05, no. 06 in 1991, crane no. 07 in 1997, and crane no. 09 in 2002/2003. Meanwhile, the cranes at the north pier have the following data: crane nos. 11 and 12 were manufactured in 2000; crane nos. 13 and 14 were manufactured in 2002/2003; and crane nos. 15, 16, 17, and 18 were manufactured in 2008.

PRODUKTIVITY DATA PT. JAKARTA INTERNATIONAL CONTAINER TERMINAL 2014 TO 2018

YEAR	SHIP ARRIVALS TOTAL	SHIP ARRIVALS >200M	BOR WEST PIER	BOR NORTH PIER	VOLUME CONTAINER (TEU)
2014	1,748	400	34%	61%	2,250,515
2015	1,749	531	40%	60%	2,223,147
2016	1,726	592	36%	61%	2,144,278
2017	1,437	499	35%	44%	1,610,864
2018	1,469	595	35%	60%	2,061,867

Figure 2 Produktivity PT. JICT 2014 - 2018

Source: PT. JICT

The development of container terminal services at PT. Jakarta International Container Terminal is shown in the table above. Ship arrivals declined from 2014 to 2018, but container volume remained around 2 million TEUs. This indicates that the number of large ships requiring a depth of 12 meters or more has increased from year to year. This is evident from the number of boats >200M arriving from 2014, which increased from 400 to 595 in 2018, and the development of the terminal at PT. Jakarta International Container Terminal must be balanced with the development of sea depth and loading and unloading equipment, such as quay cranes, given the number of ship arrivals (> 200M) and the volume of containers (TEU) served.

This study focuses on a comparative analysis of the operational performance of quay cranes between the West Pier and North Pier at PT. Jakarta International Container Terminal (JICT) uses three leading indicators, namely berth occupation ratio (BOR), gross crane rate (GCR), and vessel operation rate (VOR). The data used was taken from port operational reports for the period September 2018 to March 2019. The analysis shows a significant productivity gap between the two docks. The North Dock consistently indicates higher efficiency and productivity than the West Dock, as measured by dock utilization, equipment speed, and ship productivity while docked.

BOR, or berth utilization rate, is a measure used to assess the extent to which a berth is utilized within a specific period of time. Based on the calculations, the BOR of the North Berth was always in the range of 54%–70%, while the West Berth was only in the range of 28%–44% during the observation period. For example, in September 2018, the BOR of the West Dock was 40.53%, while that of the North Dock reached 67.62%. Similar conditions also occurred in the following months, where the BOR of the North Dock was always higher. This high BOR value indicates that the North Pier has a higher intensity of ship-loading and unloading activities, with its facilities being optimally utilized. Conversely, the low BOR at the West Pier indicates room for improvement in terms of ship scheduling, loading and unloading equipment efficiency, and inter-departmental operational coordination.

In contrast, the West Pier still uses relatively older Panamax quay cranes. Based on the data, the cranes at the West Pier were manufactured between 1978 and 2003, while those at the North Pier were manufactured between 2000 and 2008. The differences in age and technology between these tools are among the main factors affecting productivity. Older cranes have lower working speeds and lifting capacities and are not yet supported by twin-lift systems. As a result, loading and unloading times per ship are longer, leading to lower operational efficiency than at the North Pier.

In addition to equipment factors, differences in dock depth also affect operational performance. The West Dock has a depth of 11 meters, while the North Dock reaches 14.5 meters. This depth determines the size of ships that can berth. Large vessels with a length of more than 200 meters require a minimum depth of 12 meters. Therefore, the North Pier serves more large ships with high cargo capacity, thereby contributing to higher BOR and VOR values. Meanwhile, the West Pier is typically used for smaller vessels, resulting in lower total container volume handled.

PT. JICT's historical data shows an interesting trend in port operational development. Although the number of ship visits declined from 2014 to 2018, the volume of containers handled remained stable at around 2 million TEUs per year. This indicates that the ships that arrived were larger with high carrying capacities, so even though the number of vessels decreased, the cargo volume remained stable. It was recorded that the number of vessels over 200 meters increased from 400 in 2014 to 595 in 2018. This increase reinforces the urgency of adjusting dock facilities and loading and unloading equipment to serve large vessels efficiently.

To address the performance gap between the West Pier and the North Pier, the author proposes several strategies to improve operational performance. First, gradually replace the quay cranes at the West Pier with super post-Panamax cranes, enabling a twin-lift system. The use of twin-lift technology can significantly increase GCR and VOR by shortening the loading

and unloading cycle time. Second, modify the spreader systems on existing cranes to support twin-lift operations as a medium-term solution before replacing the equipment. Third, reduce non-productive time (not operating time), for example, by arranging workers' breaks in shifts so that loading and unloading activities can continue without interruption.

In addition, BOR can also be increased by deepening the west pier from 11 meters to 14 meters, in line with the depth of the North Pier. This effort will enable the West Pier to serve large ships (>200 meters) that currently can only berth at the North Pier. Fourth, optimizing the location of container stacking yards is also an important aspect. Selecting stacking areas closer to the West Pier, such as blocks A, B, C, and F, can shorten truck turnaround time by up to 6 minutes, thereby improving operational efficiency.

In the long term, improving the port's operational performance also requires a program to rejuvenate other port equipment, such as rubber-tyred gantry cranes (RTGC), internal transport trucks, and terminal automation systems. Modernizing equipment will increase service speed, reduce ship waiting time, and optimize terminal throughput capacity. This is important considering that JICT's annual container volume remains at around two million TEUs, making improved operational efficiency a determining factor in the Company's performance sustainability.

Thus, it can be concluded that the difference in operational performance between the West Quay and North Quay at PT. JICT is caused by a combination of technical factors (type and age of quay cranes, quay depth), managerial factors (operational timing), and supporting infrastructure factors (stacking location and additional equipment). Improvements in the West Pier's performance through modernized equipment, efficient operational arrangements, and adjustments to the pier's depth are expected to balance the BOR, VOR, and GCR achievements between the two piers. These steps will strengthen PT. JICT's position as a highly competitive international container terminal ready to handle increased large-ship traffic and future growth in global trade volume.

The study's results show significant differences in operational performance between the West Pier and the North Pier. Based on PT. JICT's operational data from September 2018 to March 2019 indicates that the Berth Occupation Ratio (BOR) of the North Pier is always higher than that of the West Pier. The average BOR for the North Pier was in the range of 54%–70%, while that for the West Pier was only 28%–44%. This shows that the utilization rate of the North Pier was more optimal, indicating higher loading and unloading intensity and more efficient management of ship berthing schedules.

This difference is also reflected in the Vessel Operation Rate (VOR) and Gross Crane Rate (GCR) indicators. The North Pier has an average VOR of 72.9 boxes/hour/ship and a GCR of 27.2 boxes/hour/crane, while the West Pier only achieves a VOR of 51 boxes/hour/ship and a GCR of 24.5 boxes/hour/crane. The higher productivity at the North Quay is due to the use of more modern super post-Panamax quay cranes, equipped with a twin lift system capable of lifting two containers at once, as well as an automatic control system that improves operator efficiency.

In contrast, the West Pier still uses Panamax cranes with older technology, ranging in age from 22 to 47 years. These factors—age and technology—have led to a decrease in lifting speed and an increase in idle time. In addition, the difference in dock depth (11 meters in the West and 14.5 meters in the North) also affects the size of ships that can dock. Large vessels measuring more than 200 meters can only be served at the North Dock, resulting in a higher total cargo volume handled compared to the West Dock.

Historical data from 2014 to 2018 shows that, despite a decline in ship visits, container volume remained stable at around 2 million TEUs per year. This was due to an increase in the number of large ships (over 200 meters) in operation, from 400 boats in 2014 to 595 ships in 2018. This phenomenon indicates a shift in service structure from small vessels to large ships

with much higher carrying capacity. This condition underscores the importance of improving port infrastructure and equipment to serve the trend toward larger vessels optimally.

To address the performance gap, several strategic steps are recommended:

1. Rejuvenate the quay crane at the West Pier to a super post-Panamax type that supports a twin lift system.
2. Increasing the depth of the pier from 11 to 14 meters to accommodate large ships.
3. Optimizing the layout of the container stacking yard to make the distance between the pier and the stacking area more efficient.
4. Modernizing supporting equipment, such as RTGC, internal transport trucks, and implementing a digital terminal management system.
5. Regular training and certification of crane operators to improve skills and operational speed.

Through the implementation of these measures, PT. JICT is expected to increase efficiency and reduce ship waiting times, thereby supporting the achievement of international-class container terminal productivity targets.

CONCLUSION

Based on the analysis conducted in the previous chapter, it can be concluded that there is a significant difference between the operational performance of quay cranes at the West Pier and North Pier of PT. Jakarta International Container Terminal (JICT). The West Pier is 890 meters long, with a depth of 11 meters, and is equipped with eight relatively old quay cranes, manufactured between 1978 and 2003, none of which have twin-lift capabilities. This limitation has resulted in low productivity, with an average berth occupancy ratio (BOR) of only 34.45%, a vessel operation rate (VOR) of 51 boxes/hour/vessel, and a gross crane rate (GCR) of 24.5 boxes/hour/crane during the period from September 2018 to March 2019. In contrast, the North Pier, which is 720 meters long and 14.5 meters deep, is equipped with super post-Panamax quay cranes manufactured between 2000 and 2008 that use a twin-lift system. These conditions make the North Quay superior, with an average BOR of 61.95%, VOR of 72.9 boxes/hour/ship, and GCR of 27.2 boxes/hour/crane.

Historical data also shows that the number of ship arrivals at JICT fluctuated from 2014 to 2018, with a rising trend in large ship arrivals. There were 400 ships in 2014, increasing to 595 boats in 2018. Although the number of vessels declined in 2017, container volume remained stable at around two million TEUs per year, with slight variations between 1.6 and 2.2 million TEUs. This indicates that more and more large, high-capacity ships are being served at the port. Ships larger than 200 meters require a minimum depth of 14 meters to berth safely. Under current conditions, only the North Pier meets this criterion, while the West Pier is still limited because its depth is only 11 meters. Therefore, to improve the balance of operational loads and expand capacity to serve large ships, the West Pier needs to upgrade its facilities, particularly its equipment and pier infrastructure.

Based on the above analysis, it is concluded that to achieve equivalent operational performance between the two docks, a strategic step is needed: rejuvenating the quay crane at the West Dock to give it twin-lift capabilities like those of the North Dock. Modernizing this equipment will increase GCR and VOR values, improving loading and unloading productivity. In addition, gradual dredging of the West Pier to a depth of 14 meters is necessary to allow large ships to berth and carry out loading and unloading activities at the pier. This effort must also be supported by an in-depth technical study of the pier structure design and foundation bearing capacity to ensure the feasibility of installing new quay cranes.

From a managerial perspective, an economic feasibility study and the calculation of equipment replacement investment costs are needed to implement modernization in a planned and sustainable manner. A follow-up study is also recommended to more comprehensively describe West Quay's operational conditions, including technical, financial, and operational factors. The results of these studies will form the basis for making informed decisions to

improve the efficiency and effectiveness of loading and unloading activities at PT. JICT. With these strategic steps, it is hoped that the West Pier can increase its service capacity, shorten loading and unloading times, and support the growth of large-ship traffic and container volumes in the future, thereby strengthening JICT's position as a high-standard international container port in Indonesia.

REFERENCE

- Creswell, John W. 2014. Penelitian Kualitatif dan Desain Riset: Memilih di Antara Lima Pendekatan: Pustaka Pelajar.
- Creswell, John W. 2016. Research Design: Pendekatan Kualitatif, Kuantitatif dan Campuran: Pustaka Pelajar.
- Cohen, Louis, DKK.1999. Research Methods in Education: Companion Website, Routledge.
- Dentin, K. Norman dan Yvonna S Lincoln, 2010. Handbook of Qualitative Research: Pustaka Pelajar.
- Kosasih, Engkos, Manajemen Perusahaan Pelayaran, Jakarta: PT Raja Grafindo Persada, 2007.
- Kosasih, Engkos dan Hananto Soewedo. 2007. Manajemen Perusahaan Pelayaran: Suatu Pendekatan Praktis dalam Bidang Usaha Pelayara: Rajawali Pers (ISBN 9789797691071).
- Lasse, D.A., manajemen Muatan Aktivitas Rantai Pasar Di Area Pelabuhan: Rajawali Pers (ISBN 9789797694777).
- Lasse, D.A., ManajemenPelabuhan, Jakarta: PT RajaGrafindoPersada, 2011.
- Sudarsono, 1994. Operasi Peti Kemas dan pertanggungannya. Rineka Cipta.
- Supriyono, 2010. Analisis Kinerja Terminal Petikemas di Pelabuhan Tanjung Perak Surabaya.
- Suyono, R.P., Jakarta, 2007.Shipping: Pengangkutan Intermoda Ekspor Impor Melalui Laut: PPM.
- Yin, Robert K. 2011. Studi Kasus: Desain dan Metode: Rajawali Pers.