

TERMINAL OPERATING SYSTEM (TOS) ANALYSIS IN LOADING AND UNLOADING QUEUE PRODUCTIVITY AT PT IPC TPK TANJUNG PRIOK

Simon Gultom^a, Bintang K. Pasaribu^b, Sharifah N. Aishah^c, David P. Sirait^d

^{abcd} Faculty of Management and Business, Institut Transportasi dan Logistik Trisakti,
Jakarta, Indonesia

Corresponding author : bintangpasaribu344@gmail.com

Abstract: PT IPC TPK Tanjung Priok is one of the main terminals that supports port operations to function as the main point for loading and unloading containers. Terminal Operating System (TOS) is a system that manages the operations of container terminals. The implementation of TOS in Container Terminal 1 Zone 1 (009) faces various problems that affect productivity, such as the implementation of a suboptimal system. The purpose of this study is to analyze the TOS used in Container Terminal 1 Zone 1 (009) and its impact on the productivity of loading and unloading queues. This type of research uses a qualitative method by selecting snowball sampling informants through in-depth interviews with productivity analysis, Stevenson's operations management theory and Christopher's logistics and supply chain management theory. This study shows that TOS increases port loading and unloading productivity by increasing throughput by 11.6% by July 2024 and significantly reducing vessel dwell time. In addition, TOS reduces reliance on manual processes, making the loading and unloading process more stable and efficient.

Keywords: *Productivity, Logistics, Terminal Operating System (TOS), Loading - Unloading, PT IPC TPK Tanjung Priok.*

1. Introduction

The port has a role as a center for logistics and international trade. Its role is very important in today's era of globalization. A study conducted by Suharko and Wijaya (2020) assessed that "Port efficiency in Indonesia has a strategic position in facilitating the flow of goods and increasing the competitiveness of the national industry in the global market". When ports can operate efficiently, they not only ensure the smooth flow of goods but also support the stability and growth of the global economy. Rodrigue, Notteboom, & Pallis (2020) noted that ports with high operational efficiency are better able to adapt to supply chain disruptions, "demonstrating their important role in global supply chains". Thus, port efficiency, both in Indonesia and globally, is a key factor affecting international economic competitiveness and the sustainability of overall global economic growth.

In addition, the Port of Tanjung Priok located in Jakarta is the main gateway to Indonesia's international trade, serving the country's exports and imports, its role is very important in supporting Indonesia's economy, considering that most of Indonesia's trade activities by sea take place there. The operational efficiency of the port at the Port of Tanjung Priok, the largest port in Indonesia, directly affects the cost of national logistics. As noted by the annual report of the Indonesian Ministry of Transportation (2021), the improvement of efficiency at the Port of Tanjung Priok through digitalization and modernization of infrastructure has succeeded in reducing loading and unloading times and logistics costs, which in turn has increased Indonesia's competitiveness in international trade (Ministry of Transportation, 2021). Container Terminal 1 Zone 1 (009) at PT IPC TPK Tanjung Priok is crucial for port operations, handling thousands of containers daily (Logistic News, 2024). However, there

are significant challenges in managing loading and unloading queues at this terminal. Inefficient queues lead to delays, negatively affecting terminal productivity (Logistic News, 2024). Despite a 11.6% increase in throughput by July 2024, vessel dwell time remains an issue, especially when rising volumes aren't matched by operational optimization (Jati, 2024). These delays increase shipping costs, disrupt the supply chain, and harm customer satisfaction and the port's global competitiveness.

The Terminal Operating System (TOS) at PT IPC TPK Tanjung Priok plays a crucial role in optimizing container terminal operations by managing resource allocation and minimizing queue times. Despite its many advantages, the current TOS has shortcomings that can impact efficiency and productivity. As noted, "The effectiveness of Terminal Operating Systems (TOS) is highly correlated with productivity improvements in container terminal operations, but suboptimal implementation can reduce the benefits that should be derived from such systems" (Maritime Economics & Logistics, 2024a, 2024b). Specifically, issues related to queue management and resource allocation still require improvement. Although efficient TOS usage can reduce loading and unloading times and increase throughput, poor implementation such as problems with device integration can undermine these benefits (Maritime Economics & Logistics, 2024c). Analyzing these issues is essential for identifying potential improvements to enhance TOS performance, thereby boosting overall operational efficiency and strengthening the port's global competitiveness.

Therefore, the study becomes relevant in the context of efforts to improve port competitiveness through more efficient management of loading and unloading queues. The purpose of this study is to analyze the TOS used at Container Terminal 1 Zone 1 (009) and its impact on loading and unloading queue productivity. The study will also explore possible solutions that can be applied to overcome the existing problems in improving operational efficiency. To conclude the background, the study will explain in detail the problems that have been identified, particularly regarding the implementation of the Terminal Operating System (TOS) and provide an introduction to the next section which includes a literature review on Terminal Operating System (TOS), Container Terminal (PTK), and Loading and Unloading Productivity. The methodology that will be used is a qualitative approach by using snowball sampling through in-depth interviews and secondary data analysis such as evaluation documents on the implementation of performance targets.

2. Literature Review

2.1. Logistic and Supply Chain Management

In his book entitled *Logistics and Supply Chain Management* in 2023, Martin Christopher emphasizes the importance of effective and efficient supply chain management to provide the best value to customers at the lowest cost. Logistics plays a crucial role in regulating the movement of goods, information, and the relationship between suppliers and consumers. To create excellence and reduce risk, the idea involves technology integration, close cooperation with supply chain partners, and resource optimization. This broad method concentrates on improving customer service and cost efficiency in the long run.

2.2. Operational Management

In this context, the concept expressed by William J. Stevenson in the 14th edition of *Operations Management* in 2021 also emphasizes the importance of effective and efficient operational management in managing the production process. With the management of all processes required to produce goods and services that meet customer

demand, the theory includes capacity planning, supply chain management, quality control, and the application of Just-In-Time (JIT) and lean management methods, all of which help to improve the productivity and operational efficiency of a company.

2.3. Terminal Operating System

The application system that operates the container terminal is called the Terminal Operating System (TOS). The Terminal Operating System (TOS) does the following: 1) supervises the flow of containers at the terminal with a proper placement plan so that the loading and unloading process becomes more efficient; 2) creates schedules for loading/unloading and transfer yards by referring to the information sent by shipping companies containing the position of containers on ships that will dock; 3) processes information on container shipments to the terminal sent by shipping companies; and 4) provides information on container shipments to the terminal (Liau et al., 2018). As it supports the planning, scheduling, and control of equipment, Terminal Operating System (TOS) is essential for effective and productive terminal operations. Many Terminal Operating System (TOS) functions are automated (Boer & Saanen, 2012).

2.4. Container Terminal

Containers are specially designed packaging of a certain size that can be used repeatedly and used to store all the items in it (Khalid et al., 2018). A container terminal is a special area that serves as a meeting point between land and sea modes of transportation for container transportation. In this restricted area, containers are moved from ships until they are transported out of port. The use of containers for shipping goods has grown rapidly, with volumes that continue to increase every year (Shalawatika et al., 2021).

2.3. Loading and Unloading Productivity

Productivity is a comparison of inputs and outputs, or a measure of how effectively and efficiently the available resources are used to achieve goals (Darunanto et al., 2020). According to (Amalia et al., 2020) journal, one of the main activities in ports, especially in container terminals, is loading and unloading. It includes shipping goods from ship to land and vice versa. One of the important performance indicators that determines how effective and efficient the operation of a port or terminal is is the duration of loading and unloading activities. Container loading and unloading production is affected by several factors, including tool lead times and availability of activity support equipment (Shalawatika et al., 2021).

3. Research Methods

This study uses a qualitative research category. According to (Nina Adlini et al., 2022), the purpose of this study is to gain a deeper understanding of how the Terminal Operation System (TOS) is implemented at PT IPC Terminal Petikemas Tanjung Priok. Qualitative methods allow researchers to directly engage in specific situations and conduct in-depth interviews with contributing people. The researcher tries to provide a comprehensive picture of the implementation of TOS, ranging from advantages to disadvantages. They did this by collecting data from interviews and literature research. This qualitative method allows researchers to learn more about the meaning and context of TOS implementation in a specific work environment.

The researcher conducted sampling using the Snowball Sampling method. Where according to (Naderifar et al., 2017), Snowball Sampling is an information collection method used to access certain groups of people that are difficult to reach or widely spread. This method begins with the selection of initial participants who meet the research criteria. Furthermore, participants are asked to recommend other participants who meet the same criteria. To produce an ever-growing sample, this process incorporates new participants suggested by previous participants.

This research was conducted at PT IPC Terminal Petikemas Tanjung Priok which is located in the Integrated Planning Control Meeting Room, PT IPC Terminal Petikemas, 5th Floor Engineering Building. Jl. Pasoso No. 1 Tg. Priok. Because PT IPC Tanjung Priok Container Terminal is very important for the smooth trade of Indonesia, this research was conducted there. With its status as a major export-import center, its operational productivity level will have a direct impact on the overall national logistics level. The terminal also improves overall logistics performance by reducing the waiting time for goods at the port. The informants for this research involved three interviewees, there are Participant A as Operations Control Supervisor, Participant B as Senior Yard Planning and Participant C working in Planning Control Division.

The first informant, Participant A was chosen because of his experience and position that is highly relevant to operations control in Pelindo, as well as his 15 years of experience working there. As a supervisor, he has in-depth knowledge of the Terminal Operating System (TOS) implementation at the Container Terminal, which was the main focus of the interview. Secondly, Participant B was chosen due to his strategic role in the integrated planning and control division and his 14 years of experience working at PT Pelindo. With dual roles as Yard Planning executive and Senior Assistant Manager staff, he has a deep understanding of TOS implementation and its impact on productivity. Thirdly, Participant C was chosen due to his experience working in various positions from operations to planning, since 2012. With his experience, he has insight into the transformation of TOS implementation from a manual system to the latest, more modern version, as well as the challenges that arose during the implementation.

4. Results and Discussion

As a start, the application and understanding of the Terminal Operating System (TOS) at PT IPC TPK Tanjung Priok is the first aspect that is important to be discussed for the main reason that concerns the vital function of TOS in the operation of Terminal Peti Kemas (TPK). Furthermore, a deep understanding of TOS is key in ensuring that the system can be effectively integrated into daily operational routines. So it's not just about knowing how to use the software works, it's also about understanding how TOS can be optimized to increase productivity and reduce downtime.

Table 1

Interviewees answers on implementation and understanding of TOS

Aspects	Participant C	Participant A	Participant B
Implementation and Understanding of TOS	TOS has been implemented since 2014, starting with the OPUS system and developing into ITOS and TONOS, where understanding TOS is mandatory for all related divisions.	TOS has been used since the Pelindo 2 era, initially using CITOS and then developing into OPUS and TOS Nusantara.	TOS was implemented from March 2022, with a focus on upgrading and transforming from a manual system to a more advanced system. Understanding TOS must be carried out by all personnel in the relevant divisions.

Based on interviews with Participant A, B and C. The implementation of TOS at PT IPC TPK has gone through various phases and transformations, which shows the importance of this system in supporting container loading and unloading activities. The implementation of TOS at PT IPC TPK did not happen suddenly, but through various stages that began in the early 2010s. According to Participant C, TOS was first implemented in 2014 under the name OPUS, which then developed into ITOS and finally TONOS in 2022; shows a gradual increase in the complexity and capability of the system, in line with the increasing operational needs.

Participant A added that TOS has been used since the Pelindo 2 era, with the initial system called CITOS, which later developed into OPUS and finally TOS Nusantara. The use of TOS at PT IPC TPK has become an integral part of terminal operations, from manual data recording to the use of more sophisticated and integrated systems. Meanwhile, Participant B highlighted that the TOS was officially implemented in March 2022 as part of efforts to upgrade and transform from a manual system to a more advanced system. The implementation of TOS not only functions as a tool for container data inventory, but also as a system that is able to support the entire operational cycle from start to finish.

The implementation of the Terminal Operating System (TOS) at PT IPC TPK is far more than a mere software installation; it necessitates a profound understanding from all personnel involved, covering technical, operational, and strategic dimensions to fully leverage the system's capabilities. Participant C emphasized the critical need for comprehensive knowledge of TOS among staff, especially those in the Integrated Planning and Control, Operations, and Billing and Customer Service divisions, as it directly influences the efficiency and productivity of loading and unloading operations. Participant C further underscored that mastering TOS is imperative not only for operational excellence but also for ensuring compliance with national and international standards. The transition from a manual to an advanced system like TOS requires significant shifts in both work culture and mindset, making continuous education and training indispensable. Addressing resistance to change, particularly from personnel accustomed to the previous system, poses a considerable challenge; however, with targeted education and a deep understanding of TOS's broader implications, these challenges can be effectively mitigated, ensuring a seamless and successful implementation.

Table 2

Interviewees responses to TOS implementation challenges

Aspects	Participant C	Participant A	Participant B
Implementation Challenges	The main challenge was getting used to the new system, including menu and code changes that required adaptation.	The main challenges came from customer complaints and operational staff's adjustment to the new system.	The biggest challenge is education and equalization of perceptions, as well as the procurement of adequate IT equipment and infrastructure.

The implementation of the Terminal Operating System (TOS) at PT IPC TPK (Tanjung Priok 1 Zone 1 009) has encountered several significant challenges, primarily revolving around technical, human, and organizational aspects. Participant C highlighted that one of the most formidable obstacles was familiarizing staff with the new system, as changes in menus, codes, and operational procedures demanded substantial adaptation. This shift often led to resistance, difficulties in adjustment, and a temporary decline in operational efficiency. The need to relearn these changes caused initial disruptions, increasing processing time and decreasing productivity.

Participant A pointed out that customer complaints also became a critical issue during the early phases of TOS implementation. Customers, expecting greater efficiency, were often disappointed by delays caused by staff unfamiliarity with the system. The transition from manual to system-based processes added to the challenge, creating anxiety among staff worried about making mistakes that could impact productivity. Participant B emphasized that the most significant challenge lay in the educational process and the unification of perceptions among staff and project teams. The effort required to educate and align everyone's understanding of the TOS's function and importance was immense, involving substantial resources and coordination across divisions.

The complexity of implementing TOS in an environment accustomed to manual processes underscores the multidimensional nature of these challenges. Technical issues such as system bugs and IT infrastructure upgrades must be addressed alongside human factors like resistance to change and anxiety. Moreover, organizational challenges, including aligning perceptions and ensuring inter-departmental coordination, necessitate robust project management and clear communication. By tackling these challenges through a comprehensive approach that combines technical planning, effective change management, and continuous education, PT IPC TPK can successfully integrate TOS into its operations, maximizing its positive impact on productivity and efficiency.

Table 3

Answers from interviewees on the impact of TOS on operations

Aspects	Participant C	Participant A	Participant B
Impact of TOS on Operations	TOS reduces the need for manual processes and improves operational efficiency through automation and more stable flow arrangements.	TOS improves efficiency, real-time monitoring and operational control, resulting in more accurate data and faster service.	TOS enables real-time monitoring and reporting, and improves the effectiveness of planning and operations, with more complete and accurate data.

Each speaker provided a unique perspective on the impact of the Terminal Operating System (TOS) at PT IPC Terminal Peti Kemas, but all agreed on its significant positive effect. Participant C emphasized that TOS has effectively reduced reliance on manual processes, such as using physical cards for load management, which has led to improved operational stability. The automation provided by systems like OPUS and ITOS has streamlined previously time-consuming tasks, reducing errors and enhancing the alignment between planning and execution. Participant A highlighted that TOS has notably improved real-time monitoring, allowing for immediate access to accurate data, which in turn has enhanced decision-making and operational control, reducing delays and boosting overall efficiency.

Participant B focused on how TOS has bridged the gap between field activities and system data input, ensuring that operational actions are recorded in real-time, thereby minimizing errors and improving data accuracy. The integrated platform provided by TOS has also made planning and execution more efficient, with comprehensive and accurate productivity reports offering a clear view of operational performance. These improvements underscore the system's role in enhancing productivity and operational efficiency, as all necessary data for decision-making is consolidated within a single system, facilitating smoother operations and more informed decisions.

The collective insights from Participant A, B and C illustrate how TOS has significantly increased operational efficiency at PT IPC Terminal Peti Kemas by streamlining processes, improving real-time data access, and enabling tighter operational controls. This transformation has accelerated operations, reduced costs, and ensured data accuracy, which is crucial for effective decision-making in the fast-paced environment of container terminals. Despite these advancements, the implementation of TOS also presents challenges, particularly in staff education and adaptation, as well as the ongoing need for improvements in the system's user interface and features to further enhance operational ease and efficiency.

Table 4

Interviewees answers in responding to and receiving staff

Aspects	Participant C	Participant A	Participant B
Staff Response and Acceptance	Staff initially had difficulty adapting, but after the introduction, the system began to be well received.	At first, there were difficulties with staff adaptation, but over time, they were helped by the new system.	The learning and adaptation process requires a systematic educational approach, with the main challenge being overcoming resistance and technical difficulties.

The staff's response and acceptance of the Terminal Operating System (TOS) at PT IPC Terminal Peti Kemas (Tanjung Priok 1 Zone 1 009) is a crucial factor in its success. Initially, Participant A, B and C observed that operational staff faced significant challenges in adapting to the new system, particularly with changes in menus and codes. This gap in knowledge led to initial resistance, as staff struggled with unfamiliarity. Participant A noted that this resistance was compounded by customer complaints due to delays caused by the staff's adjustment period, highlighting the psychological and emotional hurdles involved. Participant B added that the adaptation process required extensive education and effort, as staff needed not only to learn the new system but also to understand its impact on their productivity. To address these challenges, all speakers underscored the importance of intensive education and mentoring. Participant C pointed out that once the staff became

familiar with the system, resistance diminished, indicating the effectiveness of a structured training approach. Participant A emphasized that continuous learning was key to successful adaptation, as staff eventually recognized the benefits of TOS, leading to increased acceptance. Participant B stressed that ongoing education and a supportive project team are essential for ensuring that staff fully understand and can operate the system effectively, with assistance during implementation being critical for overcoming early difficulties. Based on the explanation of the three speakers, there are several key factors that determine whether or not the staff is successful in accepting and adapting to the TOS, which is illustrated in the following data visualization:

Table 5

Determining the factor key

No.	Key Factors	Condition Description	Condition Description
1.	Resistance to Change	Uncertainty and fear of the new system, staff were comfortable with the old system, which slowed down adaptation.	Inhibit, slow down the adaptation process.
2.	Availability of Education and Training	The effectiveness of training, continuing education, and mentoring during go-live boosts staff confidence.	Support, increase staff confidence and understanding.
3.	Change Management Approach	A systematic managerial approach, involving project teams, open communication, and an emphasis on long-term benefits.	Support, reduce resistance, accelerate adaptation.
4.	Psychological and Emotional Factors	The mental and emotional readiness of staff, the fear of mistakes, and the stress of new changes, require management support.	Inhibiting this requires strong management support.

If using change management theory, use the Lewin Change Model and Organizational Readiness Theory. Lewin's Model of Change (1974), consists of three stages; unfreezing, changing, and refreezing. Resistance to change reflects the unfreezing stage, where organizations need to overcome psychological and emotional barriers to prepare staff for change. The changing stage is related to the availability of education and training as well as effective change management approaches, which help facilitate the transition and increase staff confidence. Refreezing requires attention to change stabilization and emotional support, ensuring staff are ready to accept and sustain new changes. In the context of Organizational Readiness Theory, Weiner (2009) readiness to change is greatly influenced by how resistance and psychological factors are managed. If not handled properly, these factors can hinder adaptation, but with a systematic approach to change management and proper education, the collective perception of readiness to change can be improved, supporting the overall adaptation process. In this case, the resource person then provided an interesting perspective to increase loading and unloading productivity.

Table 6

Answers from interviewees on improving loading and unloading productivity

Aspects	Participant C	Participant A	Participant B
Improved Loading and Unloading Productivity	TOS improves operational time efficiency and simplifies data analysis, which has a positive impact on productivity.	TOS significantly affects productivity, with more real-time and accurate reports, but supporting data is still needed to quantify its impact.	TOS contributes to increased productivity with easier and more accurate monitoring, and more effective evaluation based on real-time data.

The three speakers provided diverse yet complementary perspectives on the impact of the Terminal Operating System (TOS) on operational efficiency and performance at PT IPC TPK. Participant C emphasized how TOS reduces the need for manual processes, particularly in loading and unloading operations. Automation through TOS enhances operational stability, minimizes human error, and increases time efficiency, thereby boosting productivity by allowing more containers to be handled in less time. Additionally, the improved data accuracy from TOS enables better decision-making and process improvements. Participant A highlighted the system's positive effects on efficiency, real-time monitoring, and operational control. TOS's ability to input and monitor data in real-time allows for immediate responses to issues, minimizing downtime and enhancing overall productivity. The accurate and accessible reports generated by TOS are vital for management decisions and performance analysis, ensuring that operational teams can promptly address field situations, contributing to continuous improvement.

Participant B provided a technical perspective, focusing on how TOS improves the planning and monitoring of operations. Real-time data and comprehensive reports from TOS facilitate accurate productivity evaluations, enabling teams to swiftly identify and address inefficiencies. This ensures that productivity targets are consistently met by allowing management to spot bottlenecks and implement corrective measures proactively. The speakers collectively agreed that while TOS has significantly increased productivity, its effectiveness depends on proper implementation and staff training. With continued improvements in system utilization and data-driven decision-making, PT IPC TPK can further enhance its operational capacity and maintain its competitiveness in the global market.

Table 7

Interviewees answer on recommendations for further improvement of TOS

Aspects	Participant C	Participant A	Participant B
Recommendations for Further Improvement	Need to standardize codes and colors in the system, as well as increase network bandwidth in certain areas.	Strengthened network infrastructure and enhanced system features to meet management reporting needs.	Improved user interface that is easier to understand and more complete features, as well as continuous education for all personnel.

In the interview, the three speakers provided recommendations that focused on several key aspects that can improve the effectiveness and efficiency of the Terminal Operating System (TOS) at PT IPC Terminal Peti Kemas. Participant C emphasized the importance of

standardizing codes and colors in the TOS system to ensure consistency across terminals. This is necessary to avoid confusion in operations and improve uniformity in reporting. In addition, he also recommends increasing network bandwidth in several areas to support the effectiveness of web-based systems such as TONOS. Participant A proposed strengthening network infrastructure, considering the dependence of TOS on a stable network system. In addition, he suggested improving the features of the TOS system to meet the needs of management in providing accurate and real-time reports. This includes the system's ability to provide more complete and detailed container throughput data, which is urgently needed by management for strategic decision-making. Participant B recommends improvements to the TOS user interface to make it more user-friendly, informative, and easy for users to understand. He emphasized that while TOS is already quite effective, there is always room for improvement, especially in making the system more intuitive for users. In addition, he highlighted the importance of continuous education, considering the complexity of the TOS system which requires a deep and continuous understanding. The learning process about TOS does not only stop at the initial implementation stage, but must continue to be carried out along with the development and update of the system.

The visualization above shows the distribution of interests of the four main elements recommended for the Terminal Operating System (TOS) upgrade at PT IPC TPK:

- Standardization of codes and colors, accounting for 22.5% of the overall narrative, where standardization is important to prevent operational errors and improve the efficiency of communication between divisions.
- Strengthening network infrastructure, accounting for 22.5% of the overall narrative delivered by the three speakers, where a strong network infrastructure can ensure that TOS operations run without obstacles, which is essential for real-time monitoring and data input.
- Improving features and data quality is the most crucial with 23.8% of the overall narrative, ensuring that the data generated by TOS can be accurate and reliable, to support strategic decision-making.
- User Interface (UI) and continuous education, accounting for 22.5% of the overall narrative, intuitive UI and continuing education program are important aspects to ensure that all staff can make optimal use of TOS.

Table 8

Interviewees answer on TOS improvement with future impact

Aspects	Participant C	Participant A	Participant B
Future Impact	TOS improves operational time efficiency and simplifies data analysis, which has a positive impact on productivity.	TOS significantly affects productivity, with more real-time and accurate reports, but supporting data is still needed to quantify its impact.	TOS contributes to increased productivity with easier and more accurate monitoring, and more effective evaluation based on real-time data.

Participant C emphasized that TOS is not only applied at PT IPC TPK, but there is a big plan to implement this system throughout Indonesia. TOS is seen as a tool that is able to improve service standards at various container terminals in Indonesia. This even implementation aims to harmonize operations between terminals, allowing data from different areas to be accessed and analyzed more quickly and accurately. This projection

shows that TOS is expected to be the backbone of operational transformation throughout Indonesia. With even implementation, it is hoped that there will be uniformity in operating standards, which will help reduce disparities between terminals. However, the main challenge that may arise is how to ensure all terminals, especially those in remote areas or with limited resources, can adopt these systems properly. Adequate technical and infrastructure support is needed to realize this vision.

Participant A revealed that the future of productivity is highly dependent on the company's ability to continuously improve and optimize the use of TOS. Although the TOS has currently had a positive impact, the technical and operational challenges that arise must be overcome in order for productivity to be maintained or even increased. Strengthening infrastructure and maintaining the system is an important key in maintaining sustainable productivity in the future. This view highlights the importance of continuous maintenance and improvement of the system. Without a commitment to continue to develop infrastructure and fix technical issues, there is a risk that the benefits derived from the current TOS could be eroded. Sustainability of productivity does not only depend on the technology itself, but also on the readiness of the organization to continue to adapt to technological developments and operational demands.

Participant B sees that the future of productivity at PT IPC TPK will be greatly influenced by several external and internal factors. Among them are the sustainability of the use of TOS, the readiness of human resources, the maintenance of tools and infrastructure, and the company's ever-increasing productivity targets. He also emphasized the importance of motivation and challenges given by companies to encourage increased productivity. Participant B provides a more holistic perspective by considering various factors that can affect the sustainability of productivity. The dependence on external factors such as the type of vessel served and the condition of the infrastructure shows that while TOS is an important tool, long-term success still requires support from a variety of other elements. Motivation and pressure to achieve targets are also key elements in ensuring that HR remains focused and committed to increasing productivity. However, it also carries the risk of burnout if not managed properly, so it is important for management to strike a balance between the demands and support provided to staff.

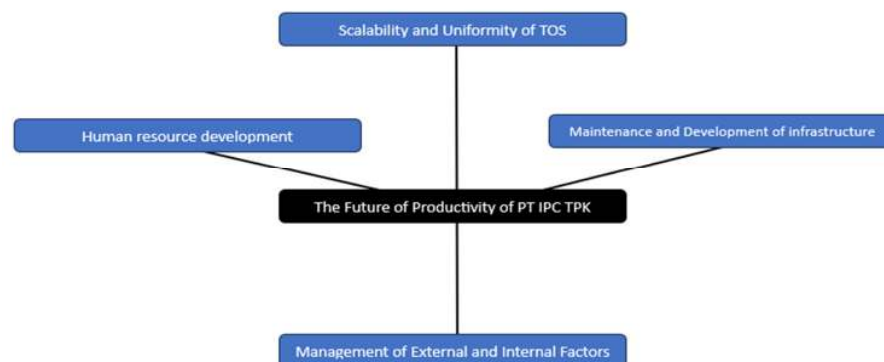


Fig. 1. PT IPC TPK Productivity Future Diagram

The Future of Productivity of PT IPC TPK is at the center of the diagram, as the center of all the factors that influence it. The four main factors that affect this productivity are: (1) Scalability and Uniformity of TOS Implementation throughout Indonesia. (2) Sustainable

Maintenance and Development of Infrastructure. (3) Development of skilled and motivated Human Resources. (4) Management of External and Internal Factors related to operations. Thus it comes to the final analysis, that in increasing the productivity of PT IPC TPK, the four factors are continuous with the concepts outlined in the books Logistics and Supply Chain Management by Martin Christopher (2021) and Operations Management by William J. Stevenson (2023).

Martin Christopher (2021) emphasizes that effective supply chain management, including scalability and system uniformity, is key to improving customer service and reducing operational costs. By implementing a uniform Terminal Operating System (TOS) across Indonesia, PT IPC TPK can ensure more efficient and consistent terminal operations. Improvements in productivity can also be supported by continuous infrastructure maintenance and development, as strong infrastructure is the foundation for a smooth supply chain and reduced operational costs, in accordance with Stevenson's derivative concept. William J. Stevenson (2023) in Operations Management emphasizes the importance of managing efficient production processes, capacity planning, and quality control. The development of skilled and motivated human resources is essential to ensure that operational processes can run smoothly, adopting methods such as Just-In-Time (JIT) and lean management to improve efficiency and reduce waste. In addition, good management of external and internal factors is required going forward to ensure that the company can continue to operate efficiently despite the changing challenges in the business environment. All three interviewees emphasised that the development of skilled human resources both internally and in conjunction with external relations is important to ensure effective understanding and implementation of the TOS. TOS has even been shown to improve operational efficiency and reduce wastage, as explained by Participant A and Participant C, although there are hurdles in terms of system familiarisation and infrastructure requirements that still need to be overcome.

5. Conclusion

The implementation of the Terminal Operating System (TOS) at PT IPC Terminal Peti Kemas has significantly changed the company's operations. To increase loading and unloading productivity, processes must be automated and data must be more accurate and more efficient. Nonetheless, many complex factors influence the success of TOS implementation, ranging from technical elements such as standardization and infrastructure to human elements such as resilience to change, quality of training, and management support. To achieve full optimization, wide scale of implementation, continuous maintenance of infrastructure, thorough development of human resources, and the ability to adapt to dynamics. It is evident that TOS improves operational efficiency, but long-term success depends on coordination between technical, human, and organizational elements. In accordance with a study conducted by Gekara and Nguyen (2020) that continuous infrastructure maintenance is essential to ensure that the TOS operates optimally over time, as outdated systems can hinder performance and lead to operational bottlenecks.

6. Implications

With the implementation of the Terminal Operating System (TOS) at PT IPC TPK Tanjung Priok, the operational efficiency and competitiveness of the terminal improved significantly. Improving loading and unloading efficiency increases throughput capacity, reduces vessel dwell time, and increases terminal revenue. PT IPC TPK strengthened its position in global competition and reduced costs thanks to resource optimization. To achieve

long-term success, PT IPC TPK and all Indonesian ports need continuous training, technology updates, and strategic policies that support the advancement of information technology.

7. Research Limitations

This study has limitations. First, this analysis only covers PT IPC TPK Tanjung Priok, so the results cannot be generalized to other terminals. Second, it focuses only on qualitative and operational data, without considering external variables such as technological changes or government policies that affect productivity. Third, this data is retrospective and observational, so it may not be indicative of current conditions. Finally, as the study was limited by time and resources and lacked consideration of the social and cultural aspects of the workforce, some important variables may not have been thoroughly analyzed.

References

- Amalia, R., Kamaludin, A. G., & Tabah, A. A. (2020). Efektivitas Pengiriman Barang di Terminal Peti Kemas (TPK) Koja The Effectiveness of Goods Delivery at Koja Container Terminal. *Jurnal Manajemen Bisnis Transportasi Dan Logistik (JMBTL)*, 6(1), 73–78. <https://journal.itltrisakti.ac.id/index.php/jmbtl>
- Boer, C. A., & Saanen, Y. A. (2012). *Testing, Tuning and Training Terminal Operating Systems*. 1–11. <https://www.researchgate.net/publication/237150055>
- Christopher, M. (2022). *Logistics & Supply Chain Management* (6th ed.). Pearson Education. www.pearson-books.com
- Darunanto, D., Endang Wahyuni, R., & Saidah, D. (2020). Produktivitas Alat Bongkar Muat (Crane) Terhadap Berthing Time Productivity Of Loading Equipment (Crane) To Berthing Time. *Jurnal Manajemen Bisnis Transportasi Dan Logistik (JMBTL)*, 6(2), 153–162. <https://journal.itltrisakti.ac.id/index.php/jmbtl>
- Gekara, V. and Nguyen, X. (2020). Challenges of implementing container terminal operating system: the case of the port of mombasa from the belt and road initiative (bri) perspective. *Journal of International Logistics and Trade*, 18(1), 49-60. <https://doi.org/10.24006/jilt.2020.18.1.049>
- Jati, D. (2024, August 17). *July, IPC TPK Throughput up 11.6% Month-on-Month*. Indonesia Shipping Gazette.
- J. Stevenson, W. (2020). *Operations Management* (14th ed.). McGraw-Hill Education.
- Kementerian Perhubungan Republik Indonesia. (2021). Laporan Kinerja 2020 Kementerian Perhubungan. Kemenhub. https://dephub.go.id/public/uploads/news/2021_Laporan_Kinerja_Kemenhub.pdf
- Khaldun, A. I., Suryailahi, V. I., & Muajir. (2018). PELAKSANAAN BONGKAR MUAT PETI KEMAS DAN WAKTU PENYELESAIAN (TURN ROUND TIME). *Jurnal Manajemen Bisnis Transportasi Dan Logistik*, 4(4), 297–302. <https://journal.itltrisakti.ac.id/index.php/jmbtl/article/view/824/414>

- Konferensi PBB tentang Perdagangan dan Pembangunan. (2021). Tinjauan Transportasi Laut 2021. UNCTAD. <https://unctad.org/webflyer/review-maritime-transport-2021>
- Lewin, K. (1947). Frontiers in group dynamics: Concept, method, and reality in social science; social equilibria and social change. *Human Relations*, 1(1), 5-41. <https://doi.org/10.1177/001872674700100103>
- Liau, J. K., Utami, D., & Pandapotan, D. (2018). *PENERAPAN IPC TERMINAL OPERATING SYSTEM DAN LAYANAN PETI KEMAS PELABUHAN TANJUNG PRIOK*. 1–7.
- Maritime Economics & Logistics. (2024a). Optimizing container terminal operations: A systematic review of operations research applications. Springer.
- Maritime Economics & Logistics. (2024b). Container terminal automation: Revealing distinctive terminal characteristics and operating parameters. Springer.
- Maritime Economics & Logistics. (2024c). Performance improvements in container terminals through the bottleneck mitigation cycle. Springer.
- Naderifar, M., Goli, H., & Ghaljaie, F. (2017). Snowball Sampling: A Purposeful Method of Sampling in Qualitative Research. *Strides in Development of Medical Education*, 14(3), 1–6. <https://doi.org/10.5812/sdme.67670>
- Nina Adlini, M., Hanifa Dinda, A., Yulinda, S., Chotimah, O., & Julia Merliyana, S. (2022). *METODE PENELITIAN KUALITATIF STUDI PUSTAKA* (Vol. 6, Issue 1).
- Rodrigue, J. P., Notteboom, T. E., & Pallis, A. A. (2020). The COVID-19 pandemic and the transformation of the shipping and port industries. *Maritime Economics & Logistics*, 22(3), 185-210. <https://doi.org/10.1057/s41278-020-00162-5>
- Shalawatika, S. M., Apriyadi, D., & Rahmawati, A. (2021). Produktivitas Combined Terminal Trailer Bongkar Muat Petikemas di Teluk Lamong Productivity of Combined Container Unloading Trailer Terminal in Lamong Bay. *Jurnal Manajemen Bisnis Transportasi Dan Logistik Trisakti (JMBTL)*, 7(1), 65–74. <https://journal.itltrisakti.ac.id/index.php/jmbtl>
- Suharko, & Wijaya, M. (2020). Peran Pelabuhan dalam Meningkatkan Daya Saing Ekonomi Indonesia. *Jurnal Logistik dan Manajemen Rantai Pasok*, 5(1), 40-52. <https://doi.org/10.25170/jlmp.v5i1.123>
- Weiner, B. J. (2009). A theory of organizational readiness for change. *Implementation Science*, 4(1), 67. <https://doi.org/10.1186/1748-5908-4-6>
- World Bank Group. (2021). Port performance indicators: Measuring and benchmarking port performance. The World Bank. <https://openknowledge.worldbank.org/handle/10986/35513>

