The Role of Applying Lean Management in Ports to Increase Customer Satisfaction "Applying to Suez Canal Container Terminal"

دور تطبيق الإدارة الرشيقة في الموانئ في زيادة رضا العملاء "تطبيق على محطة حاويات قناة السويس"

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Abstract:

This research focuses on the importance of domestic cargo and local customers in port operations, emphasizing their substantial contribution to the gross volume of cargo handled. However, challenges exist regarding customers' experiences with landside operations and the quality of customer service. So, this Research focuses on applying lean management in Egyptian ports especially in landside operations and identify solutions to these issues using lean techniques, exploring various strategies to enhance service delivery for local customers and improve port profitability and competitiveness. The Suez Canal Container Terminal (SCCT) will serve as a case study to illustrate these concepts and use a comparison study of port landside operations based on knowing the differences before and after the application of lean management in SCCT.

The research tested four variables related to landside operations in the port: Truck Turnaround Time, Truck Waiting time, Total Export, Total Import in total comparison period of 6 years divided to months, 3 years (36 months) before applying lean applications in 3 years (36 months) after applying lean management in the port. There were significant differences in three variables before and after the applications of lean management, the average number of monthly truck waiting time was decreased by around 15 hours and the average of monthly total exports have been increased with around 1770 TEUs/month, and the monthly average of total import also increased with around 864 TEUs/ month, while the applied study did not find big differences between the average Truck Turnaround time before and after the application of the lean management for the landside operations in Suez Canal Container Terminal.

The research gave some recommendations related to the expansion in applying lean methods in ports to improve the processes of the operations in landside and seaside operations such as addressing the problems in different operations levels and identifying root causes to implement effective solutions.

Key Words: Lean Management - Container Terminals - Competitiveness - Customer Satisfaction

المستخلص:

يركز البحث على تطبيق إدارة اللين في الموانئ المصرية، وخاصة في العمليات البرية، مما سيؤدي إلى زيادة رضاء العملاء وبالتالي تعزيز تنافسية وربحية الموانئ. يتم تطبيق هذه الدراسة على ميناء شرق بورسعيد (شركة قناة السويس للحاويات). تعتمد منهجية البحث على دراسة مقارنة للعمليات البرية في الميناء بناءً على معرفة الفروقات قبل وبعد تطبيق إدارة اللين في محطة قناة السويس للحاويات. يقوم هذا البحث باختبار أربعة متغيرات مرتبطة بالعمليات البرية في الميناء، وهي كما يلي: (وقت دوران الشاحنات، وقت انتظار الشاحنات، إجمالي الصادرات، إجمالي الواردات) خلال فترة مقارنة إجمالية تمتد لست سنوات مقسمة إلى أشهر. ثلاث سنوات (٣٦ شهرًا) قبل تطبيق إدارة اللين في عام ٢٠١٩، وثلاث سنوات (٣٦ شهرًا) بعد تطبيقها في الميناء.

أظهرت النتائج وجود فروقات كبيرة في ثلاثة متغيرات قبل وبعد تطبيق الإدارة الرشيقة. فقد انخفض متوسط وقت انتظار الشاحنات الشهري بحوالي (١٥) ساعة، وزاد متوسط إجمالي الصادرات الشهري بحوالي (١٧٧٠) حاوية، كما زاد متوسط إجمالي الواردات الشهري بحوالي (٨٦٤) حاوية. بينما لم تُظهر الدراسة فرقًا كبيرًا في متوسط وقت دوران الشاحنات قبل وبعد تطبيق إدارة اللين في العمليات البرية للميناء في شركة قناة السويس للحاويات. بناءً على نتائج البحث، تم تقديم بعض التوصيات المتعلقة بتوسيع تطبيق أساليب إدارة اللين في الموانئ لتحسين عمليات التشغيل في الجانبين البري والبحري، مثل معالجة المشاكل في مختلف مستويات العمليات ومحاولة إيجاد الأسباب الجذرية لها لوضع الحلول المناسبة. كما يوصى بوضع خطوات قياسية لجميع العمليات للحصول على أفضل النتائج وتجنب التأخيرات والأخطاء، والعمل على المزيد من تحسينات الكايزن لتعزيز التكامل بين نظام تشغيل المحطات والعملاء، مما يمكن العملاء من متابعة حالة شحناتهم في الوقت الفعلي. بهذه الطريقة يمكن تقليل الهدر في العمليات وتوفير الوقت والجهد والمال، وأخيرًا تحقيق رضاء العملاء وزيادة أرباح وتنافسية الميناء.

الكلمات المفتاحية: الإدارة الرشيقة – محطات الحاويات – القدرة التنافسية – رضا العملاء

1. Introduction

Lean management has emerged as a widely recognized tool for optimizing workflows and delivering value across various industries. Originally developed in the manufacturing sector, Lean management has evolved into a systematic approach for improving organizational efficiency by reducing non-value-added activities, maximizing customer value and minimizing the consumption of resources, time, and costs.

The key principles of Lean management include continuous improvement, customer respect, the optimization of processes through the identification and removal of inefficiencies by fostering a culture of excellence, engage all employees in the process of enhancing productivity and quality and creating a responsive and efficient organization that consistently delivers high value to its customers while maintaining operational sustainability.

- **Research Problem:**

The key problem addressed by this research is the presence of challenges related to local customer experiences with the port's landside operations quality prior to the implementation of Lean management, which negatively impacted both the customer satisfaction and the port's profitability and competitiveness.

The following sub-problems significantly impact the primary research problem:

- The long truck turnaround time inside the terminal.
- The long waiting time for trucks outside the terminal gates.
- Decreased number of Export containers.
- Decreased number of Import containers.

- **Research Aims:**

The main aim of this research is to increase local customer satisfaction by improving landside operations at ports through the application of Lean management tools. Port Said East Port (Suez Canal Container Terminal) will serve as the case study, with an analysis of performance before and after Lean implementation. The research will evaluate the effectiveness of Lean in optimizing processes and increasing operational efficiency.

- **Measuring Variables and Developing Hypotheses**

The study depends on knowing the differences before and after the application of lean management, and the variables which represent the landside operations performance of the ports are, Truck Turnaround Time, Truck Waiting time, Total number of Export containers and Total number of Import containers.
This study aims at testing the following hypotheses:

- **The First Hypothesis:**

There are no significant differences between the average Truck Turnaround time in the performance of the landside operations before and after the application of Lean management in the Suez Canal Container Terminal.

- **The Second Hypothesis:**

There are no significant differences between the average Truck Waiting Time in the performance of the landside operations before and after the application of Lean Management in the Suez Canal Container Terminal.

- **The Third Hypothesis:**

There are no significant differences between the average Total Export before and after the application of Lean management in the Suez Canal Container Terminal.

- **The Fourth Hypothesis:**

There are no significant differences between the average Total Import before and after the application of Lean management in the Suez Canal Container Terminal.

- **Research Methodology:**

This study employs a mixed methods approach (Qualitative & Quantitative), an inductive approach to explore the role of lean management in the port services sector and its effect on enhancing customer satisfaction within container services companies in the transport industry. It also examines how lean management contributes to the overall operational volume of ports, improving profitability and competitiveness. This theoretical analysis draws from foreign literature, periodicals, and research.
Additionally, the study employs an analytical approach by using the SPSS v.26 statistical analysis program: Comparing port land operations as a metric for increasing customer satisfaction. Specifically, it examines the differences in performance before

and after the implementation of lean management at the Suez Canal Container Terminal.

Data collection was based on two key sources:

- **Primary Data:** This included books, references, periodicals, articles, foreign academic theses, and prior research studies relevant to the topic.
- **Secondary Data:** Monthly reports on port landside operations, including metrics such as Truck Turnaround Time, Truck Waiting Time, Total Exports, and Total Imports.

These data sources were applied in the statistical analysis to test hypotheses and provide answers to the research problem.

2. Literature Review

Literature review explores the impact of Lean Management in container terminals, with a particular focus on how Lean practices influence operations management and highlighting both the theoretical frameworks and practical outcomes of Lean implementation and how Lean Management can transform container terminals operations to be more efficient and competitiveness.

Sofie Franzén, (2017), concerned with "Value Stream Mapping of Container Flows at Seaports - A case study of four seaport container terminals" which aimed to create value stream mapping for seaport container terminals and find potential inefficiencies using the mapping. Four container terminals were analyzed, and the combination of terminals resulted in a diversified and enhanced understanding of the operations occurring in the terminals. Many similarities and differences could be identified and discussed. Finally, some recommendations for enhancing the operations at container terminals were raised. In the short term, it is generally recommended that terminals assess their need for equipment with enhanced capacity. As a long-term solution, implementing automated container handling and transportation technology is recommended to obtain more standardized work and to eliminate human errors. Furthermore, improved cooperation among the participating parties is essential to achieve more balanced and coordinated flows.

Sydney Geib, (2018), concerned about "Understanding Customer Satisfaction with the Port of Virginia" (POV) which operated in a highly competitive business, it is vital for the company to continually improve service quality and achieve high customer satisfaction. The goal of this research is to look at the perspectives of various POV user

groups (such as beneficial cargo owners (BCOs), freight forwarders, brokers, ship lines, and truck lines) on the services provided by the POV and to see what aspects influence their satisfaction. Both quantitative and qualitative methods were used to collect data. The findings results, demonstrate that empathy and turnaround time were the most important factors in customer satisfaction, followed by reliability, tangibles, responsiveness, and assurance. The outcomes of this research will aid POV in identifying its strengths and weaknesses, as well as developing plans to improve POV's services and customer satisfaction, thereby increasing its market competitiveness.

The study of **APM terminals** about "Investments in Lean practices improves efficiency for APM Terminals Customers", in 2018, APM Terminals has implemented a "Lean Philosophy" to improve safety, digital customer solutions and efficiency, which lead to 40% reduction in vessel idle times at APM terminals PIPAV, INDIA. It is known in APM Terminals as 'Way of Working' that support strategic pillars to become the world best Terminal Company and 70% of APM Terminals with 22000 employees had been trained to apply lean methodologies. APM Terminals Way of Working helps to create value from the customer's perspective by eliminating waste and reducing waiting times. The biggest gains in this industry come from time (reduced waiting times – shorter port stays or delays due to avoidable equipment breakdowns). Kaizen is a continuous improvement process and its base is Standardization, Best practices are shared globally between APM Terminals.

APM terminals have saved millions of dollars, and a positive net promoter score for both landside and shipping line customers between 2019 and 2021. Without Way of Working approach, some projects were postponed due to their complexity. For example, it was identified that 90% of vessel idle time in APM Terminals POTI was due to external parties such as customs, shipping line, vessel Agents and harbor masters. Once this was identified, all external parties were involved in long Kaizen to tackle inefficiencies and improvements.

Zhang Xiaoju, (2019), regarding the "Optimization of truck appointments in container terminals," trucks appointment systems have demonstrated their efficiency in reducing container terminals congestion. In order to reducing waiting times for external trucks at both the gate side and yard side, as well as for internal trucks waiting in the yard, it is imperative to take terminal operations into account when developing a reasonable appointment quota plan. Additionally, a new model for optimizing a trucks appointment system must be proposed. By using non-stationary queuing theory, the "vacation queuing model" is used to illustrate the coordinated service process of yard cranes and is also capable of more accurately estimating truck waiting times. The

validity of the model and algorithm is demonstrated through numerical experiments. The findings showed that the model faithfully captures the features of the yard service process.

A R Nasution and Arviansyah, (2019). Concerned about "Container terminal landside operation analysis and discrete event simulation in container terminal in port", Case of Terminal 3 Ocean-going PT Pelabuhan Tanjung Priok, this research utilized an exploratory study to identify challenges in Terminal 3 Ocean-going and a descriptive analysis to assess the benefits of implementing a truck appointment system and lane segmentation. Two major issues were identified: limited yard space, which reduces berth productivity during high volumes, and terminal congestion, particularly from Friday to Sunday, caused by a weekly cycle of increased ship arrivals. These issues lead to extended landside activities and delays, even affecting access to Terminal 2.

To address these problems, the study implemented a truck appointment system and lane segmentation, optimizing the landside operation process into three stages: customs gate, terminal gate, and yard area. Trucks prepare documentation, undergo reviews and updates at the gates, handle containers at the yard, and finalize transactions before exiting. The findings highlight that the truck appointment system and lane segmentation significantly reduce terminal congestion.

Naurah Ranaindy, (2019). Concerned about "Waste analysis to improve container port performance using Lean Six Sigma method", his study aims to improve ground handling processes at container ports using Lean Six Sigma and Lean Manufacturing principles. Data were collected through observation, interviews, and time measurements, and analyzed using Big Picture Mapping (BPM) and Process Activity Mapping (PAM). Non-value-added (NVA) activities were examined using Root Cause Analysis (RCA) and the 5 Why's method to identify inefficiencies across four key factors: scheduling, management, human error, and tools and facilities.
Key findings revealed nine root causes of waste, including simultaneous open stack schedules, inadequate equipment maintenance, errors by planners and mechanics, and insufficient container yard (CY) facilities. Recommendations include creating ship-specific schedules, improving equipment maintenance, enforcing stricter submission rules for loading lists, introducing a tool logbook, repairing CY stack holes, and optimizing truck movement and container placement.

By addressing these inefficiencies, the study proposes actionable strategies to enhance productivity and streamline operations, contributing to more efficient port management.

3. Terminal operations and Lean Management

Container terminals are essential for global trade, linking maritime and inland transport. Their efficiency, particularly in landside operations, is critical for smooth supply chains. Lean principles aim to reduce inefficiencies, lower costs, and boost service quality. When applied to landside operations, Lean helps reduce container dwell times, optimize equipment use, and streamline workflows, ultimately enhancing turnaround times and customer satisfaction. This research sets the groundwork for understanding Lean's impact on import and export activities in container terminals.

3.1Operations of Container Transportation

Container transportation entails transporting various goods via containers using road, rail, inland canal, sea, and air transportation, In the meanwhile, the products in transit are given additional protection. The container transportation chain runs from the consignor to the consignee, from the export country's maker or producer to the import country's customer. The exporter is the consigner, and the importer is the consignee. (Birgitt Brinkmann, 2011).

- The processes of the export operations in the container terminal are consist of receiving, storage and loading, The process of "receiving" means that the containers are delivered to the container terminal through cars, rail, or barges, and the procedure is called "container arrival". "Container storage" refers to the temporary stacking of containers in a yard or warehouse until the vessel arrives at the port for the purpose of Container loading, The term "loading" refers to the process of loading containers onto a vessel for transportation away from the port.
- The processes of the import operations in the container terminal are consist of unloading, storage and delivery, the process of discharging containers from a ship to a port, also known as container arrival, is known as "unloading". Storage" refers to the temporary stacking of containers in a yard or warehouse until they are delivered. The departure of containers is defined as the delivery of containers by road vehicles, rail, or barge.

Import containers, like export containers, will be delivered to pre-determined yard locations based on their size, nature of products, destination, and mode of transportation, The terminal information system's container records are updated once more, and the stacking locations of the containers are recorded, so that the containers

can be discovered quickly when they need to be shipped out of the terminal or to Container Freight Station (CFS).

3.2 Suez Canal Container Terminal

The Suez Canal Container Terminal (SCCT), located at the northern entrance of the Suez Canal in Port Said, Egypt, is a vital hub in global trade, connecting major shipping routes between Europe, Asia, and Africa. As a joint venture between the Egyptian government and international shipping entities, SCCT is equipped with advanced infrastructure capable of accommodating large container vessels and facilitating substantial container traffic. The terminal offers comprehensive container handling services, including efficient management of import and export containers and transshipment cargo, with a focus on swift turnaround times and effective coordination with customs and inland transport. SCCT is dedicated to enhancing productivity and competitiveness through the adoption of modern operational strategies, such as Lean Management principles, aimed at minimizing waste and optimizing resource utilization (SCCT, 2023).

3.3 Lean Management

Originating from the Toyota Production System (TPS) in the 1940s, Lean management has since become a widely adopted approach across various industries, including manufacturing, healthcare, and logistics. Its core principle is "Kaizen," or continuous improvement, which encourages a culture of ongoing, incremental improvements throughout an organization. So, lean management is a methodology that focuses on enhancing efficiency by eliminating waste, reducing costs, and improving customer satisfaction. Lean thinking is about producing greater value with fewer resources (Womack and Jones, 2003).

Lean management identifies seven types of waste (known as muda) in processes: Transportation, inventory, motion, waiting, overproduction, over-processing, and defects. These areas are targeted for reduction or elimination to streamline operations and maximize value for customers.

3.3.1 Key Principles of Lean Management

Lean management operates on five fundamental principles (John Skaar, 2019) as showed in figure (1):

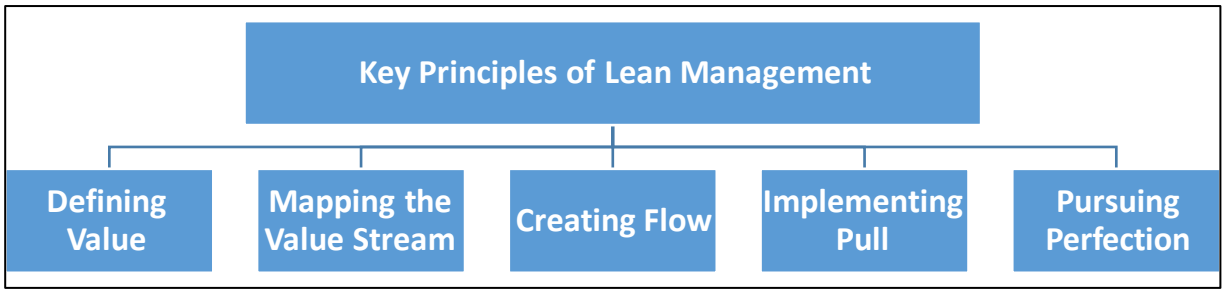

Figure (1): Key Principles of Lean Management

1. Defining Value: Lean starts by defining what customers perceive as valuable. This value determines the steps within a process that are necessary or wasteful.

By focusing on customer needs, organizations can eliminate non-essential activities.

2. Mapping the Value Stream: Value stream mapping makes it easier to see how information and materials move through a process as a whole.

3. Creating Flow: Once waste is identified, lean seeks to establish continuous and smooth process flows. This principle aims to reduce interruptions or delays by reorganizing processes for maximum efficiency.

4. Implementing Pull: Lean promotes a pull-based system where work is initiated only when there is demand, reducing excess inventory and overproduction.

5. Pursuing Perfection: Lean is an iterative process. After implementing changes, companies continuously seek areas for further improvement, moving closer to operational perfection over time.

3.3.2 Lean Tools and Techniques

According to Lean production website several tools and techniques are commonly employed in lean management to enhance process efficiency such as the following most important tools as showed in figure (2):

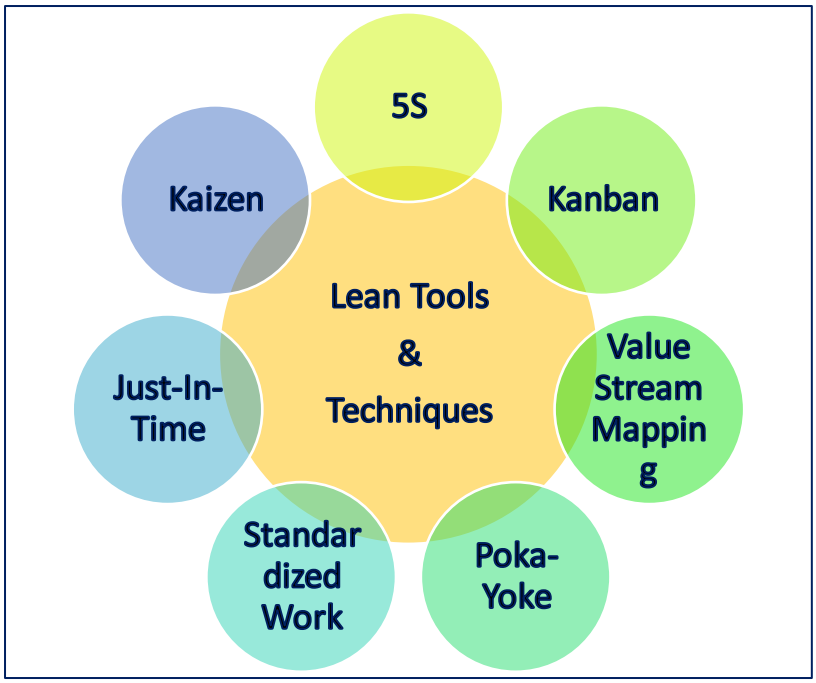

Figure (2): Lean Tools and Techniques

- **5S**: A workplace organization method involving Sort, set in order, Shine, Standardize, and Sustain to create a clean and efficient work environment.
- **Kanban**: A visual management tool that controls work in progress by signaling when more resources are needed, ensuring a pull-based production system.
- **Kaizen**: This approach focuses on continuous, incremental improvements in processes through employee involvement and problem-solving.
- **Value Stream Mapping**: A visual tool that helps identify and eliminate inefficiencies in the production process, leading to better workflow and higher productivity.
- **Just-In-Time (JIT):** Just-In-Time pulls parts through production based on customer demand instead of pushing parts through production based on projected demand. And it is highly effective in reducing inventory levels, improves cash flow and reduces space requirements.
- **Poka-Yoke:** Poka-Yoke designs error detection and prevention into production processes with the goal of achieving zero defects.
- **Standardized Work:** Standardized Work is documented procedures for manufacturing that capture best practices (including the time to complete each task). It must be easily modifiable documentation.

3.3.3 The advantages of using lean principles in a company

- Cullinane et al. (2011) found that lean implementation significantly improved efficiency by eliminating bottlenecks and aligning operations more closely with

customer needs. Lean management's focus on standardizing workflows and enhancing operational flow can also reduce environmental impacts by minimizing energy consumption and waste.

- According to journal of lean systems, the adoption of lean management principles typically results in improved organizational performance across various metrics. A key advantage is the reduction of operational costs, as wasteful activities are identified and eliminated. In their research, Shah and Ward (2007) found that firms adopting lean practices consistently achieved better performance in terms of quality, flexibility, and responsiveness compared to non-lean firms.
- Moreover, lean management has been linked to enhanced employee engagement. By fostering a culture of continuous improvement, employees are empowered to identify problems and propose solutions, resulting in a more dynamic and adaptive workforce. Studies also show that lean management contributes to higher levels of customer satisfaction by improving service delivery times and quality.

So, there are major advantages for using lean principles in a company:

- **Focus**: By applying lean methodology, you will be able to reduce waste activities so the employees will focus on the activities that bring value.
- **Improving Productivity & Efficiency:** When employees focus on delivering value, they will be more productive and efficient as they will not be distracted by unnecessary tasks.
- **Smarter Process (Pull System):** By commencing a pull system, you will deliver work only if there is actual customer demand.
- **Optimal Allocation of Resources:** When the production is based on actual demand, then you will use only the needed resources to achieve this demand.

  As a result, the company will be more flexible and able to respond to customers' requirements much faster and you will build a stable organization that identify actual problems and remove them.

3.3.4 Challenges of Lean Implementation in ports

Implementing lean requires significant cultural changes within an organization. Resistance to change, lack of management support, and inadequate training are common obstacles. According to Bhasin and Burcher (2006), successful lean transformations depend on leadership commitment and the ability to create an environment where employees are motivated to participate in continuous improvement efforts.

4. Lean in Port and Terminal Performance

Lean management has proven particularly beneficial in the context of port operations, where there is a high reliance on efficient logistics and quick turnaround times. Ports have adopted lean practices to reduce lead times, improve cargo handling, and streamline land operations.

Lean management practices have made significant strides in container terminals since 2021, delivering tangible improvements in efficiency, cost savings, and environmental impact. According to APM Terminals, where the implementation of lean methodologies led to a 40% reduction in vessel idle times at Pipavav, India. Additionally, process improvements at APM Terminals Liberia reduced vessel arrival cycles from 1 hour and 42 minutes to significantly less, further optimizing operational flows. By 2022, 70% of APM Terminals' 22,000 employees had been trained in lean practices, and they conducted nearly 200 Kaizen events that year, focusing on continuous improvement efforts. These initiatives generated millions of dollars in savings for both the terminals and their customers.

The statistics in table (1) showed the effectiveness of Lean practices in transforming terminal operations by reducing downtime, improving service delivery, reducing costs across multiple global terminals and increasing customer satisfaction, with an increase in net promoter scores between 2019 and 2021.

Table (1): statistics in lean management progress in container terminals since 2021

Statistic	Details
40% Reduction in Vessel Idle Times	Achieved at APM Terminals Pipavav through Lean initiatives.
Reduction in Vessel Arrival Cycle Time	At APM Terminals Liberia, reduced from 1 hour 42 minutes through Lean methods.
70% Workforce Trained in Lean Methodologies	By 2022, 70% of APM Terminals' 22,000 employees were trained in Lean techniques.
200 Kaizen Events in 2022	APM Terminals ran nearly 200 Kaizen events in 2022 focused on continuous improvement.
5 and 13-Point Increase in Net Promoter Scores	Customer satisfaction rose by 5 points for landside and 13 points for shipping line customers (2019-2021).

Statistic	Details
Lean Implementation in Global Ports	Various Lean practices applied in ports of Scandinavia, Indonesia, and Iran to reduce congestion and wait times.
Millions of Dollars in Savings	Lean initiatives resulted in millions of dollars saved for terminals and customers.

Source: APM terminals, 2024

5. The Case of Applying Lean Management in Suez Canal Container Terminal"

The research aims to extrapolating the role of lean management in the port services sector and its impact on increasing customer satisfaction that container services companies in the transport sector are exposed in their operations, and how they have a significant role in the overall work volume of terminals, and increasing port profits and competitiveness in addition to comparison of port land operations as a measure to increase customer satisfaction, by knowing the differences before and after the application of lean management in Suez Canal Container Terminal using the monthly reports of the port's land operations (Truck Turnaround Time, Truck Waiting time, Total Export, Total Import) in the statistical analysis of data to find answers and test hypotheses in the beginning of the implementation of lean onshore port operations at the Suez Canal Container Terminal The beginning of the year 2019 from January 2016 to December 2018, a period before the implementation of the company's lean management with the comparison period from January 2019 to December 2021 a period after applying the lean management in the SCCT terminal.

The research used the data collected through the monthly reports of the operations of the Suez Canal Container Terminal, for the period of years (2016, 2017, 2018) and the comparison period for years (2019, 2020, 2021) with a number of 36 months for each period as shown in the table (2):

Table (2): Research variables and ways to measure them

Variables performance	Dimensions Variables	Measurement
Performance of the landside operations in ports	Improve Truck Turnaround time	It is the total time spent by a truck in the terminal area. From gate-in to gate-out for picking and/or dropping a container. It includes the time from the arrival, loading, and unloading of containers, inspecting a truck, completing documentation, and going out from the terminal.

	Improve Truck Waiting Time	It is the time spent by a truck in the waiting area outside the terminal waiting for his turn.
	Total Export	The monthly total of the number of total export Moves in a Suez Canal container terminal
	Total Import	the monthly total of The Number of Total Import Moves in a Suez Canal Container Terminal

Source: by researcher according to selected variables which used to measure the results.

By using the (SPSS) program to clarify the essential differences through the Mann-Whitney test (Z-test) to measure the extent of the essential differences before and after the application of Lean management in the Suez Canal Container Terminal, to determine the validity of the proposed interpretations of these results as shown in the table (3).

Table (3): Testing the normal distribution of the research variables

Time period	**Variables**	**Kolmogorov-Smirnov[a]**			**Shapiro-Wilk**		
		Statistic	df	Sig.	Statistic	Df	Sig.
Before Implementing Lean Management 2016,2017,2018	Improve Truck Turnaround Time	0.139	36	0.076	0.914	36	0.009
	Improve Truck Waiting Time	0.092	36	0.200	0.973	36	0.524
	Total Export	0.157	36	0.024	0.930	36	0.025
	Total Import	0.106	36	0.200	0.976	36	0.614
Time period	**Variables**	Statistic	df	Sig.	Statistic	Df	Sig.
After implementing Lean Management 2019,2020,2021	Improve Truck Turnaround Time	0.075	36	0.200	0.979	36	0.713
	Improve Truck Waiting Time	0.193	36	0.002	0.816	36	0.000
	Total Export	0.155	36	0.028	0.930	36	0.025
	Total Import	0.129	36	0.140	0.935	36	0.035

Source: Data processing output using SPSS, V.26.

The test of the normal distribution of the variables represented in Improve Truck Turnaround Time, Improve Truck Waiting time, Total Export, Total Import) Before and after the application of lean management at the Suez Canal Container Terminal. The research based on the result of the Kolmogorov test, as the sample size is greater than (36). The results showed that the variables do not follow the normal distribution as the test morale is greater than the level of morale 5%, and other variables are less than the

level of morale, so the null hypothesis is rejected and the alternative hypothesis is accepted, and then the research used the nonparametric tests to research the statistical differences. By using descriptive statistics for the port's land operations variables as a measure to increase customer satisfaction, before and after the application of lean management in the Company (SCCT), in order to calculate the mean, standard deviation, minimum, and upper limit, the data covers the period from 2016 to 2021 before and after the application of lean management table (4)

Table (4): Descriptive statistics for the research variables

Time period	Variables	N	Min	Max	Mean	Std. Deviation
Before Implementing Lean Management (2016,2017,2018)	Truck Turnaround time	36	14	40	25.83	8.196
	Truck Waiting Time	36	19	38	28.00	4.905
	Total Export	36	823	5987	2796.19	1473.142
	Total Import	36	2297	5200	3802.39	724.151
After implementing Lean Management (2019,2020,2021)	Truck Turnaround time	36	16	30	22.72	3.559
	Truck Waiting Time	36	8	27	13.19	5.455
	Total Export	36	1886	8703	4571.25	1858.539
	Total Import	36	3188	6106	4666.11	935.777

Source: Data processing output using SPSS v.26.

Truck Turnaround time

- It was found before the application of Lean management that the lowest Truck Turnaround time amounted to (14) hours, while the largest Truck Turnaround time reached (40) hours, with an arithmetic mean of (25.83) hours and a standard deviation of (8.196), and that With a time series of 36 months.
- While it was found after the application of lean management that the lowest Truck Turnaround time amounted to (16) hours, while the largest Truck Turnaround time reached (30) hours, with an arithmetic mean of (22.72) hours and a standard deviation of (3.559), and that With a time series of 36 months.

Truck Waiting Time

- It was found before the application of Lean Management that the lowest Truck Waiting Time reached a value of (11.36) hours, while the largest Truck Waiting Time reached a value of (38) hours, with an arithmetic mean of (28.00) hours and a standard deviation of (4.905), and that with a time series of 36 months.
- Whereas, after applying the agile management, it was found that the lowest Truck Waiting Time amounted to (8) hours, while the largest Truck Waiting Time amounted to (27) hours, with an arithmetic mean of (13.19) hours and a standard deviation of (5.455), and that With a time series of 36 months.

Total Export

- It was found before the application of Lean management that the lowest Total Export amounted to (823) containers per month, while the largest Total Export amounted to (5987) containers per month, with an arithmetic mean of (2796.19) containers per month, and a standard deviation of (1473,142), with a time series of 36 views.
- While it was found after the application of agile management that the lowest Total Export amounted to (1886) containers per month, while the largest Total Export reached (8703) containers per month, with an arithmetic mean of (4571.25) containers per month, and a standard deviation of Its amount (1885,539), in a time series of 36 views.

Total Import

- It was found before the application of Lean Management that the lowest Total Import amounted to (2297) containers per month, while the largest Total Import reached the value of (5200) containers per month, with an arithmetic mean of (3802.39) containers per month, and a standard deviation of (724.151).), with a time series of 36 views.
- While it was found after the application of Lean Management that the lowest Total Import amounted to (3,188) containers per month, while the largest Total Import amounted to (6106) containers per month, with an arithmetic mean of (4666.11) containers per month, and a standard deviation of (935.777), with a time series of 36 views.

  By using the Mann-Whitney test (Z test) to measure the extent of the essential differences for the hypotheses and Where Wilcoxon Signed-Rank Test to test the hypothesis that the two related variables have the same distribution. The Z value is calculated as:

$$Z = W / \sqrt{\frac{N(N+1)(2N+1)}{6}}$$

Where :

W = sum of ranks for all observations

N = number of observations for each group .

According to the significance level (associated with Z value), research hypotheses could be accepted or rejected.

There are no significant differences between the average Truck Turnaround time in the performance of the landside operations before and after the application of Lean management in the Suez Canal Container Terminal.

The results of the Mann-Whitney test (Z-test) were as follows:

Table (5): The First Hypothesis Test

variable	Period	Mean Rank	Mean	Std. Deviation	Z	Sig. (2tailed)
Truck Turnaround time	Before Implementing Lean Management (2016,2017,2018)	39.486	25.833	22.723	-1.213	**0.2251**
	After implementing Lean Management (2019,2020,2021)	33.513	22.722	3.558		

Source: Data processing output using SPSS v.26.

The results showed that there were no statistically significant differences between the mean of Improve Truck Turnaround time before and after the application of the Lean management of port land operations in (SCCT) company at a confidence level of 95%, and accordingly the null hypothesis is accepted and the alternative hypothesis is rejected that There are no significant differences between the average Truck Turnaround time in the performance of the landside operations before and after the application of Lean management in (SCCT).

There are no significant differences between the average Truck Waiting Time in the performance of the landside operations before and after the application of Lean management in the Suez Canal Container Terminal.

The research used the Mann-Whitney test (Z-test) to test the hypothesis to find out the extent of the differences in the variables before and after the application of lean

management in the land operations of ports in the company (SCCT). The results were as follows:

Table 6: The second Hypothesis Test

variable	Period	Mean Rank	Mean	Std. Deviation	Z	Sig. (2tailed)
Truck Waiting Time	Before Implementing Lean Management (2016,2017,2018)	53.04	28.00	4.9048	-6.717	**0.0000**
	After implementing Lean Management (2019,2020,2021)	19.958	13.194	5.4553		

Source: Data processing output using SPSS v.26.

The results showed that there were significant statistically significant differences between the average changes in the performance of Truck Waiting Time before and after the application of lean management in the land operations of ports in the (SCCT) company at a confidence level of 95%, and these differences were in favor of the average changes in the performance of Truck Waiting Time after applying Lean management, where the number of hours decreased to (13.194) hours, while the average Truck Waiting Time before Lean management was (28.00) hours, and accordingly the null hypothesis is rejected and the alternative hypothesis is accepted. There are significant differences between the average Truck Waiting Time in the performance of the landside operations before and after the application of Lean management in the Suez Canal Container Terminal.

There are no significant differences between the average Total Export before and after the application of Lean management in the Suez Canal Container Terminal

The research used the Mann-Whitney test (Z-test) to test the hypothesis to find out the extent of the differences in the variables before and after the application of lean management in the land operations of ports in the company (SCCT). The results were as follows:

Table 7: The third Hypothesis Test

variable	Period	Mean Rank	Mean	Std. Deviation	Z	Sig. (2tailed)
Total Export	Before Implementing Lean Management (2016,2017,2018)	27.277	2796.194	1473.14	-3.638	**0.0003**
	After implementing Lean Management (2019,2020,2021)	45.722	4571.25	1858.53		

Source: Data processing output using SPSS v.26.

The results showed that there were significant statistically significant differences between the average changes in the performance of Total Export before and after the application of lean management in the land operations of ports in the company (SCCT) at a confidence level of 95%, and these differences were in favor of the average performance of Total Export after the application of lean management, as The monthly average was (4571.25) container, while the monthly average of Total Export performance before the application of Lean management (2796.194) container, and accordingly the null hypothesis is rejected and the alternative hypothesis is accepted that there are significant differences between the average Total Export before and after the application of Lean management in the Suez Canal Container Terminal

There are no significant differences between the average Total Import before and after the application of Lean management in the Suez Canal Container Terminal.

The research used the Mann-Whitney test (Z-test) to test the hypothesis to find out the extent of the differences in the variables before and after the application of lean management in the land operations of ports in the company (SCCT). The results were as follows:

Table 8: The Fourth Hypothesis Test

variable	Period	Mean Rank	Mean	Std. Deviation	Z	Sig. (2tailed)
Total Import	Before Implementing Lean Management (2016,2017,2018)	27.277	3802.3	724.15	-3.74	**0.0002**
	After implementing Lean Management (2019,2020,2021)	45.722	4666.1	935.77		

Source: Data processing output using SPSS v.26.

The results showed that there were significant statistically significant differences between the average changes in the performance of Total Import before and after the application of Lean management in the land operations of ports in (SCCT) company at a confidence level of 95%, and these differences were in favor of the average performance of Total Import after the application of Lean management, where The monthly average reached (4666.1) containers, while the monthly average performance of Total Import before the application of Lean management (3802.3) containers. Therefore, the null hypothesis is rejected and the alternative hypothesis is accepted that there are significant differences between the average Total Import before and after the application of Lean management in the Suez Canal Container Terminal.

6. Conclusion and Recommendations

6.1 The Results of the applied research

In this part, the research presents the results of the research, and based on the previous results and the statistical analysis related to these results as shown in the previous tables referred to for the hypothesis tests and based on the conclusions of those tables, the following results were reached:

- Acceptance of the first hypothesis and rejection of the alternative hypothesis that there are no significant differences between the average Truck Turnaround time in the performance of the landside operations before and after the application of Lean management in (SCCT).

  Where the results showed that there were no statistically significant differences between the average Truck Turnaround time before and after the application of the lean management of port landside operations in (SCCT) at a confidence level of 95%, and

accordingly the null hypothesis is accepted and the alternative hypothesis is rejected as shown in figure (3):

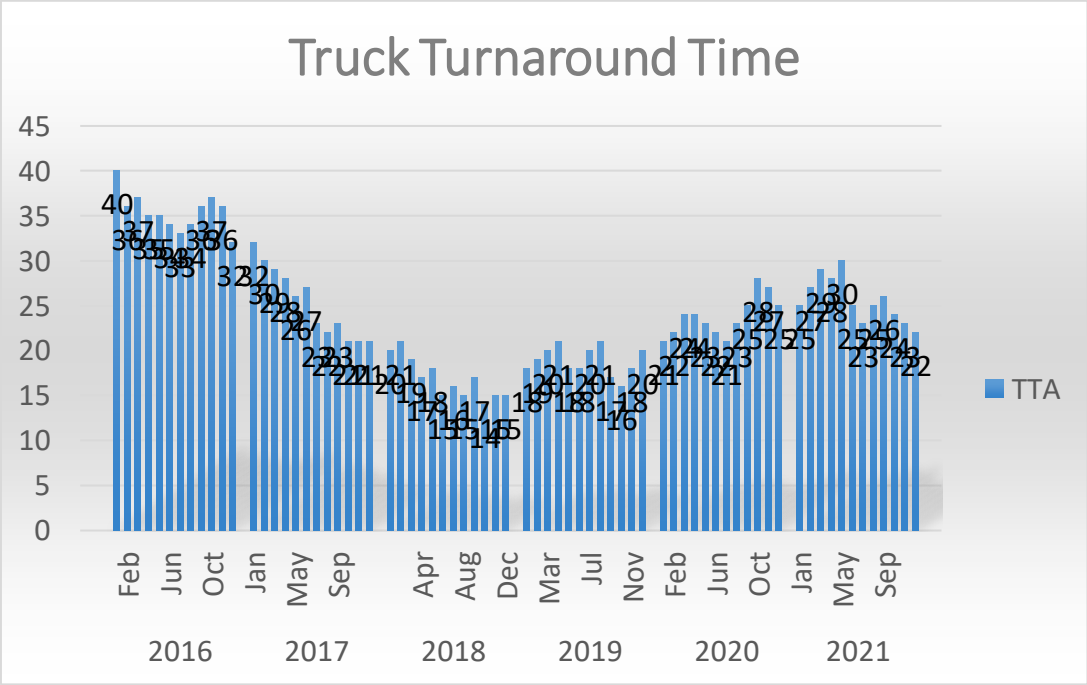

Figure (3): Truck Turnaround Time Statistics

- Rejecting the second hypothesis and accepting the alternative hypothesis that there are significant differences between the average Truck Waiting Time in the performance of the landside operations before and after the application of Lean management in the Suez Canal Container Terminal.

  Where the results showed that there were significant statistically differences between the average changes in the performance of Truck Waiting Time before and after the application of lean management in the landside operations of ports in (SCCT) company at a confidence level of 95%, and these differences were in favor of the average changes in the performance of Truck Waiting Time after applying Lean management, where the number of hours decreased to (13.194) hours, while the average Truck Waiting Time before Lean management amounted to (28.00) hours, and therefore the null hypothesis is rejected and the alternative hypothesis is accepted as shown in figure (4):

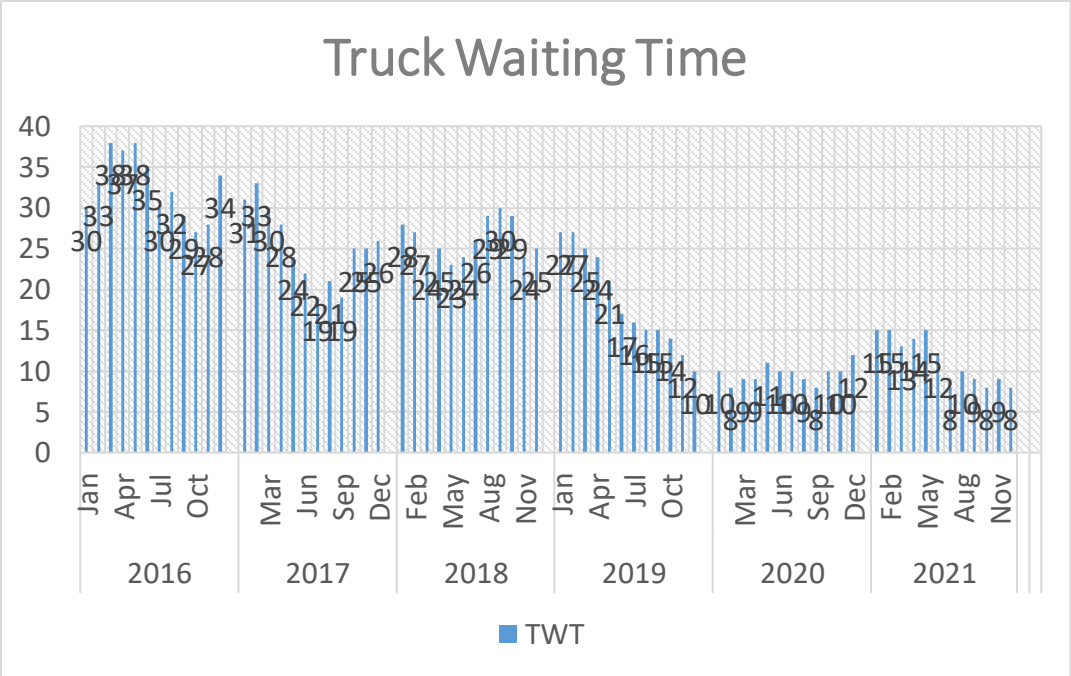

Figure (4): Truck Waiting Time Statistics

- Rejection of the third hypothesis and acceptance of the alternative hypothesis that there are significant differences between the average Total Export before and after the application of Lean management in the Suez Canal Container Terminal.

  Where the results showed that there were significant statistically differences between the average changes in the performance of Total Export before and after the application of lean management in the landside operations of ports in (SCCT) company at a confidence level of 95%, and these differences were in favor of the average performance of Total Export after the application of lean management, where The monthly average amounted to (4571.25) containers, while the monthly average of Total Export performance before the application of Lean management was (2796.194) containers, and accordingly the null hypothesis is rejected and the alternative hypothesis is accepted as shown in figure (5):

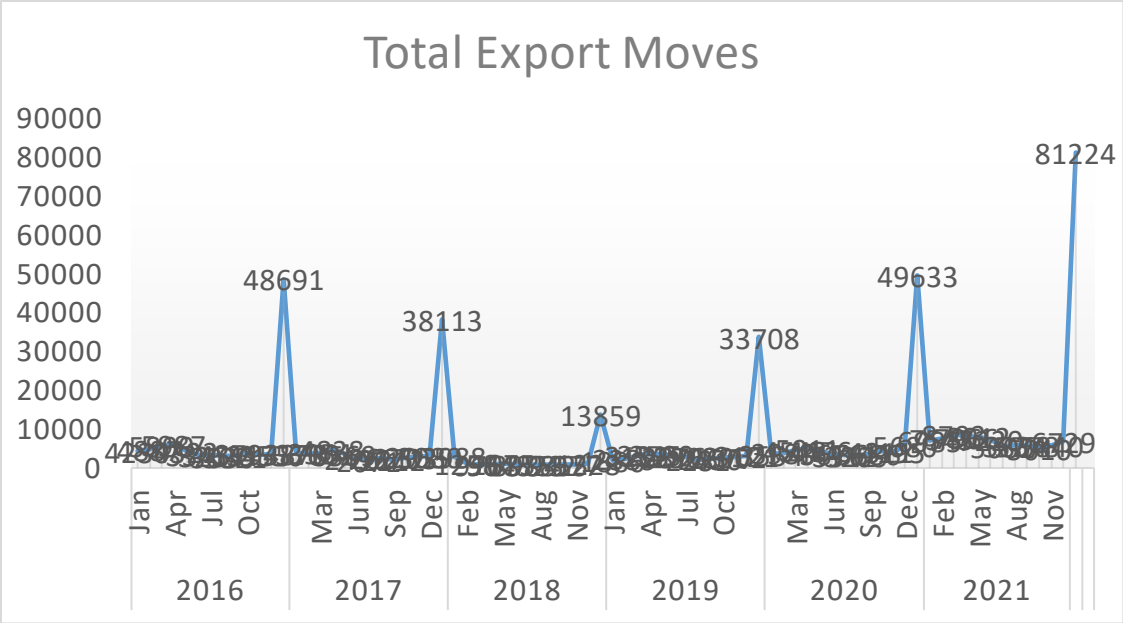

Figure (5): Total Export Moves Statistics

- Rejecting the fourth hypothesis and accepting the alternative hypothesis as there are significant differences between the average Total Import before and after the application of Lean management in the Suez Canal Container Terminal.
  Where the results showed the existence of significant statistical differences between the average changes in the performance of Total Import before and after the application of lean management in the landside operations of ports in (SCCT) company at a confidence level of 95%, and these differences were in favor of the average performance of Total Import after the application of lean management, as The monthly average amounted to (4666.1) containers, while the monthly average of Total Import performance before the application of Lean management was (3802.3) containers, and accordingly the null hypothesis is rejected and the alternative hypothesis is accepted as shown in figure (6):

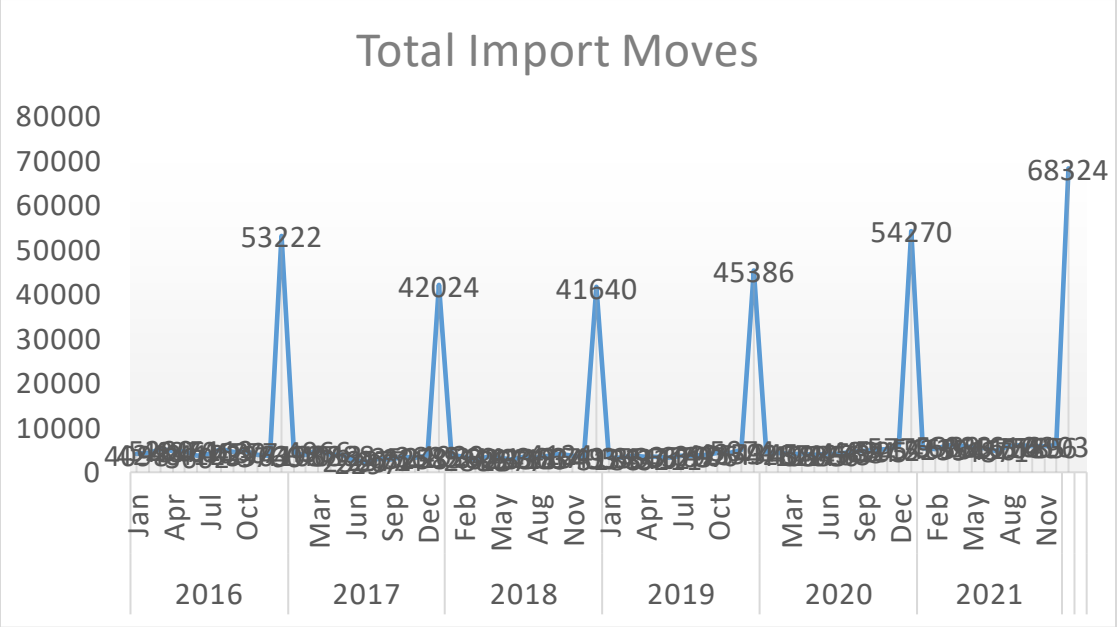

Figure (6): Total Import Moves Statistics

6.2 Recommendations

- It is necessary to address the problems in all levels of the department and trying to find the root cause of them to put the correct solutions.
- The standardization of processes for all employees must be prioritized and this is essential for achieving consistency and efficiency.
- The necessity of Integration between the operations system and customers, so that the customers can log in system and track their cargo status at any time.
- Lean management team must give the training for all employees so they can think lean and know the correct way of problem solving and work development.
- To ensure the best customer service, the commercial manager should create new department for Customer Care which will be responsible for local customers to solve their problems and follow up their requests at any time.

Further Researches

- The effect of applying lean techniques on seaside operations to improve the productivity and minimize the port waiting time for the vessels in the port.
- The effect of integration between operations and supply chain in ports in decreasing the operating costs.

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