Evaluation of the Impact of Container Ship Waiting Time on the Shipping Business in Tanzania

[1]Mohamed Juma Mikanu, [2]Benjamin Mbeba Meli and [3]Lucas Pastory Mwisila
[1]Mohamed Juma Mikanu P.o Box 4643, Dares Salaam,
Tanzania, East Africa, Email: mudimikanu@gmail.com
[2]Benjamin Mbeba Meli, Dares Salaam Maritime Institute,
Department of Science and Management, P.O Box 6727, Dares Salaam, Tanzania, East Africa, email: benjaminmbeba@gmail.com/Benjamin.meli@dmi.ac.tz
[3]Lucas Pastory Mwisila, Dares Salaam Maritime Institute, Department of Science and Management, P.o Box 6727, Dares Salaam, Tanzania, East Africa, email: lmwisila@yahoo.com/ lucas.mwisila@dmi.ac.tz
DOI:10.56201/ijebm.v10.no8Sept.2024.pg211.243

Abstract
This paper employed the data from the study conducted at Dares Salaam port study investigated about the impacts of container ship waiting times on the shipping business at Dar es Salaam port, Tanzania, as one of the key maritime gateways in East Africa. The port plays a vital role in regional trade and economic development. However, operational inefficiencies, particularly port congestion, have raised concerns about the port's overall efficiency and competitiveness. The paer evaluated on how waiting time affects the shipping business's operational efficiency, financial implications, and schedule reliability. The study employed a mixed-methods approach, combining qualitative and quantitative data from interviews with port stakeholders and quantitative data from port logs and shipping records. The sample comprised 60 respondents, including port officials, shipping companies, logistics providers and maritime experts. Key findings revealed by this paper is that increased waiting times significantly extend ship turnaround times, reduce berth occupancy rates, and lower crane productivity. Financial analysis indicated that waiting time contributed to higher operational costs and revenue loss due to delays and disruptions in the supply chain. Furthermore, the paer shows a strong correlation between waiting and schedule deviations, resulting in decreased on-time arrival rates and increased customer complaints. The findings contributed to the existing knowledge in maritime logistics and port management by providing detailed insights into the operational, financial, and scheduling impacts of waiting times. To enhance the shipping business at Dar es Salaam port, the study recommended implementing advanced scheduling systems, improving port infrastructure, and streamlining customs procedures to reduce waiting times. Additionally, it is suggested by this paper that adopting emerging technologies such as predictive analytics and blockchain to optimise port logistics and reduce. Addressing operational bottlenecks and inefficiencies is critical for improving the ports' competitiveness and supporting the broader economic stability of the region.

Key words: *Shipping Business, Shipping waiting time, Operational Efficiency, Financial Implication, Ship delays and Port Operations Indicators.*

1.0 Introduction

The undeniable dominance of containerised cargo in global trade is evidenced by the fact that container ships currently handle over 80% of the world's merchandise trade by volume (United Nations, 2022). The critical role of efficient maritime transportation in global supply chains highlights the importance of marine transport. Nevertheless, the increase in port congestion and waiting time outside ports in recent years has had a detrimental impact on the shipping business, causing ripple effects throughout the global trade network (Michail & Melas, 2023).

While containerisation has revolutionised shipping efficiency, recent years have witnessed a growing concern about delays experienced by container ships at outer anchorages. An outer anchorage is a designated area outside a port where ships wait to berth and unload or load cargo. These anchorages serve as a temporary holding area when a port experiences congestion or when a ship needs to wait for its designated berth to become available (Argüello et al., 2022). Waiting time significantly disrupts the smooth flow of maritime operations; hence, these delays impact the shipping business (Marine Digital, 2020)

Several factors lead to long waiting times, which are frequently located close to ports. A key factor is a continuous increase in the dimensions and capabilities of container vessels. While mega-ships offer cost benefits to shipping companies, numerous ports have not received the required infrastructure improvements to manage them efficiently (Notteboom, 2020b), This discrepancy in capacity can lead to a scenario where there are not enough berths available for incoming ships, causing long waiting times at port.

Furthermore, inefficiencies in port operations can contribute to long waiting times at port. Complicated bureaucratic procedures, such as intricate customs protocols and extensive inspections, may obstruct the efficient clearance of cargo and delay the timely unloading of vessels (United Nations, 2022), Moreover, a lack of workers or insufficient collaboration among different parties involved in the supply chain can exacerbate these issues (United Nations, 2019).

Asia has become a key trading partner for Africa, as the exchange of manufactured goods fuels containerised shipping traffic (UNCTAD, 2024). Efforts aimed at enhancing regional integration, such as the African Continental Free Trade Area (ACFTA), are anticipated to drive a greater surge in containerised trade within Africa (World Bank, 2020). However, this expansion poses a difficulty for numerous African ports. Unlike their developed counterparts, African ports frequently suffer from insufficient infrastructure and operational effectiveness to manage the increasing container traffic due to limited capacity, bureaucratic bottlenecks, and operational inefficiencies. These elements collectively result in long waiting times at African ports, impacting the overall shipping business and impeding the continent's ability to fully benefit from the potential of expanding trade volumes (Kuyoro et al., 2023).

Dar es Salaam Port serves as the primary gateway for Tanzania's trade and a vital trade centre for neighbouring countries in East and Southern Africa. Despite attempts to shorten cargo dwell time, issues such as capacity constraints, bureaucratic obstacles, and operational inefficiencies persist, leading to long waiting times for container vessels at port fields (Mapunda, 2016). Despite enhancements, Dar es Salaam Port continues to face challenges and capacity limitations. The existing number of berths and handling equipment may not be adequate to manage the current level of container traffic, resulting in congestion and ships queuing at the anchorage field (World Bank, 2018). Streamlining the procedures for customs clearance continues to be a persistent issue in Dar es Salaam. The intricacies and extensive paperwork involved can greatly impede the process of clearing cargo, leading to delays for arriving vessels and forcing them to linger at anchors (Mapunda, 2016).

Numerous studies have examined the effects of ship delays on the shipping industry, particularly at the port of Dar es Salaam. It has been discovered that these delays result in traffic jams, lengthier container waiting or service times, delays in vessel clearance, and lengthy document processing times (Dr. Menyhárt & Ewamer, 2022). Due to the traffic and delays, revenue loss, working hours, increasing operational costs, and cargo diverted to other ports, These delays have been made worse by the COVID-19 outbreak, which has caused major disruptions to port operations and longer idle hours for container ships. Increased fuel consumption, pollutants, and fouling have resulted from the longer idle times. Decongestion techniques, port infrastructure upgrades, and the application of eco-friendly technology to prevent biofouling are all necessary to lessen these effects (Maanga, 2013).

While recent data on container ship waiting time specifically at Dar es Salaam is limited, anecdotal evidence and ongoing discussions about the shipping business suggest the issue remains a concern. Addressing this is crucial for Tanzania to maintain its position as a key trade gateway and benefit from the growing African maritime trade sector.

2.0 Literature Review Guided the Study

2.1.1 Ship

According to Nguhulla (2022), a term Ship is a vessel that carries goods from where they are to where they're discharged. The word ship is known from numerous angles. The word ship is known as a provider of transport services, a facilitator of business, a ship doing business itself, providing port networks, and uniting authorities (Nguhulla, 2022). There are numerous forms of ships within the world used for maritime transport; these are container ships, con-rigerated ships, tanker ships, general cargo ships, passenger ships, and bulk carriers.

2.1.2 Container

A container, in the context of shipping, refers to a substantial, standardised shipping enclosure utilised for the transportation of goods. Such containers are constructed from resilient materials such as steel and are engineered to facilitate seamless transfer across diverse modes of transportation—from vessel to railway to truck without the need for unloading and reloading the contents. Containers are available in a range of dimensions, the most prevalent being 20 feet and 40 feet in length, denoted as twenty-foot equivalent units (TEUs) and forty-foot equivalent units (FEUs), respectively. They are secure, capable of being stacked, and configured to optimise space utilisation and streamline logistical operations in the worldwide distribution of merchandise. (LaGore, 2020)

2.1.3 Shipping Business

The shipping business includes the transportation of merchandise and wares across different modes of transport, including ocean, air, and land. This industry includes the tasks of boats, aeroplanes, trucks, and trains that move items between various areas around the world. It additionally incorporates overseeing strategies, planning supply chains, taking care of cargo activities at ports and air terminals, and appropriation focuses. The shipping business is essential for worldwide exchange, supporting monetary exercises by empowering the trading of goods at global and homegrown levels. (Gibson & Coyle, 2020)

2.1.4 Shipping waiting time

Refers to when the container ship remains idle at a port before it can commence cargo handling operations, including loading or unloading. This period starts from the moment the ship arrives at the port and is ready to dock, to the point when it finally arrives and begins cargo operations.

2.1.5 Operational Efficiency

Operational efficiency is defined as "the organization's ability to decrease wastage of inputs and maximize resource utilization by increasing supply quality and eliminating low-quality products and services for customers (Jayawardena, 2020)

In the context of this study on the impact of container ship waiting times at Dar es Salaam Port, operational efficiency refers to how effectively the port manages its resources such as berths, cranes, labour, and equipment to minimize delays and maximize the throughput of ships (Stephen, 2024)

High operational efficiency at the port would mean that ships are processed quickly, with minimal waiting time, ensuring that cargo is loaded and unloaded swiftly. This would involve optimizing processes such as berth allocation, crane operations, and coordination between different port services. Efficient operations lead to reduced turnaround times for ships, lower operational costs for shipping companies, and increased customer satisfaction due to reliable schedules (Hart, 2019)

2.1.6 Financial Implication

Financial implications in the context of logistics and operations research refer to the impact of financial factors on the efficiency and effectiveness of logistics operations. These implications often involve the assessment of costs, revenues, and financial risks associated with logistical activities, such as transportation, warehousing, and supply chain management. Understanding financial implications helps organizations optimize resource allocation, reduce operational costs, and enhance profitability by making informed financial decisions within their logistics operations (Liu & Zhang, 2022)

2.1.7 Ship delays

Ships delays may be a situation where the ships have to wait longer at the port to try and do their operations than they originally planned or expected to enter the port. Shipment delays can cause delays in shipment. A shipment delay tends to affect all aspects of the port's performance: unhappy customers, income trouble, manufacturing hold-ups, additional expenses like demurrage, detention, and port storage charges, and the last effect is loss of cargo value (Bhonsle, 2022).

2.1.8 Port Performance

Refers to carrying out port operations that satisfy the needs of port customers (users) and meet the goals established by the owners and service providers (Notteboom, 2020a). port performance indicators are a measure of the efficiency of port activities. Such indicators provide reliable input to the top management in the quay areas of port operations. The indicators are categorised into two groups namely, operational indicators, and performance indicators but this study intends to look at one side of operational indicators.

***Table* 2.1: Statistics of key performance indicators of Dar es Salaam Port from 2020 - 2023**

Item	Unit Measure	2020	2021	2022	2023	Benchmark
Waiting time	Days	6.87	10.9	6.95	6.12	
Turnaround time	Days	10	14	11	9	3 Days
Berth occupancy	%	77	79	74	77	70 per cent
Crane productivity	move/day	613	617	579	551	600 moves per day
Container vessel	calls	295	302	302	430	
Container “000”	TEUS	706	750	881	979	
Port throughput “0000”	Tonnage	1,591	1,703	2002	2298	

Source: Container terminal report, (2024)

2.2 Theoretical Literature Review

Studying various theories and carrying out theoretical analyses is required to understand the impacts of how container ship waiting time impacts the shipping business. Here's a review of some supporting theories and theoretical frameworks relevant to this study.

2.2.1 Queuing Theory

Queuing Theory is defined as a collection of mathematical theories and models that attempt to create various typical queue-waiting scenarios. (). Queuing theory was adopted in this study to analyse and model the waiting time experienced by container ships at Dar es Salaam port. This theory provides a mathematical framework to understand and predict the behaviour of queues, which are common in various operations settings including ports. Given that often face delays due to the congestion at the port. Queuing theory is particularly for evaluating how factors such as the arrival rate of the ships the service rate at berth, and the availability of the resources impact overall waiting times and port efficiency.

The application of queuing theory, the study can quantitatively assess how various in-port operations, such as the number of available berghs or the efficiency of cargo handling, influence the time ships spend waiting before they can dock and unload. This allows for the identification of bottlenecks in the port operations and helps in proposing targeted interventions to reduce waiting times, prove turnaround, and enhance the port’s overall efficiency. Moreover, Queuing theory enables the simulation of different operational scenarios, helping port authorities make data-driven decisions to optimize resource allocation and minimize delays.

Generally, the theory was adopted due to its ability to model the complex dynamics of port operations, providing insights into how to manage and reduce waiting times effectively. Its application in this study is crucial for understanding the operational challenges at Dar es Salaam port and for developing strategies to enhance its performance in handling container ships.

2.2.3 Supply Chain Management (SCM) Theory

Supply Chain Management (SCM) theory is a useful tool for analysing the effects of container ship waiting times at Dar es Salaam Port on Tanzania's shipping industry. The optimisation of the flow of products, services, and information from suppliers to final customers is a key component of supply chain management (SCM) theory. This theory offers a framework for comprehending how inefficiencies at a critical supply chain node, like port operations, can have a domino impact on the system as a whole, which is relevant to this study.

First, the theory of supply chain management emphasises the significance of lead time. The entire time it takes for items to go from the supplier to the final customer is known as the lead time. Lead times are directly increased by delays in port handling of container ships, which can cause disruptions in downstream operations including inventory control, production scheduling, and delivery schedules. Longer lead times can result in stockouts or increased inventory holding costs, both of which have a detrimental effect on business success. (Gong, 2020).

Furthermore, supply chain management theory emphasises how important cost-effectiveness is to supply chain operations. Extended waiting periods for container ships may lead to greater operating expenses, such as increased storage costs for importers and demurrage fees for transportation companies. Consumer prices rise as a result of these increased expenses, which are frequently transferred down the supply chain and lower profit margins for companies. Accordingly, supply chain inefficiencies at the port can increase costs and decrease competitiveness, especially in a global market where cost-effectiveness is crucial (Christopher, 2022).

Another fundamental tenet of supply chain management (SCM) philosophy is effective coordination. Coordination between several parties, such as shipping firms, port authorities, customs, and inland transport providers, is essential to the efficient operation of a supply chain. A breakdown in this coordination is indicated by delays at the port, which results in inefficiencies that have an impact on all parties. The supply chain may be further disrupted by these delays, which can be made worse by inadequate communication and misaligned timelines (Rushton, Croucher, & Baker, 2023).

Last but not least, SCM theory regards customer satisfaction as a crucial result. Deliveries may be delayed as a result of port delays, which can negatively affect client loyalty and satisfaction. These delays can be especially harmful to companies using just-in-time (JIT) inventory systems since these companies depend on on-time delivery to keep up production schedules and satisfy consumer expectations. According to Chopra and Meindl (2023), inefficiencies at ports have the potential to undermine customer confidence and damage the standing of companies that rely on prompt imports and exports.

2.3 Empirical Literature Review

2.3.1 Related studies in developed countries

According to (Akakura, 2023). “Analysis of offshore waiting at world container terminals and estimation of CO_2 emissions from waiting for ships” Global supply chains and container services are significantly impacted by port/terminal congestion and offshore waiting especially the just-in-time approach. A technique for locating offshore waiting, ships, estimating the increase in CO2 emissions, and computing their waiting times was created as part of the study. There is a connection between congestion and offshore waiting time capacity, according to the analysis of major ports worldwide. It was discovered that longer wait times at terminals led to higher CO2 emissions. The results highlight the necessity of taking practical steps to lessen traffic and wait times at container terminals to lessen the negative environmental effects of rising CO2 emissions.

The study of (Ivče et al., 2022). "Impact of the COVID–19 on Container Ships Efficiencies" The COVID-19 epidemic has had a major influence on the efficiency of container ships and worldwide commerce, causing delays in scheduled schedules and disruptions in port operations. Due to the increased idle time brought on by the shipping slowdown, container ships are more susceptible to hard and biofouling, which raises emissions, fuel consumption, and speed losses because of increased hydrodynamic drag. Because container ship lay times have increased dramatically during the COVID-19 pandemic, the authors stress the necessity of using innovative, ecologically friendly technology to prevent biofouling.

The study of Lin et al., (2020). "Subjective and objective analysis of schedule delaying factors for container shipping lines" The multi-criteria decision-making (MCDM) technique was employed in the study to determine how significant the delaying variables were in a sailing schedule. The method of consistent fuzzy preference relations (CFPR) was utilised to ascertain the subjective significance of the elements that caused delays. The objective relevance of the delaying variables was estimated using the entropy weight approach in conjunction with the actual performance of the container shipping company.

The assessment hierarchy was developed using a combination of brainstorming sessions, expert interviews with shipping businesses, and previous relevant research. Three elements were recognised: portability and planning. The questionnaire data was utilised to compute the subjective and objective weights, which were then utilised to determine the relative significance of the delaying variables. The criteria for fleet allocation (A2), transhipment arrangements (A4), sailing schedule control (A3), B4 (chase strategy), and A1 (planning for ports along routes) were discovered by experts to be possibly disregarded, indicating that shipping corporations had to give these elements greater consideration and enhance their performance correspondingly.

The study of viellechner & Spinler, (2020). "Novel data analytics meets conventional container shipping: Predicting delays by comparing various machine learning algorithms" To predict container vessel delays, the paper discusses the necessity of predictive analytics and risk management systems in the container shipping sector. Using ten regression models and seven classification models, the authors create a prediction model based on 315 explanatory factors. Neural network and support vector machine methods yield the best results, with 77 per cent prediction accuracy vs. 59 per cent for a basic baseline model. Senders, carriers, terminal operators, and recipients are just a few of the shipping participants who stand to gain from the prediction model's greater transparency on shipment delays. The model is intended for long-term operational decisions and strategic planning; however, short-term modifications based on real-time data may be the focus of future research. There may be further uses for the prediction

model, with modifications to the choice of explanatory variables, for various modes of transportation, such as rail transportation.
According to Budiyanto et al., (2021), in the study “The application of business impact analysis due to electricity disruption in a container terminal” Container terminals collect containers from the hinterland and ports for distribution, reflecting a country's economic conditions. Business impact analysis (BIA) is often used to analyse disruptions at these facilities, which can be caused by natural disasters, pandemics, and human activities. This paper aims to provide a perspective on BIA procedures for container terminals, focusing on operational constraints. The case study of a container terminal caused by electrical disruption highlights six categories of disruptions: decreased productivity, economic loss, reduced employee productivity, decreased customer numbers, a decline in company reputation, and wasted energy. This paper provides a perspective on adjusting the BIA procedure for container terminal businesses.

According to Pruijn et al., (2020), Markov chain analysis (MCA) is used to more accurately analyze and probabilistically estimate port waiting times caused by congestion. Ships must wait to access the port's facilities due to congestion. At the beginning of a journey, these traffic jams are frequently erratic and transient. Estimating these waiting periods might help with planning and boost the effectiveness of cargo transportation. Queuing theory analysis of current port waiting times caused by port congestion has been researched in the past. This study looks into the prediction of port waiting times in the bulk shipping sector caused by port congestion using machine learning algorithms. MCA is not now commonly employed in the shipbuilding and shipping industries. MCA is frequently used in various areas, such as weather models, valuation of stocks, and deterioration and maintenance modelling. The research's findings are intended to forecast port congestion and identify patterns that help shippers more accurately forecast their services.

The impact of unknown waiting periods and fuel prices on a shipowner's choice of bunker fuel stops during tramp shipping. We examine the stochastic bunkering waiting times in the bunkering optimisation problem using scenarios derived from vessel Automatic Information System (AIS) records and assess their importance to the bunkering decision. Our findings illustrate the trade-off between port efficiency, as measured by waiting times, and the economic benefits of obtaining bunkers from cheaper port alternatives and concluding the voyage in more expensive bunker regions. Although the absence of waiting time would have produced identical results in our empirical setup, incorporating waiting times altered the dynamics, making a price-attractive port like Piraeus less appealing when risk aversion is modelled, particularly given the risk of prolonged waiting (Fuentes et al., 2024)

Waiting times for trucks, trains, aeroplanes and ships in service are obvious transport system inefficiencies, and actions to decrease them may have the potential to reduce transport GHG emissions. Transportation researchers in international shipping have noted that reduced wait time associated with port calls offers great promise. To investigate the potential for GHG reduction through port call optimisation, focussing on crews and their employers - shipping corporations. Empirical data in the transportation literature confirms the occurrence of idle time during port calls and goes beyond to describe its causes. Studies show how many port stakeholders, including government authorities, constrain the crews' and shipping corporations' ability to negotiate port calls. Also demonstrates why the process of lowering waiting time in shipping is more complex than in onshore transport modes, where real-time traffic intelligence

informs driver route choices, reducing congestion and waiting time. Our findings have consequences for policymakers and transportation researchers (Poulsen & Sampson, 2020)
The study examines the problems associated with preoperational waiting times for dry bulk carriers, which can have a negative influence on stakeholders' income and the marine sector's long-term sustainability. These waiting times, which are frequently linked to port congestion, indicate that Just-In-Time (JIT) arrival potentials are not being completely realised. To address these delays, solutions such as Vessel Arrival Systems (VAS) and Virtual Arrival (VA) agreements are being used, to transform waiting hours into additional navigation time rather than eliminate them. However, these solutions have limitations; VAS may only be effective in certain circumstances, and JIT and VA agreements may be impractical or mismatched with trade requirements, resulting in continuous reliance on less efficient ways such as the First Come First Serve (FCFS) approach.

To increase efficiency, a new VAS concept is proposed that transitions from a static to a dynamic system based on time, distance, and speed, as indicated by expected berth and cargo operation availability. This method employs a circular Reporting Line that adjusts dynamically based on the closest available berthing opportunity, allowing for more strategic and efficient line-up positions while ensuring fairness and supporting VA applications. This dynamic VAS intends to improve both environmental efficiency and operational performance in the maritime industry (Senss et al., 2023)

Efficiency and sustainability are undoubtedly the most important goals for modern ports. Current port service exercises still lack performance profiling for arriving vessels in terms of punctuality, compliance with port resource schedules for Just-in-Time (JIT) service, and efforts to reduce emissions through reduced turnaround time within the port. As a result, a performance-based reward is unavailable. Including an incentive component may help to achieve both port efficiency and environmental goals. Blockchain technology, with intrinsic features such as immutability, traceability, governance and provenance, and built-in tokens (for most public chain platforms), enables the development of system solutions to record key performance indicators (KPIs) and distribute incentives to high performers.

This study is the first to propose a blockchain-based system to encourage JIT and green operations in ports. The platform system design and operating procedures are thoroughly discussed, and a prototype system based on the Solana blockchain has been developed to show the key characteristics. Given the industry's growing understanding of its environmental impact, the existing system has significant potential. Continuous development can be supported by connecting to market-based initiatives such as carbon pricing and emission trading in the maritime sector (Nguyen et al., 2023)

2.3.2 Studies in Developing Countries

Measurement of delay factors in container ports of a developing economy: a study of Lagos container terminal, Nigeria" The weight of delay-causing elements on ship turnaround times at Nigeria's Lagos Container Terminal was calculated by the study using a multi-regression model. According to the study, the variables X5, X6, X8, and X7 are crucial for port delays. According to the report, to combat corruption, fewer government entities should be stationed at the port. Additionally, inland container depots and cargo stations should be established outside of port boundaries to deter the handling of cargo and container paperwork within the port (Osadume et al., 2024)

A study by Raballand et al., (2016). Investigate the causes of cargo delays in Sub-Saharan African ports to assess the effectiveness of expenditures made by organisations such as the World Bank. Identifying and quantifying these delays is critical to ensuring that interventions result in meaningful improvements while also addressing the underlying causes that cause long port delays. Dwell time data are important in attracting cargo and producing revenue for port authorities and terminal operators; therefore, lowering them is crucial to attracting more cargo. With ports increasingly competing with one another, having independently verifiable dwell time data is crucial to proving that initiatives are lowering delays according to schedule.

According to (Nyema, 2014). Examines the factors impacting container terminal efficiency at the Mombasa Entry Port. Inadequate quay/gantry crane equipment, container ship delays, dwell time, truck turnaround time, customs clearance, insufficient storage space, poor multimodal connections, and infrastructure all have a direct impact on terminal efficiency. Improving port infrastructure helps alleviate congestion, whereas a lack of an integrated IT system increases delays in customs-clearing operations. The Kenyan government should invest in improving physical infrastructure such as berthing facilities, yard capacity, quayside, railway, and hinterland links to boost overall port efficiency.

Research by Akinyemi, (2016). Focuses on the delay factors that affect the productivity of Nigerian ports, namely the Rivers Ports Complex in Port Harcourt. These delay problems have remained from the pre-concession to the post-concession eras, impeding optimal port performance despite the involvement of private terminal operators and upgraded infrastructure. Government policy inconsistencies, a lack of infrastructure, bad planning, port management concerns, inadequate dredging, and dock workers' problems have all been identified as causes of delay. To address these delay reasons and increase the efficiency of Nigerian ports, highlighting the need to resolve government policy inconsistencies, improve infrastructural development, and correct inadequate planning practices to maximise port productivity.

Today, the maritime transportation industry is critical to the country's economic cycle, as almost 90% of freight is handled by sea. Meanwhile, container terminals are gaining importance as a link between the sea and land. As a result, the quality of services provided at ports is critical for expediting the transportation process, responding quickly to consumers, and recruiting new ones. The current article investigates the best time to service ships at container port berths by identifying a logical-mathematical relationship between important parameters. The contributing factors are needed service time, delay time, ship length, length of the berth, number of 20 or 40-inch containers discharged or loaded, quantity of equipment assigned to each berth, and berth water depth.
Finally, the best service time is determined by first identifying the fitness function and initial population, and then putting constraints on the genetic algorithm (GA). Although the GA is widely utilised due to its powerful algorithms in optimisation, the port optimisation problem was not addressed, which is the paper's uniqueness. The optimisation findings reveal that 4323 containers were discharged and 1020 containers were loaded for 5186 minutes with a single gantry crane. Loading or unloading each container takes an average of 0.97 minutes. Using two gantry cranes, this operation can be done in 5100 minutes, with an average of 0.95 minutes for

each container, while the time required for three gantry cranes was 4908 minutes, with an average of 0.95 minutes for each container, while three gantry cranes required 4908 minutes, with an average of 0.91 minutes per container. According to the paper's findings, two major elements to minimising waiting time with berth allocation are defining appropriate access channel depths and expanding the number of berths, both of which are investigated and analysed as feasible options (Mahpour et al., 2021)

The study Miller & Hyodo, 2022) explores the reasons behind long container dwell times in African ports, specifically the Port of Douala, which hinders economic development. It examines the relationship between consignees' logistics performance, port operator efficiency, and customs clearance processes. Key factors include fiscal regime, value density, packaging type, last port of call, region of origin, and commodity group. The study examines external factors like agent performance, shipper practices, and shipping line strategies, and identifies cargo dwell times' characteristics like broad tails, high variance, and right-censoring, requiring thorough statistical analysis for policy recommendations.

The port container terminal is an essential changeover point in the shipping business. With the growing number of port terminals around the world, competitiveness is becoming increasingly vital. Vessel processing time at port terminals is an essential component that influences their desirability. In addition, most port terminals attempted to cut ship waiting time by improving their facilities. This article focused on ship waiting time at the port container terminal's berthing area and attempted to solve the queuing problem during ship tugging operations to lower the average waiting time. The data was acquired as a case study from a major Malaysian port container terminal. The port terminal was modelled utilising Arena 13.5 simulation software, and the model was validated using real data from the case study. Various scenarios were then examined on the tugging operation using the port simulation model. The data reveal that after implementing these scenarios, the average ship waiting time at the berthing area reduced significantly, from 180 hours to 140 hours for each ship (Shahpanah et al., 2014)

Currently, there is a great deal of scrutiny surrounding the emissions from commercial shipping. Container ships are one of the ship types that use the most fuel and are therefore the biggest air polluters. Their quick service is the primary cause. Speed reduction is a widely utilised operational approach that has gained popularity recently for reducing fuel consumption and emissions. Such an operational scenario is examined in this research. There is a great interest in exploring potential methods to reduce time in port, as slow steaming results in an increase in time at sea. Cutting the port service time is one approach to achieve this. The quick berthing of vessels upon arrival is another potential strategy to reduce disturbance and maximise efficiency. In light of this, an associated berthing policy is being looked into as a way to shorten wait times. The goal of cutting emissions throughout the maritime intermodal container chain is compared to a decrease in operational expenses and other aspects of the services. There are a few examples provided to help clarify (Kontovas & Psaraftis, 2011)

Private companies are currently receiving concessions from the governments of numerous developing nations to run container terminals. The project's technical and financial evaluation is a crucial step in this procedure. In actuality, demand levels fluctuate throughout time. The capacity expansion problem with stochastic demand is covered in the first section of the study. After that, a dynamic programming procedure is used by an optimisation model to determine the optimal epochs for adding new berths. Ship waiting periods are incorporated into the main model as upper bounds based on global practice, having been calculated using queuing models. Lastly, a real alternatives analysis is carried out to assess the consequences of eventually abandoning the project within a predetermined time frame. Subsequently, the container terminal of the Port of Rio Grande, Brazil, is utilised to apply the model (Haralambides, 2017).

In light of stochastic fuel consumption for each leg and stochastic fuel prices at each port, this study looks into the best control strategy for a liner ship to determine when and how much fuel to refuel. A dynamic programming approach is then created based on certain qualities demonstrated in this work to produce certain significant threshold values, which are utilised in the best control policy for ship refuelling decisions. Numerous tests demonstrate that the suggested approach can find the best solution for a range of issue instance sizes (up to 30 ports) and probability distribution parameters in a respectable amount of time (about 170 s). Furthermore, several comparative studies demonstrate that the suggested ideal choice is in a respectable amount of time (about 170 s) for a range of problem instance sizes (up to 30 ports) and probability distribution parameters. Furthermore, comparison trials demonstrate that the best choice policy suggested can save fuel consumption costs by at least 8% when compared to some relatively simple rules and by around 1% when compared to some very cleverly developed rules (Zhen et al., 2017)

2.3.3 Studies in Tanzania

Evaluation of seaport service quality in Tanzania: From the Dar es Salaam seaport perspective" The research assessed the quality of services provided by Tanzanian seaports, with a specific focus on the Dar es Salaam seaport. Utilising the SERVQUAL model, the study examined the perceptions and expectations of seaport users regarding the services offered. The results indicated a discrepancy in service quality, suggesting inadequacies in the services provided by the Dar es Salaam seaport. The study distinguished five key dimensions of seaport service quality, namely tangibility, empathy, reliability, assurance, and responsiveness. Among these dimensions, responsiveness was identified as a significant factor influencing customer satisfaction, whereas empathy and assurance showed minimal impact on satisfaction levels. Furthermore, reliability was found to be a major driver of customer dissatisfaction, whereas tangibility had a negligible effect on dissatisfaction. This research makes a valuable contribution to management practices by presenting seaport administrators, managers, and executives with a structured approach to assessing customer satisfaction and guiding investments in seaport service quality as part of a relational marketing strategy (M. Mwendapole & Jin, 2021)

Poor port performance in Tanzania, particularly at Dar es Salaam port, is impacted by a variety of factors such as inadequate hinterland connections, socio-economic and political challenges, deficiencies and shortcomings in port infrastructure, a lack of expertise, ICT management deficiencies, and ineffective supervision and motivation. The performance of a seaport can be assessed through port performance indicators, which encompass operational and financial metrics. To enhance seaport performance, it is recommended in the study to implement measures like efficient customs clearance procedures, strong links between the seaport and hinterlands, and the upgrade of modern maritime and port facilities. The research paper concludes that a proficient port can significantly boost a country's economic development (M. J. Mwendapole, 2015).

The study of (M. J. Mwendapole & Zhihong, 2020). “Status, challenges, and strategies of Dar es Salaam seaport-hinterland connectivity” The Dar es Salaam seaport is currently facing congestion as a result of the growing demand for foreign goods from inland areas, leading to a sluggish connection between the seaport and its hinterland. This seaport heavily relies on road transportation, lacks adequate railway links, and has substandard road and railway infrastructure. Obstacles hindering the efficiency of seaport-hinterland linkage encompass routine tariff hikes on imports, traffic congestion on roads, and the nonexistence of new freight terminals. Proposed measures to enhance connectivity entail the development of new roads adhering to global benchmarks, reducing travel time through wider roads, and minimising road checkpoints to lower inspection charges. It is advised that security in Tanzania's central corridor be enhanced, which is significant for the economies of the inland regions. The successful execution of these strategies necessitates cooperation among pertinent authorities and stakeholders.

According to Maneno, (2019). “Assessment of factors causing port congestion: a case of the port of Dar es Salaam” The study identifies measures that the government and the Tanzania Port Authority can implement to alleviate congestion and enhance operations at the port. Collecting data through interviews is challenging due to stakeholders' reluctance to share information and legal constraints on data dissemination, as highlighted in the research. Addressing issues like inadequate documentation, limited berths, equipment inefficiencies, and insufficient infrastructure is crucial to tackling port congestion, as emphasised in the paper. Training employees, expanding the port, upgrading technology systems, simplifying customs processes, reducing red tape, and enhancing equipment efficiency are among the suggested strategies to mitigate congestion, according to the research.

The impact of port congestion on port efficiency has been examined within the context of Dar es Salaam port in Tanzania. The objective of the research was to pinpoint the factors causing port congestion and suggest appropriate solutions to address them. The review of existing literature underscored the significance of ports in driving the economic development of a nation. Queuing theory and simulation were recognised as pertinent theoretical frameworks for comprehending port congestion and efficiency. The research adopted a blend of qualitative and quantitative methodologies, utilising questionnaires and interviews for data collection. Results indicated that port congestion could have a notable influence on economic progress, underscoring the necessity for effective strategies to alleviate congestion. The study proposed the formation of a committee for port enhancement, the procurement of extra handling equipment, and campaigns to promote timely cargo clearance as measures to boost port efficiency (M. Magibho, 2017)

Another study Tengecha & Zhang, (2020), “Status, constraints, and strategies of marine traffic flow at Dar es Salaam Port, Tanzania” The study found several factors, such as longer container waiting and service times, delayed vessel clearance, and berth occupancy, that contribute to marine traffic congestion in the port of Dar es Salaam. Long document processing times, congestion on anchorage vessels, and poor incoming and outgoing traffic flow are some of the problems that need to be addressed to improve marine traffic flow at the port.

According to (Kunambi & Zheng, 2024) on his study uses a hybrid data envelopment analysis (DEA) methodology that includes the contextual value-added approach (CVA) to conduct a contextual comparison analysis between the ports of Dar es Salaam and Mombasa. The assessment uses a variety of inputs (quay length, number of cranes, and storage area) and outputs (number of ship calls and cargo throughput) to calculate efficiency scores, providing deep insights into both ports' strengths, limitations, and opportunities for improvement. Methods: Efficiency scores are calculated using the hybrid DEA model with CVA, which takes into account the various inputs and outputs.

This method provides for a thorough assessment of the relative performance of the Dar es Salaam and Mombasa ports. The study also investigates the impact of trade-related externalities on port efficiency, resulting in a comprehensive understanding of the factors influencing port operational performance. Results: The efficiency scores show significant performance trends between the Dar es Salaam and Mombasa ports. Notably, Dar es Salaam demonstrated maximum efficiency (efficiency value of 1) in 2018 and 2021, whereas Mombasa performed optimally (efficiency value of 1) in 2021. However, efficiency values for both ports change in other years, ranging from 0.895 to 0.985 for Mombasa and 0.924 to 0.960 for Dar es Salaam. Conclusions: This study examines the dynamic efficiency levels of Dar es Salaam and Mombasa ports over time and identifies key factors impacting their performance. The findings add new insights to the field of port analysis, assisting port management and policymakers in improving the efficiency and competitiveness of these critical maritime centres.

Delays in international trade hurt the global economy, commerce, and politics. We used Global Schedule Reliability (GSR) and the Global Supply Chain Pressure Index (GSCPI) to experimentally evaluate the asymmetrical effect of container shipping vessel arrival delays on the global supply chain's pressure. The dataset contains 76 observations and spans the period from January 2017 to April 2023. The findings reveal that the impact of delays on the supply chain is uneven; increasing delays increases pressure while decreasing delays have no effect. This demonstrates that the consequences of supply chain delays are persistent and require a long time to resolve. Policies are advocated to reduce the impact of delays on international trade (Açik, 2023)

The study on Tanzania Ports Authority (TPA) investigates the institution's efforts to improve performance, particularly in terms of cargo handling and income generation, in response to a call from the country's political leadership. The study is based on change management and public value theories and was carried out at TPA headquarters, with a focus on management and employees. Using semi-structured questionnaires and document reviews, the study discovered that, while there were triumphs in performance improvement, there were also obstacles connected to change variables, particularly those involving humans. The study underscores the importance of internal leadership in facilitating sustainable change, as opposed to depending solely on external political influences. It implies that for long-term benefits, a more systematic, internally championed transformation process is required The study helps to better understand how top-down leadership initiatives affect public sector performance, particularly in developing nations, while also emphasising the importance of a comprehensive strategy to fostering long-term public value creation. (Issa & Masanja, 2022)

Seaport congestion is a serious issue affecting the efficiency of marine transport in Tanzania. It lays the groundwork for understanding how this congestion affects regional trade and logistics. The study emphasises the necessity to investigate decongestion solutions to improve port operations. It suggests that good congestion management is critical to improving the overall performance of Tanzania's shipping industry. The study's findings should be useful for Tanzanian politicians and port officials as they aim to increase port efficiency and minimise congestion, resulting in better economic benefits for the region (Kondo, 2014)
Measuring capacity and capacity utilisation at seaport terminals is critical to ensuring the efficient use of the harbour's infrastructure and superstructure. Most of the methodologies used to measure capacity utilisation are difficult to understand for a typical harbour operator. Most of the methods are also data-intensive and thus unsuitable for developing countries. This article aims to employ well-known standard queuing models to estimate capacity utilisation in a seaport, using Dar es Salaam (Tanzania) as a case study. The model was validated using historical data on terminal performance for both general cargo and container terminals. (Ivče et al., 2022)

According to typical queuing models, terminal capacity at both terminals is underutilised, resulting in needlessly high wait times for ships; a more detailed simulation model supports this finding. Although some of the assumptions used to develop common queuing models may not be valid in practice, it is believed that conventional queuing models can be used as a rapid scan for assessing seaport terminal capacity utilisation. If precise measurements are required, further data may be required to identify real ship arrivals and service time distributions and construct an appropriate simulation model. The approach proposed in this article, though validated using port performance data for the port of Dar es Salaam, is immediately relevant to all other seaports (Dullaert, 2014)

About 90% of international freight passes via seaports, and more than 80% of seaborne cargo is transported in containers; therefore, major seaports must handle their container operations successfully and efficiently. Using data on ship working hours, crane allocation, and the number of loaded and discharged containers from July 2011 to June 2012, this study developed a ship turnaround model tailored to specialised container terminals in Dar es Salaam Port to aid in container logistics planning. Using the right econometric methodology of co-integration analysis, Discovered that there is a substantial association between crane allocation and ship working hours at berth, whereby allocating one extra quay crane (i.e., Ship-Shore Gantry crane) can minimise ship turnaround time by 9.4 hours. Because one of the primary goals of port management is to reduce ship turnaround time by maximising the use of port resources, this model estimates port performance indicators such as ship turnaround time and various operating strategies in container logistics planning (particularly those dealing with the assignment and coordination of port equipment). Reducing turnaround time improves the port's competitiveness, allowing for efficient and cost-effective services that benefit the national economy (Danladi et al., 2024)
The article assesses the service quality of public transport in Dar es Salaam, Tanzania, focusing on road public transport (RPT), such as minibuses and buses, and urban rail transit (URT). Due to the intangibility of service quality criteria, the study uses a fuzzy evaluation model that combines the Fuzzy Entropy Method (FEM) and the Technique for Order Preference by Similarity to Ideal Solution (TOPSIS). The approach starts with selecting criteria for service quality through literature research and expert feedback, then utilising FEM to calculate the

criteria weights and TOPSIS to rank the total quality. The data show that urban rail transit provides superior service quality than vehicle public transportation. However, the report observes that urban rail transport in Dar es Salaam remains undeveloped, with few routes available. To address this, the article suggests that the Tanzanian government, in collaboration with Tanzania Railway Limited (TRL) and Reli Assets Holding Company (RAHCO), pursue Public-Private Partnership (PPP) schemes to invest in expanding the rail network and acquiring additional rolling stock, locomotives, and waggons. This investment would increase the availability of rail travel along more lines, encouraging healthy competition with road transport firms (Issa & Masanja, 2022)

3.0 Methodology

This paper discusses the study methodology, including the area of the study, research design, population, sampling technique, sample size, data collection, data analysis, validity and reliability, and ethical considerations.

3.1 Area of the Study

This study was conducted at Dar es Salaam Port, the principal port serving Tanzania, located in the Kurasini ward of Temeke District of the Dar es Salaam region. The port is one of the largest ports in the country and handles over 90% of the country's cargo traffic. The port serves as a gateway for commerce and trade for Tanzania and neighbouring countries, including Malawi, Zambia, Rwanda, Burundi, the Democratic Republic of the Congo, Uganda, and Zimbabwe. The port handles various types of cargo, including containers, bulk, and general cargo, and plays a crucial role in the region's economy by facilitating international trade and commerce. (TPA, 2024)

3.2 Research Design

Research design is a blueprint, a roadmap, or an inquiry plan created to find the answers to research questions (Khanday & Khanam, 2023). This study employed a case study research design, integrating both qualitative and quantitative approaches. The qualitative approach involved interviews and surveys with key stakeholders, including the port authority, shipping companies, logistics companies, and maritime experts, to gain insight into the experiences and perspectives of stakeholders. Quantitative data was collected on the duration and frequency of delays experienced by container ships in waiting time. Key variables include operational efficiency, financial implications, and schedule reliability.

3.3 Sampling Design

3.3.1 Study Population

The particular set of people or subjects that a researcher is interested in examining is referred to as the study population. It stands for the broader target population that the samples are taken from (Creswell, 2024). The study population consists of a wide range of individuals with interests in or impacted by the activities occurring at the port of Dar es Salaam. This encompasses port officials, logistics companies, shipping companies, and maritime experts. This broad group provides a comprehensive understanding of the impacts of container ship waiting times as well as potential solutions to mitigate these issues. These insights cover both local operational viewpoints and wider economic effects on Tanzania's shipping industry.

3.3.2 Sampling Techniques

Purposive sampling is a non-probability sampling method in which a researcher purposively targets a group of people believed to be liable for the study ((Bisht, 2023). This study used both non-probability and probability sampling, known as purposive sampling, and simple random sampling techniques. Purposive sampling will be used to collect qualitative data, allowing the researcher to select key stakeholders who possess relevant knowledge and experience related to the information needed. Additionally, simple random sampling techniques are employed to collect quantitative data to ensure representation across different representatives.

3.3.3 Sample Size

For this study the population is set at 150, which includes shipping companies, port officials, logistics companies, and maritime experts with a precision level of 10%, calculating a sample size of 60 respondents. To ensure a robust analytical framework, the sampling techniques incorporate both purposive and simple random sampling techniques.

3.4 Data Collection Methods

Data collection refers to gathering specific information aimed at proving or refuting some facts. There are two major sources of data used by researchers, which are primary and secondary sources (Rwegoshora & Hossea, 2016). Data collection for this study involved a comprehensive approach to capture both quantitative and qualitative data relevant to the research objectives. The data collection methods include semi-structured interviews, questionnaires, and documentary reviews, each targeting specific variables or sets of data.

3.4.1 Interviews

A semi-structured interview is a data collection strategy in which participants are asked a series of open-ended questions and then followed up with probe questions to delve deeper into their responses and the topic of interest (Burkholder et al., 2019). Semi-structured interviews were conducted with a diverse range of stakeholders, including port operational managers, logistic managers, shipping companies, and maritime experts. These interviews explored various aspects related to container ship waiting time, including personal and institutional experiences with container ship waiting time, perceptions of operational efficiency, financial implications on the shipping business, and suggestions for mitigating delays and improving operational efficiency.

3.4.2 Questionnaire

A questionnaire is a research method that consists of a series of questions to gather data from respondents (George Thomas, 2021). Questionnaires were administered to port officials, shipping companies, and other key stakeholders to collect quantitative and qualitative data on delay duration, frequencies, and associated costs. The questionnaire included closed-ended questions to gather numerical data on the duration and frequency of delays, financial losses incurred due to waiting times, and costs associated with waiting times, including freight charges, storage fees, operational costs, and customer satisfaction levels and perceptions of service quality. Open-ended questions were also included to gather qualitative insights on the impacts of delays on business operations and supply chain management, and the challenges faced in addressing delays and implementing solutions.

3.4.3 Documentary Review

Documentary review is the method of collecting data using various publications written by previous authors. Documentary review will involve the collection of secondary data from various sources, including port logs, shipping records, and financial reports. This data will provide objective measures of delays and their impacts, including average waiting times for vessels at the outer anchorage, financial losses incurred by shipping companies and logistics companies due to delays, compensatory measures taken by businesses to mitigate the impacts of delays, and historical trends in delay duration and frequency over time.

3.5 Data Analysis

The data collected was transcribed from the data collection tools into an electronic database designed using Microsoft Access. Data cleaning involves exporting raw data to Microsoft Excel, removing duplicate entries, correcting inaccurate data, handling missing values, standardising formats, and ensuring data integrity. The Cleaned data was processed and analysed using IBM SPSS version 27.0. A descriptive analysis including medians, frequencies, and proportions was done to understand the basic patterns and distributions within the data. Inferential statistics will involve correlation and regression analysis to determine the statistical association between factors for container ship waiting times (duration and reasons) and impact variables to assess the overall impact on the shipping business

3.6 Validity and Reliability

3.6.1 Validity

Validity refers to how well a method measures what it is designed to measure. The study ensured the validity of its impact on the shipping business by using a comprehensive approach, including expert consultation, clear definitions, a pilot study, internal validity through regression analysis, and external validity by selecting a representative sample.

3.6.2 Reliability

Reliability is the consistency of a method used to measure something (Middleton, 2019). The study's reliability was verified through strategic methods like standardised data collection, reliability testing on a sample subset, and separate data coding by multiple researchers. Cronbach's Alpha for internal consistency was 0.87, indicating high reliability. A test-retest method yielded a Pearson correlation of 0.82, demonstrating stability over time. Cohen's Kappa for inter-rater reliability for qualitative data was 0.75, indicating substantial agreement between raters.

4.0 Findings and discussion of the Study

4.1 Overview

The data analysis conducted to this study were assessed the effects of container ship waiting times on the shipping business in Dar es Salaam Port. . The paper begins with thorough, descriptive statistics, followed by regression analysis, correlation analysis and a discussion of the results

4.2 The Impact of Container Ship Waiting Times on the Operational Efficiency of The Shipping Business

4.2.1 Descriptive Statistics

The descriptive statistics summarise the study's key variables: waiting time, turnaround time, berth occupancy, crane productivity, container vessel, container (TEUS), and port throughput.

***Table* 4.1 Descriptive Statistics of Key Variables**

Variables	Mean	Std. Dev	Min	Max
Waiting time (days)	7.48	1.59	5.14	11.16
Turnaround time (days)	17.04	2.83	10.63	21.00
Berth occupancy (%)	76.99	1.33	75.00	79.00
Crane productivity (move/day)	589.44	79.23	462.00	703.00
Container vessel (calls)	333.55	55.64	258.00	423.00
Container (TEUS) "000"	831.03	220.71	529.00	1206.00
Port throughput (Tonnage) "0000"	1903.80	141.90	1695.00	2157.00

Source: Model Results

The average waiting time for container ships at Dar es Salaam Port is 7.48 days, with a standard deviation of 1.59 days, indicating some variability. The mean turnaround time is 17.04 days, suggesting that, on average, ships spend nearly seventeen days in port. Berth occupancy, crane productivity, container vessel, container (TEUS), and port throughput show substantial variations reflecting the operational dynamics of the port.

4.2.2 Correlation Analysis

The correlation analysis explores the relationships between waiting time and other operational efficiency metrics

***Table* 4.2: Relationship between Waiting Time and Other Operational Efficiency Metrics**

Variable 1	Variable 2	Correlation coefficient
Waiting time	Turnaround time (days)	0.976
Waiting time	Berth occupancy (%)	-0.632
Waiting time	Crane productivity (move/day)	-0.822
Waiting time	Container vessel (calls)	-0.662
Waiting time	Container (TEUS) "000"	-0.822
Waiting time	Port throughput (Tonnage) "0000"	-0.797

Source: Model Results

There is a strong positive correlation between waiting time and turnaround time (0.976), indicating that longer waiting times are associated with longer turnaround times. Conversely, waiting time has a strong negative correlation with berth occupancy (-0.632), crane productivity (-0.822), container vessel (-0.662), container (TEUS) (-0.822), and port throughput (-0.797). These negative correlations suggest higher waiting times adversely affect the port's operational efficiency.

4.2.3 Regression Analysis

The regression analysis assesses the impact of waiting times on operational efficiency metrics.

***Table* 4.3*:* Regression Analysis of the Impact of Waiting Times on Turnaround Time**

Variable	Coef.	Std. Err	p>t	t	95% Conf. Interval	
Waiting time	1.230	0.071	17.40	0.000	1.081	-1.380
Berth Occupancy	-0.066	0.035	-1.88	0.078	-0.139	- 0.008
Crane Productivity	0.079	0.096	0.82	0.426	-0.124	- 0.282
Port Throughput	0.000	0.000	0.95	0.357	-0.000	- 0.001

Source: Model Results

The regression model indicates that waiting time is a significant predictor of turnaround time with a coefficient of 1.230 ($p < 0.05$). This means that the turnaround time increases by approximately 1.23 hours for every additional hour of waiting. The R-squared value suggests that the model can explain a significant portion of the variability in turnaround time.

4.2.4 Discussion

The results from the tables presented in the study provide clear evidence of the significant impacts that container ship waiting time has on the operational efficiency of the shipping business at Dar es Salaam port.

Tables 4.1 show that the average waiting time for container ships is 7.48 days, with a standard deviation of 1.59 days, indicating some variability but overall a significant delay. The mean turnaround time is recorded at 17.04 days, which is considerably high and suggests that ships are spending a substantial amount of time in a port. Berth occupancy averages 76.99%, which is above the optimal level of 70%, indicating congestion. Crane productivity is also affected, with a mean of 589.44 moves per day, below the benchmark of 600 moves per day, highlighting inefficiencies in cargo handling operations.

Table 4.2 further reinforces these findings. There is a very strong correlation (0.976) between waiting time and turnaround time, suggesting that as waiting time increases, so does the overall time spent at the port. This is a critical finding, as it directly links the inefficiency in handling ships to prolonged operations, which can have cascading effects on port throughput and the broader supply chain. Additionally, the negative correlation between waiting time and other operational metrics such as berth occupancy (-0.632), crane productivity (-0.822), and port throughput (-0.797), underlines the adverse impacts of waiting time on the overall port performance indicator. These correlations indicate that higher waiting times are associated with reduced operational efficiency as resources such as berths, and cranes are not utilised optimally, leading to lower throughput and productivity.

Table 4.3 provides further quantitative evidence of the impacts of waiting times. The regression model shows that the waiting time is a significant predictor of turnaround time, with a coefficient of 1.230 ($p < 0.05$). This means that for every additional day of waiting, turnaround time increases by approximately 1.23 days. This finding underscores the critical importance of managing waiting times to improve the efficiency of port operations. The regression results also indicate that while berth occupancy and crane productivity are influenced by waiting times, their effects are not statistically significant in this model. However, the negative coefficients for these variables suggest that improvements in reducing waiting times could potentially enhance these operational aspects, even if the effect is not as pronounced as turnaround time.

These outcomes agree with those of other investigations. Similar trends, for example, have been noted in studies conducted at other ports, where lengthy wait times and high berth occupancy have resulted in notable drops in operating efficiency (Onwuegbuchunam, 2018) These studies stress that to improve overall port performance, congestion must be reduced and resource use must be optimised.

4.3 The Impact of Container Ship Waiting Times on the Financial Implications of the Shipping Business.

The Dar es Salaam Port in Tanzania is an important hub for the worldwide shipping sector, but container ship delays can have a serious financial impact. These delays can result in higher operational costs like fuel, crew, and port charges. This study will analyse stakeholder views through a structured survey to determine the financial impact of these delays. The investigation will shed light on the economic effects of port inefficiencies while also identifying areas for improvement to improve the port's performance and the overall shipping business environment in Tanzania. Understanding the financial implications of these delays is critical for stakeholders such as shipping companies, port authorities, and government agencies.

Table 4.4 **Provides insight into respondents' perceptions of the impact of waiting time on operational costs**

Response	Frequency	Per cent	Valid Percent	Cumulative Percent
Agree	11	18.3	18.3	71.7
Disagree	7	11.7	11.7	38.3
Don't Know	9	15.0	15.0	53.3
Neutral	8	13.3	13.3	100.0
Strongly Agree	16	26.7	26.7	26.7
Strongly Disagree	9	15.0	15.0	86.7
Total	60	100.0	100.0	

Source: Model Results

Table 4.4 shows that 26.7% of the respondents strongly agreed that waiting time significantly impacts operational costs, 18.3% of respondents agreed with this statement, 13.3% of respondents are neutral on the matter, 15.0% of respondents do not know if waiting time impacts operational costs, 11.7% of respondents disagreed that waiting time significantly impacts operational costs, and 15.0% of respondents strongly disagreed.

***Table* 4.5 SummariSes the perspectives of 60 respondents about the influence of waiting time on revenue loss. The replies were distributed as follows:**

Response	Frequency	Per cent	Valid Percent	Cumulative Percent
Agree	11	18.3	18.3	71.7
Disagree	7	11.7	11.7	83.3
Don't Know	8	13.3	13.3	53.3
Neutral	10	16.7	16.7	100.0
Strongly Agree	17	28.3	28.3	28.3
Strongly Disagree	7	11.7	11.7	40.0
Total	60	100.0	100.0	

Source: Model Results

Table 4.5 shows that 28.3% of respondents strongly agreed that waiting time significantly impacts revenue loss; 18.3% of respondents agreed with this statement; 16.7% of respondents are neutral on the matter; 13.3% of respondents do not know if waiting time impacts revenue loss; 11.7% of respondents disagreed that waiting time significantly impacts revenue loss; and 11.7% of respondents strongly disagreed with this statement.

***Table* 4.6 Summarises the perspectives of 60 respondents about the influence of waiting time on Transportation costs. The replies were distributed as follows:**

Response	Frequency	Per cent	Valid Percent	Cumulative Percent
Agree	15	25.0	25.0	25.0
Disagree	9	15.0	15.0	40.0
Don't Know	6	10.0	10.0	50.0
Neutral	8	13.3	13.3	63.3
Strongly Agree	18	30.0	30.0	93.3
Strongly Disagree	4	6.7	6.7	100.0
Total	60	100.0	100.0	

Source: Model Results

Table 4.5 shows that 30.0% of respondents strongly agreed that waiting time significantly transportation costs; 25.0 of respondents agreed with this statement; 13.0% of respondents are neutral on the matter; 10.0% of respondents do not know if waiting time impacts transportation costs; 15.0% of respondents disagreed that waiting time significantly impacts transportation cost; and 6.7% of respondents strongly disagree with this statement.

4.3.1 Discussion

Table 4.4 shows that a significant portion of respondents (45%) believe that waiting time at the port significantly impacts operating costs. This result is consistent with previous research, which indicates that port delays might increase operational costs due to factors such as demurrage charges, higher labour costs, and increased fuel consumption. For example, a study

(Panayides, 2015) found that port efficiency is critical for reducing operating costs in shipping, as delays can have a leading impact on supply chain costs.

However, a sizable proportion of respondents (26.7% combined) do not believe that waiting time has a substantial impact on operating costs, which may suggest variations in the experiences of different stakeholders. Some businesses may have more effective logistical techniques or contingency plans to reduce the effects of port delays. Other research, such as that by (Wilmsmeier & Sanchez, 2017) has revealed that the impact of port inefficiencies can vary dramatically based on different shipping companies' individual logistical and operating tactics.

Furthermore, 15% of respondents were unsure about the impact, indicating either a lack of direct experience with the subject or inadequate data to develop an informed conclusion. This uncertainty could be reduced by further educating stakeholders about the hidden costs of waiting times and providing more public reporting on port efficiency indicators.

Table 4.5 shows that a sizable proportion of respondents (46.6% total) feel that waiting time at the port has a major influence on revenue loss. This conclusion is consistent with previous literature, which indicates that port delays can result in large revenue losses for shipping businesses owing to missed opportunities and increased operational costs. For example, (Gayathri et al., 2021). highlighted that port efficiency directly affects the financial performance of shipping companies.

However, a sizable proportion of respondents (23.4% combined) do not feel that waiting time has a substantial influence on revenue loss, indicating that various stakeholders' experiences may vary. Some companies may have more effective logistical strategies or contingency plans to reduce the impact of port delays. The variability is also supported by other studies, such as (Agüero-Tobar et al., 2023) which have indicated that the economic impact of port inefficiencies can vary greatly depending on the unique logistical and operational strategies of different shipping companies.

Furthermore, 13.3% of respondents were unclear about the impact, indicating either a lack of direct experience with the subject or inadequate evidence to develop a firm conclusion. This uncertainty might be reduced by further educating stakeholders about the hidden costs of waiting times and providing more public reporting on port efficiency indicators.

The results of the study show that to minimise shipping revenue losses, wait times at the Dar es Salaam Port must be kept to a minimum. These results align with other recent research emphasising the role that port efficiency plays in overall financial performance. Reducing the financial burden on shipping companies and improving port operations could increase the port's competitiveness.

Table 4.6 shows that 55% of respondents (combining "Agree" and "Strongly Agree") believe that waiting times have a significant impact on transportation costs. This indicates a clear consensus among the majority that delays at ports like Dar es Salaam lead to higher costs for shipping businesses. These higher costs are mainly due to increased fuel consumption from idling ships, extended use of port facilities, and potential demurrage charges incurred when containers are not moved out of the port within the allocated free time.

Research supports these findings, highlighting that prolonged waiting times result in higher operational costs and inefficiencies. (Fuentes et al., 2024). found that reducing waiting times can significantly cut operational costs, emphasising the importance of efficient port management and logistics. Additionally, (Mwita Magibho, 2017b) pointed out that delays at ports contribute to increased transportation costs due to additional fuel consumption and longer handling times.

Interestingly, 21.7% of respondents (combining "Disagree" and "Strongly Disagree") do not see waiting times as a significant factor in transportation costs. This discrepancy could be due to variations in individual operational experiences or different approaches to cost management among shipping companies. Some stakeholders might have more efficient systems in place to mitigate the impact of waiting times, or they may operate routes where delays are less frequent.

The presence of neutral 13.3% and uncertain 10% responses further suggests that not all stakeholders are equally affected by or aware of the cost implications of waiting times. This variability underscores the complexity of port operations and the necessity for targeted interventions to address specific challenges faced by different operators.

The findings indicate that waiting times at Dar es Salaam port are perceived by the majority as significantly increasing transportation costs. This underscores the need for improved port management practices to enhance operational efficiency, reduce delays, and lower transportation costs for the shipping industry in Tanzania. Addressing these issues is crucial for improving the competitiveness of the Tanzanian shipping industry and supporting broader economic growth.

4.4 The Impact of Container Ship Waiting Time on Schedule Reliability in the Shipping Business

Container ship waiting time is an important performance statistic for ports, impacting schedule reliability, operating costs, delays, and customer dissatisfaction. This objective seeks to assess the impact of waiting periods on schedule reliability at Dar es Salaam port by investigating the relationship between waiting times and key performance metrics such as on-time arrival rates, schedule deviations, and customer complaints. Understanding these dynamics is critical for port authorities and shipping corporations as they adopt initiatives to reduce delays, improve service delivery, and maintain a competitive edge in the marine business.

4.4.1 Descriptive Statistics

***Table* 4.7 Descriptive Statistics of Key Variables**

variables	Mean	Std. Dev	Min	Max
Waiting time	7.48707	1.641118	5.132305	11.18886
On-time arrival rate	53.45	30.31497	8	99
Scheduled deviation	7.695	5.624615	1	17
Customer complaints	9	6.357755	0	20

Source: Model Results

The analysis indicates that waiting times have a major impact on schedule reliability at the Dar es Salaam port. According to the data, container ships have an average waiting time of 7.5 days and a 53.45% on-time arrival rate. The average schedule variation is 7.695 days, and there are approximately 9 consumer complaints on average.

4.4.2 Correlation Analysis

***Table* 4.8: Relationship between Waiting Time and Other Variables**

Variable 1	Variable 2	Correlation coefficient
Waiting time	Waiting Time	1.0000
Waiting time	On-Time Arrival Rate	-0.9904
Waiting time	Schedule Deviation	0.9922
Waiting time	Customer Complaints	0.9918

Source: Model Results

There is a substantial negative connection (-0.9904) between waiting time and on-time arrival rate, showing that as waiting times rise, the on-time arrival rate falls. In contrast, there is a high positive association between waiting time and schedule deviation (0.9922) as well as waiting time and customer complaints (0.9918), showing that as waiting times rise, so do schedule deviation and customer complaints also increase significantly.

4.4.3 Regression analysis

***Table.* 4.9: Regression Analysis of the Impact of Waiting Time on Customer Reliability**

Source: Model Results

Variable	Coefficient	Std. Err.	t	95% Conf. Interval
Waiting Time (Days)	-3.9514	0.2075	-19.05	4.3884, -3.5144
Schedule Deviation (days)	0.8574	0.0895	9.57	0.6698, 1.0450
Customer Complaints	1.0194	0.1057	9.64	0.7960, 1.2427

The regression analysis suggests that waiting time has a considerable impact on schedule reliability. Each hour of waiting reduces the on-time arrival rate by 3.95 percentage points (significant at $p < 0.05$), increases schedule deviation by 0.86 days, and raises customer complaints by about 1.02. Waiting time, schedule deviation, and customer complaints account for 99.88% of the variability in schedule dependability indicators, indicating a strong model fit (R-squared = 0.9988).

4.44 Discussion

On-Time Arrival Rate

Correlation analysis shows a significant negative relationship (r= -0.99) between waiting time and on-time arrival rates. This means that when the waiting time for container ships at the Dar es Salaam port grows, the percentage of ships arriving on time falls considerably. This finding is consistent with prior research, such as (Ksciuk et al., 2023) which emphasises that extended waiting times alter scheduled schedules, making it difficult for ships to meet their arrival time frames.

The impact is further quantified by the regression analysis, which shows that the on-time arrival rate decreases by roughly 3.95 percentage points for every extra hour of waiting. This significant decline emphasises how important it is to have effective port operations to reduce wait times and improve schedule dependability. Maintaining consumer trust and operational efficiency in the shipping business requires higher on-time arrival rates.

Schedule Deviation

Additionally, a very strong positive association (r = 0.99) between waiting time and schedule deviation is revealed by the analysis. There is a significant increase in the deviation from the scheduled arrival times as waiting times increase. The regression model indicates that the schedule deviation rises by roughly 0.86 hours for every extra hour of delay. Effective port operations are essential in lowering schedule deviations and preserving dependable shipping schedules (Danladi et al., 2024)

Increased schedule deviations cause delays in following activities and may result in financial losses by upsetting the entire supply chain. The negative effects on the shipping industry may be exacerbated by these aberrations, which may also lead to inefficiencies in the distribution and processing of cargo. According to (Zhang et al., 2024), these effects can be lessened by putting advanced scheduling systems into place and controlling ship arrivals more effectively.

Customer Complaints

Waiting times and the number of customer complaints have a high positive correlation (r = 0.99). This suggests that there is a substantial increase in consumer complaints in tandem with longer wait times. Regression research reveals that customer complaints rise by about 1.02 for every extra hour of waiting. This outcome aligns with the study conducted (Worlitz et al., 2020), which examines the effects of longer wait times and disgruntled customers on the economy and reputation.

An increase in customer complaints is indicative of growing dissatisfaction with the port's overall service quality and the dependability of shipping schedules. This unhappiness may harm the port's reputation and drive away customers. According to (Yeo et al., 2015) resolving client complaints and enhancing service dependability are essential to the marine industry's ability to remain competitive.

5.0 Conclusion

5.1 Overview

This paper contains the study's conclusion concerning the goals of the investigation. It goes over their contributions to knowledge, how the shipping sector might use them, and suggestions for continuing shipping operations and port administration.

5.2 Conclusion

This research paper has demonstrated the substantial impact of container ship waiting times on the shipping business in Tanzania at Da r es Salaam port, revealing critical insights into operational inefficiencies, financial implications, and challenges in maintaining schedule reliability. The study shows that prolonged waiting times significantly extend ship turnaround times, decrease berth occupancy and crane productivity, and lead to higher operational costs and revenue loss. These findings highlight the urgent need for strategic interventions to optimise port operations, enhance infrastructure, and streamline customs procedures.

Regarding the marine industry and port authority, this research underscores the importance of addressing operational bottlenecks to improve overall port efficiency and competitiveness. The study contribution provides a detailed understanding of how inefficiencies at major ports can ripple through the supply chain, affecting not only the financial performance of the shipping companies but also the broader economic stability of regions dependent on maritime trade. The insights are precious for policymakers, port authorities, and logistics companies striving to enhance the performance of port-developing economies.

The possible applications of this research include implementing advanced scheduling systems, predictive analytics, and infrastructure upgrades to reduce waiting times and improve operations. Furthermore, the study findings can be extended to explore similar issues in other ports, providing a comparative framework for identifying best practices and tailoring solutions to different operational environments. Future research could build on this work by investigating the role of emerging technologies, such as artificial intelligence and blockchain, in further optimising port logistics and reducing inefficiencies, thereby setting a new standard for port management in the maritime industry.

5.3 Contributions to New Knowledge/Application

The study's conclusions greatly add to the body of knowledge previously accessible in port management and maritime logistics, particularly about developing countries.

Included in the contributions are:

1. **Operational Efficiency Insights:** The study provides detailed insights into how waiting times impact various operational metrics such as turnaround time, berth occupancy, and crane productivity. This understanding can help port authorities and shipping companies optimise their operations and reduce inefficiencies.
1. **Financial Implications:** By quantifying the financial impact of waiting times, this research highlights the hidden costs associated with port delays. This information is crucial for stakeholders to make informed decisions about resource allocation, cost management, and strategic planning.
2. **Schedule Reliability:** The study underscores the importance of schedule reliability in the shipping business. The strong correlation between waiting times and schedule

deviations emphasises the need for effective scheduling systems and better management of ship arrivals.

3. **Policy and Strategic Recommendations:** The research provides actionable recommendations for policymakers and port authorities to address the challenges of long waiting times, which lead to port congestion. These include infrastructure upgrades, streamlined customs procedures, and improved coordination among various stakeholders.

5.4 Recommendations

Based on the findings, the following recommendations are proposed to improve the efficiency and competitiveness of Dar es Salaam Port:

1. **Infrastructure Enhancement:** Invest in expanding and modernising port infrastructure to accommodate larger vessels and higher cargo volumes. This includes increasing the number of berths, upgrading handling equipment, and improving storage facilities.
2. **Streamlined Customs Procedures:** Simplify and digitise customs procedures to reduce delays in cargo clearance. Implementing electronic data interchange (EDI) systems can enhance the speed and accuracy of customs processing.
3. **Operational Improvements:** Adopt advanced scheduling systems and predictive analytics to optimise vessel arrivals and departures. Implementing a queue management system can help reduce waiting times and improve turnaround times.
4. **stakeholder Collaboration:** Foster better collaboration among port authorities, shipping companies, and logistics providers. Regular communication and joint problem-solving initiatives can address bottlenecks and enhance overall port efficiency.
5. **Training and Capacity Building:** Invest in the training and development of port personnel to improve their skills and efficiency. Continuous professional development programs can help staff adapt to new technologies and operational practices.
6. **Environmental Considerations:** Implement eco-friendly technologies and practices to reduce the environmental impact of port operations. This includes measures to reduce emissions from idling ships and adopting green infrastructure solutions.

Generally, addressing the issue of container ship waiting times at Dar es Salaam Port requires a multifaceted approach involving infrastructure enhancement, operational improvements, and policy reforms. By implementing the recommendations outlined in this study, the port can improve its efficiency, reduce costs, and enhance its competitiveness in the global maritime industry.

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